LAROCHE AVENUE CULVERT REPLACEMENT
CHATHAM COUNTY, GA

TECHNICAL SPECIFICATIONS

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Contract No.: QBS 09-3-4

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A/E Project No.: 7124

SECTION 01600

SPECIAL CONDITIONS

PART 1 – PROJECT DESCRIPTION

1.01 LOCATION AND DESCRIPTION OF WORK

A. The project is located at Laroche Avenue between Neva Avenue and Lansing Avenue in unincorporated Chatham County.

B. The work consists of replacing the brick arch culvert under Laroche Avenue with a 12'x6' box culvert.

C. All associated work for the culvert replacement is included on the construction drawings. The associated work includes the relocation of a water and sewer main. These relocations shall be performed with minimal interruption of services.

D. Laroche Avenue shall be closed to public traffic from north of Neva Avenue to the parking area of the restaurant while construction is in progress. The existing right of way within this boundary shall be used as staging and storage areas. At the completion of the project the Contractor shall restore all areas to equal or better than its preconstruction condition.

PART 2 – CONTRACT DOCUMENTS

2.01 TECHNICAL SPECIFICATIONS

A.	02220	Site Demolition
B.	02231	Clearing and Grubbing
C.	02300	Earthwork
D.	02373	Geotextile
E.	02460	Steel H Piles and Sheet Piles
F.	02490	Soil Anchors
G.	02510	Water Distribution
H.	02531	Sanitary Sewers
I.	02630	Storm Drainage
J.	02704	Graded Aggregate Base Course (GABC)
K.	02745	Hot Mix Asphalt Concrete Pavement
L.	03300	Cast-in-Place Concrete
M.	03410	Precast Structural Concrete
N.	05500	Metal Fabrications
O.	09930	Protective Coating for Steel

2.02 DRAWINGS

A.	G-001	Cover Sheet
B.	G-002	General Notes and Abbreviations Sheet 1 of 2
C.	G-003	General Notes and Abbreviations Sheet 2 of 2
D.	G-004	ESPC General Notes Sheet 1 of 3
E.	G-005	ESPC General Notes Sheet 2 of 3

F.	G-006	ESPC General Notes Sheet 3 of 3
G.	G-101	Project Site Plan
H.	G-102	Traffic Control Plan Sheet 1 of 2
I.	G-103	Traffic Control Plan Sheet 2 of 2
J.	B-001	Boring Logs
K.	V-101	Existing Site Plan
L.	C-101	Initial ESPC Plan
M.	C-102	Intermediate & Final ESPC Plan
N.	C-103	Demolition Plan
O.	C-104	Storm Drainage & Utility Plan
P.	C-105	Paving & Grading Plan
Q.	C-106	Signage & Striping Plan
R.	C-301	Typical Section & Elevations
S.	C-302	Storm Drainage & Utility Profiles
T.	C-501	ESPC Details Sheet 1 of 4
U.	C-502	ESPC Details Sheet 2 of 4
V.	C-503	ESPC Details Sheet 3 of 4
W.	C-504	ESPC Details Sheet 4 of 4
X.	C-505	Miscellaneous Civil Details
Y.	C-601	Working Point Schedules
Z.	S-101	Culvert & Pile Plan
AA.	S-301	Box Culvert Sections
BB.	S-302	West Headwall & Wingwall Elevations & Sections
CC.	S-303	East Headwall & Wingwall Elevations & Sections
DD.	S-304	Concrete Apron Sections
EE.	S-501	Steel Sheet Pile Details Sheet 1 of 2
FF.	S-502	Miscellaneous Structural Details
GG.	S-601	Pile Schedule

PART 3 – PRE-CONSTRUCTION AND POST-CONSTRUCTION INSPECTIONS

3.01 PRE-CONSTRUCTION INSPECTION

A. A pre-construction conditions video (standard DVD format) is required and must be submitted to Chatham County Department of Engineering for approval prior to start of any land disturbing work. Special emphasis shall be given to record pre-disturbance condition of roadway pavements, curbing, sidewalks, driveways, buildings, utilities and other improvements located within or within 100 feet of the project limits. This is in addition to other inspections and surveys required of the Contractor or performed by the County. The video shall be prepared by a professional photographer having experience in similar work and approved by the County. A voice narrative shall identify location and features of the preconstruction video. A typewritten version of the voice narrative shall be provided upon request.

B. The Contractor shall provide a pre-construction video of the sanitary sewer main showing existing conditions. The limits of the video shall extend to the first sanitary sewer manhole outside the project limits in each direction.

C. A pressure test shall be performed on the existing water system to determine conditions prior to construction.

3.02 POST-CONSTRUCTION INSPECTION

A. The Contractor shall provide and pay all costs of a video inspection record of the completed pipe systems produced by a qualified sewer inspection company or agency (Chatham County or City of Savannah inspection crews are acceptable, however the Contractor shall remain responsible for paying all costs). The video inspection record shall be provided on standard DVD and compatible with County viewing software. All deficiencies identified by the inspection shall be corrected by the Contractor prior to acceptance of the work as substantially complete.

PART 4 – STAKING

4.01 CONSTRUCTION STAKING AND CONTROL OF WORK

A. The County shall engage a surveyor registered by the State of Georgia to provide initial construction stakeout and demarcation project limits and property lines. Ongoing control of the project work shall be the responsibility of the Contractor. The cost for resurvey work to reestablish initial project controls shall be paid for by the Contractor. The Contractor shall provide access and schedule all work in order to accommodate the survey work by the County's surveyor.

PART 5 - DOCUMENTATION

5.01 DOCUMENTATION TO BE PROVIDED WITH REQUESTS FOR PAYMENT

A. In addition to the documentation described elsewhere in the Contract Documents, the Contractor shall submit with each request for payment the following:

1. Inspection reports of the sediment and erosion control facilities as described in the General Permit No. GAR100002. A copy of the Georgia Soil and Water Conservation Commission certification card(s) of the person(s) completing the reports shall also be submitted. Missing or incomplete documentation of inspection reports may be cause for delay/denial of payment.

2. Copies of material delivery tickets. The Contractor shall be responsible for collecting these documents at the time of delivery. The delivery tickets shall not relieve the Contractor of his responsibility to ensure the materials are in accordance with the contract documents. Missing or incomplete documentation of delivered materials may be cause for delay/denial of payment.

3. Prior to submitting a request for payment, the Contractor shall review the extent of work completed with the County's representative for accuracy and completeness.

PART 6 – EROSION AND SEDIMENTATION CONTROL

6.01 DUTIES

A. The Contractor will be responsible for installation, maintenance and repair of the sedimentation and erosion control facilities and for any modifications or adjustments necessary for the project to remain in compliance with the Georgia Erosion and Sedimentation Act during performance of the work. The Contractor will have on site at all times of construction activity a Georgia Soil and Water Conservation Commission Level 1A certified person.

B. The contractor shall perform sediment and erosion control inspection and reporting requirements, recording daily precipitation amounts, and other duties as described in the contract documents. Inspection reports shall be provided on forms provided by the County or as approved by the County. Signed copies of the Contractor's reports shall be submitted to the County with each Request for Payment. Water quality testing and reporting will be provided by the County.

C. The total contract amount will be reduced by an amount as specified in the fines section below for each occurrence of failure to conform to the sediment and erosion control requirements of the contract. For the purpose of this paragraph an occurrence shall be defined as each 24-hour period with consecutive 24-hour periods being measured as separate occurrences. This fee shall be in addition to any penalties or assessments made against the Contractor for non-compliance of the Georgia Water Quality Control Act.

PART 7 - FINES AND LIQUIDATED DAMAGES

7.01 FINE

A. A $200 per day fee shall be assessed against the Contractor and withheld from the Lump Sum Contract Price for each and every day that the erosion and sedimentation control plan is not in proper operation. This fee shall be in addition to any penalties or assessments made against the Contractor for non-compliance of the Georgia Water Quality Control Act.

7.02 LIQUIDATED DAMAGES

A. Liquidated Damages shall be assessed at $500 per calendar day for work not completed within the Contract period. The full amount of liquidated damages will be deducted from the final payment to the Contractor.

PART 8 - ALLOWANCE

8.01 FIELD CONDITION ALLOWANCE

A. The Field Condition Allowance shown on the bid sheet shall belong to Chatham County. The purpose of this Allowance is to allow the County to designate actions associated with completion of the project which are not indicated on the plans, but which are dictated by field conditions. Bidders shall not use this Allowance to assume any Contractor costs known or unknown at the bidding.

Chatham County must approve use of the Allowance. All bidders shall include this Field Condition Allowance within their base bid. Any unused allowance shall revert to Chatham County.

PART 9 - SPECIAL REQUIREMENTS OF CONSTRUCTION

9.01 REQUIREMENTS

A. Work hours shall be limited to 7:00 am to 7:00 pm Monday through Friday and shall exclude holidays unless otherwise approved by Chatham County.

B. **The Contractor shall obtain an Encroachment Permit from the Department of Public Works prior to any work within road rights of way.** All work is to be performed within the existing rights of way and easements as shown on the plans unless coordinated with others. Permission to use private property outside of these areas shall be obtained by the Contractor in writing. Copies of such agreements shall be provided to the Chatham County Engineering Department.

C. The Contractor shall provide approved means and methods upstream and downstream of the excavation to control water as needed in any open excavations as required for construction. The Contractor's means and methods shall apply to a normal tide cycle and not impede natural drainage through the construction site. The County must approve the Contractor's plan for maintenance of flow prior to beginning work.

D. Watering past the date of substantial completion of the work shall be provided on seeded areas to achieve full coverage to match existing conditions and as accepted by Chatham County.

E. There are existing water and sewer mains to be relocated within the project limits. These mains will be relocated without interruption to services unless otherwise permitted by Chatham County. The County must approve the Contractor's plan for maintaining water and sewer services and flow during the construction period prior to disturbance of the systems.

F. The Contractor shall provide traffic control during the construction of the project. No work shall commence until a detailed traffic control plan is reviewed and approved by Chatham County. Laroche Avenue shall be closed to traffic. The Contractor shall notify all emergency services of any road closure as well as the school system for bus routes. All signage regarding closure shall be posted no less than one week prior to any closures.

G. The Contractor shall make every effort to minimize the length of time required for the Laroche Avenue road closure. A detailed time schedule for the road closure and re-opening shall be provided to and approved by Chatham County prior to beginning demolition or construction.

H. Unsuitable material shall be removed and replaced with suitable material meeting the requirements of the specifications. Measurement of unsuitable material shall exclude excavation of all materials within the limits of excavation shown on the drawings. Measurements of unsuitable material shall be made by cross section

method as approved by Chatham County. Measurement by truck count will not be allowed unless otherwise stated.

I. Contractor to remove and replace 6” concrete pad on the adjacent lot east of Laroche Avenue north of the canal.

PART 10 - GEOTECHNICAL INVESTIGATION

10.01 DATA

A. A boring log provided by Terracon Consultants, Inc. is included in the plans on sheet B-001 with locations shown on V-101. This data is offered for information only with no responsibility by the Owner or Engineer for variation in subsoil quality or conditions at the boring locations or at locations other than those shown or at times when the borings were made.

SECTION 02220

SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

Work under this section includes requirements for removal of reinforced concrete, asphalt pavement, a masonry drainage structure, tabby wingwalls, guardrails, and other miscellaneous and incidental items and removals as they relate to the work for this project. The Contractor shall furnish all labor, equipment and utilities to complete the work as indicated on the project drawings and as specified herein.

1.2 GENERAL REQUIREMENTS

Do not begin demolition until authorization is received from Chatham County. The work includes demolition of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Chatham County property and the project site daily, unless otherwise directed. Materials that cannot be removed daily shall be stored in areas approved by Chatham County.

1.2.1 Site Examination

The Contractor shall be responsible for visiting and examining the project site to assess the extent of demolition, removal and general work to be done.

1.3 SUBMITTALS

The following shall be submitted in accordance with this section.

1.3.1 Statements

A. Demolition Plan

Submit proposed demolition and removal procedures for approval before work is started. The Demolition Plan shall include coordination with other work in progress, a disconnection schedule and procedure for the utility systems in service, and a detailed description of methods and equipment to be used for each operation and the sequence of operations. Include statements affirming a Contractor inspection of the existing structure and its' components and its' suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Particular focus should be provided on the control of water and timing of the work.

1.4 REGULATORY AND SAFETY REQUIREMENTS

Comply with federal, state, and local hauling and disposal regulations.

1.5 DUST AND DEBRIS CONTROL

Prevent the spread of dust and debris off-site and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

1.6 PROTECTION

1.6.1 Traffic Control Signs

Where pedestrian and driver safety is endangered in the area of removal work, mark all hazards with signs, traffic barricades and flagmen as necessary to warn of construction work in progress. Anchor barricades in a manner to prevent displacement by wind. The Contractor shall be responsible for any damage caused by his operations. Notify Chatham County prior to beginning such work. Additionally, follow work delineation as shown on the Drawings.

1.6.2 Existing Conditions

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work.

1.6.3 Items to Remain in Place

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of Chatham County. Repair or replace damaged items as approved by Chatham County. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload pavements to remain. Repairs, reinforcement, or structural replacement require approval by Chatham County prior to performing such work.

1.6.4 Existing Construction

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.6.5 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition operations.

1.6.6 Protection of Personnel

Before, during and after the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site.

1.6.7 Work

Assume responsibility for all demolition work and protection of demolition work. Provide additional grading, as necessary, to prevent damage to demolition work by water (surface runoff) at no additional cost to Chatham County.

1.6.8 Debris in Canal

The Contractor shall remove all rubbish and debris that is within the limits of the project site, which includes the existing embankments and canal. This shall include all broken concrete, trash, tree stumps, tree branches and other vegetation.

1.7 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.8 ENVIRONMENTAL PROTECTION

Comply with all local, state and federal environmental protection requirements.

1.9 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Choice of equipment to perform specified operations is the responsibility of the Contractor.

B. When performing work outside of designated work hours:

(1) Obtain written approval from Chatham County.

(2) Provide and maintain sufficient artificial lighting to permit proper demolition work, observation, and inspection.

2.2 FILL MATERIAL

Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill voids, depressions or excavations resulting from demolition of structures. See Section 02300 “Earthwork.”

PART 3 - EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Structures

Remove existing structures indicated to be removed. Existing piles, if discovered during excavation for culvert installation, shall be cut off at a location below the sill of the culvert bottom. Consideration shall be given for the vertical clearance from the bottom of the new culvert and the horizontal location of the new piles before driving.

3.1.2 Utilities and Related Equipment

3.1.2.1 Disconnecting Existing Utilities

Remove existing utilities, as indicated or uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Chatham County. When utility lines are encountered that are not indicated on the drawings, Chatham County shall be notified prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of Chatham County.

3.1.3 Paving

Remove asphaltic concrete paving as indicated. Provide and maintain neat sawcuts at limits of pavement removal as indicated.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished until all demolition in the area has been completed and debris removed. Holes and other hazardous openings shall be filled.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

All materials and equipment removed and not reused, shall become the property of the Contractor and shall be removed from Chatham County property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by Chatham County of the Contractor's Demolition Plan, and authorization by Chatham County to begin demolition. Chatham County will not be responsible for the condition or loss of, or damage to, such property after contract award. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment listed and indicated to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.4 CLEANUP

Debris and rubbish shall be removed from the project site. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Disposal General

Dispose of debris, rubbish, scrap, and other non-salvageable materials resulting from removal operations in accordance with all applicable federal, state and local regulations. Removed materials shall not be stored on the project site.

3.5.2 Burning on County Property

Burning of materials on Chatham County property will not be permitted.

3.5.3 Removal from Owner Property

Transport waste materials from property for legal disposal.

End of Section 02220

SECTION 02231

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 SUMMARY

Work under this section includes requirements for clearing and grubbing the project area as indicated on the drawings. The work of this section shall include, but not be limited to clearing and disposing of all trees, stumps, shrubbery growth, roots and other vegetation within the project limits. The Contractor shall furnish all labor, equipment and utilities to complete the work as indicated on the project drawings and as specified herein.

1.2 SITE CONDITIONS

The Contractor shall be responsible for visiting and examining the project site to assess the extent of clearing and grubbing work to be done.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 LIMITS OF SITE CLEARING AND GRUBBING

The Contractor shall perform site clearing to the limits of the work area shown on the drawings.

3.2 PROTECTION

3.2.1 Roads and Walkways

Keep roads and walkways free of dirt and debris at all times.

3.2.2 Trees, Shrubs, and Existing Facilities

Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by the erection of barriers or by such other means as the circumstances require.

3.2.3 Utility Lines

Protect existing utility lines that are indicated to remain from damage. Notify Chatham County immediately of damage to or an encounter with an unknown existing utility line. The Contractor shall be responsible for the repairs of damage to existing utility lines that are indicated or made known to the Contractor prior to start of clearing and grubbing operations. When utility lines which are to be removed are encountered within the area of operations, the Contractor shall notify Chatham County in ample time to minimize interruption of the service.

3.3 CLEARING

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within the areas to be cleared. Clearing shall also include the removal and disposal of structures that obtrude, encroach upon, or otherwise obstruct

the work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface.

3.4 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.5 GRUBBING

Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the designated grubbing areas. Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated to be grubbed and in areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

End of Section 02231

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing for the excavation, backfilling, and compaction of all structures, utilities, pavements, and the canal embankments indicated on the project drawings and as specified herein.

1.2 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	(2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in) Drop
AASHTO T 224	(2001) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D 1140	(2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 2487	(2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 422	(1963; R 2002) Particle-Size Analysis of Soils

ASTM D 4318	(2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 698	(2000ae1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu.m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	(1983) Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3a	(1999) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods; Third Edition; Final Update III-A

GEORGIA DEPARTMENT OF TRANSPORTATION (GDOT)

GDOT	(2001) State of Georgia - Standard Specifications for Construction of Transportation Systems

1.3 MEASUREMENT

1.3.1 Excavation & Backfilling

All excavation and backfilling of the embankments shall be done on a unit cost basis.

1.3.2 Select Granular Material

Select granular material shall be measured in place as the actual cubic yards replacing wet or unstable material in trench bottoms and to bring embankments to the indicated grades. The unit price shall include furnishing and placing the granular material, excavation and disposal of unsatisfactory material, and additional requirements for sheeting and bracing, pumping, bailing, cleaning, and other incidentals necessary to complete the work.

1.4 DEFINITIONS

1.4.1 Satisfactory or Suitable Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, SW, SP, and SM. The plasticity index shall not be greater than 10 percent when tested in accordance with ASTM D 4318, and not more than 25 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140. Satisfactory materials for grading shall be comprised of stones less than 8 inches, except for fill material for pavements which shall be comprised of stones less than 3 inches in any dimension.

1.4.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills, trash, refuse, backfills from previous construction, and material classified as satisfactory which contains root and other organic matter or frozen material. Chatham County shall be notified of any contaminated materials.

1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.4.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

1.4.5 Topsoil

Material suitable for topsoils obtained from offsite and onsite areas, or excavations is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.4.6 Hard/Unyielding Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" with stones greater than 48 inches in any dimension. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.4.7 Rock

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1/2 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.4.8 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, pavement or appurtenant structure.

1.4.9 Select Granular Material

1.4.9.1 General Requirements

Select granular material shall consist of materials classified as GW, GP, SW, SP by ASTM D 2487 where indicated. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index shall not be greater than 5 percent when tested in accordance with ASTM D 4318, and not more than 10 percent by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D 1140. Coefficient of permeability shall be a minimum of 0.002 feet per minute when tested in accordance with ASTM 2434.

1.4.10 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 50 when tested in accordance with ASTM 4318.

1.5 SUBSURFACE DATA

Subsurface soil boring logs are shown on the drawings and in Appendix A. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations. The Contractor is responsible for making any additional subsurface investigations as necessary to perform the specified work.

1.6 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.7 BLASTING

Blasting will not be permitted.

1.8 CRITERIA FOR BIDDING

Base bids on the following criteria:

A. Surface elevations are as indicated.

B. Pipes or other artificial obstructions, except those indicated, will not be encountered.

C. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

D. Material character is indicated by the boring logs.

E. Hard materials and rock will not be encountered.

1.9 DEWATERING WORK PLAN

Submit procedures for accomplishing dewatering work.

1.10 SHORING AND SHEET PLAN

See Paragraph 3.3 for requirements.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Offsite soils brought in for use as backfill shall be tested for TPH, BTEX and full TCLP including ignitability, corrosivity and reactivity. Backfill shall contain less than 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and less than 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall not fail the TCPL test. TPH concentrations shall be determined by using EPA 600/4-79/020 Method 418.1. BTEX concentrations shall be determined by using EPA SW-846.3-3a Method 5030/8020. TCLP shall be performed in accordance with EPA SW-846.3-3a Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a

composite sample of material from the borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by Chatham County.

2.2 MATERIAL FOR RIP RAP

Provide filter fabric conforming to GDOT SHS, Section 881.2.05 (plastic woven) and rip rap conforming to GDOT SHS, Section 603 and 805. Rip rap material shall be Type 1 or Type 3 as indicated.

2.2.1 Rock

Rock fragments sufficiently durable to ensure permanence in the structure and the environment in which it is to be used. Rock fragments shall be free from cracks, seams, and other defects that would increase the risk of deterioration from natural causes. The size of the fragments shall be such that no individual fragment exceeds a weight of 150 pounds and that no more than 20 percent of the mixture, by weight, consists of fragments weighing 2 pounds or less each. Specific gravity of the rock shall be a minimum of 2.50. The inclusion of more than trace (2 percent or less) quantities of dirt, sand, clay, and rock fines will not be permitted.

2.3 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes

Blue:	Water Systems
Green:	Sewer Systems

2.3.1 Warning Tape for Metallic Piping

Acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of tape shall be 0.003 inch. Tape shall have a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.3.2 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.4 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

2.5 GEOTEXTILE FABRIC

Provide Mirafi Geolon® HP 570 woven geotextile fabric or approved equal in areas indicated on the drawings.

PART 3 - EXECUTION

3.1 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered below Top of Subgrade within the limits of the work shall be excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of by the Contractor. Unsatisfactory excavated material shall be removed from the project site and disposed of by the Contractor. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be provided by the Contractor from offsite sources.

3.1.1 Channel Changes

Excavation of channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Material excavated shall be disposed of as directed, except that in no case shall material be deposited less than 4 feet from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.1.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock or other hard foundation material shall be cleaned of loose debris and cut to a firm, level, stepped, or serrated surface. Loose disintegrated rock and thin strata shall be removed. When concrete is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete is to be placed.

3.1.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.1.4 Dewatering

Groundwater or surface water flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 12 inches below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly. Measure and record performance of dewatering system at same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system.

3.1.5 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 4 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than 3 feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 24 inches plus pipe outside width. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to Chatham County.

3.1.5.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 2 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.5.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 6 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.5.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to Chatham County.

3.1.5.4 Excavation for Appurtenances

Excavation for wingwalls, manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure parapets as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the

excavation. Excavation to the final grade level shall not be made until just before the concrete is to be placed.

3.1.6 Underground Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to utilities as indicated in accordance with procedures outlined by the utility company. Excavation made with power-driven equipment is not permitted within two feet of known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the affected Utility. Report damage to utility lines or subsurface construction immediately to Chatham County.

3.1.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved prior to concrete placement. Backfill and compact over excavations and changes in grade to 95 percent of ASTM D 698 maximum density.

3.2 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from approved private sources. No borrow shall be obtained within the limits of the project site.

3.3 OPENING AND DRAINAGE OF EXCAVATION

The Contractor shall notify Chatham County sufficiently in advance of the opening of any excavation to permit elevations and measurements of the undisturbed ground surface to be taken. Except as otherwise permitted, excavation areas shall be excavated providing adequate drainage. Overburden and other spoil material shall be transported to designated spoil areas or otherwise disposed of as directed. The Contractor shall ensure that excavation of any area or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.4 SHORING

3.4.1 General Requirements

The Contractor shall submit a Shoring and Sheeting Plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a Registered Professional Engineer in the State of Georgia, describing the methods for shoring and sheeting of excavations. Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.4.2 Geotechnical Engineer

The Contractor is required to hire a registered Professional Geotechnical Engineer in the State of Georgia to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses

to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing Chatham County of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with Chatham County at any time throughout the contract duration.

3.5 GROUND SURFACE PREPARATION

3.5.1 General Requirements

Unsatisfactory material at surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by Chatham County. Where satisfactory material is present, the surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material.

3.6 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed. Approximately level surfaces shall be roughened, and sloped surfaces shall be cut as indicated into rough steps or benches to provide a satisfactory bond.

3.7 SUBGRADE PREPARATION

3.7.1 General Requirements

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by Chatham County. Where the in situ material passes proofrolling (stable) and is satisfactory, the surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. 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.

3.7.2 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed. Low areas resulting from removal of unsatisfactory material shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. The elevation of the finished subgrade shall not vary more than 0.05 foot from the established grade and cross section.

3.7.3 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. All material used as backfill shall be placed at optimum moisture content or within 2 percent below optimum moisture content. At a minimum, the top 12 inches of subgrade shall be compacted to at least 95 percent of laboratory maximum density per ASTM D1557.

3.7.4 Frozen Material

Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph TESTING.

3.8 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be removed from Chatham County property. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Coarse rock from excavations shall be stockpiled and used for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.9 BACKFILLING AND COMPACTION

3.9.1 Backfilling with Select Granular Material for Pavement

Select Granular Material should be placed over a stable or stabilized subgrade. Select Granular fills should be placed in thin (8 to 10 inch loose) lifts and compacted to specified density. Fill brought to the site should be within three percent (wet or dry) of the optimum moisture content. Some manipulation of the moisture content (such as wetting or drying) will be required during the filling operation to obtain the required degree of compaction. The manipulation of the moisture content is highly dependent on weather conditions and site drainage conditions. The Contractor should be prepared to both dry and wet fill materials to obtain the specified compaction during grading.

3.9.2 Backfill Adjacent to Structures

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph SUBGRADE PREPARATION. Compaction requirements for backfill materials shall also conform to the applicable portions of this paragraph and paragraphs SUBGRADE PREPARATION and EMBANKMENTS, and Section 02630 “Storm Drainage”

3.9.3 Compaction

Select Granular Material placed above the Top of Subgrade shall be compacted to at least 98% laboratory maximum density per ASTM D1557. Compaction of select granular material for pavement shall be accomplished by heavy-duty vibratory roller or other approved equipment.

3.9.4 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall only be backfilled to the spring line of the pipe until all specified tests are performed.

3.9.4.1 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.9.4.2 Bedding and Initial Backfill

Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D 698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide coarse sands and gravels with maximum particle size of 1.5 inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

3.9.4.3 Final Backfill

The remainder of the trench, except for special materials for roadways, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

A. Roadways: Backfill shall be placed up to the required elevation as specified. Water flooding or jetting methods of compaction will not be permitted.

3.9.5 Backfill for Appurtenances

After the wingwall has been constructed, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on the sides of the structure to prevent eccentric loading and excessive stress.

3.10 SPECIAL REQUIREMENTS

Special Requirements for both excavation and backfill are as follows:

3.10.1 Rip Rap Construction

Construct rip rap on filter fabric in accordance with GDOT SHS, Section 603 in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.10.1.1 Filter Fabric Placement

Spread filter fabric shall be placed in accordance with GDOT SHS, Section 881.2.05 and as indicated on the project plans. Compaction of bedding is not required. Finish bedding to present even surface free from mounds and windrows.

3.10.1.2 Stone Placement

Place rock for rip rap on prepared bedding described in Paragraph 3.12.1.1 to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip rap throughout the entire mass and eliminate “pockets” of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.10.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.11 EMBANKMENTS

3.11.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.12 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials. Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades re-established to the required elevations and slopes.

3.12.1 Subgrade & Embankments

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until subbase, base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No subbase, base course, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall subbase, base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade.

3.12.2 Grading Around Structures

All areas shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.13 TESTING

Testing shall be performed by Chatham County and shall include the following:

3.13.1 Fill and Backfill Material Gradation

One test per 500 cubic yards stockpiled or in-place source material. Gradation of fill and backfill material shall be determined in accordance with ASTM D 422 or GDOT Section 812.

3.13.2 In-Place Densities

A. One test per 500 square yards, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

B. One test per 300 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

3.13.3 Check Tests on In-Place Densities

If ASTM D 2922 is used, in-place densities shall be checked by ASTM D 1556 as follows:

A. Two check tests per day.

3.13.4 Moisture Contents

In the stockpile, excavation, or borrow areas, a minimum of two tests per day per type of material or source of material being placed during stable weather conditions shall be performed. During unstable weather, tests shall be made as dictated by local conditions and approved by Chatham County.

3.13.5 Optimum Moisture and Laboratory Maximum Density

Tests shall be made for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 300 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.13.6 Tolerance Tests for Subgrades

Continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION shall be made during construction of the subgrades.

3.13.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. Pipes with sizes below 36 inches shall be examined and inspected as established in Section 01600. If the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to Chatham County.

3.14 DISPOSITION OF SURPLUS MATERIAL

Surplus material or other soil material not required or suitable for filling or backfilling, concrete, rubble and brush, refuse, stumps, roots, and timber shall be removed from Chatham County property and disposed of by the Contractor.

End of Section 02300

Geotechnical Engineering Report

LaRoche Avenue Culvert Replacement
Savannah, Georgia
August 24, 2010
Terracon Project No. ES105040

Prepared for:
Moffatt & Nichol
Savannah, GA 30401

Prepared by:
Terracon Consultants, Inc.
Savannah, Georgia

August 24, 2010

Moffatt & Nichol
2 East Bryan Street Suite 501
Savannah, GA 30401

Attn: Mr. Jason Ball, P.E.
Project Manager
P: 912-231-0044
jball@moffattnichol.com

Re: Geotechnical Engineering Report
LaRoche Avenue Culvert Replacement
Savannah, Georgia
Terracon Project Number: ES105040

Dear Mr. Ball:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning the design and construction of the foundations for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

Nitin Dudani, P.E.
Senior Geotechnical Engineer

Guoming Lin, Ph.D., P.E.
Senior Principal
Senior Geotechnical Consultant

Enclosures
cc: 1 – Client (PDF)
1 – File

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APPENDIX

GEOTECHNICAL ENGINEERING REPORT
LAROCHE AVENUE CULVERT REPLACEMENT
SAVANNAH, GEORGIA

Terracon Project No. ES105040
August 24, 2010

1.0 INTRODUCTION

A geotechnical engineering report has been completed for the proposed LaRoche Avenue Culvert Replacement project located on LaRoche Avenue in Savannah, Georgia. The proposed plan involves replacement of the existing culvert underneath LaRoche Avenue. One (1) Cone Penetration Testing (CPT) sounding was performed to a depth of 62 feet below the existing ground surface to explore the subsurface soil conditions.

The purpose of the study is to provide subsurface information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- foundation design and construction
- Seismic considerations

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See Appendix, Figure II: Exploration Location Plan.
Structures and Elevations	A Pre-stressed Concrete Box Culvert will be installed at depth of 10 to 12 feet below existing ground surface. This culvert will be constructed at the place occupied by the existing culvert. The existing culvert will be removed.
Maximum loads	Not provided.

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The site is located at the intersection between La Roche Avenue and Neva Avenue in Savannah, GA
Existing improvements	Replacing the existing culvert underneath La Roche Avenue

ITEM	DESCRIPTION
Current ground cover and access conditions	The ground is paved and accessible by truck-mounted CPT rig.
Existing topography	Level

The new culvert will be constructed at the same place where the existing culvert is located. The existing culvert will be demolished for the new construction. The foundation system used for the existing culvert is unknown at the time of this report. The bottom of culvert is approximately 10 to 12 feet lower than the road elevation from which CPT sounding was performed. Based on the information provided by Mr. Jason Ball, we understand the no fill placement is planned to raise the site or road elevation.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the field exploration, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	N60 derived from CPT sounding
Stratum 1	58	soft lean clay	2 to 3
Stratum 2	Below stratum 1	Marl	15 to 30

3.2 Groundwater

The groundwater level within CPT sounding was at depths of 4 to 6 feet below ground surfaces at the time of CPT sounding. The boring location is relatively close to the tidal salt marsh therefore we anticipate tidal fluctuations of the groundwater level. Groundwater levels tend to fluctuate with seasonal and climatic variations, as well as with construction activities. As such, the possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. The groundwater table should be checked prior to construction to assess its effect on site work and other construction activities.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

Based on the data obtained from the CPT sounding, the site is underlain by very soft clay in the upper 58 feet, followed by the marl formation underneath. The marl formation is commonly used as the pile bearing stratum in this area. It has to be noted that the soft clays in stratum 1 are highly compressible and have low undrained shear strength. Presence of this layer will cause large settlement to even very lightly loaded structures supported on shallow foundation systems. Therefore, pile foundations are recommended for the proposed culvert replacement. We understand the additional fill will not be placed to raise the site or road elevation. It is very important to note that the site is underlain with very weak soils which may have implications on construction such as stockpiling of excavated material and excavation support. The contractor shall consider the subsurface conditions when developing construction method. WPC can provide additional and more detailed evaluation if necessary after construction plan is developed.

4.2 Pile Foundations Recommendation

We evaluated various deep foundations in terms of their cost and effectiveness, and recommend HP 14×73 steel piles as the deep foundation system to support the proposed culvert. The information regarding existing foundation is not provided at the time of this report. It is strongly recommended that the contractor should identify the existing foundation and remove it before the installation of new pile foundation. Otherwise, the old foundation may interfere with the new pile installation. Vibration caused by the driving of the new piles is another important concern to the existing businesses and homes. We strongly recommend performing pre-condition survey of all the properties in the close vicinity prior to the installation of piles and start of other construction activities. The pre-condition survey will protect Chatham County and site contractors from any unwarranted damage claims arising from the property owners and at the same time provide the property owners with baseline information about their property conditions prior to the construction to assess potential damage during and after the construction. Vibration monitoring should be performed during the construction and pile driving activities to monitor the vibration levels caused and effect of vibrations on the existing structures.

We recommend performing pile dynamic testing on at least two (2) piles during the installation process. The dynamic pile testing will confirm the pile capacities and final lengths will be adjusted in the field to meet the required pile capacities.

4.2.1 Pile Length and Vertical Capacity

As a standard practice in this area and a recommendation for this project, all piles should penetrate through the upper layers and embedded into the marl formation. The depth to the marl is approximately 58 feet below existing ground surface which is 10 to 12 feet higher than the bottom of culvert elevation. Considering the exiting soft lean clay layer, we recommend an embedment depth into marl formation of at least 15 feet, which corresponds to a total pile length of 65 feet below the bottom of culvert. The pile capacities are estimated based on soil stratigraphy and CPT tip and side friction values within the soil strata. A factor of safety of 2.0 is included in the allowable pile capacities. Tentatively, we recommend an allowable compression capacity of 25 tons and an allowable uplift capacity of 15 tons for the pile of at least 65 feet below the culvert bottom.

4.2.2 Pile Lateral Capacity

The behaviors of piles under lateral loads are analyzed using a computer program LPILE 4 Plus. The LPILE program employs the p-y method based on the user specified soil and pile properties. The deflections, shear force, and bending moments in the pile are calculated by solving the beam bending equation using finite difference numerical techniques. The allowable lateral pile capacities are a function of the allowable lateral deflection at the pile top. The pile head deflections will be largely determined by the type of connections between pile head and pile cap. The actual connection may fall somewhere between fixed head and free head conditions. Details of pile behavior under various lateral loads are presented graphically in the appendix as a reference for determining lateral capacities.

4.2.3 Pile Foundation Settlement

Based on our experience with similar projects in the area, we anticipate the foundations supported on driven steel piles would experience very small settlements. We recommend the structural engineer to calculate pile settlement as 1/8 of an inch at pile tip plus the elastic shortening of the piles under the design load. We do not expect a significant increase of settlement from a pile group.

4.3 Construction Considerations

Since the bottom of culvert lies in the tidal zone, dewatering activities will be necessary to keep the work area dry and operational. The dewatering system may consist of parallel ditches to divert the water away from the construction area. Pumping equipment should be prepared if the above ditch system cannot effectively drain water away from the site. Failure to establish dewatering system will result in construction delays and costs to the contractor and the owner.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Health and Safety Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will probably be required during culvert construction operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

4.4 Seismic Considerations

Based on the findings in the CPT boring and our knowledge of the local geological formations in the project area, the site can be classified as Site Class E in accordance with IBC 2006. The seismic design parameters obtained based on IBC 2006 are summarized in table below. The design response spectrum curve, as presented in the appendix, was developed based on the S_{DS} and S_{D1} values according to IBC 2006.

Code Used	Site Classification
2006 International Building Code (IBC) [1]	E [2]

1. In general accordance with the *2006 International Building Code,* Section 1613
2. The 2006 International Building Code requires a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100 foot soil profile determination. CPT sounding for this project extended to a maximum depth of 62 feet and this seismic site class definition considers that the competent soils would continue below the maximum depth of the subsurface exploration.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such

variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, and bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX

- **Field Exploration Description**
- **Site Vicinity Map**
- **Exploration Location Plan**
- **Cone Penetration Test (CPT) Sounding Records**
- **Lateral Pile Analysis**
- **Seismic Considerations**
- **General Notes**
- **Unified Soil Classification System**

Field Exploration Description

Our field exploration program consisted of a total of 1 cone penetration test (CPT) sounding. The exploration location was selected by an engineer from Terracon, Inc based on access conditions and underground utility locations. The locations of the CPT soundings as shown in the Exploration Location Plan should be considered accurate only to the degree implied by the means and methods used to define them.

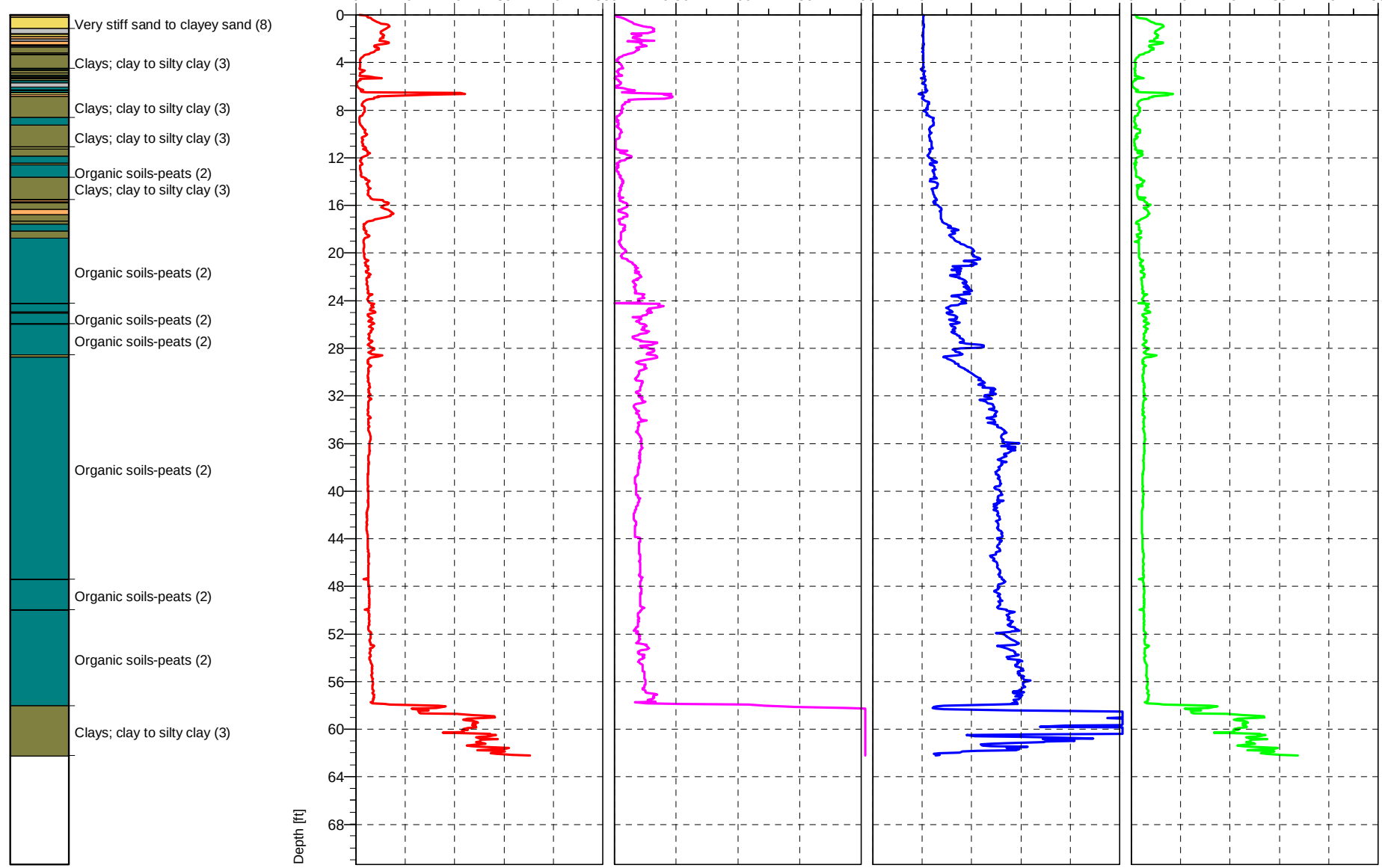
The CPT soundings were performed in accordance with ASTM D 5778 using a Pagani rig mounted on a rubber track vehicle. During a CPT sounding, an electronically instrumented cone was hydraulically pushed through the soil to measure tip stress, sleeve friction and pore water pressure at two-centimeter intervals (approximately 1 inch). Based on the published empirical relationships, the measured data was used to derive stratigraphic profile and to estimate soil engineering properties including compressibility, strength and permeability.

N W E S	**SCALE:** NTS	Terracon	**SITE VICINITY PLAN**
	CHECKED BY: GL		**LA ROCHE AVENUE CULVERT REPLACEMENT**
	DRAWN BY: WL		**SAVANNAH, GEORGIA**
	DATE: 8/11/2010		**ES105040**

Figure No.

I

● CPT Soundings	SCALE: NTS	Terracon	EXPLORATION LOCATION PLAN	Figure No.
	CHECKED BY: GL		LA ROCHE AVENUE CULVERT REPLACEMENT	II
	DRAWN BY: WL		SAVANNAH, GEORGIA	
	DATE: 8/11/2010		ES105040	

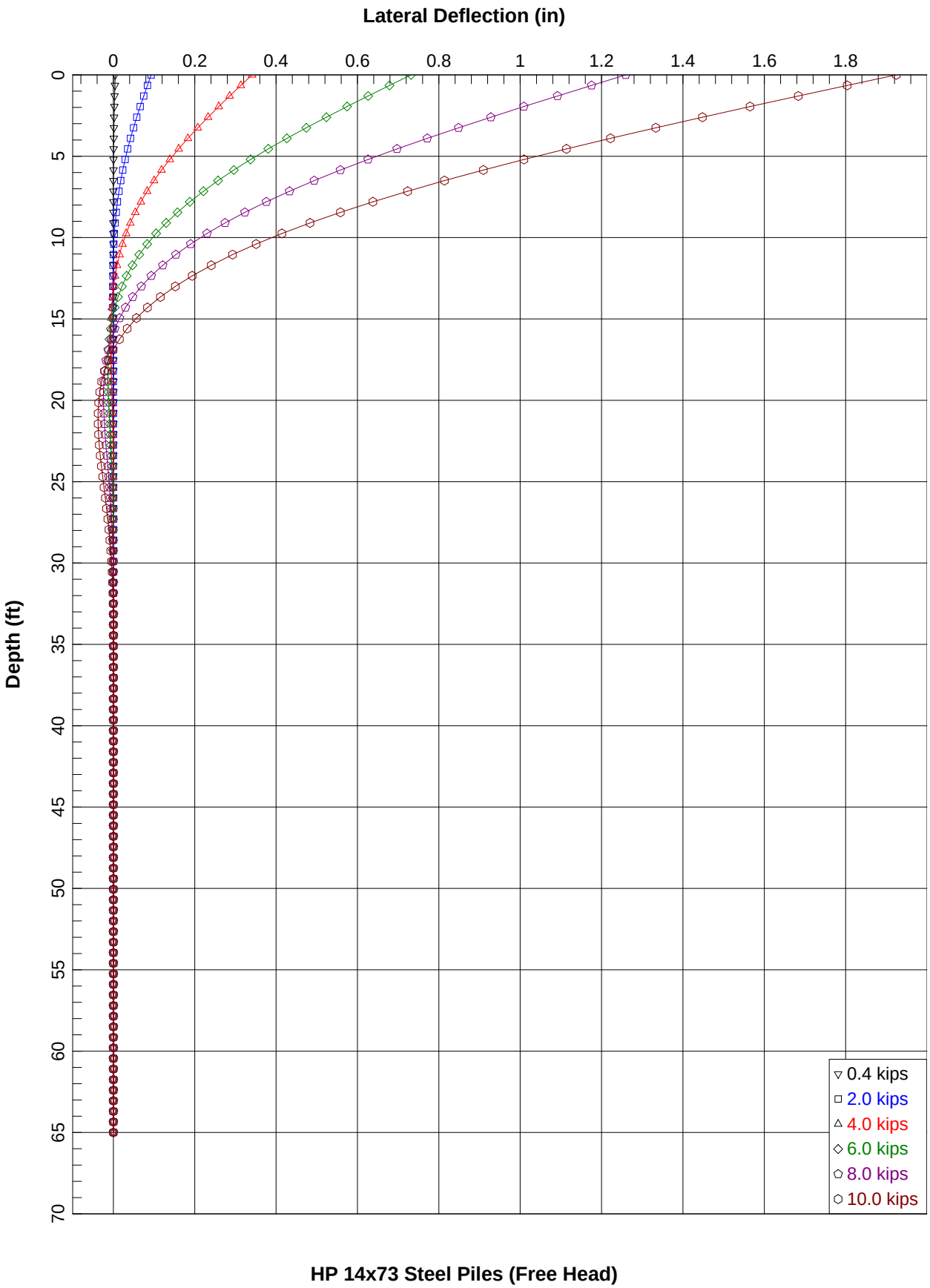


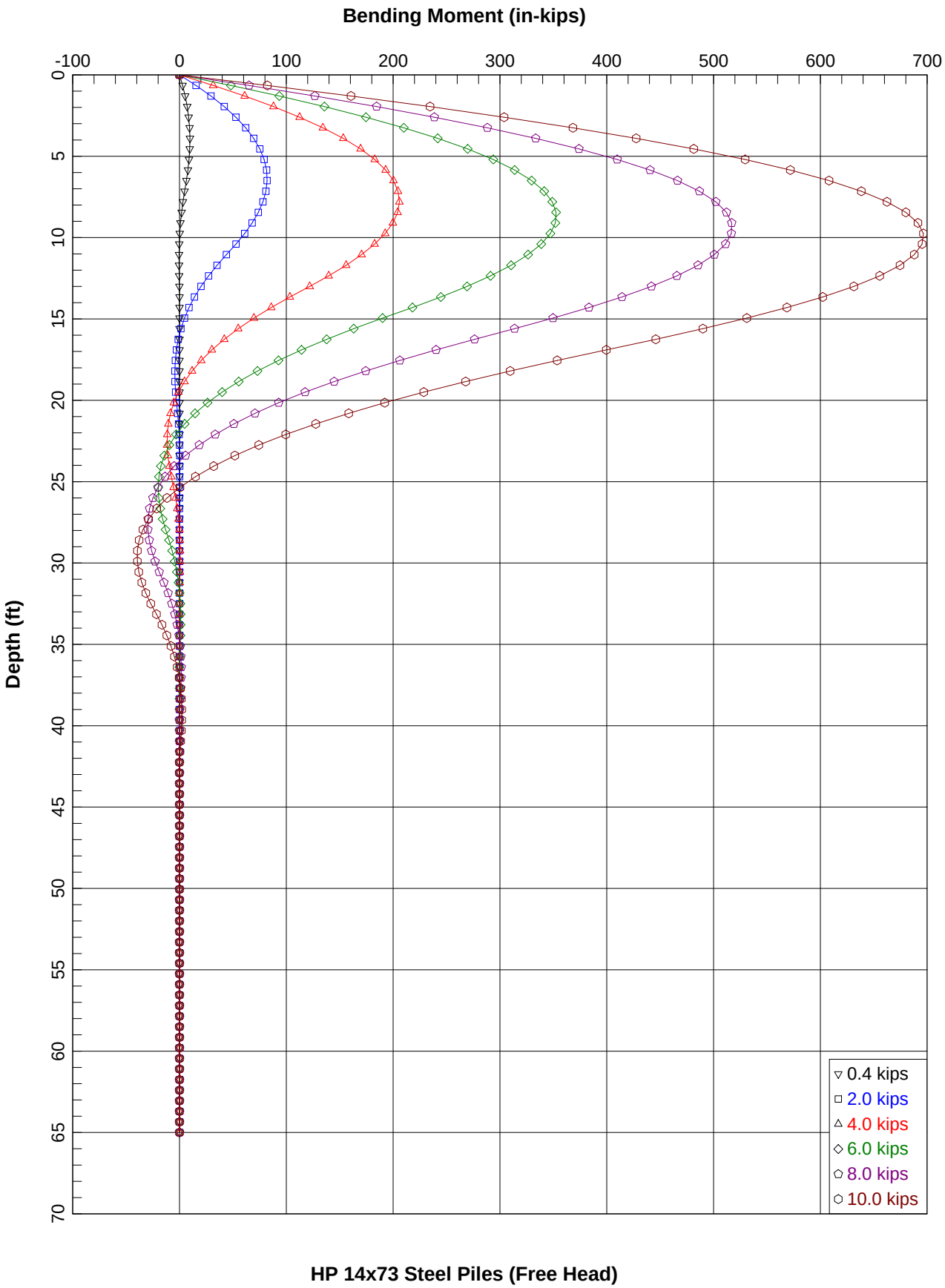
U2

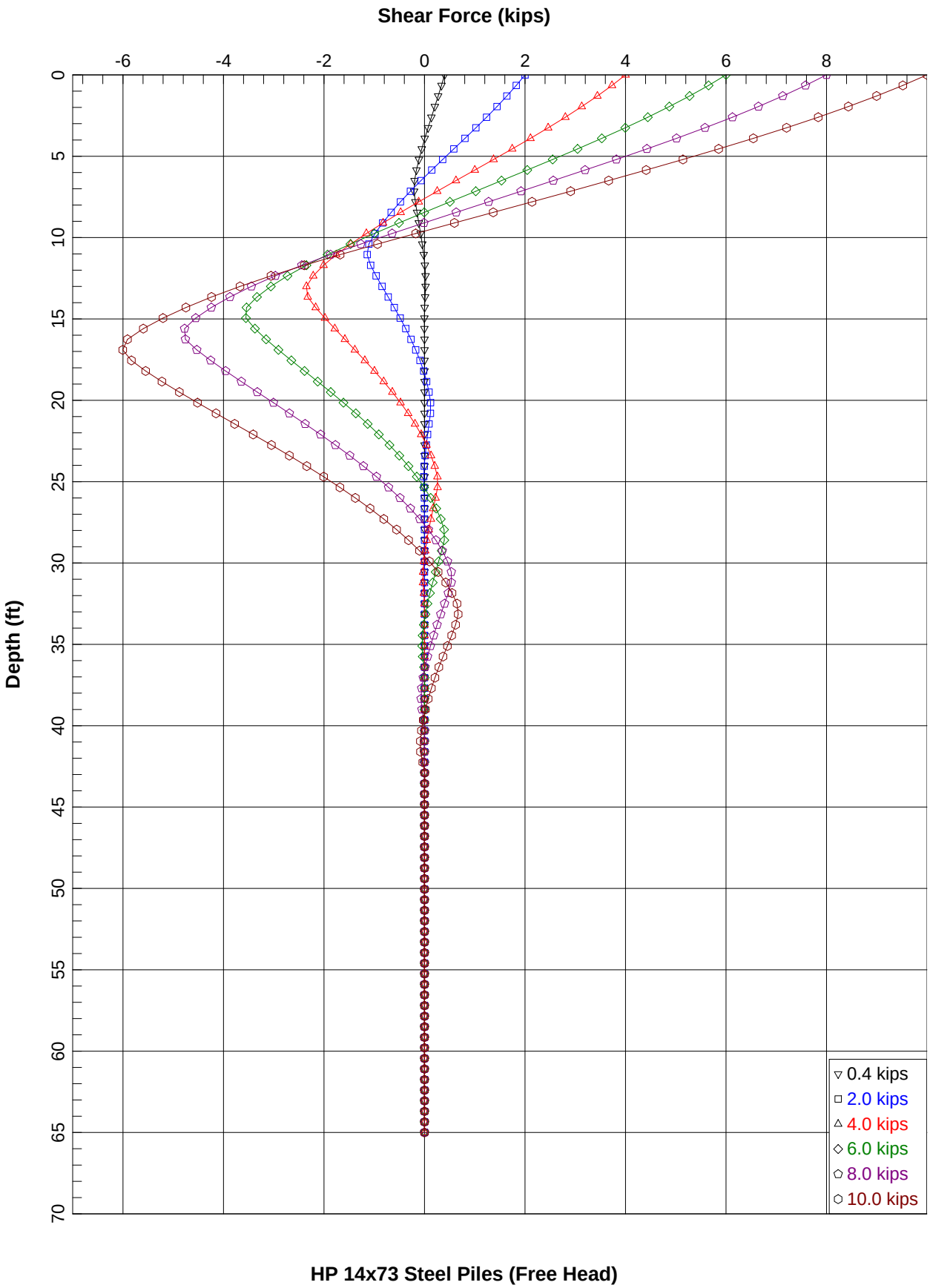
Terracon

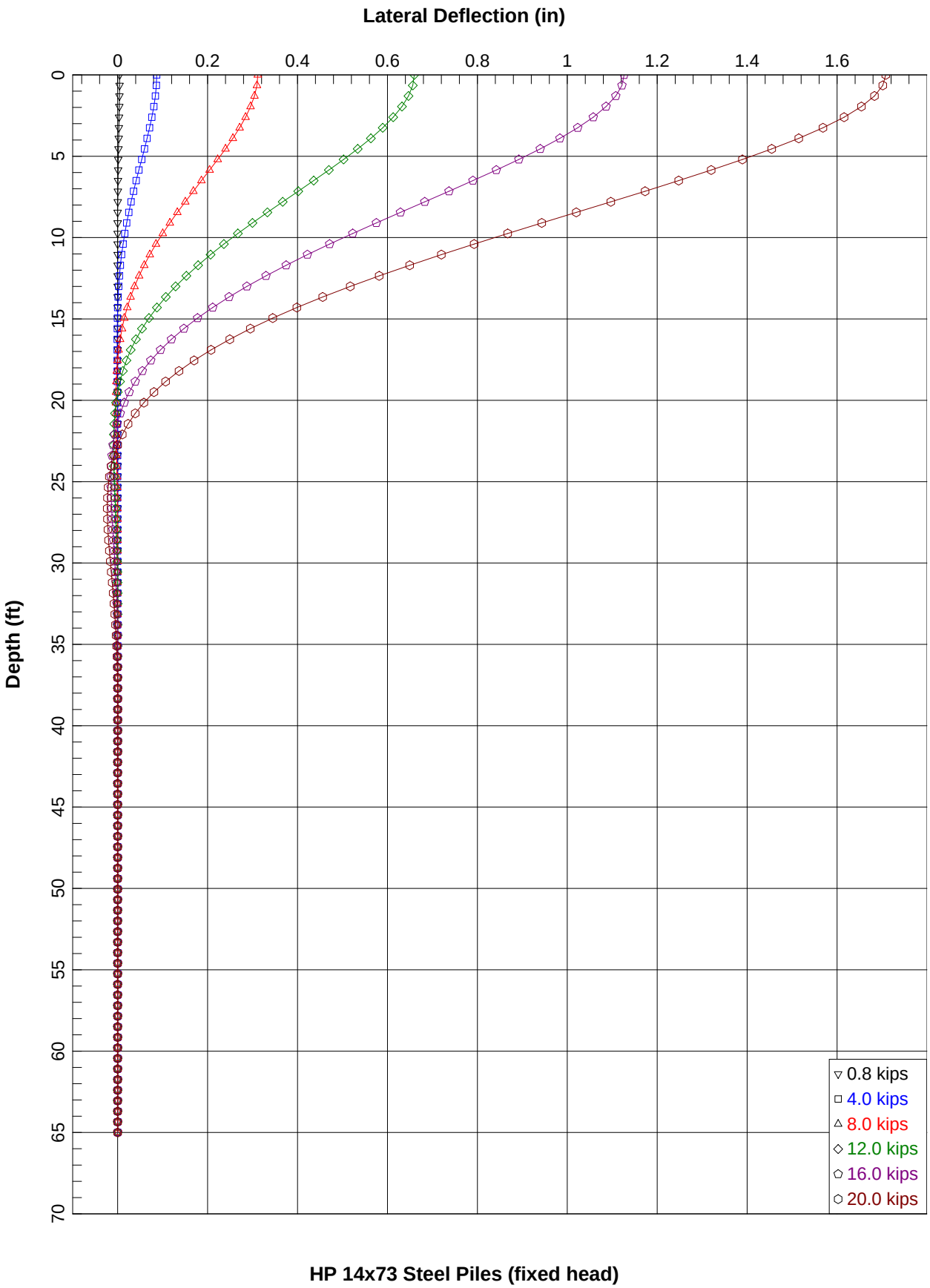
Cone No: 0
Tip area [cm2]: 1
Sleeve area [cm2]: 0

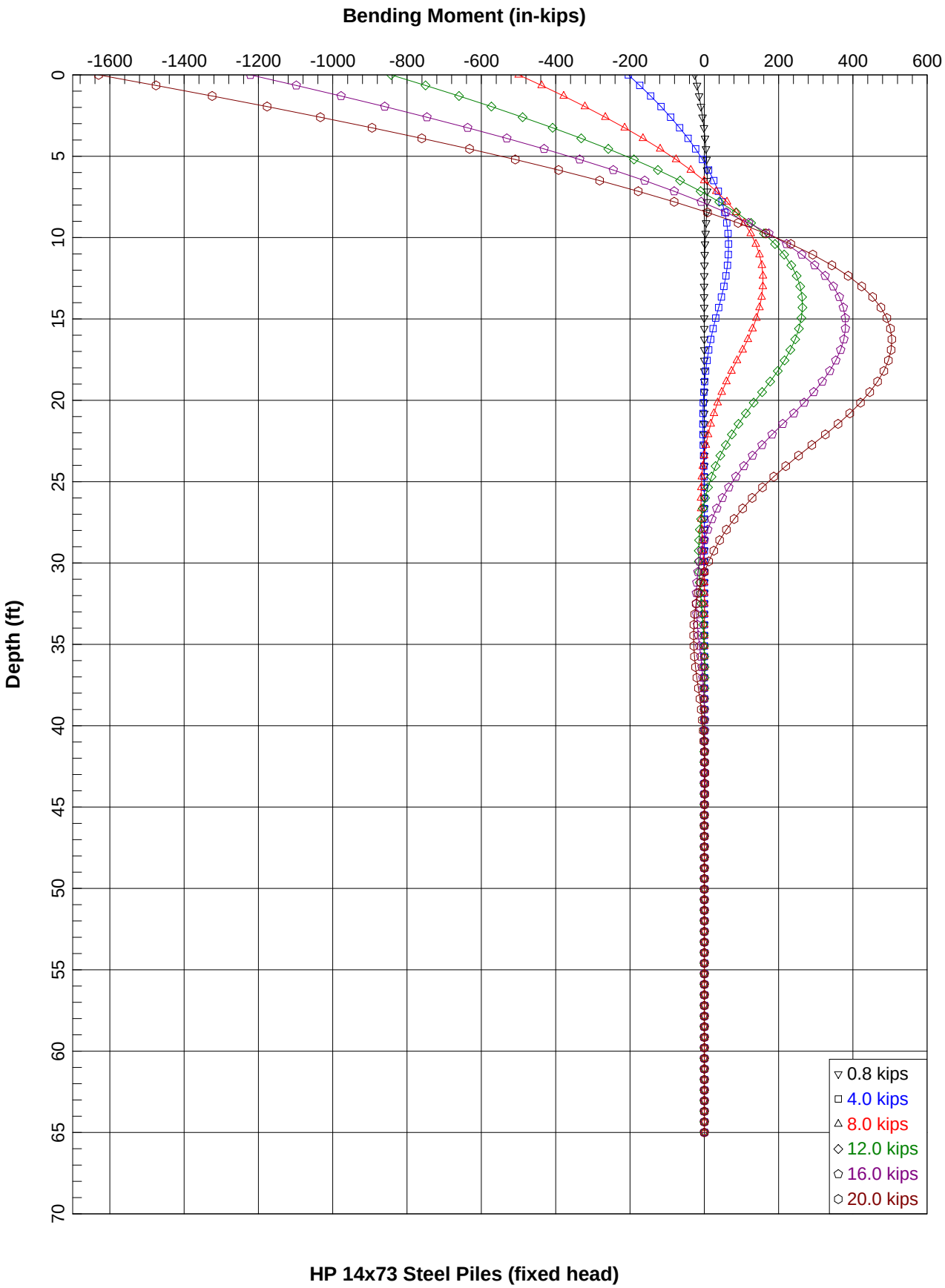
Location: Savannah, Georgia	Position:	Ground level:	Test no: C-1
Project ID: ES105040	Client: Moffatt & Nichol	Date: 4/21/2010	Scale: 1 : 150
Project: LaRoche Ave. Culvert Replacemen		Page: 1/1	Fig:
		File: C1.CPT	

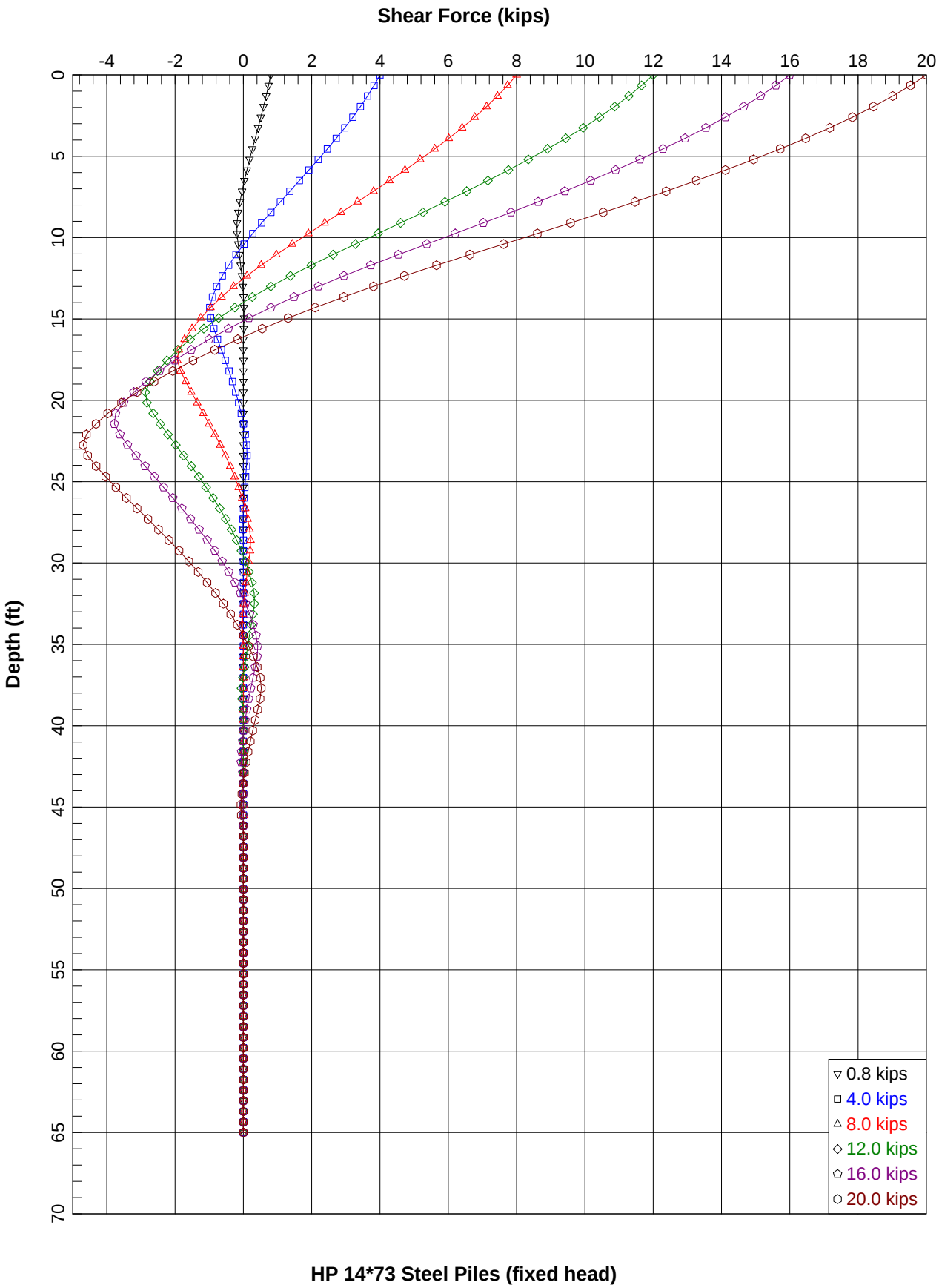

Lateral Deflection (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
0.4 kips
2.0 kips
4.0 kips
6.0 kips
8.0 kips
10.0 kips
HP 14x73 Steel Piles (Free Head)


Bending Moment (in-kips)
-100
0
100
200
300
400
500
600
700
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
0.4 kips
2.0 kips
4.0 kips
6.0 kips
8.0 kips
10.0 kips
HP 14x73 Steel Piles (Free Head)


Shear Force (kips)
-6
-4
-2
0
2
4
6
8
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
0.4 kips
2.0 kips
4.0 kips
6.0 kips
8.0 kips
10.0 kips
HP 14x73 Steel Piles (Free Head)


Lateral Deflection (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
0.8 kips
4.0 kips
8.0 kips
12.0 kips
16.0 kips
20.0 kips
HP 14x73 Steel Piles (fixed head)

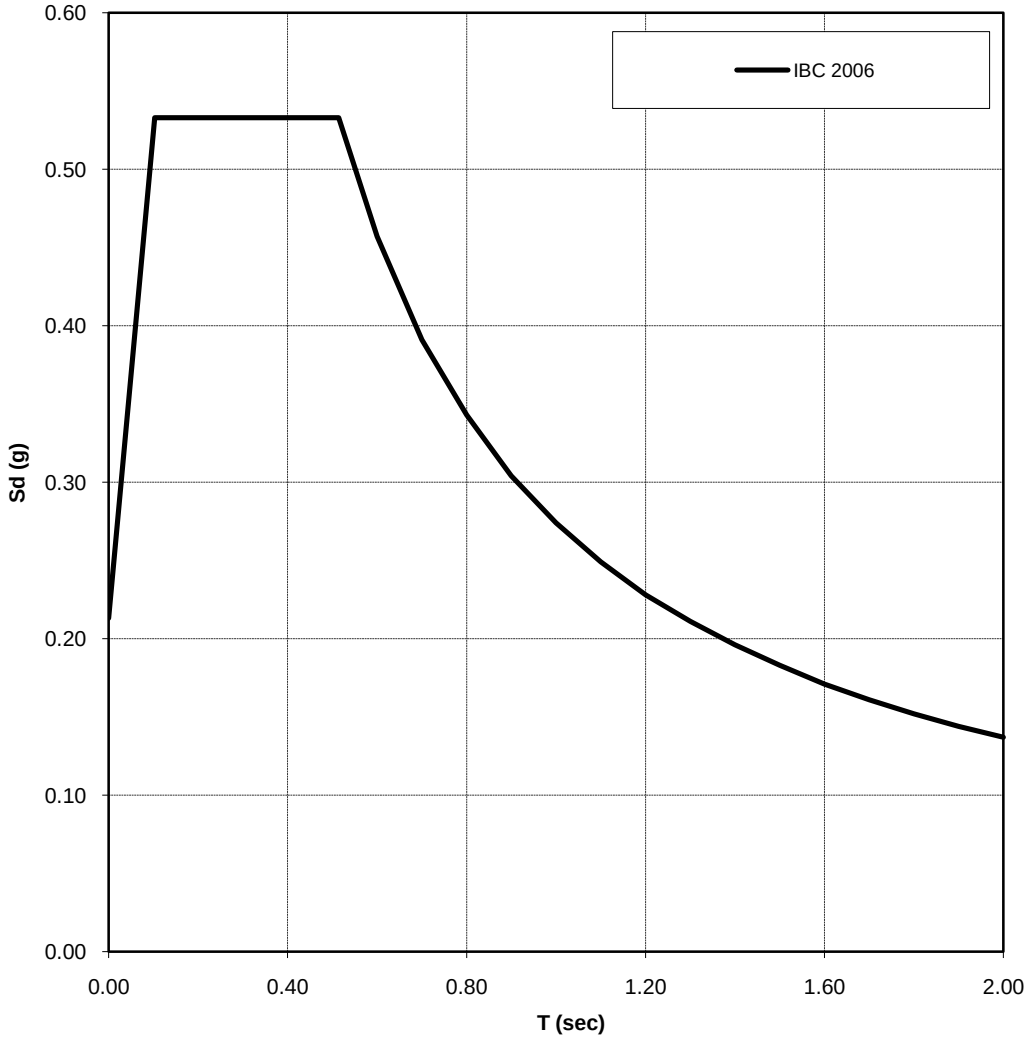

Bending Moment (in-kips)
-1600
-1400
-1200
-1000
-800
-600
-400
-200
0
200
400
600
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
0.8 kips
4.0 kips
8.0 kips
12.0 kips
16.0 kips
20.0 kips
HP 14x73 Steel Piles (fixed head)


Shear Force (kips)
-4
-2
0
2
4
6
8
10
12
14
16
18
20
Depth (ft)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
0.8 kips
4.0 kips
8.0 kips
12.0 kips
16.0 kips
20.0 kips
HP 14*73 Steel Piles (fixed head)

IBC2006 General Procedure
Project Name: LaRoche Avenue Culvert Replacement
Project Number: ES105040

Conterminous 48 States
2006 International Building Code
Latitude = 31.000144
Longitude = -81.063769
Design Response Spectra for Site Class Site Class E
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class D - Fa = 2.054 ,Fv = 3.442

Period (sec)	Sa (g)	Sd (inches)
0.000	0.213	0.000
0.103	0.533	0.055
0.200	0.533	0.208
0.514	0.533	1.376
0.600	0.457	1.606
0.700	0.391	1.874
0.800	0.343	2.142
0.900	0.304	2.410
1.000	0.274	2.677
1.100	0.249	2.945
1.200	0.228	3.213
1.300	0.211	3.481
1.400	0.196	3.748
1.500	0.183	4.016
1.600	0.171	4.284
1.700	0.161	4.552
1.800	0.152	4.819
1.900	0.144	5.087
2.000	0.137	5.355



GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 – 1	Very Soft
500 – 1,000	2 – 4	Soft
1,001 – 2,000	4 – 8	Medium Stiff
2,001 – 4,000	8 – 15	Stiff
4,001 – 8,000	15 – 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 – 10
Medium	11 – 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N] / Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P] / Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

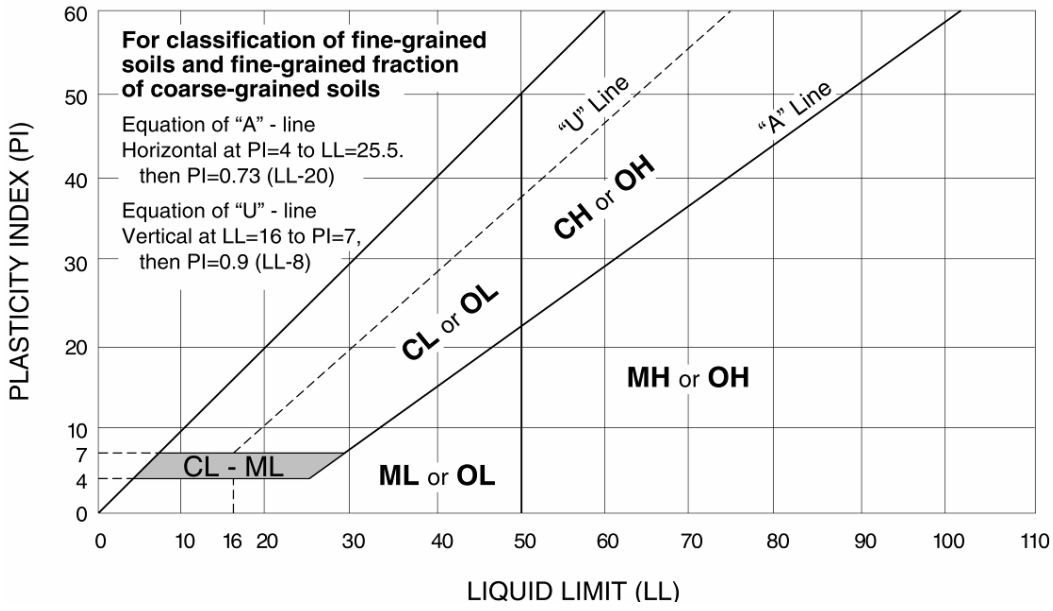
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



PROJECT No. ES105083

LaRoche Avenue Culvert Replacement
Savannah, Ga

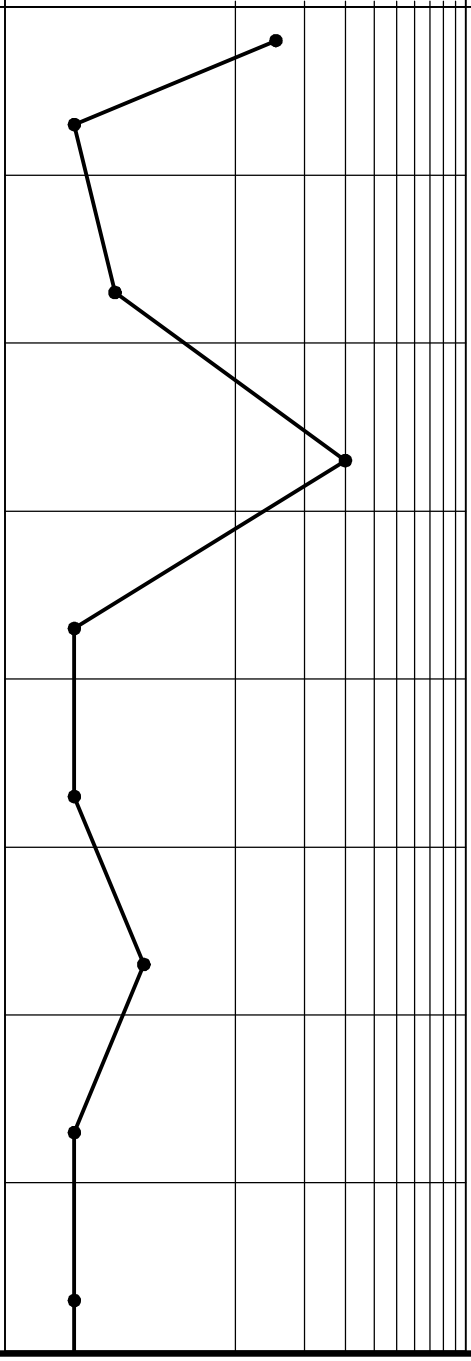
LOG OF BORING NO. B-1

DATE :	9/28/2010	LOGGED BY:	JM
DRILLING METHOD:	Mud Rotary	HAMMER TYPE:	Safety
DRILLING RIG:	CME-45 Truck	DRILLER:	Old South Drilling
WATER LEVEL @ TOB:	8.5	WATER LEVEL @ 24 hrs:	NA

NOTES:
Soil classified in accordance with ASTM 2488. The SPT blow counts have not been adjusted for hammer or overburden pressure.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO/TYPE	N VALUE
	Augured through concrete and asphalt from 0 to 1' BGS Concrete thickness 10"		SS1	15
	Medium dense, tan, poorly graded SAND (SP), moist		SS2	2
5	Very loose, tan and brown, poorly graded SAND with silt (SP-SM), moist			
	Very loose, brown, tan, and orange, clayey SAND (SC), wet		SS3	3
10				
	Medium dense, light grey, silty SAND (SM), with wood debris and some black rock fragments, wet		SS4	30
15				
	Very soft, grey, sandy lean CLAY (CL), wet		SS5	2
20				
	Very soft, grey, sandy lean CLAY (CL), wet		SS6	2
25				
	Soft, grey, sandy lean CLAY (CL), wet		SS7	4
30				
	Very soft, grey, sandy lean CLAY (CL), wet		SS8	2
35				
	Very soft, grey, sandy lean CLAY (CL), with some broken shell fragments, wet		SS9	2

STANDARD PENETRATION TEST DATA (blows/foot)



Terracon

24-hrs water table

Water table at end of the boring

PROJECT No. ES105083

LaRoche Avenue Culvert Replacement
Savannah, Ga

LOG OF BORING NO. B-1

DATE :	9/28/2010	LOGGED BY:	JM
DRILLING METHOD:	Mud Rotary	HAMMER TYPE:	Safety
DRILLING RIG:	CME-45 Truck	DRILLER:	Old South Drilling
WATER LEVEL @ TOB:	8.5	WATER LEVEL @ 24 hrs:	NA

NOTES:
Soil classified in accordance with ASTM 2488. The SPT blow counts have not been adjusted for hammer or overburden pressure.

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/foot) 0 10 20 30 50 80	N VALUE
45		Very soft, grey, lean CLAY (CL), with few broken shell fragments, wet		SS10		2
50		Very soft, grey, lean CLAY (CL), wet		SS11		2
55		Soft, grey, sandy lean CLAY (CL), with few broken shell fragments, wet		SS12		3
60		Very dense, grey and olive green, silty SAND (SM), wet		SS13		52
65		Very dense, light grey and olive green, poorly graded SAND with silt (SP-SM), wet		SS14		>> 50/5
70		Very dense, grey and olive green, silty SAND (SM), wet		SS15		>> 50/5
		END OF BORING at 70.0 ft.				

Terracon

24-hrs water table

Water table at end of the boring

PROJECT No. ES105083

LaRoche Avenue Culvert Replacement
Savannah, Ga

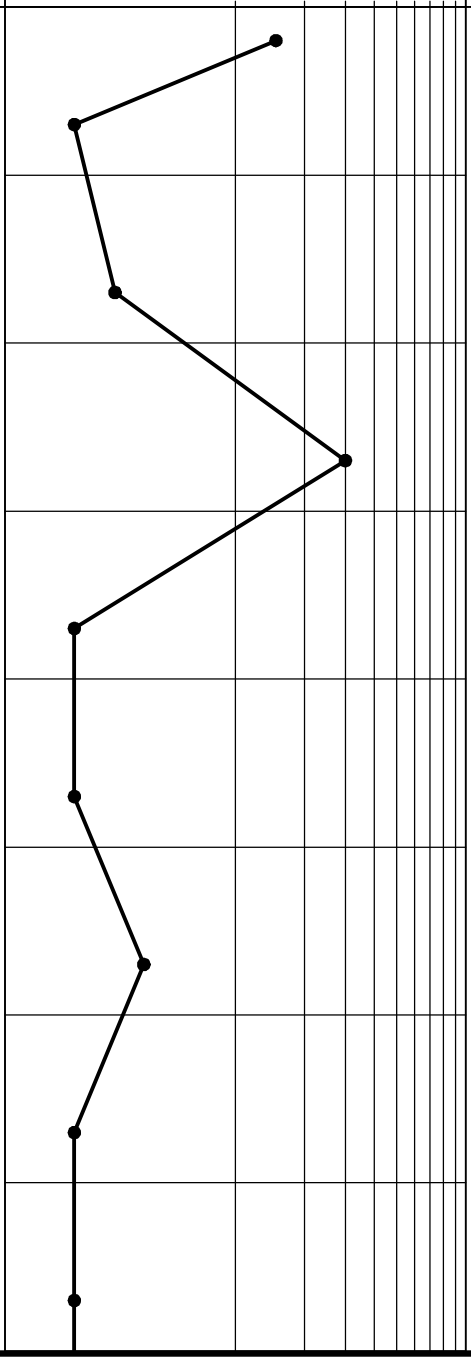
LOG OF BORING NO. B-1

DATE :	9/28/2010	LOGGED BY:	JM
DRILLING METHOD:	Mud Rotary	HAMMER TYPE:	Safety
DRILLING RIG:	CME-45 Truck	DRILLER:	Old South Drilling
WATER LEVEL @ TOB:	8.5	WATER LEVEL @ 24 hrs:	NA

NOTES:
Soil classified in accordance with ASTM 2488. The SPT blow counts have not been adjusted for hammer or overburden pressure.

DEPTH (feet)	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO/TYPE	N VALUE
	Augured through concrete and asphalt from 0 to 1' BGS Concrete thickness 10"		SS1	15
	Medium dense, tan, poorly graded SAND (SP), moist		SS2	2
5	Very loose, tan and brown, poorly graded SAND with silt (SP-SM), moist			
	Very loose, brown, tan, and orange, clayey SAND (SC), wet		SS3	3
10				
	Medium dense, light grey, silty SAND (SM), with wood debris and some black rock fragments, wet		SS4	30
15				
	Very soft, grey, sandy lean CLAY (CL), wet		SS5	2
20				
	Very soft, grey, sandy lean CLAY (CL), wet		SS6	2
25				
	Soft, grey, sandy lean CLAY (CL), wet		SS7	4
30				
	Very soft, grey, sandy lean CLAY (CL), wet		SS8	2
35				
	Very soft, grey, sandy lean CLAY (CL), with some broken shell fragments, wet		SS9	2

STANDARD PENETRATION TEST DATA (blows/foot)



Terracon

24-hrs water table

Water table at end of the boring

PROJECT No. ES105083

LaRoche Avenue Culvert Replacement
Savannah, Ga

LOG OF BORING NO. B-1

DATE :	9/28/2010	LOGGED BY:	JM
DRILLING METHOD:	Mud Rotary	HAMMER TYPE:	Safety
DRILLING RIG:	CME-45 Truck	DRILLER:	Old South Drilling
WATER LEVEL @ TOB:	8.5	WATER LEVEL @ 24 hrs:	NA

NOTES:
Soil classified in accordance with ASTM 2488. The SPT blow counts have not been adjusted for hammer or overburden pressure.

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION (feet)	SAMPLE NO/TYPE	STANDARD PENETRATION TEST DATA (blows/foot) 0 10 20 30 50 80	N VALUE
45		Very soft, grey, lean CLAY (CL), with few broken shell fragments, wet		SS10		2
50		Very soft, grey, lean CLAY (CL), wet		SS11		2
55		Soft, grey, sandy lean CLAY (CL), with few broken shell fragments, wet		SS12		3
60		Very dense, grey and olive green, silty SAND (SM), wet		SS13		52
65		Very dense, light grey and olive green, poorly graded SAND with silt (SP-SM), wet		SS14		>> 50/5
70		Very dense, grey and olive green, silty SAND (SM), wet		SS15		>> 50/5
		END OF BORING at 70.0 ft.				

Terracon

24-hrs water table

Water table at end of the boring

SECTION 02373

GEOTEXTILE

PART 1 - GENERAL

1.1 SUMMARY

The work for this section consists, in general, of furnishing all labor, materials, tools, equipment and utilities to install geotextile as indicated on the project drawings, and as specified herein.

1.2 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 D 4354	(1999) Sampling of Geosynthetics for Testing
ASTM D 4759	(2002) Determining the Specification Conformance of Geosynthetics
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.3 MEASUREMENT

Measurement shall be made of the as-built surface area in square yards covered by geotextile. Allowance will be made for geotextile in anchor and/or drainage trenches but no allowance will be made for waste, overlaps, damaged materials, repairs, or materials used for the convenience of the Contractor.

1.4 PAYMENT

Geotextile installed and accepted will be paid for at the respective contract unit price in the bidding schedule. This unit price shall include the cost of materials, equipment, installation, testing, and other costs associated with placement of the geotextile.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01300, “Submittals.”

1.5.1 Product Data

A. Manufacturer’s Product Data for Geotextile

1.5.2 Certificates

A. Geotextile

A minimum of 7 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could

damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.6.1 Delivery

Chatham County shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.6.2 Storage

Rolls of geotextile shall be protected from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.6.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 Geotextile

Geotextile shall be Nicolon/Mirafi HP 570 or an approved (woven) equivalent.

2.1.2 Thread

Sewn seams shall be constructed with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

The Manufacturer shall be responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 - EXECUTION

3.1 INSTALLATION

3.1.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 02300 “EARTHWORK.”

3.1.2 Placement

The Contractor shall notify Chatham County a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes steeper than 10 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.2 SEAMS

3.2.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 12 inches at all longitudinal and transverse joints. Where seams must be oriented across the slope, the upper panel shall be lapped over the lower panel. If approved, sewn seams may be used instead of overlapped seams.

3.2.2 Sewn Seams

The stitch type used shall be a 401 locking chain stitch or as recommended by the manufacturer. For field and factory seams which are sewn, the Contractor shall provide at least a 2-meter sample of sewn seam before the geotextile is installed. For seams that are field sewn, the seams shall be sewn using the same equipment and procedures as will be used for the production seams. If seams are sewn in both the machine and cross machine direction, samples of seams from both directions shall be provided. Skipped stitches or discontinuities shall be sewn with an extra line of stitching with a minimum of 18 inches of overlap.

3.3 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 14 days after installation.

3.4 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced. Repairs shall be performed at no additional cost to Chatham County.

3.5 COVERING

Geotextile shall not be covered prior to inspection and approval by Chatham County. Rip Rap shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, rip rap shall be placed from the bottom of the slope upward. Rip rap shall not be dropped onto the geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of Chatham County. Rip rap material type, compaction, and testing requirements are described in Section 2300, “Earthwork.” Equipment placing rip rap shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

End of Section 02373

SECTION 09930

STEEL H PILES AND SHEET PILES

PART 1 - GENERAL

1.1 SUMMARY

Work under this section consists, in general, of furnishing all labor, materials, tools, equipment, utilities and incidentals to install all Steel H Piles under the box culvert and wingwalls and Steel Sheet Piles along the northwest wingwall for the project as indicated on the construction drawings, and as specified herein.

1.2 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 572/A 572M	(2007) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM D 4945	(2008) Standard Method for High-Strain Dynamic Testing of Piles

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(2008) Structural Welding Code - Steel

1.3 SUBMITTALS

Submit the following certifications, test procedures, and other submittals shall show the appropriate ASTM test(s) for each material.

1.3.1 Certificates

A. Material Certificates

Submit manufacturer's certified test reports, for each heat, indicating that materials have been tested and certified to meet the specified chemical, mechanical, and section properties prior to delivery at the site. Certifications shall be submitted for all materials, including but not limited to:

1. Steel H Piling

2. Steel Sheet Piling

1.3.2 Shop Drawings

Submit drawings for approval prior to start of work or ordering materials. Drawings for piling shall include complete dimensions, minimum section properties, fabricated sections, and an overall

layout. Include details of top protection, special reinforcing tips, tip protection, lagging, splices, fabricated additions to plain piles, and corrosion protection.

1.3.3 Work Plan

Submit a listing of major equipment to be used to install piles. Pile driving hammer information shall include, but not be limited to, manufacturer's name and model number, rated energy, ram weight, stroke, cushion, and cap block materials.

A. The Contractor shall submit details of equipment, materials, methods, and procedures for the following items:

1. Pile installation. Plan shall include methods for handling piling, driving, and cut-off methods, details and dimensions of templates and other temporary guide structures for installing the piling.

2. Pulling piling.

3. Clearing obstructions.

B. Approval by the Owner will not relieve the Contractor of his responsibility to perform work in accordance with the Drawings and these Specifications.

1.3.4 Pile Driving Equipment and Methods

A. Pile hammer:

1. Make and model
2. Hammer classification (i.e. diesel, air/steam, vibratory, etc.)
3. Hammer type (single acting, double acting, etc.)
4. Energy range
5. Weight of striking part (impact hammers only)
6. Total weight
7. Total length
8. Maximum stroke, if applicable
9. Chart of blowcount rate versus energy through hammer (impact hammers only)
10. Eccentric moment, inch-pound (vibratory hammers only)
11. Dynamic force, tons (vibratory hammers only)
12. Steady state frequency or frequency range, cycles per minute (vibratory hammers only)
13. Vibrating weight, pounds (vibratory hammers only)
14. Amplitude, inches (vibratory hammers only)
15. Maximum pull capacity, tons (vibratory hammers only)
16. Non-vibrating weight, pounds (vibratory hammers only)
17. Power pack description (vibratory hammers only)

B. Driving helmets

C. Capblocks

D. Pile centering guide/template

E. Leads

F. Special driving shoes or points

1.3.5 Wave Equation Analysis

A. Submit wave equation analysis as described in Paragraph 2.3.1 of this Section to support selection of driving equipment.

B. Analysis shall be submitted for each proposed driving equipment to be used, and type, size, and configuration of piles specified.

C. Submittal should summarize the required driving resistance, maximum compressive stress, and maximum tensile stress anticipated based on the analysis.

D. Submit at least two (2) weeks prior to pile installation.

E. Should the proposed driving equipment be changed at any time during the term of the Contract the wave equation analysis shall be resubmitted.

1.3.6 Welding Procedures:

A. Submit copies of the welding procedure specifications and procedure qualification test results for each type of welding required. Approval of any procedure does not relieve the Contractor of the responsibility for producing acceptable welds.

B. The Contractor shall submit the method of field splicing, including welding rod type, for approval.

C. Do not start welding work prior to procedure approval.

1.3.7. Qualifications: Contractor shall submit qualifications for the following:

A. Third party inspection agency;

B. Dynamic Testing Consultant (DTC);

C. Qualify welders in accordance with AWS D1.1 using procedures, materials, and equipment of the type required for work. Before assigning welders or welding operators to the work, submit their names, together with certification that each individual is performance qualified as specified. The certification shall state the type of welding and positions for which each is qualified, the code procedure under which each is qualified, date qualified, and the firm and individual certifying the qualification tests.

1.3.8. Statements: The following shall be submitted:

A. Welding procedure qualifications;

B. Nondestructive examination (NDE) procedures;

C. NDE personnel certification procedures;

D. Submit inspector certification and NDE personnel certification for record.

E. Welding Permits.

1.3.9. Dynamic Testing Reports: Submit dynamic pile test reports as described in Paragraph 2.3.1 of this Specification Section.

1.3.10. Refined Wave Equation Analysis:

A. Following the completion of the installation of the dynamic test piles, submit a refined wave equation analysis as described in Paragraph 3.4.E.1 of this Specification Section.

B. Analysis shall be submitted for each type, size, and configuration of piles specified. Submittal shall summarize the required driving resistance, maximum compressive stress, and maximum tensile stress anticipated based on the analysis.

C. Submittal shall include recommended pile driving criteria.

1.3.11 Records:

A. Weld Identifications: Submit a list of the welder's names and symbol for each welder. To identify welds, submit written records indicating the location of welds made by each welder or welding operator.

B. Weld inspection reports

C. Pile Driving Records: Submit complete and accurate job pile records as specified in paragraph entitled "Records" of this section, within 15 calendar days after completion of driving.

D. Record Drawings: Submit marked up drawings showing all deviations from planned arrangement or details that occurred during construction.

1.4 QUALITY CONTROL AND QUALITY ASSURANCE

A. The Contractor shall be fully experienced in all aspects of steel pipe and sheet pile installation having a minimum of 5-years of experience in performing this type of work.

B. Pile Driving Inspection Agency: An independent third party shall be provided by the Contractor for observation of pile installation. Agency shall employ technicians with one or more of the following qualifications to perform inspection:

1. Current Certified Engineering Technologist (CT) from the National Institute for Certification in Engineering Technologies (NICET).

2. Graduate of accredited engineering or geology program with one year relevant experience, under the supervision of a Georgia registered Professional Engineer (Geotechnical).

3. Georgia licensed Professional Engineer (Geotechnical) with relevant experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. The manufacturer's logo and mill identification mark shall be provided on the piling as required by the referenced specifications.

B. Steel sheet piling shall be stored and handled in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks. Support on level blocks or racks spaced not more than ten (10) feet apart and not more than two (2) feet from the ends. Supports between multiple lifts shall be in a vertical plane. Storage of sheet piling should also facilitate required inspection activities.

C. Protect piling to prevent damage to coatings and to prevent corrosion prior to installation.

D. Weld Material: Deliver filler metals, electrodes, fluxes and other welding materials to the site in manufacturer's original packages and store in a dry space until used. Label and design packages properly to give maximum protection from moisture and to assure safe handling.

1.6 BASIS FOR BIDS

Base bids on the number, size, and length of piles from tip to cutoff as indicated. Should the total number of piles or number of each length vary from that specified as the basis for bidding, an adjustment in the contract price and time of completion will be made. Adjustment in contract price will not be made cutting off piles, disposing of pile cut offs, for damaged or rejected piles, or for pile splices necessary for the pile contract length.

PART 2 - PRODUCTS

2.1 BOX CULVERT AND WINGWALL PILES

A. Steel H Piles: ASTM A 572/A 572M, Grade 50. Pile tips shall be square and blunt, as received from the mill.

B. Steel Sheet Piles: Steel sheet piles shall consist of a Z-shaped sheet pile, AZ 14-770 as manufactured by Skyline Steel or approved equal, ASTM A572 Grade 50.

1. Testing of steel sheet piling shall meet the requirements of ASTM A6.

2. The interlocks of sheet piling shall be hot rolled and free-sliding, provide a swing angle suitable for the intended installation, but not less than five (5) degrees.

3. Sheet piling including special fabricated sections shall be full-length sections of the dimensions shown on the Contract Drawings.

2.1.1 Coating

Coat the top 15 feet of all piles in accordance with Specification Section 09930 "Protective Coating for Steel".

2.2 DRIVING TIPS

At the Contractor's option driving tips for the steel king piles may be provided. They shall be fabricated pile points consisting of ASTM A572 Grade 50 material or hardened pile shoes

conforming to ASTM A27, Grade 65/35 cast steel. Driving tips shall be inside fitting having an outside diameter equal to or less than the diameter of the king piles and shall be open ended.

2.3 EQUIPMENT

2.3.1 Wave Equation Analyses

Retain an independent geotechnical engineer experienced in wave equation analysis of piles driven into similar soils as this project to perform the work. This shall be deemed the "Contractor's Geotechnical Engineer." The Contractor's Geotechnical Engineer shall be a professional engineer registered in the State of Georgia and shall be approved by the Owner prior to commencing the work.

The Contractor's Geotechnical Engineer shall perform an initial wave equation analyses that accurately reflects the Contractor's proposed driving system. The analyses should consider, at a minimum, the following:

A. Hammer impact velocity
B. Hammer energy
C. Hammer ram weight
D. Hammer ram stroke
E. Driving helmet and cushion
F. Hammer cushion or capblock
G. Pile size, weight and length
H. Character of subsurface material to be encountered
I. Pile stresses during driving (compression and tension)
J. Pile penetration

2.3.2 Pile Driving Hammers

A. Furnish a hammer capable of developing the indicated ultimate pile capacity considering hammer impact velocity; ram weight; stiffness of hammer and pile cushions; cross-section, length and total weight of pile; and the character of subsurface material to be encountered. Operate hammer at the rate(s) recommended by the manufacturer throughout the entire driving period. The Contractor may need to modify the driving equipment depending on localized conditions. Repair damage to piling caused by use of a pile hammer with excess delivered force or energy.

B. The use of a vibrating hammer to install the H piles is acceptable. Contractor shall provide a suitable hammer for dynamic testing as required if a vibratory hammer is used. The size or capacity of vibratory hammer shall be as recommended by the manufacturer for the pile mass weight and soil formation to be penetrated. The hammer shall provide for maintaining a rigid connection between the hammer and the pile.

2.3.3 Driving Helmets and Cushion Blocks

A. Driving Helmets or Caps and Pile Cushions: Use a steel driving helmet or cap including a pile cushion between top of pile and driving helmet or cap to prevent impact damage to pile. Use a driving helmet or cap and pile cushion combination capable of protecting pile head, minimizing energy absorption and dissipation, and transmitting hammer energy uniformly over top of pile. Provide driving helmet or cap fit sufficiently loose around top of pile so that pile may be free to rotate without binding within driving helmet. Use pile cushion of solid

wood or of laminated construction using plywood, softwood or hardwood boards with grain parallel to end of pile. Provide pile cushion with thickness of 6 inches minimum and 14 inches maximum. Replace pile cushion when it becomes highly compressed, charred or burned, or has become spongy or deteriorated in any manner. Show details of driving helmets, capblocks, and pile cushions.

B. Hammer Cushion or Capblock: Use a hammer cushion or capblock between driving helmet or cap and hammer ram consisting of aluminum and micarta (or equal) discs stacked alternately in a steel housing. Use steel plates at top and bottom of capblock. Replace aluminum or micarta discs that have become damaged, split or deteriorated in any manner. Do not use small wood blocks, wood chips, rope or other materials that permit excessive loss of hammer energy.

2.3.4 Dynamic Testing

The dynamic monitoring shall be performed using a Pile Driving Analyzer Model PAK, PAL, or PAX. The DTC shall furnish all equipment necessary for the dynamic monitoring such as gages, cables, etc. The equipment shall conform to the requirements of ASTM D4945. The approved DTC shall operate the Pile Driving Analyzer in the field.

PART 3 - EXECUTION

3.1 DYNAMIC PILE TESTING FOR H PILES

3.1.1. General

Pile testing shall consist of dynamic testing during production driving. During production, 2 production piles will have PDA testing performed during installation. The purpose of the production testing will be to verify pile capacity.

3.1.2 Preconstruction Wave Equation Analyses:

A. Two (2) weeks prior to driving the piles, the Contractor shall submit the pile and complete driving equipment data form. The DTC shall use the submitted information to perform wave equation analyses and shall prepare a summary report of the wave equation results. The wave equation analyses shall be used to assess the ability of the proposed driving system to install the pile to the required capacity and desired penetration depth within the allowable driving stresses. Driveability to the estimated tip elevation indicated on the Contract Drawings shall be evaluated considering pile capacities of 20% to 120% of the ultimate required capacity.

B. Wave equation analysis (GRLWEAP version 1998 or newer) shall consider at least the following:

1. Hammer impact velocity
2. Hammer energy
3. Hammer ram weight
4. Hammer ram stroke
5. Driving helmet and cushion
6. Hammer cushion or capblock
7. Pile size, weight and length

8. Character of subsurface material to be encountered
9. Pile stresses during driving
10. Pile stresses during driving (compression and tension)
11. Pile design load
12. Ultimate pile capacity
13. Pile penetration

C. Approval of the proposed driving system by the Engineer shall be based upon the wave equation analyses indicating that the proposed driving system can develop the required ultimate pile capacity (and minimum tip elevation, when applicable), indicated on the Contract Drawings, at an acceptable driving resistance not greater than 10 blows per inch within allowable driving stress limits. The hammer shall also be sized such that the penetration per blow at the required ultimate capacity does not exceed 0.33-inches.

D. The Dynamic Testing Consultant shall recommend a preliminary driving criteria based on this wave equation analysis and anticipated soil strength changes after driving, subject to further dynamic testing results.

E. A new pile driving system, modifications to existing system, or new pile installation procedures shall be proposed by the Contractor if the pile installation stresses predicted by wave equation analysis or calculated by the Pile Driving Analyzer exceed the following maximum values:

1. Steel H Piles

   Compression Stresses: 0.9 times minimum yield strength (f_y)

   Tension Stresses: 0.9 times minimum yield strength (f_y)

2. The Contractor and DTC shall accommodate the Owners representative during testing. The Owners representative will be present at the test site and closely observing the pile testing.

3.1.3. Dynamic Testing Reports:

A. Production Piles:

1. Within one (1) day of production pile testing, the DTC shall prepare a draft field report summarizing the dynamic testing results. As a minimum, the daily reports shall included the calculated driving stresses, transferred energy, and estimated Case Method pile capacity at the time of testing. Variations from previous dynamic pile tests shall also be noted.
2. CAPWAP analyses shall be performed on all of the production piles dynamically tested.
3. Not more than four (4) working days following testing, the DTC shall prepare a written report in accordance with ASTM D 4945 summarizing the dynamic testing results.

3.1.4. Production Pile Driving:

Upon completion of the test pile program the DTC will review the available data and establish a recommended pile driving criteria for installation of production piles. Pile driving criteria shall be established based on refined wave equation analysis criteria.

3.2 INSTALLATION

Inspect piles when delivered and when in the leads immediately before driving. Piles shall be handled so as to protect pile coatings. Repair damage or defects in pile coatings as specified. Cut piles at intended butt elevation by an approved method.

3.2.1 Driving Piles

Drive piles to indicated tip elevation. During initial driving and until pile has penetrated beyond layers of very soft soil, use a reduced driving energy of the hammer. Afterwards, operate hammer at manufacturer's rated speed, and drive pile without interruption indicated tip elevation. If a pile fails to reach indicated tip elevation or if a pile reaches tip elevation without reaching required driving resistance, notify Owner and perform corrective measures as directed. Provide hearing protection when noise levels exceed 140 dB. All pile driving schedules shall be coordinated with Chatham County.

3.2.2 Driving Equipment

Place hammer cushion or cap block between ram and the pile cap or drive cap. Hammer cushion or cap block shall have consistent elastic properties, shall minimize energy absorption, and shall transmit hammer energy uniformly and consistently during the entire driving period. Do not use a pile cushion block.

3.3 TOLERANCES IN DRIVING

At cutoff elevation, butts shall be within 2 inches of the location indicated. A variation of not more than 0.25 inch per foot of pile length from the vertical for plumb piles will be permitted. Inspect piles for heave. Redrive heaved piles to the required tip elevation. Remove and replace with new piles those damaged, mislocated, driven below the design cutoff, or driven out of alignment, or provide additional piles, driven as directed.

3.4 JETTING OF PILES

Jetting shall not be permitted.

3.5 PREDRILLING

Pre-drilling shall not be permitted.

3.6 LONG PILES

Handle and drive piles of a high slenderness ratio carefully to prevent overstress. Provide pile driving rig with rigid supports so that leads remain accurately aligned.

3.7 SPLICES

When approved, provide splices of the full penetration butt weld type or proprietary prefabricated splicer sleeves. Use only one splice per length of pile. Avoid field splices for lengths under 80

feet. Construct splices to maintain the true alignment and position of the pile sections. Splices shall develop the full strength of the pile in both bearing and bending.

3.8 WELDING

AWS D1.1.

3.9 RECORDS

The Contractor's Geotechnical Engineer shall keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from design location, cross section shape and dimensions, original length, ground elevation, tip elevation, cutoff elevation, penetration in blows per foot for the entire length of penetration, hammer data including rate of operation, make, and size, and unusual pile behavior or circumstances experienced during driving such as redriving, heaving, weaving, obstructions, and unanticipated interruptions. Preprinted forms for recording pile driving data are attached below.

PILE DRIVING LOG

DATE _____
CONTRACT NO._____ CONTRACT NAME_____
CONTRACTOR_____ TYPE OF PILE_____
PILE LOCATION_____ PILE SIZE: BUTT/TIP: _____ LENGTH_____
GROUND ELEVATION_____ CUT OFF ELEVATION_____
PILE TIP ELEVATION_____ VERTICAL (_____) BATTER 1 ON (_____)
SPLICES ELEVATION_____ COMPANY_____

HAMMER: MAKE & MODEL_____ WT. RAM_____
STROKE_____ RAM RATED ENERGY_____
DESCRIPTION & DIMENSIONS OF DRIVING CAP_____
CUSHION MATERIALS & THICKNESS_____

INSPECTOR_____

"DEPTH" COLUMN OF PILE DRIVING RECORD REFERENCED TO:
_____ CUT-OFF ELEVATION
_____ FINISH FLOOR ELEVATION

TIME: START DRIVING_____ FINISH DRIVING_____ DRIVING TIME_____
INTERRUPTIONS (TIME, TIP ELEV. & REASON)_____
JET PRESSURE & ELEVATIONS_____

_____

DRIVING RESISTANCE

DEPTH FT.	NO. OF BLOWS	DEPTH FT.	NO. OF BLOWS	DEPTH FT.	NO. OF BLOWS
0	_____	18	_____	36	_____
1	_____	19	_____	37	_____
2	_____	20	_____	38	_____
3	_____	21	_____	39	_____
4	_____	22	_____	40	_____
5	_____	23	_____	41	_____
6	_____	24	_____	42	_____
7	_____	25	_____	43	_____
8	_____	26	_____	44	_____
9	_____	27	_____	45	_____
10	_____	28	_____	46	_____
11	_____	29	_____	47	_____
12	_____	30	_____	48	_____
13	_____	31	_____	49	_____
14	_____	32	_____	50	_____
15	_____	33	_____	51	_____
16	_____	34	_____	52	_____
17	_____	35	_____	53	_____

54	_____	77	_____	99	_____
55	_____	78	_____	100	_____
56	_____	79	_____	101	_____
57	_____	80	_____	102	_____
58	_____	81	_____	103	_____
59	_____	82	_____	104	_____
60	_____	83	_____	105	_____
61	_____	84	_____	106	_____
62	_____	85	_____	107	_____
63	_____	86	_____	108	_____
64	_____	87	_____	109	_____
65	_____	88	_____	110	_____
66	_____	89	_____	111	_____
67	_____	90	_____	112	_____
68	_____	91	_____	113	_____
69	_____	92	_____	114	_____
70	_____	93	_____	115	_____
71	_____	94	_____	116	_____
72	_____	95	_____	117	_____
73	_____	96	_____	118	_____
74	_____	97	_____	119	_____
75	_____	98	_____	120	_____
76	_____				

_____

DRIVING RESISTANCE IN BLOWS PER INCH FOR LAST FOOT OF PENETRATION:

DEPTH_____ DEPTH_____

1"___2"___3"___4"___5"___6"___7"___8"___9"___10"___11"___12"___

ELEV._____ ELEV._____

REMARKS_____

_____

CUT OFF ELEVATION: FROM DRAWING _____

TIP ELEVATION = GROUND ELEVATION - DRIVEN DEPTH = _____

DRIVEN LENGTH = CUT OFF ELEVATION - TIP ELEVATION = _____

CUT OFF LENGTH = PILE LENGTH - DRIVEN LENGTH = _____

SHEET 2 OF 2

End of Section 02460

SECTION 02490

SOIL ANCHORS

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 252	(2009) Standard Specification for Corrugated Polyethylene Drainage Pipe

ACI INTERNATIONAL (ACI)

ACI 301	(2005; Errata 2008) Specifications for Structural Concrete
ACI 318	(2008; Errata 2008; Errata 2009; Errata 2009; Errata 2009; Errata 2009; Errata 2009) Building Code Requirements for Structural Concrete and Commentary

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5CT	(2005; Errata 2006; Errata 2006) Specification for Casing and Tubing

ASTM INTERNATIONAL (ASTM)

ASTM A 53	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 416	(2010) Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM A 500	(2010) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 536	(1984; R 2009) Standard Specification for Ductile Iron Castings
ASTM A 572	(2007) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 779	(2010) Standard Specification for Steel Strand, Seven-Wire, Uncoated, Compacted, Stress-Relieved for Prestressed Concrete

ASTM A 882	(2004a; R 2010) Standard Specification for Filled Epoxy-Coated Seven-Wire Prestressing Steel Strand
ASTM A 981	(1997; R 2007) Standard Specification for Evaluating Bond Strength for 15.2 mm (0.6 in.) Diameter Prestressing Steel Strand, Grade 270, Uncoated, Used in Prestressed Ground Anchors
ASTM C 33	(2008) Standard Specification for Concrete Aggregates
ASTM C 109	(2008) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 144	(2004) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2009) Standard Specification for Portland Cement
ASTM C 1107	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1784	(2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 3350	(2010) Polyethylene Plastics Pipe and Fittings Materials
ASTM D 4101	(2010) Standard Specification for Polypropylene Injection and Extrusion Materials

POST-TENSIONING INSTITUTE (PTI)

PTI 4	(June 1996) Recommendations for Prestressed Rock and Soil Anchors
PTI 8	(1985) Specifications for Unbonded Single Strand Tendons
PTI A	(Nov 1990) Post-Tensioning Manual

1.2 DEFINITIONS

The following definitions are in addition to those given in PTI 4, Section 2.0:

1.2.1 Anchored Structure - The wall, foundation or other structure to which the anchor is to transfer force.

1.2.2 Demonstration Test Anchor - An anchor which is performance tested to verify design assumptions and installation practices.

1.3 SYSTEM DESCRIPTION

Prior to commencing any work on the anchors, the Contractor, including all field personnel to be involved in drilling and installation of the anchors, shall meet with Chatham County to review the drawings and specifications, work plans, and submittals. Drilling may commence upon approval of the anchor installation plan and procedures described in Paragraph “SUBMITTALS” and after the conduct of the Preparatory Meeting.

1.3.1 General Requirements

The work includes design, fabrication and installation of the soil anchor system. The anchors shall be fabricated and installed as shown on the drawings. Prepare fabrication and installation drawings and an installation plan for approval. Soil anchors shall be strand type.

1.3.2 Scope of work

Provide the design of the soil anchor system that will be completely the Contractor's responsibility. General design criteria are given in Paragraph “ANCHOR DESIGN”. The materials, design, stressing, load testing, and acceptance shall be in accordance with PTI 4 and these Specifications. Soil anchors shall be strand type. The Contractor is responsible for the design of the anchor and bearing plate, determining drilling methods, and determining hole diameter and bond length. The complete design, including design computations, fabrication and installation drawings and installation plan, shall be certified by a registered Professional Engineer registered in the State of Georgia and shall be submitted for approval. Approval of the design by Chatham County will not relieve the Contractor of responsibility for design and performance of the soil anchors.

1.3.3 Anchor Design

Design the individual soil anchors to meet the following criteria:

A. Anchor Location - as shown on the drawings

B. Horizontal Spacing - 10 feet minimum, 15 feet maximum

C. Hole Diameter - 6 inches minimum, 8 inches maximum

D. Design Load – 110 kips (service)

E. Assumed Soil-Grout Bond Strength - 25 psi (ultimate)

F. Minimum Unbonded Length - 50 feet

G. Minimum Required Bond Length - 20 feet

H. Maximum Bond Length - 70 feet

I. Corrosion Protection - Class I, Encapsulated Tendon

J. Angle of Anchor Inclination – 40 degrees from horizontal, as indicated on the project drawings, with a tolerance of plus or minus 3 degrees

The design load shall not exceed 60 percent of the ultimate strength of the prestressing steel. The lock-off load shall not exceed 70 percent of the ultimate strength of the prestressing steel. The maximum test load shall not exceed 80 percent of the ultimate strength of the prestressing steel. The designer should include consideration of group effect of closely spaced anchors when determining design load and minimum spacing. Design the bearing plates so that the bending stresses in the plate do not exceed the yield strength of the steel when a load equal to 95 percent of the minimum specified ultimate tensile strength of the prestressing steel is applied and so that the average bearing stress on the structure does not exceed 3,500 psi. Design the anchorage assembly connection to the structure in accordance with ACI 318.

1.4 SUBMITTALS

Submit the following certifications, test procedures, and other submittals shall show the appropriate ASTM test(s) for each material.

1.4.1 Shop Drawings

A. Fabrication and installation drawings

Drawings and detailed installation procedures and sequences showing complete details of the installation procedure and equipment; anchor fabrication; grouting methods; grout mix designs; anchor and casing placement and installation; corrosion protection for bond length, stressing length and anchorage; anchorage and trumpet; stressing and testing procedures with lengths, forces, deformations, and elongations for approval by Chatham County. Shop drawings for anchors shall include locations and details of the spacers, centralizers, and banding. If different types of anchors are to be installed, each anchor type shall be readily identifiable. Once reviewed by Chatham County, no changes or deviation from shop drawings will be permitted without further review by Chatham County.

1.4.2 Product Data

A. Equipment

Catalog cuts, brochures, or other descriptive literature describing the equipment to be used for drilling, grouting, handling, and installing the soil anchors. Sketches, drawings or details showing the access and temporary supports where required for the drilling equipment and stressing frames. Descriptions of stressing jacks, gages, dynamometers, load cells, or other devices for measuring stressing load, certified calibration records for each set of jacking equipment, and current testing curves for stress measurement gages which show that gages have been calibrated for the jacks for which they are used 30 days prior to the start of the testing operations.

B. Designer qualifications

C. Fabricator qualifications

D. Installer qualifications

E. Core logging and soil sampling

The qualifications and experience records for approval. Experience records shall identify all the individuals responsible for the anchors and shall include a listing of projects of similar scope performed within the specified period along with points of contact. Qualifications prior to the installation of any anchors specified in this Section.

F. Installation plan

A plan for installing the soil anchors for review and comment. The proposal shall describe the sequence for installation and other restrictions as outlined on the drawings or specified. The anchor and casing installation procedures shall be determined by the Contractor as part of the anchor design. The installation plan shall also include descriptions of methods and equipment to be used for alignment checking of anchor holes and casings.

1.4.3 Design Data

A. Design computations

Design computations and data for the soil anchors, bearing plates, and bond zones. The computations shall include drawings, design assumptions, calculations, and other information in sufficient detail to verify the design proposed. The design shall be certified by a registered Professional Engineer with proven experience in design of soil anchor components as stated in Paragraph “QUALIFICATIONS”. Calculations shall be included for the stressing frames. Chatham County will approve the Contractor's design calculations. Approval of the Contractor's design calculations will not relieve the Contractor of responsibility for unsatisfactory performance of the installed soil anchors. All design computations shall be furnished at least 30 calendar days prior to the proposed commencement of drilling.

B. Anchor design

A design schedule for the anchors which includes the following:

1. Anchor number

2. Anchor design load

3. Type and size of tendon

4. Minimum total anchor length

5. Minimum bond length

6. Minimum tendon bond length

7. Minimum unbonded length

8. Details of corrosion protection, including details of anchorage and installation

The design schedule at least 30 days prior to commencement of work on the anchors covered by the schedule.

1.4.4 Test Reports

A. Prestressing steel

Certified test reports for each heat or lot of prestressing steel with materials delivered to the site. Test reports for strands shall include bond capacity test results in accordance with ASTM A 981.

B. Cement grout mixture proportions

The mixture proportions that will produce grout of the quality required, 30 days prior to installation of anchors. Applicable test reports to verify that the grout mixture proportions selected will produce grout of the quality specified.

1.4.5 Certificates

A. Prestressing steel

Copies of mill reports and copies of a certificate from the manufacturer stating chemical properties, ultimate strengths, yield strengths, modulus of elasticity, and any other physical properties needed for the required computations, for the type of steel furnished.

1.4.6 Closeout Submittals

A. Driller logs

The original handwritten log and three (3) copies in typed format within two days of the completion of each hole.

B. Anchor records

Upon completion of installation of each anchor, top of bond zone elevation, bond length, free stressing length of anchor, grout mix, grouting pressure, bags of cement injected, a report of performance test or proof test, and extended creep test results,. The performance test, proof test and extended creep test results shall include measured lengths of drill holes and anchors, the loads and elongations recorded during testing, monitoring and stressing of the anchors, and graphs of test results.

1.5 QUALITY ASSURANCE

Submit anchor designer, fabricator and installer qualifications for approval in accordance with Paragraph “SUBMITTALS”. The submittals shall, where applicable, identify individuals who will be working on this contract and their relevant experience. No changes shall be made in approved personnel without prior approval of Chatham County.

1.5.1 Designer Qualifications

The anchors shall be designed by Professional Engineers who have designed a minimum three soil anchor projects similar in size and scope to this project within the past ten years. The drawings and calculations shall be signed by the Professional Engineer.

1.5.2 Fabricator Qualifications

The anchors shall be fabricated by a manufacturer that has been in the practice of designing and fabricating soil anchors similar in size and scope to this project for at least ten years.

1.5.3 Installer Qualifications

The anchors shall be installed by a firm which is regularly engaged in the installation of soil anchors and has at least ten years experience in the installation of similar anchors. The superintendent shall have installed anchors on at least five projects of similar scope and size.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be suitably wrapped, packaged or covered at the factory or shop to prevent being affected by dirt, water, oil, grease, and rust. Protect materials against abrasion or damage during shipment and handling. Place materials stored at the site aboveground on a well supported platform and covered with plastic or other approved material. Materials shall be protected from adjacent construction operations. Grounding of welding leads to prestressing steel will not be permitted. Reject and remove from the site prestressing steel which is damaged by abrasion, cuts, nicks, heavy corrosions, pitting, welds or weld spatter. Inspect tendons prior to insertion into anchor holes for damage to corrosion protection. Any such damage shall be repaired in a manner recommended by the tendon manufacturer and approved by Chatham County.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Prestressing Steel

A. Strand

ASTM A 416, Grade 270, low relaxation strand. Strand shall not be welded.

B. Compact Strand

ASTM A 779, Type 270, low relaxation strand. Strand shall not be welded.

C. Epoxy Coated Strand

ASTM A 882, Grade 270, including Supplementary Requirements S1.

2.1.2 Structural Steel

ASTM A 572, Grade 50.

2.1.3 Steel Pipe

ASTM A 53, Type E or S, Grade B.

2.1.4 Steel Tube

ASTM A 500 or API Spec 5CT, Grade N-80, Oil Field Seconds / Mill Secondary Tubing.

2.1.5 Ductile Iron Castings

ASTM A 536.

2.1.6 Polyethylene Tubing

A. Smooth Polyethylene Tubing

ASTM D 3350 or ASTM D 1248, Type III.

B. Corrugated Polyethylene Tubing

AASHTO M 252, with average minimum wall thickness of 0.06 inch.

2.1.7 Smooth Polypropylene Tubing

ASTM D 4101, designation PP 210 B5542-11.

2.1.8 Polyvinyl Chloride (PVC) Pipe

ASTM D 1785, Schedule 40.

2.1.9 Polyvinyl Chloride (PVC) Tubing

A. Smooth Polyvinyl Chloride (PVC) Tubing

ASTM D 1784.

B. Corrugated Polyvinyl Chloride (PVC) Tubing

Manufactured from rigid PVC compounds conforming to ASTM D 1784, Class 13464-8 with average minimum wall thickness of 0.04 inch.

2.1.10 Heat Shrinkable Sleeve

Radiation crosslinked polyolefin tube internally coated with and adhesive sealant.

2.1.11 Corrosion Inhibiting Compound

The corrosion inhibiting compound shall conform to the requirements of Section 3.2.5 of PTI 8.

2.2 MANUFACTURED UNITS

2.2.1 Anchor Head

Anchor head shall consist of steel bearing plate with wedge plate and wedges for strand anchors, trumpet and corrosion protection. Anchorage devices shall be capable of developing 95 percent of the guaranteed ultimate strength of prestressing steel. The anchorage devices shall conform to the static strength requirements of Section 3.1.6 (1) and Section 3.1.8 (1) and (2) of PTI A. Wedges shall be designed to not cause premature failure of the prestressing steel due to notching or pinching. Provide special wedges as required for epoxy coated strand. Removal of epoxy coating to permit use of standard wedges will not be permitted. The trumpet used to provide a transition from the anchorage to the unbonded length corrosion protection shall be fabricated from steel pipe or steel tube. The minimum wall thickness shall be 0.125 inch for

diameters up to 4 inches and 0.20 inch for larger diameters. The trumpet shall be welded to the bearing plate.

2.2.2 Prestressing Steel Couplers

Splicing of strand will not be permitted.

2.2.3 Centralizers and Spacers

Centralizers and spacers shall be fabricated from plastic, steel or other approved material which is nondetrimental to the prestressing steel. Wood shall not be used. The centralizer shall be able to support the tendon in the drill hole and position the tendon so a minimum of 0.5 inch of grout cover is provided. Centralizers and spacers shall permit grout to freely flow up the drill hole.

2.2.4 Casing

Casing shall be steel pipe or steel tube selected and sized by the Contractor where required. Casing shall be the necessary type and size to permit proper drilling of anchor holes and placing of anchors as specified herein and shown on the drawings. Straightening of casings and machining of joints may be necessary in order to meet specified alignment tolerances.

2.3 EQUIPMENT

The Contractor's Quality Control Manager shall verify that the equipment used on site is the same as the equipment submitted for approval.

2.3.1 Drilling Equipment

Provide drilling equipment suitable for advancing the drill tools to the depths and at the alignment required.

2.3.2 Grouting Equipment

A. Grout Mixer

The grout mixer shall be a high-speed, high-shear, colloidal type grout mixer capable of continuous mechanical mixing that will produce uniform and thoroughly mixed grout which is free of lumps and undispersed cement. The mixer shall be equipped with suitable water and admixture measuring device[s] calibrated to read in cubic feet and tenths and so designed that after each delivery the hands can be conveniently set back to zero.

B. Grout Pump

The grout pump shall be of the positive displacement type, and shall be capable of pumping at all flow rates below 20 gpm, shall be capable of pumping at the pressure of at least 50 psi at zero flow rate. For neat cement grout, the pump shall have a screen with 0.125 inch maximum clearance to sieve the grout before being introduced into the pump. Screens are not required for shear type mixers. Make available a pump which is capable of pumping both neat cement grout mixes and sanded grout mixes. The pumping equipment shall have a pressure gage capable of measuring pressures of at least 150 psi or twice the required grout pressure, whichever is greater.

2.3.3 Stressing Equipment

Stressing equipment shall be hydraulically operated and shall have a capacity sufficient to stress the anchors to the required test loads within the rated capacity in one stroke. Pumps shall be capable of applying each load increment in less than 60 seconds and shall be capable of maintaining the hydraulic pressure within 50 psi. The equipment shall permit stressing of the tendon in increments and raising or lowering the load in the tendon. Stressing equipment for strands shall be capable of stressing all elements equally and simultaneously. The equipment shall be calibrated with an accuracy of plus or minus 2 percent and the calibration certificate and graphs shall be available at the site. The production gage shall have graduations of 100 psi or less. A second certified gage shall be maintained for periodic verification of the production gage. A dial gage or approved device shall be provided to measure total tendon elongation at each load increment to the nearest 0.001 inch. The dial gage shall be capable of measuring the entire anchor movement without being reset. Calibration of gages shall be verified no more than 30 calendar days prior to commencing work under this contract and at six-month intervals throughout the period of use.

2.3.4 Testing Equipment

Provide testing equipment consisting of a hydraulic jack with calibrated pressure gage for applying the load and a dial gage or vernier scale to measure anchor movement. The ram travel of the stressing equipment shall be not less than the theoretical elastic elongation of the total anchor length at the maximum test load. The pressure gage shall be graduated in 100 psi increments. The stressing equipment and pressure gage must have been calibrated as a unit no more than 30 calendar days prior to commencing work under this contract and at six-month intervals throughout the period of use. The movement measuring device shall have a minimum travel equal to the theoretical elastic elongation of the total anchor length at the maximum test load without resetting the device.

2.4 GROUT

2.4.1 Cement

ASTM C 150, Type I, II, III or V.

2.4.2 Water

Provide fresh, clean, potable water free from injurious amounts of sewage, oil, acid, alkali, salts, or organic matter.

2.4.3 Aggregates

Fine aggregate for sand-cement grout shall conform to ACI 301 and ASTM C 33 for grout for backfilling holes or ASTM C 144 for grout for pregrouting. Aggregates shall not contain substances which may be deleterioulsy reactive with alkalies in the cement.

2.4.4 Admixtures

Admixtures which control bleed, improve flowability, reduce water content and retard set may be used in the grout subject to the approval of Chatham County. Any admixtures used shall be compatible with the prestressing steel and shall be mixed in accordance with the manufacturer's recommendations.

2.4.5 Grout for Anchors

Cement grout mixture proportions are the responsibility of the Contractor. Grout for grouting anchors shall consist of a homogenous, pumpable, stable mixture of Portland cement and water. Submit the proposed mix design to Chatham County for approval. The water content shall be the minimum necessary for proper placement but the water-cement ratio shall not exceed 0.45 by weight. Final proportions of materials shall be based on results of tests made on sample mixtures of grout. The minimum compressive strength of two-inch cubes, molded, cured, and tested in accordance with ASTM C 109, shall be 6,000 psi at the time of stressing. The Contractor is responsible for taking, curing, and breaking of grout test cubes for determining mix design, and all testing shall be done by an independent laboratory approved by Chatham County. Soil conditions and temperatures shall be replicated in the curing process.

2.4.6 Sand-Cement Grout

Grout for waterproofing holes, grouting holes which fail the watertightness test, and for backfilling holes which are abandoned shall consist of a mixture of Portland cement, fine aggregate and water. The grout shall consist of one part Portland cement and two parts fine aggregate by volume, mixed with sufficient water to provide a uniform consistency. The grout mix proportions are the responsibility of the Contractor. Submit the proposed mix design to Chatham County for approval. The water content shall be the minimum necessary for proper placement. Final proportions of materials shall be based on results of tests made on sample mixtures of grout. The minimum compressive strength of two-inch cubes, molded, cured, and tested in accordance with ASTM C 109, shall be 6,000 psi. The Contractor is responsible for taking, curing, and breaking of grout test cubes for determining mix design, and all testing shall be done by an independent laboratory approved by Chatham County. Soil conditions and temperatures shall be replicated in the curing process.

2.4.7 Grout for Anchor Pads

Use non-shrink grout conforming to ASTM C 1107 for leveling bearing plates.

2.5 TENDON FABRICATION

2.5.1 General

Fabrication of the anchors shall be as recommended by the suppliers. Anchors shall be completely assembled with all centralizers, spacers, grout and vent tubes and corrosion protection prior to insertion into the hole. Fabricated anchors shall be protected, transported and stored in a manner to prevent contamination or damage to any components.

2.5.2 Tendon

All spacers for multiple element tendons shall be located as indicated on the approved shop drawings. Furnish strands full length with no splicing or coupling permitted. Tendon material shall be unblemished and free of pitting, nicks, grease, or injurious defects. When required to maintain the tendon location within the hole, provide centralizers at a maximum of 10 foot intervals center-to-center throughout the bond length. The entire bond length of the tendon shall be free of dirt, lubricants, loose rust, corrosion-inhibiting coatings or other contaminants.

2.5.3 Bond Breaker

Bond breaker for free stressing length of unbonded anchors shall consist of smooth polyethylene tubing, minimum wall thickness 0.04 inch, or smooth PVC tubing, minimum wall thickness 0.04 inch.

2.5.4 Vent Tubes

Vent tubes used during grouting operations, if necessary, shall be any appropriate type for the job, as recommended by the supplier of the anchors.

2.5.5 Grout Tubes

Grout tubes shall be polyethylene tubing or as recommended by the anchor manufacturer and approved by Chatham County. Inside diameter of grout tubes shall be adequate to fully grout the entire hole.

2.5.6 Corrosion Protection

Corrosion protection shall be as indicated. Corrosion protection shall be provided for the entire anchor and shall include anchorage covers and trumpets filled with grout and encapsulation of the free stressing length and bond length.

A. Anchorage Protection

The trumpet shall be sealed to the bearing plate and shall overlap the free stressing length encapsulation by at least 4 inches. The trumpet and anchorage cover shall be completely filled grout.

B. Free Stressing Length Encapsulation

Encapsulation for free stressing length shall consist of a sheath of smooth polyethylene tubing, minimum wall thickness 0.06 inch; smooth polypropylene tubing, minimum wall thickness 0.06 inch; smooth PVC tubing, minimum wall thickness 0.04 inch; steel pipe or tube with minimum wall thickness 0.20 inch or corrugated tubing conforming to Paragraph “BOND LENGTH ENCAPSULATION”. Sheath for strands may be heat shrinkable sleeve with a minimum thickness of 0.024 inch. Free stressing length encapsulation shall extend at least 4 inches into the trumpet, but shall not contact the bearing plate during testing and stressing of the tendon. Where corrugated tubing is used for sheath for unbonded anchors, a separate bond breaker shall be provided.

C. Bond Length Encapsulation

Bond length encapsulation shall consist of corrugated polyethylene tubing, minimum wall thickness 0.060 inch or corrugated PVC tubing, minimum wall thickness 0.040 inch.

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

Perform required material tests, on prestressing steel and accessories, by an approved laboratory to demonstrate that the materials are in conformance with the Specifications. Test grout in accordance with ASTM C 109. These tests shall be at the Contractor's expense. Furnish to Chatham County prestressing steel test results prior to beginning fabrication of any anchors and within 24 hours of testing.

PART 3 EXECUTION

3.1 DRILLING HOLES

3.1.1 General

The top of bond zone elevations and other physical conditions indicated on the drawings are the result of soil sampling. Holes shall be drilled at the locations and inclinations shown and to the depths and diameters determined by the Contractor to provide the design bond length and capacity indicated on the drawings. The locations of the holes may be changed only as approved by Chatham County. Any redesign of the anchored structure due to relocation of anchor holes shall be performed by the Contractor. Unless otherwise specified, the Contractor shall determine the drilling method to be used. No holes shall be drilled within 50 feet of a grouted hole until the grout has set at least 24 hours. Pressure grouting and drilling shall not be simultaneously performed within a distance of 50 feet. Care shall be taken while drilling to avoid damage of any kind to the existing structures. Damages of any nature will be evaluated by Chatham County and repairs or replacements shall be made as required. Holes shall be drilled a maximum of 3 feet beyond the required anchor bond length. Provide a temporary plug for all holes drilled more than 10 days prior to installation of the anchor. Waste water from drilling operations shall be collected and recycled or treated; it shall not be discharged directly into the water or on the ground.

3.1.2 Drilling Through Existing Structures

Holes through existing structure shall be drilled by any method which does not cause damage to the surrounding structure. The Contractor is advised that foreign material, including metals and other materials remaining from original construction of the existing structure, may be encountered during drilling through existing structures.

3.1.3 Drilling in Soil

Holes in soil may be drilled by rotary drilling, rotary percussive, or vibratory driven casing. Holes in soil shall be provided with steel casing where required for support of the surrounding material. Casing shall be removed prior to or during anchor grouting. Hollow-stem augers which are used for installation of the tendon shall be removed during anchor grouting. Where soil is susceptible to caving, holes through soil shall be drilled by the duplex method using an inner and outer casing with return water flow between the casings.

3.1.4 Casing

Casing shall be utilized for drilling through unstable soil formations and through existing structures as applicable. The casing shall be advanced by rotary drilling or driving.

3.1.5 Records

Submit driller logs and records as specified in Paragraph “DRILLER LOGS”. The presence of a Government inspector or the keeping of separate drilling records by Chatham County shall not relieve the Contractor of the responsibility for the work specified in this Paragraph.

3.1.6 Alignment

A. Tolerances

The anchor hole shall be located within 12 inches of the plan location. The entry angle shall be within 3 degrees of the specified inclination. The alignment of the drilled hole shall be within 3 degrees of the theoretical alignment. If the hole alignment is not within these tolerances, the hole shall be backfilled with cement or sand-cement grout and a new hole drilled adjacent to the rejected hole.

3.2 INSTALLATION OF ANCHORS

3.2.1 General

The Contractor is responsible for each drilled hole until the anchor has been installed, grouted, stressed and accepted. Casings shall be cleaned by pressurized air and/or water to remove drill cuttings and mud. The anchors designated as demonstration test anchors shall be installed and tested prior to drilling the bond zone for other anchors within the area represented by the demonstration test anchor.

3.2.2 Placing

All the equipment used in handling and placing the anchors shall be such that it does not damage or deteriorate the prestressing steel, corrosion protection, or the anchorages. Each anchor shall be inspected prior to insertion into the hole. Any damage to corrosion protection shall be repaired prior to insertion or, if determined by Chatham County to be not repairable, the anchor shall be replaced. Insertion of anchors shall be in accordance with PTI 4.

3.2.3 Grouting of Soil Anchors

A. General

Within the bond length, grout placement shall proceed such that the hole is filled in a manner to prevent air voids. The soil anchor hole shall be progressively filled with grout and maintained completely full from bottom to top of the zone until the grout has set. Grouting of a soil anchor hole shall be performed within 48 hours of the time the hole is drilled. Grouting may be accomplished through the casing pipe, grout tubes, hollow-stem augers or hollow drill rods. The grouting procedure used shall provide soil anchors which meet the specified design capacity. Post-grouting will normally result in higher bond values.

B. Gravity Grouting

Gravity grouting shall proceed from the bottom of the hole to the top of the hole.

C. Pressure Grouting

The method of pressure grouting shall be determined by the Contractor and proven in the demonstration anchor. Production anchors shall be grouted using the methods and target pressures that were used on the acceptable demonstration anchor. Grouting pressures and pumping rates shall be controlled to prevent ground surface heave or fracturing. Grouting pressures shall be incrementally increased until a refusal is reached or an acceptable amount of grout is pumped.

D. Post-Grouting

The number of phases of post-grouting shall be determined by the Contractor and proven in the demonstration anchor. Production anchors shall be grouted using the methods and target pressures that were used on the acceptable demonstration anchor. Grouting pressures and pumping rates shall be controlled to prevent ground surface heave or fracturing. Grouting pressures shall be incrementally increased until a refusal is reached or an acceptable amount of grout is pumped.

3.2.4 Anchorage Installation

The bearing plate and anchor head shall be installed perpendicular to the tendon, within 3 degrees, and centered on the tendon without bending of the stressing steel. Wedges, wedge holes and tendons shall be free of dirt, grout or other contaminants. Corrosion protection shall be maintained intact at the anchorage and any damage shall be repaired prior to stressing.

3.3 STRESSING

3.3.1 General Requirements

After the anchor grout has reached sufficient strength in accordance with the Contractor's design specified strength, as verified by grout cube break, the anchors shall be stressed. Prior to stressing, surfaces upon which the stressing equipment is resting must be clean and the stressing equipment shall be aligned as nearly with the center of the hole as possible. An alignment load of 10 percent of the design load shall be applied to the anchor prior to setting dial gauges. Stress the anchor in accordance with the anchor manufacturer's recommendation, subject to the approval of Chatham County. Design and lock-off loads are given on the project drawings and/or specifications. Determine the lock-off procedure so that the lift-off results meet the acceptance criteria specified in Paragraph “ACCEPTANCE”. The maximum stress shall never exceed 80 percent of the guaranteed ultimate strength of anchor steel. The process of stressing the anchors shall be so conducted that accurate elongation of the anchor steel can at all times be recorded and compared with the computations submitted to, and accepted by Chatham County. Stressing elements of strand anchors shall be stressed simultaneously. Safety precautions shall be taken to prevent workers from being behind or in front of the stressing equipment during stressing. Stressing of the anchors shall be performed in a sequence submitted by the Contractor for review by Chatham County. All stressing shall be done in the presence of a representative of Chatham County. At no time during the stressing and testing of an anchor shall the stressing equipment be disconnected from the temporary stressing head or anchor. Each anchor to be performance tested shall be declared acceptable before proceeding with drilling for other anchors within the section [type] represented by that anchor.

3.3.2 Lock-Off

After completion of the all required tests, the load shall be returned to the alignment load and the specified lock-off load shall be applied to the anchor. For this project, the lock-off load shall be 75% of the design load in accordance with the recommendations of the “Report of Subsurface Investigation” in Appendix “B” of these Specifications. A lift-off test shall be made to verify the load in the anchor tendon before the tendon is locked-off and the stressing equipment is removed. The lift-off reading shall be within five percent of the specified lock-off load. If the lift-off reading is not within five percent of the specified lock-off load, the anchorage shall be reset and another lift-off reading shall be made. This procedure shall be repeated until a satisfactory lift-off reading is obtained. After lock-off, the trumpet shall be filled with grout and the anchorage recess shall be fully grouted flush with the adjacent surfaces.

3.4 FIELD QUALITY CONTROL

3.4.1 General

The first two anchors shall be designated as demonstration test anchors. Designated demonstration test anchors shall be used to verify soil quality and the adequacy of the Contractor's anchor design and installation procedures. Demonstration test anchors shall pass the performance test prior to placing other anchors within the section represented by the respective demonstration test anchor. All other anchors shall be proof tested. During the stressing of each anchor, a record shall be kept of gage pressure and of anchor elongation at each stage of stressing to the specified test or lock-off load, as applicable. The test load shall not be exceeded. Provide a qualified engineer to evaluate the anchor test results and determine the acceptability of the anchors in accordance with the criteria indicated hereunder. Final acceptance of each anchor will be made by Chatham County. All tests shall be run in the presence of Chatham County or his representative.

3.4.2 Performance Test

Performance test shall consist of cyclically and incrementally loading and unloading the anchor, and shall be conducted in accordance with PTI 4, Paragraph 8.3.2. During the testing of each anchor, a record shall be kept of gage pressure and of anchor elongation at each stage of stressing to each test load required by PTI 4. Measurements of the elongation of prestressing steel shall be made in accordance with PTI 4. If the total movement at the end of 10 minutes at the test load exceeds 0.040 inch, the test load shall be held an additional 50 minutes and the movement readings shall be taken at the interval specified in PTI 4, Paragraph 8.3.2. Test records, including plots and graphical analysis of test data, shall be furnished upon acceptance of each performance tested anchor in accordance with Paragraph “SUBMITTALS”.

3.4.3 Proof Test

Proof test shall consist of incrementally loading the anchor and shall be conducted in accordance with PTI 4, Paragraph 8.3.3. During the testing of each anchor, a record shall be kept of gage pressure and of anchor elongation at each stage of stressing to the test load required by PTI 4. Measurements of the elongation of prestressing steel shall be made in accordance with PTI 4. If the total movement at the end of 10 minutes at the test load exceeds 0.040 inch, the test load shall be held an additional 50 minutes and the movement readings shall be taken at the interval specified in PTI 4, Paragraph 8.3.3. Test records, including plots and graphical analysis of test data, shall be furnished upon acceptance of each proof tested anchor in accordance with Paragraph “SUBMITTALS”. The proof test results shall be compared with similar anchors in which performance tests have been performed. If any significant variation from the proof tests occurs, Chatham County may require additional performance tests.

3.4.4 Supplementary Extended Creep Test

Where specified, anchors shall have an extended creep test performed. Creep test shall consist of cyclically and incrementally loading and unloading the anchor, and shall be conducted in accordance with PTI 4, Paragraph 8.3.4. Each maximum load shall be held in accordance with PTI A, Table 8.3.4. A plot of each family of creep curves shall be submitted along with the recorded readings taken at time of the test.

3.4.5 Driller Logs

Keep accurate driller logs and records of all work accomplished under this Contract and deliver complete, legible copies of these logs and records to Chatham County upon completion of the

work or at such other time or times as he may be directed. All such records shall be preserved in good condition and order by the Contractor until they are delivered and accepted, and Chatham County shall have the right to examine such records at any time prior to their delivery. Separate logs shall be made for each hole. Use DRILLING LOG, ENG FORM 1836 and 1836A or other approved form which provides the required information for logs. The following information shall be included on the logs or in the records for each hole:

A. Hole number or designation and elevation of top of hole

B. Inclination of the hole

C. Make and manufacturer's model designation of drilling equipment

D. Dates and time when drilling operations were performed

E. Time required for drilling each run

F. Steel casing seat elevation

G. Depths and elevations at which core was recovered or attempts made to core including top and bottom depth of each run

H. Geologic classification or description by depths of each stratigraphic unit cored. This classification or description shall be made immediately following the taking of the core.

I. Depth and elevation of rod drops and other unusual occurrences

J. Depth and elevation at which groundwater is encountered

K. Depths and elevations at which drill water is lost and regained and amounts

L. Depth and elevation of bottom of hole, determined by measuring the drill steel length

3.4.6 Anchor Records

Upon completion of installation of each anchor, the anchor records shall be furnished to Chatham County as specified in Paragraph “SUBMITTALS”. In addition, as-built drawings showing the completed installation of the anchors shall be furnished upon completion of installation of all anchors.

3.5 ACCEPTANCE

3.5.1 General

Acceptance of anchors shall be determined by Chatham County. The following criteria will be used in determination of the acceptability of each anchor:

A. Creep - Creep movement shall not exceed 0.040 inch at maximum test load during the first 10 minutes of the performance or proof test. If the creep movement exceeds this limit, it shall not exceed 0.080 inch at the maximum test load at the end of 60 minutes. If the creep movement exceeds 0.080 inch at the maximum test load at the end of 60 minutes, the anchor shall be rejected.

B. Movement - Apparent free length shall be calculated from the observed elastic movement in accordance with PTI 4, Section 8.3.2.

1. Minimum Apparent Free Length - The calculated free length shall be not less than 80 percent of the designed free tendon length plus the jack length. If the anchor does not meet this criteria, the anchor shall be restressed from the alignment load to the test load and the apparent free length shall be recalculated. If the anchor does not meet this criteria after 3 attempts (original plus 2 restresses), the anchor shall be rejected.

2. Maximum Apparent Free Length - The calculated free length shall be not more than 100 percent of the designed free tendon length plus 50 percent of the bond length plus the jack length. If the anchor does not meet this criteria, and the cause of the behavior is not investigated and explained to the satisfaction of Chatham County, the anchor shall be rejected.

C. Initial Lift-Off Reading - The initial lift-off reading shall be within 5 percent of the specified lock-off load. If the anchor does not meet this criteria, the anchor shall be adjusted as necessary and the lift-off reading shall be repeated.

3.5.2 Replacement of Rejected Anchors

Any anchor that fails the performance or proof test or is rejected by Chatham County shall be replaced. A replacement anchor, including a new anchor hole, shall be provided by the Contractor at no expense to the Government. The location of the replacement anchor shall be as determined by the Contractor in accordance with the redesign of the anchored structure. Provide all materials, supplies, equipment, and labor necessary to provide a new anchor assembly to the satisfaction of Chatham County. No drilling shall be performed for a replacement anchor until the grouting of all anchors within 50 feet of the replacement anchor location has been allowed to set for at least 24 hours. Either remove failed anchors and thoroughly ream and clear the anchor hole or remove the load and cut the anchor and casing flush.

*****END OF SECTION 02490*****

SECTION 02510

WATER DISTRIBUTION

PART 1 – GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing the water distribution system indicated on the construction drawings and as specified herein.

1.2 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 WATER WORKS ASSOCIATION (AWWA)

AWWA B301	(2004) Liquid Chlorine
AWWA C110/A21.10	(2008) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(2005) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	(2002; Errata 2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153/A21.53	(2006) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(2002; R 2003) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2005) Dry-Barrel Fire Hydrants
AWWA C508	(2001) Swing-Check Valves for Waterworks Service, 2 In. (50 mm) Through 24 In. (600 mm) NPS
AWWA C509	(2001) Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2005) Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA M23	(2002) Manual: PVC Pipe - Design and Installation
AWWA M9	(1995) Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B16.1	(2005) Standard for Gray Iron Threaded Fittings; Classes 125 and 250

ASTM INTERNATIONAL (ASTM)

ASTM A 536	(1984e1; R 2004) Standard Specification for Ductile Iron Castings
ASTM D 1557	(2002e1) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2774	(2008) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM F 402	(2005) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(2008) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(2006) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

UNDERWRITERS LABORATORIES (UL)

UL 246	(1993; Rev thru Dec 1998) Hydrants for Fire-Protection Service
UL 262	(2004) Standard for Gate Valves for Fire-Protection Service
UL 312	(2004) Check Valves for Fire-Protection Service

UL 789	(2004; Rev thru Aug 2008) Indicator Posts for Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	(1992) Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)

1.3 DESIGN REQUIREMENTS

1.3.1 Water Distribution Mains

Provide water distribution mains indicated as 8 inch diameter lines of ductile-iron or polyvinyl chloride (PVC) pipe. Provide water main accessories as specified and where indicated.

1.4 SUBMITTALS

The following shall be submitted for review by Chatham County before ordering materials:

A. Product Data

1. Piping Materials

2. Water distribution main piping, fittings, joints, and couplings

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on joints. Include information concerning gaskets with submittal for joints and couplings.

B. Design Data

1. Design calculations of water piping

C. Test Reports

1. Bacteriological Disinfection

2. Test results from commercial laboratory verifying disinfection

D. Certificates

1. Water distribution main piping, fittings, joints, valves, and coupling

2. Shop-applied lining

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

E. Manufacturer's Instructions

1. Delivery, storage, and handling

2. Installation procedures for water piping

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Materials on site shall be stored in enclosures or under protective covering. Plastic piping, jointing materials and rubber gaskets shall be stored under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to Chatham County. Rubber gaskets that are not to be installed immediately shall be stored under cover and out of direct sunlight.

PART 2 – PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

A. Pipe and Fittings: Pipe, except flanged pipe, AWWA C151/A21.51, Pressure Class 350. Flanged pipe, AWWA C115/A21.15. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53 fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, twice the standard thickness.

B. Joints and Jointing Material:

1. Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints unless otherwise indicated. Provide mechanical joints where indicated.

2. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

3. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

4. Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron,

ASTM A 536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

5. Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

6. Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled “Sleeve-Type Mechanical Couplings.”

2.1.2 Water Main Accessories

2.1.2.1 Sleeve-Type Mechanical Couplings

Couplings shall be designed to couple plain-end piping by compression of a ring gasket at each end of the adjoining pipe sections. The coupling shall consist of one middle ring flared or beveled at each end to provide a gasket seat; two follower rings; two resilient tapered rubber gaskets; and bolts and nuts to draw the follower rings toward each other to compress the gaskets. The middle ring and the follower rings shall be true circular sections free from irregularities, flat spots, and surface defects; the design shall provide for confinement and compression of the gaskets. For ductile iron and PVC plastic pipe, the middle ring shall be of cast-iron. Gaskets shall be designed for resistance to set after installation and shall meet the applicable requirements specified for gaskets for mechanical joint in AWWA C111. Bolts shall be track-head type, ASTM A 307, Grade A, with nuts, ASTM A 563M ASTM A 563, Grade A; or round-head square-neck type bolts, ANSI B18.5.2.1M and ASME B18.5.2.2M with hex nuts, ASME B18.2.2. Bolts shall be 16 mm 5/8 inch in diameter; manufacturer’s recommendation shall be used when considering minimum number of bolts for each coupling. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Mechanically coupled joints using a sleeve-type mechanical coupling shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.2.2 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 10 feet from any sewer line.

A. Water Piping Installation Parallel With Sewer Piping

1. Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

2. Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

a. The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

b. Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

c. The sewer manhole shall be of watertight construction and tested in place.

B. Installation of Water Piping Crossing Sewer Piping

1. Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

2. Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

a. Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

b. Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02300, “EARTHWORK.”

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the

pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where indicated and where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installations. Depth of cover over top of pipe shall not be less than 2 ½ feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such a manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

A. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with the gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight; avoid undue strain on flanges, fittings, valves, and other equipment and accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fitting has dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Use setscrewed flanges to make flanged joints where conditions prevent the use of full-length flanged pipe and assemble in accordance with the recommendations of the setscrewed flange manufacturer. Ensure that there is no metal-to-metal contact between dissimilar metals after the joint has been assembled.

B. Allowable Deflection: The maximum allowable deflection shall be as given in AWWA C600. If the alignment requires deflection in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth.

C. Pipe Anchorage: Provide metal harness for pipe anchorage. Metal harness shall be in accordance with the requirements of AWWA C600 for thrust restraint, using tie rods and clamps as shown in NFPA 24.

3.1.3 Disinfection

Prior to disinfection, obtain Chatham County approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain Chatham County approval of the proposed method for disposal of waste water from hydrostatic testing. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test ductile-iron water mains and water service lines in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints shall not exceed the amounts given in AWWA C600; no leakage will be allowed at joints made by any other method. Test PVC plastic water mains and water service lines made with PVC plastic pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at flanged joints.

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test. A Chatham County representative must be present during this test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

*** End of Section 02510***

SECTION 02531

SANITARY SEWERS

PART 1 – GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing the sanitary sewer system indicated on the construction drawings and as specified herein.

1.2 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 WATER WORKS ASSOCIATION(AWWA)

AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C153	(2000) Ductile-Iron Compact Fittings for Water Service
AWWA C600	(1999) Installation of Ductile-Iron Water Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM A 746	(2003) Ductile Iron Gravity Sewer Pipe
ASTM C 270	(2004a) Mortar for Unit Masonry
ASTM C 443	(2003) Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2003a) Precast Reinforced Concrete Manhole Sections
ASTM C 923	(2002) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 924	(2002) Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 969	(2002) Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines

ASTM C 972	(2000) Compression-Recovery of Tape Sealant
ASTM C 990	(2003a) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D 2321	(2000) Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	(2002) Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 3034	(2004) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 4101	(2004a) Polypropylene Injection and Extrusion Materials
ASTM D 412	(1998a; R 2002e1) Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	(2000e1) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 949	(2003) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS A-A-60005	(Basic) Frames.Covers, Gratings, Steps, Sump and Catch Basin, Manhole

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.27	Fixed Ladders

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.3 SYSTEM DESCRIPTION

1.3.1 Sanitary Sewer Gravity Pipeline

Provide mains of ductile-iron or polyvinyl chloride (PVC) pipe. Provide the system complete and ready for operation. The exterior sanitary gravity sewer system includes equipment, materials, installation, and workmanship as specified and where indicated.

1.4 GENERAL REQUIREMENTS

The Contractor shall replace damaged material and redo unacceptable work at no additional cost to Chatham County. Backfilling shall be accomplished after inspection by Chatham County. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and

shall follow these instructions unless directed otherwise by Chatham County. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.5 SUBMITTALS

The following shall be submitted for review by Chatham County before ordering materials:

A. Shop Drawings

1. Precast concrete manhole

2. Metal items

3. Frames and covers

B. Product Data

1. Pipeline Materials

Submit manufacturer’s standard drawings or catalog cuts.

C. Test Reports

1. Test and inspection reports, as specified

D. Certificates

1. Portland Cement

Certificates of compliance stating the type of cement used in precast manholes.

2. Gaskets

Certificates of compliance stating that the fittings or gaskets used for waste lines designated on the plans are resistant.

E. Manufacturer's Instructions

1. Delivery, storage, and handling

2. Installation procedures for sanitary sewer gravity pipeline.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery and Storage

1.6.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping, jointing materials, and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.6.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.6.1.3 Cement, Aggregate and Reinforcement

As specified in Section 03300 CAST-IN-PLACE CONCRETE.

1.6.2 Handling

Handle pipe, fittings, and other accessories in such a manner as to ensure delivery to the trench in sound undamaged condition. Carry, do not drag, pipe to trench.

PART 2 – PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.1.1.1 Ductile Iron Gravity Pipe and Fittings

Ductile iron pipe shall conform to ASTM A 746. Fittings shall conform to AWWA C110 or AWWA C153. Fittings shall have strength at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the joints specified hereinafter. Pipe and fittings shall have cement-mortar lining conforming to AWWA C104, standard thickness.

2.1.1.2 Ductile Iron Gravity Joints and Jointing Materials

Pipe and fittings shall have push-on joints, except as otherwise specified in this paragraph. Mechanical joints only shall be used where indicated. Push-on joint pipe ends and fitting ends, gaskets, and lubricant for joint assembly shall conform to AWWA C111. Mechanical joint requirements for pipe ends, glands, bolts and nuts, and gaskets shall conform to AWWA C111.

2.1.2 PVC Plastic Gravity Sewer Piping

2.1.2.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.2.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.2 CONCRETE MATERIALS

2.2.1 Cement Mortar

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.2.2 Portland Cement Concrete

As specified in Section 03300 CAST-IN-PLACECONCRETE.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C 478; base and first riser shall be monolithic.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C 443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C 923 or ASTM C 990.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties	Test Methods	EPDM	Neoprene	Butyl Mastic
Tensile, psi	ASTM D 412	1840	2195	–
Elongation, percent	ASTM D 412	553	295	350
Tear Resistance, ppi	ASTM D 624 (Die B)	280	160	–
Rebound, percent, 5 minutes	ASTM C 972 (mod.)	–	–	11
Rebound, percent, 2 hours	ASTM C 972	–	–	12

2.3.4 Metal Items

2.3.4.1 Frames, Covers, and Gratings for Manholes

FS A-A-60005, cast iron; figure numbers shall be as follows:

A. Traffic manhole:

Frame: Figure 1, Size 22A

Cover: Figure 8, Size 22A
Steps: Figure 19

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C 443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.4 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 02300 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements".

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building. Where the location of the sewer is not clearly defined by dimensions on the drawings, do not lay sewer line closer horizontally than 10 feet to a water main or service line. Where sanitary sewer lines pass above water lines, encase sewer in concrete for a distance of 10 feet on each side of the crossing. Where sanitary sewer lines pass below water lines, lay pipe so that no joint in the sewer line will be closer than 3 feet, horizontal distance, to the water line.

A. Sanitary piping installation parallel with water line:

1. Normal conditions: Sanitary piping or manholes shall be laid at least 3 m 10 feet horizontally from a water line whenever possible. The distance shall be measured edge-to-edge.

2. Unusual conditions: When local conditions prevent a horizontal separation of 3 m 10 feet, the sanitary piping or manhole may be laid closer to a water line provided that:

   a. The top (crown) of the sanitary piping shall be at least 450 mm 18 inches below the bottom (invert) of the water main.

b. Where this vertical separation cannot be obtained, the sanitary piping shall be constructed of AWWA-approved ductile iron water pipe pressure tested in place without leakage prior to backfilling.

c. The sewer manhole shall be of watertight construction and tested in place.]

B. Installation of sanitary piping crossing a water line:

1. Normal conditions: Lay sanitary sewer piping by crossing under water lines to provide a separation of at least 18 inches between the top of the sanitary piping and the bottom of the water line whenever possible.

2. Unusual conditions: When local conditions prevent a vertical separation described above, use the following construction:

a. Sanitary piping passing over or under water lines shall be constructed of AWWA-approved ductile iron water pipe, pressure tested in place without leakage prior to backfilling.

b. Sanitary piping passing over water lines shall, in addition, be protected by providing:

1. A vertical separation of at least 18 inches between the bottom of the sanitary piping and the top of the water line.

2. Adequate structural support for the sanitary piping to prevent excessive deflection of the joints and the settling on and breaking of the water line.

3. That the length, minimum 20 feet, of the sanitary piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the water line.

C. Sanitary sewer manholes: No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 02300, EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell ends in the upgrade direction. Adjust spigots in bells to give a uniform space all around. Blocking or wedging between bells and spigots will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose.

3.1.2 Special Requirements

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation and joint assembly.

A. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111.

B. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105, using polyethylene film.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03300, CAST-IN-PLACE CONCRETE. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

A. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may

impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

B. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Chatham County will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests and provide labor, equipment, and incidentals required for testing. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

A. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

B. Low-pressure air tests: Perform tests as follows:

1. Ductile-iron pipelines: Test in accordance with the applicable requirements of ASTM C 924. Allowable pressure drop shall be as given in ASTM C 924. Make calculations in accordance with the Appendix to ASTM C 924.

2. PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

A. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

1. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

2. Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4 degrees C 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

3. Center bored and through-bolted with a 6 mm 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

4. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

B. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

C. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

D. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe, replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Field Tests for Concrete

Field testing requirements are covered in Section 03300 CAST-IN-PLACE CONCRETE.

3.3 CLEANUP

Upon completion of the installation of sewer pipelines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

*** End of Section 02531***

SECTION 02630

STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

The work under this section consists, in general, of furnishing all labor, materials, tools, equipment, and incidentals for providing for the installation of drop inlets, reinforced concrete pipe drains, and other related utilities.

1.2 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 M 198	(2003) Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 48/A 48M	(2003) Gray Iron Castings
ASTM A 536	(1984; R 2004) Ductile Iron Castings
ASTM C 139	(2003) Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 231	(2004) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 270	(2004a) Mortar for Unit Masonry
ASTM C 32	(2004) Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 425	(2004) Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(2003) Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 478	(2003a) Precast Reinforced Concrete Manhole Sections
ASTM C 55	(2003) Concrete Brick
ASTM C 62	(2004) Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 76	(2004a) Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 789	(2000) Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers

ASTM C 877	(2002) External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C 923	(2002) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM D 1557	(2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2167	(1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(2004) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 MEASUREMENT AND PAYMENT

1.3.1 Pipe Culverts

The length of pipe installed will be measured along the centerlines of the pipe from end to end of pipe. Additional pipe will be paid for at the contract unit price for the number of linear feet of culverts placed in the accepted work.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by Chatham County.

1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 - PRODUCTS

2.1 PIPE FOR CULVERTS

Pipe for culverts shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76, Class III, Wall B, Lifting holes are not allowed.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 5000 psi concrete under Section 03300 “Cast-in-Place Concrete.” The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C 231. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.2.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.2.3 Joints

2.2.3.1 Flexible Watertight Joints

A. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

B. Test Requirements: See Section 01600.

PART 3 - EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS

Excavation of trenches, and for appurtenances and backfilling for culverts, shall be in accordance with the applicable portions of Section 02300 “Earthwork” and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside width of the pipe plus 12 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified. Contractor shall not over excavate.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and

replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to Chatham County.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary.

3.3.1 Concrete Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.5 BACKFILLING

3.5.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 12 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of Chatham County, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.5.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches.

3.5.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.5.4 Compaction

3.5.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.5.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

A. Under pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

B. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

C. Under nontraffic areas, density shall be not less than that of the surrounding material.

3.5.5 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to Chatham County. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is

used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished Chatham County. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

End of Section 02630

SECTION 02704

GRADED AGGREGATE BASE COURSE (GABC)

PART 1 – GENERAL

1.1 SUMMARY

Work under this section includes requirements for providing a dense graded aggregate base course for the new asphalt pavement on the project. The Contractor shall furnish all labor, equipment and utilities to complete the work as indicated on the project drawings and as specified herein.

1.2 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.

GEORGIA DEPARTMENT OF TRANSPORTATION (GDOT)

GDOT	(2001) State of Georgia - Standard Specifications for Construction of Transportation Systems

1.3 SUBMITTALS

The following shall be submitted:

A. Materials Source: Submit name of graded aggregate base course material supplier and location of source 15 days prior to delivery. Provide materials from the same source throughout the work. Change of source requires Engineer's approval.

B. Letter of Certification: The material supplier shall furnish a letter to Chatham County certifying that the dense graded aggregate base course has been tested by an independent testing laboratory and the material complies with specification requirements. Copies of substantiating test reports shall also be provided.

C. Compaction Test Reports: Contractor shall submit all compaction test results performed in accordance with GDOT Section 310.3.06.

1.4 WEATHER LIMITATION

Construction shall be done when the atmospheric temperature is above 35 degrees F. Completed areas damaged by rainfall or other weather conditions shall be corrected to meet specified requirements.

1.5 EQUIPMENT AND TOOLS

All equipment and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 – PRODUCTS

2.1 AGGREGATE

A. The aggregate shall be free of salt, vegetable matter and other extraneous matter, and conforming to the requirements of GDOT Sections 310 and 815.2.01 of the Standard Specifications for Group II aggregate.

B. Gradation

	PERCENT PASSING BY WEIGHT	
SIEVE SIZE	MINIMUM	MAXIMUM
2 in.	100	
1½ in.	97	100
¾ in.	60	90
No. 10	25	45
No. 60	5	30
No. 200	4	11

C. Recycled Materials: Reclaimed concrete and aggregate base materials will be allowed provided the material meets the specifications.

2.2 EQUIPMENT

A. Equipment shall be in accordance with GDOT Section 310 of the Standard Specifications.

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

A. When the GABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms; except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 STOCKPILING MATERIAL

A. Prior to stockpiling of material, storage sites shall be cleared and leveled by the Contractor. All materials, including approved material available from excavation and grading, shall be stockpiled in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by Chatham County to prevent segregation.

3.3 PREPARATION

A. Prior to constructing the GABC, the underlying course or subgrade shall be cleaned of all foreign substances. The surface of the underlying course or subgrade shall meet

specified compaction and surface tolerances immediately before placement of the graded aggregate base. No materials shall be placed on muddy or frozen surfaces. The underlying course shall conform to Section 02300, "Earthwork." Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the GABC is placed.

3.4 INSTALLATION

A. General

Graded aggregate base courses shall be constructed in accordance with GDOT Section 310 of the Standard Specifications, except as herein modified.

B. Placing

The base material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 6 inches or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 6 inches is required, the material shall be placed in layers of equal thickness. No layer shall exceed 6 inches or be less than 3 inches when compacted. The layers shall be so placed that when compacted they will be true to the grades or level required with the least possible surface disturbance. Where the GABC is place in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable GABC.

C. Grade Control

The finished and completed GABC shall conform to the lines, grades, and cross sections shown. Underlying materials shall be excavated and prepared at sufficient depth for the required (GABC) thickness so that the finished GABC with the subsequent surface course will meet the designated grades.

D. Moisture Content

When the base material does not contain the proper moisture content to insure the required density, wetting or drying operations must be performed. When water is added to the base material, it shall be uniformly mixed to the full depth of the course.

E. Compaction

Each layer of the GABC shall be compacted as specified with approved compaction equipment. Ensure that the moisture content of materials is uniformly distributed and allows compaction to the specified density. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least on-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of maximum dry density, Modified Proctor. At least two (2) density determinations shall be made by the Contractor's Testing Laboratory on each course for

each day's completed work; other density determinations shall be performed as directed by Chatham County. No material shall be spread until density determinations have been performed on the underlying course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

F. Thickness

Compacted thickness of the aggregate course shall be as indicated on the drawings. The total compacted thickness of the GABC shall be within ½ inch of the thickness indicated. Where the measured thickness is more than ½ inch deficient, such areas, shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than ½ inch thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within ¼ inch of the thickness indicated. The total thickness of the GABC course shall be measured at intervals in such a manner as to ensure two (2) measurement for each 500 square yards of base course. Measurements shall be made in 3 inch diameter test holes penetrating the base course.

G. Finishing

The surface of the top layer of GABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of GABC is ½ inch or more below grade, then the top layer should be scarified to a depth of at least 3 inches and new material shall be blended in and compacted to bring to graded. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompacted or it shall be replaced as directed.

H. An accumulation of large size aggregates will not be permitted in the finished surface of the dense graded aggregate base. Determination of this condition shall be the opinion of Chatham County. This condition may be the result of excessive handling, low stockpiles or other conditions. When in the opinion of Chatham County this condition exists, the Contractor shall remove the effected area a minimum of 4 inches deep and replace with new material that meets the gradation requirements. The new material shall be compacted in accordance with Paragraph 3.4.E.

I. Smoothness

The finished surface of the base shall be checked using a 15 foot straightedge. Surface elevations shall not exceed ¼ inch at any point. Measurements shall be taken in successive positions to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Deviations exceeding ¼ inch can be surveyed to determine if base material need to be added/removed to correct the grade or areas can be cored to determine stone thickened and to make corrections. The Contractor shall bare all costs associated with determination and corrective measure.

3.5 TRAFFIC

A. Traffic shall not be allowed on the completed aggregate course.

3.6 MAINTENANCE

A. The GABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any area of GABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.7 DISPOSAL OF UNSATISFACTORY MATERIALS

A. Any unsuitable materials that must be removed shall be disposed of by the Contractor or as directed. No additional payments will be made for materials that must be replaced.

3.8 FIELD ENGINEERING:

A. The Contractor shall be solely responsible for all field engineering required for construction, furnishing all lines, grades, and control points necessary for construction, starting from control points and elevations furnished by Chatham County or shown on the plans.

End of Section 02704

SECTION 02745

HOT MIX ASPHALT CONCRETE PAVEMENT

PART 1 – GENERAL

1.1 DESCRIPTION

The work to be performed under this section shall consist of furnishing labor, materials, equipment and services necessary to construct asphalt concrete pavement, including aggregate base to the section and at the locations as specified in this section and as indicated on the Contract Drawings.

1.2 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 SOCIETY OF TESTING AND MATERIALS (ASTM)

ASTM D 698	(1991) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600kN-m/cu. m.))
ASTM D 1188	(1989) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1556	(1990) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 2726	(1990) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

GEORGIA DEPARTMENT OF TRANSPORTATION (GDOT)

GDOT	(2001) State of Georgia - Standard Specifications for Construction of Transportation Systems

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO – 2005)

AASHTO M320	(2005) Performance Graded Asphalt Binder
AASHTO MP2	(2005) Specification for Superpave Volumetric Mix Design
AASHTO T30	(2005) Mechanical Analysis of Extracted Aggregate
AASHTO T164	(2005) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
AASHTO T166	(2005) Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

AASHTO T209	(2005) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
AASHTO T269	(2005) Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
AASHTO T312	(2005) Preparing and Determining the Density of Hot Mix Asphalt Specimens by Means of the SHRP Gyratory Compactor

1.3 JOB CONDITIONS

A. ENVIRONMENTAL REQUIREMENTS:

1. Asphalt concrete mixture shall only be placed on existing pavement surfaces when the ambient air temperature is at least 40 degrees F and rising for base course mixes and 50 degrees F and rising for surface course mixes.

2. In case of sudden rain, Chatham County may permit placing of mixture then in transit from the plant provided that the surface upon which the mix is being placed is free from pools of water. In addition, the laydown temperatures must conform to the above requirements. Such permission, however, shall not be interpreted as a waiver of any of the quality requirements.

B. New and existing manholes, catch basins, and utility vault covers shall be adjusted to conform to the new pavement grades. Paving shall be finished ¼ inch to ½ inch higher than adjacent structures, unless otherwise shown or specified.

C. Existing underground utilities: The Contractor shall locate existing underground utilities in the area of the work. Those utilities which are to remain shall be adequately protected from damage.

D. All permanent utilities shall be installed prior to final paving. All utility trenches shall be patched with asphalt pavement as shown on the drawings.

E. Dust control: The Contractor shall be responsible for dust control at the site. As a minimum, a water truck and vacuum truck shall be used on site for dust control when required by Chatham County.

1.4 TERMINOLOGY

A. Blended aggregate – The combined mixture of coarse aggregate, fine aggregates, and mineral filler.

B. Coarse aggregate – The aggregate fraction retained on the No. 4 sieve.

C. Fine aggregate – The aggregate mass fraction passing the No. 4 sieve and retained on the No. 200 sieve.

D. Flat and elongated particles – Coarse aggregate particles with a maximum to minimum dimension ratio greater than five to one (5:1) as measured by ASTM D 4791.

E. Nominal maximum aggregate size – One sieve size larger than the first sieve to cumulatively retain more than ten (10) percent of the blended aggregate.

F. Maximum aggregate size – One sieve size larger than the nominal maximum aggregate size. Typically, the smallest sieve size that allows one hundred (100) percent of the blended aggregate to pass.

G. Mineral filler – The mass fraction of blended aggregate passing the No. 200 sieve.

H. Working day – For purposes of testing, working days will consist of Monday through Friday.

I. Binder Course – None.

1.5.1 SUBMITTALS

The following shall be submitted in accordance with Section 01300 "Submittals."

1.5.1 Asphalt Concrete Pavement

A. Submit all job mix formula data for each type of asphalt concrete mix, from each plant and each new source of material, at least 20 days prior to the start of production. As a minimum, all job mix formula submittals shall contain the following:

1. Mix designation.

2. Plant location where the mix will be produced.

3. Coarse aggregate certified test reports:

a. Source location and type of aggregate.

b. Coarse aggregate angularity.

c. Bulk and apparent specific gravity.

d. Flat and elongated particles.

e. Soundness.

f. LA abrasion.

4. Fine aggregate certified test reports:

a. Source location and type of aggregate.

b. Bulk and apparent specific gravity.

c. Liquid limit.

d. Plastic index.

e. Percent natural sand (if used).

f. Sand equivalent.

g. Soundness.

h. LA abrasion.

i. Uncompacted void content.

5. Anti-strip agent (if required):

    a. Certification.

    b. Amount Used.

6. Proportions and percentage of aggregate.

7. Plot of the blended aggregate gradation and gradation control points on the Federal Highway Administration (FHWA) 0.45 power gradation curve.

8. Gyratory compaction curve.

9. Bulk specific gravity at N_{DESIGN} gyrations.

10. Air void content at $N_{INITIAL}$, N_{DESIGN}, and N_{MAX} gyrations.

11. Voids in mineral aggregate at N_{DESIGN} gyrations.

12. Voids filled with asphalt at N_{DESIGN} gyrations.

13. Graphical plots of air voids, voids in the mineral aggregate, voids filled with asphalt, fines to effective binder content ratio, and unit weight verses asphalt content. Plots shall indicate values at -0.5 percent design asphalt content, design asphalt content, and +0.5 percent asphalt content.

14. Tensile strength ratio (TSR) and worksheets.

B. The certification(s) shall show the appropriate AASHTO/ASTM test(s) for each material, test results, and a statement that the material meets the specification requirement. The certification(s) will be provided by the material supplier or the approved independent testing laboratory.

PART 2 - PRODUCTS

2.1 TACK COAT

A. Tack coat shall be neat PG64-22 or PG67-22 asphalt conforming to the requirements of Section 413 of the GDOT Standard Specifications.

2.2 ANTI-STRIPPING AGENT

A. If required to meet tensile strength requirements specified herein, the Contractor shall add a suitable anti-stripping agent conforming to GDOT Standard Specifications.

2.3 ASPHALT CEMENT

A. Asphalt shall conform to the requirements of AASHTO M320 and Section 820 of the GDOT Standard Specifications for the Performance Grade (PG) Specified herein.

2.4 AGGREGATES

A. Coarse aggregate – Material shall conform to Section 800 and 802 of the GDOT Standard Specifications for Group II, Class ‘A’ coarse aggregate as modified below:

Test	Specification
Flat and Elongated Particles (ASTM D 4791, Using a Ratio of 5:1)	8%, Maximum
Coarse Aggregate Angularity (ASTM D 5821)	100% with 1 or more fractured faces and 95% with 2 or more fractured faces
LA Abrasion Wear (AASHTO T96, 500 Revolutions)	40%, Maximum
Magnesium Sulfate Soundness Loss (AASHTO T104, 5 Cycles)	15%, Maximum

B. Fine aggregate – Fine aggregate shall consist of clean, sound, durable, angular shaped particles produced by crushing stone for gravel. Natural (non-manufactured) siliceous sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The fine aggregate shall not contain more than 10 percent natural sand by weight of total aggregates. Fine aggregate shall conform to Section 802 of the GDOT Standard Specifications for Group II fine aggregate as modified below:

Test	Specification
LA Abrasion Wear (AASHTO T96, 500 Revolutions)	40%, Maximum
Magnesium Sulfate Soundness Loss (AASHTO T104, 5 Cycles)	18%, Maximum
Sand Equivalent (AASHTO T176)	45%, Minimum
Uncompacted Void Content (AASHTO T304, Method A)	45%, Minimum
Plasticity Index (AASHTO T90)	6, Maximum
Liquid Limit (AASHTO T89)	25, Maximum

C. Mineral filler shall conform to ASTM D 242 and have a ratio to asphalt by weight not exceeding 1.2.

D. RECLAIMED ASPHALT PAVEMENT (RAP)

1. The maximum proportion of reclaimed asphalt pavement permitted within each mix shall not exceed 10 percent, unless approved by Chatham County.

2. RAP shall have 100 percent passing the 50mm sieve, 95 percent passing the 25mm sieve, and shall be a mixture of only coarse aggregate, fine aggregate, and asphalt cement, free of solvents and other contaminating substances.

3. Fine and coarse aggregate contained in the RAP shall meet the requirements for virgin aggregates outlined above.

E. BLENDED AGGREGATES

1. Fine aggregate, coarse aggregates and RAP, when blended, shall not contain more than two (2) percent by mass, clay and other friable particles as determined by AASHTO T112.

2. Superpave Gradations: Each gradation contains maximum and minimum control points. Job mix formula gradations must fall within control points for the specified nominal aggregate size. The combined aggregate shall conform to the gradation requirements as set forth in AASHTO MP2 as modified below and tested in accordance with AASHTO T11 and T27. Gradation requirements are shown below:

12.5 mm Nominal Maximum Gradation

Sieve (mm)	Control Points	
	Minimum	Maximum
3/4" (19)		100
1/2" (12.5)	90	100
3/8" (9.5)	70	85
No. 8 (2.36)	34	39
No. 200 (0.075)	3.5	7

19 mm Nominal Maximum Gradation

Sieve (mm)	Control Points	
	Minimum	Maximum
1" (25)		100
3/4" (19)	90	100
1/2" (12.5)	60	89
3/8" (9.5)	55	75
No. 8 (2.36)	29	34
No. 200 (0.075)	3.5	6.0

3. Aggregate for asphalt concrete shall be provided in sufficient sizes to produce a uniform mixture. The Contractor shall indicate on the proposed job-mix formula the separate approximate sizes of aggregate to be used. Not less than two separate coarse and two separate fine aggregate sizes shall be used to produce the blended aggregate mixture.

   It is recommended that the Bailey Method of Gradation Evaluation be used to evaluate the packing of aggregate particles and constructability of the blended aggregate mix. If segregation or non-uniformity is evident in the finished pavement, Chatham County reserves the right to require the Contractor to discontinue the use of crusher run or aggregate blends and to furnish separate sizes of open graded aggregate material.

2.5 BITUMINOUS MIX DESIGN

A. Job mix designs shall be prepared by the Contractor in accordance with AASHTO PP28 as modified herein.

B. Asphalt binder:

   1. Surface course: Asphalt cement meeting the requirements of PG67-22.

   2. Binder course: Asphalt cement meeting the requirements of PG67-22.

C. Aggregate gradation:

   Surface course – 12.5 mm nominal maximum aggregate size gradation.

Binder course – 19 mm nominal maximum aggregate size gradation.

D. Gyration levels for mix preparation shall conform with the following, as set forth in AASHTO PP28:

Mix Designation	$N_{INITIAL}$	N_{DESIGN}
12.5 mm Surface Course	7	75
19 mm Surface Course	7	75

E. The voids filled with asphalt (VFA) at the target air void level shall be as follows:

Mix Designation	VFA (Percent)
12.5 mm Surface Course	65-78
19 mm Binder Course	65-78

F. The voids in mineral aggregate (VMA) of the mix design shall be based on the nominal maximum aggregate size and conform to the requirements shown below:

Nominal Maximum Aggregate Size	Voids in Mineral Aggregate (Percent)
	Minimum
12.5 mm	14
19 mm	13

G. Temperature requirements for mixing and compaction shall be established by the liquid asphalt supplier. The temperature to which the asphalt must be heated to produce viscosities of 170 +/- 20 centistokes kinematic and 280 +/- 30 centistokes kinematic shall be established as the laboratory mixing and compaction temperature, respectively.

H. The mix design when compacted in accordance with AASHTO T312, shall meet the density specified below at the initial, design, and maximum compaction levels.

Compaction Level (Number of Gyrations)	Required Density (% of Theoretical Maximum Specific Gravity)
$N_{INITIAL}$	$\%G_{MM}$ <= 90.5
N_{DESIGN}	$\%G_{MM}$ = 96
$N_{MAXIMUM}$	$\%G_{MM}$ <= 98

I. The dust to binder ratio shall be between 0.6 and 1.3 for all mix designs.

J. Compacted mix designs shall have a tensile strength ratio (TSR) greater than or equal to 85 percent when tested in accordance with AASHTO T283. In addition, the mixture shall have a minimum dry tensile strength of 1380 KPA (200 pounds per square inch). In the event the mix design does not meet the tensile requirements the Contractor shall add an approved anti-stripping agent or take other corrective action to satisfy the specification.

K. Following completion of the volumetric mix design, mixes shall be evaluated for rutting susceptibility. Mixes shall be tested by an approved third-party or state testing laboratory according to GDOT publication GDT 115. Design limits for this test are as follows:

	GDT 115 Rutting Susceptibility Test	
Mix Designation	Test Temperature (^{O}F)	Maximum Deformation (mm)
12.5 mm Surface Course	147	7.0
19 mm Surface Course	147	7.0

In the event a mix does not meet the test requirements for rutting susceptibility, the volumetric mix design shall be adjusted as necessary and the susceptibility tests repeated.

PART 3 - EXECUTION

3.1 CONSTRUCTION METHODS

A. Asphalt mixing plant – Asphalt shall be produced at a plant approved by the Georgia Department of Transportation (GDOT). Plants shall conform to Section 400 of the GDOT standard specifications, as modified herein.

B. Hauling Equipment:

1. Hauling equipment shall conform to Section 400.2.01 of the GDOT standard specifications.

2. Trucks shall be equipped with tarps, in good condition without holes, which can be tied down over the sides and ends of the truck beds during periods of inclement weather to prevent rain from entering the truck bed and coming in contact with the asphalt concrete mix.

3. Trucks shall be loaded using a multiple-drop method (front then back then middle) to minimize truck to truck segregation.

C. Transfer equipment – Provide and use a material transfer vehicle (MTV) to independently deliver asphalt mixtures from the hauling equipment to the paving equipment. When Chatham County determines the use of the MTV is not practical for a portion of the project he may waive its requirement for that portion. As a minimum, the MTV shall possess the following characteristics:

1. High capacity truck unloading system, capable of 600 tons per hour, that will receive asphalt mixtures from the hauling equipment,

2. Storage bin with a minimum capacity of 14 tons of asphalt mixture,

3. An auger system in the storage bin to continuously blend the asphalt mixture prior to discharge to the conveyor system: and

4. A discharge conveyor, with the ability to swivel, to deliver the mixture to the paving spreader.

D. Paving Equipment – Asphalt pavers shall conform to Section 400.3.02 of the GDOT Standard Specifications.

E. Compaction Equipment – Rollers shall conform to Section 400.3.02 of the GDOT Standard Specifications.

F. Preparation of the asphalt binder material (asphalt cement):

1. The binder shall be stored within the temperature range specified by the supplier of the binder for the grade of asphalt cement being used. Different grades of asphalt binder (cement) shall be stored separately and not mixed together at any time.

2. The binder shall be heated in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature.

3. The temperature of the binder delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 350 degrees F unless otherwise required by the asphalt binder (cement) manufacturer.

G. Preparation of aggregates:

1. The aggregate for the mixture shall be heated and dried prior to introduction into the mixer. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates.

2. The aggregate temperature shall not be lower than is required to obtain complete coating and uniform distribution of the aggregate particles and to provide a mixture of satisfactory workability.

H. Preparation of bituminous mixture:

1. The aggregates and the bituminous material shall be properly proportioned and introduced into the mixer in the amount specified by the job mix formula.

2. The moisture content of all bituminous mix upon discharge shall not exceed 1.0 percent.

I. Preparation of the underlying surface:

1. Asphalt materials shall not be placed until the underlying course has been tested by the Contractor and accepted by Chatham County.

2. Immediately before placing asphalt materials, clean all underlying pavement surfaces and previous courses of all loose and foreign material by sweeping with hand brooms, power sweepers or blowers as directed by Chatham County.

3. Tack coat:

a. Apply tack coat only when the underlying surface is dry, and the ambient temperature meets the requirements for the pavement course being placed as described in Paragraph 1.6.A (1).

b. Tack coat shall be applied in accordance with Section 413 of the GDOT Standard Specifications, except the residual asphalt coating shall be 0.03 to 0.05 gallons per square yard on newly placed asphalt surfaces.

4. Manholes, valve boxes, inlets, and other appurtenances within the area to be paved shall be adjusted to grade as shown on the drawings.

J. Transporting, placing, and finishing:

1. The asphalt concrete mixture shall be transported from the mixing plant to the site in vehicles conforming to the requirements specified herein.

2. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature.

3. Compacted asphalt concrete lift thickness shall be equal to or greater than 3 times the nominal maximum aggregate size, but not more than 4 inches, unless approved by Chatham County.

4. The initial placement of the asphalt concrete mixture shall occur at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250 degrees F, unless approved by Chatham County.

5. Upon arrival, the mixture shall be placed to the full width of the paving lane. It shall be struck off in a uniform layer of such depth that, when the mix is properly compacted, shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet except where edge lanes require less width to complete the area.

6. Joints:

    a. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 6 inches; however, the joint in the surface course shall be at the centerline of the pavement if that pavement is to be used by normal car or truck traffic.

    b. Transverse joints in one course shall be offset by at least 10 feet longitudinally from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet.

7. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and raked by hand tools.

K. Compaction of mixture:

1. After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor.

2. Compaction shall be completed before the mixture cools below 175 degrees F, unless otherwise approved by Chatham County. Temperature shall be determined using an infrared thermometer.

3. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

4. In areas not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers.

5. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

L. Joints:

1. The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

2. The roller shall not pass over the unprotected transverse end of the freshly laid mixture except when necessary to form a temporary stop. After a temporary stop and prior to the continuation of paving, the tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face before placing the adjacent lane.

3. Longitudinal joints which are irregular, damaged, uncompacted, or otherwise defective shall be cut back to expose a clean, vertical sound surface for the full depth of the course. Apply tack coat on all newly exposed contact surfaces before placing any fresh mixture against the joint.

3.2 Corrections of deficiencies:

A. Deficiencies in asphalt mixture properties, mat density or joint density:

1. The Contractor may be directed by Chatham County to remove and replace the lot or sublot in question at no additional cost to Chatham County.

B. Deficiencies in layer thickness:

1. The Contractor may be directed by Chatham County to remove and replace the lot or sublot in question at no additional cost to Chatham County.

C. Deficiencies in final surface smoothness and finish grade tolerance:

1. In the event surface smoothness and/or surface grades fail to comply with the specifications, make corrections as specified below at no additional cost to Chatham County.

2. The area of deficiencies in surface smoothness and/or surface grade tolerance shall be defined as the area enclosed by a line of points half way between the grade in excess of the specified tolerance and the next finished grade shown on the contract drawings that meets the specified tolerance, both longitudinally and transversely.

3. Replace pavement deficient in final surface smoothness and/or final surface grade tolerance requirements or, at the option of Chatham County, add overlays where required to correct deficiencies in accordance with all applicable requirements of the contract drawings and this section, at times approved by Chatham County, so as not to interfere with operations of Chatham County or others using the area. A minimum thickness of 2 inches shall be placed as an overlay. Existing pavement shall be removed as necessary to provide square joints for the full depth of the overlay.

4. Where the deficiency in surface grade tolerance is in excess of ½ inch above or below the grade shown on the contract drawings but where a contour pattern satisfying riding quality

and drainage as shown on the contract drawings has been established to the satisfaction of Chatham County, pavement may be left in place.

D. All deficiencies identified by surveys conducted in accordance with Paragraph 1.3 shall be corrected prior to placement of the top course. Submit detailed paving plan to Chatham County a minimum of 3 days prior to planned installation of the top course to address proposed corrective measures.

End of Section 02745

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

Work under this section includes requirements for materials, mixing, forming, placing, finishing, and curing reinforced cast-in-place concrete for all structural members. The Contractor shall provide all labor, materials, equipment, and incidental items necessary to provide all cast-in-place concrete indicated on the project drawings and as specified herein.

1.2 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 CONCRETE INSTITUTE (ACI)

ACI 117	(1990; R 2002) Standard Tolerances for Concrete Construction and Materials & Commentary
ACI 211.1	(1991; R 2002) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	(1999) Specifications for Structural Concrete for Buildings
ACI 302.1R	(2004) Guide for Concrete Floor and Slab Construction
ACI 304.2R	(1996) Placing Concrete by Pumping Methods
ACI 304R	(2000) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318M/318RM	(2002) Metric Building Code Requirements for Structural Concrete and Commentary
ACI 347R	(2003) Guide to Formwork for Concrete
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 2000) Burlap Cloth Made from Jute or Kenaf
AASHTO T 259	(2002) Standard Method of Test for Resistance of Concrete to Chloride Ion Penetration

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	(1995) Basic Hardboard
	ASTM INTERNATIONAL (ASTM)
ASTM A 185	(2002) Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A 496	(2002) Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	(2002) Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 615/A 615M	(2004b) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 617/A 617M	(1996a) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 82	(2002) Steel Wire, Plain, for Concrete Reinforcement
ASTM C 1017/C 1017M	(2003) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107	(2002) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM C 143/C 143M	(2003) Slump of Hydraulic Cement Concrete
ASTM C 150	(2004a) Portland Cement
ASTM C 171	(2003) Sheet Materials for Curing Concrete
ASTM C 172	(2004) Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2001e1) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2002) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 227	(2003) Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
ASTM C 231	(2004) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2001) Air-Entraining Admixtures for Concrete
ASTM C 295	(2003) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(2003) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2003a) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2003) Concrete Aggregates

ASTM C 39	(1993a) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2004) Chemical Admixtures for Concrete
ASTM C 618	(2003) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM C 94/C 94M	(2004a) Ready-Mixed Concrete
ASTM C 989	(2004) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM D 1190	(1997) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood (APA V995)

1.3 DEFINITIONS

A. "Cementitious material" as used herein shall include all portland cement, pozzolan, fly ash, and ground iron blast-furnace slag.

B. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

1.4 SUBMITTALS

The following shall be submitted:

1.4.1 Shop Drawings

A. Reinforcing steel

Reproductions of contract drawings are unacceptable. ACI SP-66. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.4.2 Product Data

A. Materials for curing concrete

B. Epoxy bonding compound

1.4.3 Design Data

A. Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by Chatham County. The submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. In addition, copies of the fly ash, and pozzolan test results shall be submitted. The approval of fly ash, and pozzolan test results shall have been within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

1.4.4 Test Reports

A. Concrete mix design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cement, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Obtain approval prior to concrete placement.

B. Fly ash

Submit test results in accordance with ASTM C 618 for fly ash.

C. Aggregates

ASTM C 227 for potential alkali-silica reactions, ASTM C 295 for petrographic analysis.

D. Compressive strength tests

1.5 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" had been substituted for the words "should" or "could" or "may," wherever they appear. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean Chatham County.

1.6 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

1.6.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

PART 2 - PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required. Lumber shall be square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Plywood: PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Steel form surfaces shall not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI 211.1, ACI 301, and ACI 318M/318RM except as otherwise specified. The compressive strength (f'c) of the concrete for each portion of the structure(s) shall be as indicated and as specified below.

Location	f'c (Min. 28 Day Comp. Strength) (psi)	ASTM C 33 Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water-Cement Ratio (by weight)	Air Entr. (percent)	Minimum Cementitious Material (lb/cy)	Minimum Portland Cement (lb/cy)
All areas	5,000	57	4 to 5	0.40	6.0	675	505

Maximum slump shown above may be increased 1 inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when super-plasticizers are used. Provide air entrainment using air-entraining admixture. Air entrainment shall be within plus or minus 1.5 percent of the value specified.

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test report indicating

compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1. The trial mixture shall use at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required will be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast-furnace slag by weight equivalency method. Laboratory trial mixture shall be designed for maximum permitted slump and air content. Each combination of material proposed for use shall have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39 for 7 and 28 days. From these results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition a curve shall be plotted showing the relationship between 7 and 28 day strengths.

2.3.1.2 Required Average Strength of Mix Design

The selected mixture shall produce an average compressive strength exceeding the specified strength by the amount indicated in ACI 301. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation shall be calculated and the required average compressive strength shall be determined in accordance with ACI 301. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength shall be as 6,200 psi:

2.4 MATERIALS

2.4.1 Cement

ASTM C 150, Type II or ASTM C 595/C595M, Type IP(MS).

2.4.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Types N and F. Add with cement.

2.4.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 120.

2.4.2 Water

Water shall be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C 33, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.4.4 Nonshrink Grout

Grout should be in accordance with ASTM C 1107. For all non-shrink grout, provide high strength non-shrink grout manufactured by Five Star or an owner approved equal.

2.4.5 Admixtures

2.4.5.1 Air-Entraining

ASTM C 260

2.4.5.2 Accelerating

ASTM C 494, Type C

2.4.5.3 Retarding

ASTM C 494, Type B, D, or G

2.4.5.4 Water Reducing

ASTM C 494, Type A, E, or F

2.4.5.5 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494, Type F and ASTM C 1017

2.4.5.6 Calcium Nitrite Corrosion Inhibitor

ASTM C 494, Type C

Calcium Nitrite Corrosion Inhibitor shall be added to the concrete mix. The admixture shall consist of a Corrosion Inhibitor at a rate of 3.5 gallons per cubic yard. Any air-entraining, water-reducing, and/or set-controlling admixtures used in the production of concrete mixtures for concrete shall be compatible with calcium nitrite solutions.

The Contractor shall strictly adhere to the manufacturer's written recommendations regarding the use of the admixture including storage, transportation, and method of mixing. The calcium nitrite, which acts as an accelerator, may be used in conjunction with the retarder to control the set of concrete, as per manufacturer's recommendation.

2.4.5.7 Anti-Washout Admixture

When concrete will be cast in water, provide V-MAR 3 anti-washout admixture manufactured by Grace Construction Product or an owner approved equal. Provide an anti-washout admixture dosage to achieve a maximum 5% loss of weight. Calcium chloride shall not be used as an admixture.

2.4.6 Materials for Curing Concrete

2.4.6.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.6.2 Pervious Sheeting

AASHTO M 182.

2.4.6.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.4.7 Liquid Chemical Sealer-Hardener Compound

Compound shall be magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions. Compound shall not reduce the adhesion of waterproofing, or other material applied to concrete.

2.4.8 Epoxy Bonding Compound

ASTM C 881. Provide Type I for bonding hardened concrete to hardened concrete and Type II for bonding freshly mixed concrete to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.5 REINFORCEMENT

2.5.1 Reinforcing Bars

ACI 301 unless otherwise specified. ASTM A 615/A 615M and ASTM A 617/A 617M with the bars marked A, S, W, Grade

2.5.2 Mechanical Reinforcing Bar Connectors

ACI 301. Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Wire

ASTM A 82 or ASTM A 496.

2.5.4 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material.

PART 3 - EXECUTION

3.1 FORMS

ACI 301. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.

3.1.1 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.1.2 Removal of Forms and Supports

After placing concrete, forms shall remain in place for the time periods specified in ACI 347R. Prevent concrete damage during form removal.

3.1.2.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.1.3 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, slabs and beams over 10 feet in span and cantilevers over 4 feet shall be reshored for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carrying capabilities as original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3 FORMED SURFACES

3.3.1 Tolerances

ACI 347R and as indicated.

3.3.2 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used.

3.4 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI 301. Provide bars, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.4.1 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.4.2 Splicing

As indicated. For splices not indicated ACI 301. Do not splice at points of maximum stress.

3.4.3 Cover

ACI 301 for minimum coverage, unless otherwise indicated.

3.4.4 Construction Joints

Locate joints to least impair strength. Location of construction joints shall be approved by Chatham County. Continue reinforcement across joints unless otherwise indicated.

3.5 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C 94/C 94M, ACI 301, ACI 302.1R, and ACI 304R, except as modified herein. Batching equipment shall be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.5.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.5.2 Mixing

ASTM C 94/C 94M and ACI 301. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 85 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.5.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.6 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.6.1 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by Chatham County. Excavation width shall be a minimum of 4 inches greater than indicated.

3.6.2 Vibration

ACI 301 Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 18 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 18 inch maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.6.3 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.6.4 Pumping

ACI 304R and ACI 304.2R. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. Rapid changes in pipe sizes shall be avoided. Maximum size of course aggregate shall be limited to 33 percent of the diameter of the pipe. Maximum size of well rounded aggregate shall be limited to 40 percent of the pipe diameter. Samples for testing shall be taken at both the point of delivery to the pump and at the discharge end.

3.6.5 Cold Weather

ACI 306.1. Do not allow concrete temperature to decrease below 50 degrees F Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 5 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.6.6 Hot Weather

ACI 305R. Maintain required concrete temperature using Figure 2.1.5 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7 SURFACE FINISHES

3.7.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347R. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.7.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.

3.7.3 Formed Surfaces

3.7.3.1 Tolerances

ACI 117 and as indicated.

3.7.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.8 FLOOR AND SLAB FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI 302.1R, unless otherwise specified.

3.8.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and

supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.8.1.1 Floated

Use for exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float shall begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, surface shall be checked with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. High spots shall be cut down and low spots filled during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.9 CURING AND PROTECTION

ACI 301 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating.

3.9.1 Moist Curing

Remove water without erosion or damage to the structure.

3.9.1.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water shall not be more than 20 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.9.1.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.9.1.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Sheeting shall be at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.9.1.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.9.2 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI 305R indicates that hot weather conditions will cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.9.2.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.9.2.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.9.3 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. The sealer-hardener shall not be applied until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.9.4 Curing Periods

ACI 301, 21 days for concrete that will be in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval by Chatham County.

3.10 FIELD QUALITY CONTROL

3.10.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.10.2 Testing

Testing shall be performed by an approved independent testing laboratory subject to approval.

3.10.2.1 Slump Tests

ASTM C 143/C 143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.10.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.10.2.3 Compressive Strength Tests

ASTM C 39. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Precautions shall be taken to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Samples for strength tests of each mix design of concrete placed each day shall be taken not less than once a day, nor less than once for each 50 cubic yards of concrete. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result shall be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 500 psi, take a minimum of three ASTM C 42/C 42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.10.2.4 Air Content

ASTM C 173/C 173M or ASTM C 231 for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

End of Section 03300

SECTION 03410

PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

Work under this section includes requirements for materials, mixing, forming, placing, finishing, and curing precast concrete for all structures, including but not limited to: drainage structures, drop inlets, utility vaults, etc. The Contractor shall provide all labor, materials, equipment, and incidental items necessary to provide all precast concrete indicated on the project drawings and as specified herein.

1.2 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 304R(2000)	Measuring, Mixing, Transporting, and Placing Concrete
ACI 309R(1996)	Consolidation of Concrete
ACI 318/318R(2002)	Building Code Requirements for Structural Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M(2003)	Steel Castings, Carbon, for General Application
ASTM A 47/ A 47M(1999)	Ferritic Malleable Iron Castings
ASTM A 82(1997)	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 123/A 123M(2002)	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M(2003)	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 496(2002)	Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M(2004)	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 780(2001)	Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 33(2003)	Concrete Aggregates
ASTM C 94/ C 94M (2003; Rev. A)	Ready-Mixed Concrete
ASTM C 150 (2002; E2003 Rev. A)	Portland Cement
ASTM C 260(2001)	Air-Entraining Admixtures for Concrete

ASTM C 494 (1999; E2001 Rev. A)	Chemical Admixtures for Concrete
ASTM C 1107(2002)	Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1260(2001)	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4(1998)	Structural Welding Code - Reinforcing Steel

PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116(1999)	Quality Control for Plants and Production of Precast Prestressed Concrete Products
PCI MNL-120(1999)	Design Handbook - Precast and Prestressed Concrete

1.3 SYSTEM DESCRIPTION

The work includes the provision of precast non-prestressed concrete herein referred to as precast structures. Precast structures shall be the product of a manufacturer specializing in the production of precast concrete structures.

1.4 SUBMITTALS

The following shall be submitted:

A. Shop Drawings

1. Drawings of precast structures

B. Design Data

1. Concrete mix design

C. Test Reports

1. Concrete mix design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cement, aggregates, and admixtures. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained versus sieve size. Test reports shall be submitted along with the concrete mix design. Obtain approval before concrete placement.

2. Aggregates

Submit test results for aggregates in accordance with ASTM C 1260 for potential alkali-silica reactions.

3. Compressive Strength tests

D. Certificates

1. Quality control procedures

   Submit quality control procedures established in accordance with PCI MNL-116 by the precast manufacturer.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Manufacturer Qualifications

PCI MNL-116. Plants shall be certified by the PCI Plant Certification Program. At Chatham County's option, PCI Plant quality control program records shall be available for review.

1.5.2 Regulatory Requirements

Provide precast structures in conformance with ACI 318/318R and AWS D1.4.

1.5.3 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag, and admixtures, and applicable reference specification. Provide mix proportion data using at least three different water-cement ratios for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. No material shall be provided unless proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by Chatham County. The submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregates changes.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Transportation

1.6.1.1 Transporting Structures

In transporting structures by truck, railroad car, or barge, provision shall be made for supporting the structures as described above, except battens can be continuous over more than one stack of units, with adequate bracing to ensure their maintaining the vertical position and damping of dangerous vibrations. Trucks with double bolsters are satisfactory provided the structures are fully seated on the outer bolsters at not more than 3 feet or the depth of the member from the end and the inner bolster is not more than 8 feet from the end of the member or the designated pickup point. Adequate padding material shall be provided between tie chains or cables to preclude chipping of concrete.

1.6.2 Storage

1.6.2.1 Storage Areas

Storage areas for precast structures shall be stabilized, and suitable foundations shall be provided, so differential settlement or twisting of structures will not occur.

1.6.3 Handling of Structures

The location of pickup points for handling of the structures and details of the pickup devices shall be shown in shop drawings. Structures shall be handled only by means of approved devices at designated locations. Structures shall be maintained in an upright position at all times and picked up and supported as shown in approved shop drawings.

PART 2 - PRODUCTS

2.1 CONTRACTOR-FURNISHED MIX DESIGN

ACI 318/318R. The minimum compressive strength of concrete at 28 days shall be 5000 psi. The maximum water cement ratio shall be 0.40.

2.2 MATERIALS

2.2.1 Cement

ASTM C 150, Type II

2.2.2 Water

Water shall be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete, ACI 318/318R.

2.2.3 Aggregates

2.2.3.1 Aggregates Selection

ASTM C 33, Size 57. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement, nor in an amount sufficient to cause excessive expansion of concrete. Prior to fabrication, submit certified test reports for the following tests specified in ASTM C 33

2.2.3.2 Alkali-Silica Reactivity

Evaluate and test fine and coarse aggregates to be used in all concrete for alkali-aggregate reactivity in accordance with ASTM C 1260. Test both coarse aggregate size groups if from different sources.

2.2.4 Grout

2.2.4.1 Nonshrink Grout

ASTM C 1107.

2.2.4.2 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method.

2.2.5 Admixtures

2.2.5.1 Air-Entraining

ASTM C 260.

2.2.5.2 Accelerating

ASTM C 494/ C 494M, Type C or E.

2.2.5.3 Water Reducing

ASTM C 494/ C 494M, Type A, E, or F.

2.2.5.4 Calcium Nitrite Corrosion Inhibitor

Calcium Nitrite Corrosion Inhibitor shall be added to the concrete mix. The admixture shall consist of a Corrosion Inhibitor at a rate of 3.5 gallons per cubic yard. Any air-entraining, water-reducing, and/or set-controlling admixtures used in the production of concrete mixtures for concrete shall be compatible with calcium nitrite solutions.

The Contractor shall strictly adhere to the manufacturer's written recommendations regarding the use of the admixture including storage, transportation, and method of mixing. The calcium nitrite, which acts as an accelerator, may be used in conjunction with the retarder to control the set of concrete, as per manufacturer's recommendation.

2.2.6 Reinforcement

2.2.6.1 Reinforcing Bars

ASTM A 615/A 615M, Grade 60

2.2.6.2 Wire

ASTM A 82 or ASTM A 496.

2.2.7 Metal Accessories

Provide ASTM A 123/A 123M or ASTM A 153/A 153M galvanized.

2.2.7.1 Inserts

ASTM A 47/ A 47M, Grade 32510 or 35018, or ASTM A 27/A 27M Grade U-60-30.

2.3 PRODUCTION QUALITY CONTROL PROCEDURES

PCI MNL-116 unless specified otherwise.

2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 3/4 inch, unless otherwise indicated. Provide threaded or snap-off type form ties.

2.3.2 Reinforcement Placement

ACI 318/318R for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

2.3.3 Concrete

2.3.3.1 Concrete Mixing

ASTM C 94/ C 94M. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

2.3.3.2 Concrete Placing

ACI 304R and ACI 309R, unless otherwise specified.

2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 50 and 190 degrees F. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by Chatham County prior to repairs. Precast structures containing hairline cracks which are visible and are less than 0.01 inches in width, may be accepted, except that cracks larger than 0.005 inches in width for surfaces exposed to the weather shall be repaired. Defects that involve more than 36 square inches of concrete shall be grounds for rejection. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose stressing tendons or reinforcing shall be rejected. Defects shall be repaired or rejected as specified in paragraph "Defects."

2.3.4.1 Unformed Surfaces

Provide a steel troweled finish.

2.3.4.2 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

a. Unexposed Surfaces: Provide a standard grade surface finish.

b. Exposed Surfaces: Provide a standard grade surface finish

2.3.5 Acceptance/Rejection of Defects

2.3.5.1 Minor Defects

All honeycombed areas, chipped corners, air pockets over 1/4 inch in diameter, and other minor defects involve less than 36 square inches of concrete shall be repaired. Form offsets of fins over 1/8 inch shall be ground smooth. All unsound concrete shall be removed from defective areas prior to repairing. All surfaces permanently exposed to view shall be repaired by a blend of portland cement and white cement properly proportioned so that the final color when cured will be the same as adjacent concrete.

2.3.5.2 Major Defects

Major defects are those which involve more than 36 square inches of concrete or expose stressing tendons or reinforcing steel. If one or more major defects appear in a member, it shall be rejected. Cracks of a width of more than 0.01 inch shall be cause for rejection of the member.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

2.4.1 Factory Inspection

At the option of Chatham County, precast units may be inspected by Chatham County prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect Chatham County's right to enforce contractual provisions after units are transported or erected.

PART 3 - EXECUTION

3.1 EXAMINATION

Prior to erection, and again after installation, precast structures shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by Chatham County structures that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new precast structures.

3.2 ERECTION

Precast structures shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Provide a 1:500 tolerance, if no tolerance is specified. Brace precast structures, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast structures level, plumb, square, and true within tolerances. Align member ends.

3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast structures and adjoining field placed surfaces.

3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

3.5 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Engineer and the precast manufacturer. Drill holes less than 12 inches in diameter with a diamond tipped core drill.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

End of Section 03410

SECTION 05500

METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

Work under this section consists in general of furnishing all labor, materials, tools, equipment, and incidentals to provide all metal fabrications including, but not limited to pile connection angles, guardrails, handrails and tie-back system components as indicated on the Construction Drawings and specified herein.

1.2 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 INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	(2000) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2008) Structural Welding Code – Steel
AWS D1.2/D1.2M	(2008) Structural Welding Code – Aluminum

ASME INTERNATIONAL (ASME)

ASME B18.22.1	(1965; R 2003) Plain Washers

ASTM INTERNATIONAL (ASTM)

ASTM A 108	(2003) Standard Specification for Steel Bar, Carbon, and Alloy Cold Finished
ASTM A 123/A 123M	(2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 276	(2006) Standard Specification for Stainless Steel Bars and Shapes
ASTM A 325	(2006) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 449	(2007b) Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A 500	(2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 514	(2000a) High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 572	(2006) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 563	(2004a) Carbon and Alloy Steel Nuts
ASTM A 653/A 653M	(2009) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 666	(1996) Annealed or Cold Worked Austentitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A 780	(2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 992/A 992M	(2006a) Standard Specification for Structural Steel Shapes
ASTM B 209	(2004) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2004a) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM D 1187	(1997; R 2002e1) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM E 488	(1996; R 2003) Strength of Anchors in Concrete and Masonry Elements
ASTM F 593	(1998) Stainless Steel Bolts, Hex Cap Screws, and Studs

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-P-664	(Rev D) Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant

1.3 SUBMITTALS

Submit the following:

A. Shop Drawings

1. Pile Connection Angles, fabrication drawings

2. Guardrails, fabrication and installation drawings

3. Anchoring System, fabrication and installation drawings

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation details.

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M for welding steel and AWS D1.2/D1.2M for welding aluminum. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 – PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A 992/A 992M or ASTM A 572/A 572M Grade 50.

2.1.2 Bolts, and Nuts

ASTM A325 (Galvanized Bolts), ASTM A563 (Galvanized Nuts)

2.1.3 Washers

Provide plain galvanized or stainless steel washers to conform to ASME B18.22.1.

2.2 COATING

2.2.1 Steel

Steel members that shall be embedded in concrete shall be coated with two coats of coal tar epoxy after fabrication. Each coat shall have an 8 mil dry film thickness. Prepare steel and coat per the manufacturer's instructions.

2.2.2 Repair of Galvanized Surfaces

Repair damaged galvanized surfaces with 2 coats of a brush on type galvanizing repair compound which is in conformance with ASTM A 780 and approved by the Owner. Let first coat dry per the manufacturer's instructions prior to applying the second coat. Spray on type galvanizing repair compounds are not acceptable.

2.3 Manhole Covers

Manhole covers shall be in accordance with Georgia Department of Transportation Standards.

2.4 Guardrails

Guardrails shall be in accordance with Georgia Department of Transportation Standards.

PART 3 – EXECUTION

3.1 INSTALLATION

Install items at locations indicated, according to manufacturer's instructions. Items listed below require additional procedures.

3.2 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.3 FINISHES

3.3.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a coat conforming to FS TT-P-664 to prevent galvanic or corrosive action.

3.3.2 Environmental Conditions

Do not clean or field paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Owner.

3.4 UTILITY VAULT COVERS & FRAMES

Install the tops of cover plates and frames flush with concrete.

*** End of Section 05500 ***

SECTION 09930

PROTECTIVE COATING FOR STEEL

PART 1 - GENERAL

1.1 SUMMARY

Work under this section consists, in general, of furnishing all labor and materials to provide a protective coating on steel sheet piles as indicated on the construction drawings, and as specified herein.

1.2 REFERENCES

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 572/A 572M	(2007) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM D 4945	(2008) Standard Method for High-Strain Dynamic Testing of Piles

AMERICAN WELDING SOCIETY, INC. (AWS)

AWS D1.1	(2008) Structural Welding Code - Steel

1.3 QUALITY ASSURANCE

1.3.1 Qualification of Coaters

A. Application of coal tar epoxy coating shall be made by workmen thoroughly skilled and trained in the application of coal tar epoxy coating on structural steel items.

B. Indication of lack of skill on the part of the coating applicators shall be sufficient grounds for Chatham County to reject applied coatings and require repairs at no additional cost to the Owner.

1.3.2 Codes and Standards

Material used shall meet all requirements of Federal Specification MIL-P-23236 for coal tar epoxy, Type 1, Class 2, and/or Corps of Engineers Formula C-200, and/or Steel Structures Painting Council Specification SSPC-Paint No. 16, Coal Tar Epoxy Polyamide Black Paint.

1.3 SUBMITTALS

Submit the following:

1.3.1 Material Technical Data: Submit to Chatham County the technical specifications for the product being used.

1.3.2 Manufacturer's Recommendations: Submit to Chatham County the manufacturer's current recommended method of application.

1.4 PRODUCT HANDLING

1.4.1 Protection: Use all means necessary to protect the materials of this Section before, during, and after installation.

1.4.2 Replacement: In the event of damage or rejection, immediately make all repairs and replacements necessary to the approval of the Owner/Engineer and at no additional cost to the Owner.

1.4.3 Other: Each container or separately packaged component shall be clearly and durably labeled to indicate the purchaser's order number, date of manufacture, manufacturer's batch number, quantity, color, component identification, and the designated name and formula or specification number of the coating together with special instructions.

PART 2 - PRODUCTS

2.1 COAL TAR EPOXY

All coal tar epoxy coating shall be self-curing and consist of two components such as Amercoat 78 HB, manufactured by the Ameron Company; Amine Coal Tar Epoxy 538, manufactured by NAPKO; Copper Coat 300M, or an equal approved in advance by the Owner/Engineer.

2.2 OTHER MATERIALS

All other materials not specifically described but required for a complete and proper installation of the work of this section shall be new, first quality of their respective kinds and subject to approval of the Owner/Engineer.

PART 3 - EXECUTION

3.1 EXTENT OF COATING

Coat all surfaces of both faces for the top 15 feet of the steel sheet piles.

3.2 SURFACE PREPARATION

3.2.1 All weld spatter, rough welds, burrs and sharp projections will be ground smooth prior to abrasive blasting operations.

3.2.2 Abrasive blast cleaning shall be to a "Near White" metal as defined by Steel Structures Painting Council Specification No. 10. Commercial blasting will not be acceptable.

3.2.3 All surfaces blasted in one day must be coated the same day as blasted, prior to sunset of that day and before any visible rusting occurs.

3.2.4 All surfaces to be coated must be completely dry and free of moisture, soil, dust, and grit at the time of application.

3.2.5 Abrasive blasting and painting operations shall be scheduled so that they will not be in progress while there is wet coating within the blast contaminating area.

3.3 APPLICATION OF COATING

Apply coatings either by brush or spray using commercially available spray equipment. The coatings shall exhibit reasonable leveling without excessive sagging when applied at the required film thickness. Proper adhesion between coats shall be ensured, depending on method of coating application, without undue restrictions concerning timing, temperature or other conditions associated with application. Jetting shall not be permitted.

3.4 COATING THICKNESS

3.4.1 A minimum thickness (not average) of 16 mils (0.4 mm) dry film is required on all surfaces to be coated.

3.4.2 Where two coats are required to achieve the recommended film thickness for the coal tar epoxy, the time interval between coats should be as short as possible. To ensure maximum intercoat adhesion, the following shall be done: (1) the next coat be applied as soon as possible after the previous coat is firm; and (2) if the previous coat has cured for more than the recoat time specified by the manufacturer, wash with fresh water, then brush blast to provide an adequate mechanical bond before recoating.

3.5 FINAL CURING TIME

Coated surfaces shall be permitted as long a drying time as practicable, but, in any event, the following minimum requirements shall be met. The steel coated with the coal tar epoxy system shall not be driven or handled until the finished coating has been cured at least 7 days at 77 0F (25 0C), or has been post-cured at higher temperatures for a shorter time period in accordance with the coating manufacturer's recommendations. The Owner/Engineer may reject shipment if coating is damaged during transit or loading operations.

3.6 INSPECTION

3.6.1 Satisfactory performance will be based upon acceptance of the completed work by Chatham County. All Work will be inspected by Chatham County or his representative.

3.6.2 Dry film thickness will be measured by either an elcometer or by microtest dry film thickness gauge.

3.7 APPEARANCE OF FINISHED COATING

3.7.1 The finished coating shall be generally smooth and free of sharp protuberances which could be removed by abrasion. A minor amount of sags, dimpling or curtaining which does not exceed 2% or 3% of the surface will not be considered cause for rejection, unless they present sharp edges which might be removed by abrasion.

3.7.2 Sharp protuberances shall be cut off using a sharp wood chisel laid flat against the surface. The areas from which material has been removed shall be recoated to smooth the surface.

3.8 PROTECTION OF COATED STEEL

The Contractor shall exercise extreme care in the handling of all coated steel so that no damage occurs to the coated surface. Any damaged areas due to penetrations, welding, mishandling, etc. shall be field painted with coal tar epoxy or Engineer-approved equivalent. After installation of

pipe piles and sheet piles, all areas will be inspected for damaged coating. The Contractor will repair all damage to the coating due to handling or construction operations at no additional expense to the Owner. The Contractor's method of repairing damage to the coating, for both above and below water repairs, shall be submitted to the Engineer for review.

End of Section 09930