Columbia Water
Drinking Water • Wastewater • Stormwater

Columbia Water
Columbia, South Carolina

Technical Specifications

For the

Lower Saluda Relief Sewer and Pipe Rehabilitation

CIP #SS7428

BC Project #152166

Bid Documents

October 2020

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TECHNICAL SPECIFICATIONS

FOR

CIP #SS7428
Lower Saluda Relief Sewer and Pipe Rehabilitation

Prepared for:

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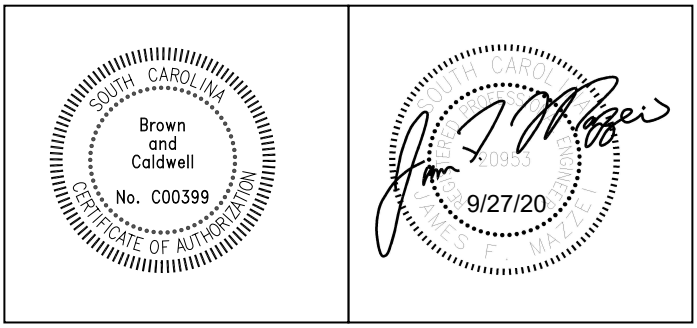

The Standard Technical Specifications ("specifications") and Construction Details ("details") bound into this booklet have been reviewed by the above ("Engineer") and have been found to be in conformance and consistent with the construction illustrated in the design drawings ("plans") prepared for this utility construction project. Discrepancies found between the plans and the specifications of the details shall be communicated to the Engineer for interpretation.

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CIP PROJECT SS7428
LOWER SALUDA RELIEF SEWER & MAJOR PIPE REHABILITATION
FOR THE CITY OF COLUMBIA, SOUTH CAROLINA

LIST OF SPECIFICATION SECTIONS

DIVISION 0 – FRONT END DOCUMENTS
Provided by the City of Columbia

*****City of Columbia Standard Documents. Not included in design submittal.

TECHNICAL SPECIFICATIONS

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DIVISION 01

GENERAL REQUIREMENTS

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SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 LOCATION OF WORK

A. The work of this Contract is located at:

The work covered under this contract will be performed generally alongside the Saluda River from the Saluda River Pump Station, upstream through Saluda Shoals Park, and along Rawls Creek to Bush River Road.

1.02 SCOPE OF WORK

A. The overall project will consist of the construction of a new 42-inch and 36-inch gravity trunk sewer, manholes, diversion structures, associated appurtenances, erosion/sedimentation control, and equipment for the installation of the new sewer main.

B. The Work includes, but is not necessarily limited to, the following:

1. Clear the site of trees, brush, fences, buildings and obstructions occupying space needed for construction. No building or structure partially encroaching on the right-of-way or located so as not to interfere with construction operations, shall be removed unless specifically noted on the Drawings or directed by the Engineer.

2. Installation of approximately 2,175 linear feet of 42-inch gravity sewer main, approximately 17,000 linear feet of 36-inch gravity sewer main via open cut, 1,400 linear feet of 36-inch gravity sewer via pipe-bursting, rehabilitating 1,700 linear feet of 30- and 36-inch sewer via CIPP, 75 manholes, 2 pre-cast concrete vault diversion structures, and all associated fittings, and appurtenances to complete the work.

3. Connections to the existing City of Columbia sewer collection system.

4. Replace 3 segments of existing 27-inch concrete sewer pipe with 36-inch HDPE via pipe bursting

1.03 WORK BY OTHERS (N/A)

1.04 WORK SEQUENCE

A. Work sequence shall also be in accordance with Section 01014, Sequence of Work.

1.05 CONTRACTOR'S USE OF PREMISES

A. Contractor shall have complete and exclusive use of the premises for the performance of the Work.

B. Contractor shall limit the use of the premises for his/her Work and for storage to allow for:

1. Work by other contractors.

2. Owner occupancy

3. Public use.

C. Coordinate use of premises with Owner.

D. Contractor shall assume full responsibility for security of all his/her and his/her subcontractors materials and equipment stored on the site.

E. If directed by the Owner or Engineer, move any stored items which interfere with operations of Owner or other contractors.

F. Obtain and pay for use of additional storage or work areas if needed to perform the Work.

1.06 OWNER OCCUPANCY (NOT USED)

1.07 PARTIAL OWNER OCCUPANCY

A. Partial SCDHEC Permits to Operation (PTO) for portions of the new gravity sewer system will need to obtained over the construction period, as indicated on the Drawings.

B. The Contractor shall furnish to the Engineer the periodic as-built drawings and test records necessary for the PTO submittals.

C. Wastewater shall not be diverted into the new gravity sewer mains until the PTO is issued by SCDHEC.

1.08 OWNER-FURNISHED PRODUCTS (NOT USED)

END OF SECTION

SECTION 01014
CONSTRUCTION SEQUENCE

PART 1 GENERAL

1.01 SITE CONDITIONS

A. Several areas of construction under this contract must be coordinated with the City Operating Personnel and accomplished in a logical order to maintain the process flow through the pump station and pipelines and to allow construction to be completed within the time allowed by Contract Documents. Coordinate the activities with the other contractors, if any, to allow orderly and timely completion of all the work.

B. When access through construction areas must be disrupted, provide alternate acceptable access for the plant operators or other contractors.

C. Coordinate the activities in the common areas with other contractors and the plant operators. Submit to the Engineer a description and schedule as to how the common areas will be utilized, recognizing the required coordination with other contractors and the plant operators.

1.02 CONSTRUCTION CONSTRAINTS

A. This section contains constraints to consider in developing the overall plan of construction. This list is not intended to release the Contractor from the responsibility to coordinate the work in any manner which will ensure project completion within the time allowed. A suggested sequence within each area, where necessary, is included.

B. Clearing and grubbing or land disturbing activity shall not be performed in any area until the Contractor has installed appropriate sediment and erosion control measures. Should the Contractor elect to use multiple full-time pipe laying crews, clearing and grubbing may take place in multiple sections simultaneously upon approval by the Engineer.

C. The Contractor shall adhere to the following general construction sequence within the project area unless otherwise specified.

1. Notify all stakeholders and impacted property owners.

2. Conduct pre-construction photography and videotaping.

3. Install temporary construction entrances.

4. Survey and stake permanent and temporary construction easement lines.

5. Install construction barrier fencing and safeguards.

6. Install tree protection systems.

7. Install sedimentation and erosion control devices.

8. Preform clearing and grubbing.

9. Collect core coupons from pipe segments selected for pipe bursting to confirm suitability of concrete pipe for bursting. The Contractor shall immediately notify the Engineer if the pipe material contains asbestos or is prestressed concrete cylinder pipe (PCCP).

10. Pipe installation from Saluda River PS to MH-A-09 (Diversion Structure). Conduct sewer testing in accordance with technical sections. Obtain partial PTO and place in service.

11. Pipe installation from MH-A-09 to MH-A-44 (Diversion Structure). Conduct sewer testing in accordance with technical sections. Obtain partial PTO and place in operation.

12. Pipe installation from MH-A-44 to MH-A-54. Conduct sewer testing in accordance with technical sections. Obtain partial PTO and place in operation. Install temporary gravity bypass from 18987MH to MH-A-53. Abandonent of remaining sewer scheduled for abandonment or replacement between 18988MH and 18685MH.

13. Divert all wastewater flow into new 36” and 42” sewer using the two diversion structures. Conduct rehabilitation of high priority line segments and manholes. Conduct sewer testing in accordance with technical sections.

14. Pipe installation from MH-A-54 to MH-A-77. Conduct sewer testing in accordance with technical sections. Obtain partial PTO and place in operation. Abandonent of any remaining sewer scheduled for abandonment or replacement.

15. Temporary restoration of each section within 14 days after pipe installation is complete in that section.

16. Complete connections to existing system.

17. Remove construction barrier fences and safeguards.

18. Remove sediment and erosion control devices and tree protection systems upon approval of the Engineer.

19. Remove any temporary access roadways constructed by the Contractor for his/her own use incidental to the construction.

20. Cleanup, repairs, and final restoration.

21. Conduct post-construction photography and videotaping.

1.03 SCHEDULE CONSTRAINTS

A. Installation of the pipeline must be substantially complete within 455 calendar days and fully complete within 515 calendar days of issuance of the Notice to Proceed for the project.

B. Contractor shall provide test results and as-built drawings needed for the Engineer to submit a request for a partial permit to operate (PTO) as indicated on the plans. Wastewater shall not be diverted into newly installed segments of sewer lines until the PTO has been issued by SCDHEC.

C. Construction between the boat landing at Saluda Shoals Park and Bush River Road must only occur between the months of January to October as to not interfere with the annual holiday lights event in the park.

D. Contractor shall coordinate with the Saluda Shoals Park staff to identify scheduled events, such as races, to limit the impact construction activities will have on the events.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE

A. This Section includes specification for the measurement and payment of the various elements of the Work; with provisions applicable to lump sum prices, unit prices, and allowances, if applicable.

B. The Contractor shall receive no payment for any portion of the work until it is installed. The only exception to this is payment for stored materials on site if the Contract provides for the payment of stored materials. Partial payment may be requested for items partially installed.

1.02 LUMP SUM ITEMS

A. Lump Sum measurement will be for the entire item, unit of work, structure, or combination thereof, as specified and as indicated in the Schedule of Prices in the Bid Form. Measurement and payment for all bid items indicated as Lump Sums shall include the cost of all labor, materials and equipment necessary to furnish, install, clean, test, and place each bid item into operation; including permitting, general conditions, overhead and profit.

B. Progress payments will be based on the Schedule of Values, as specified in Section 01370, prepared by the Contractor and approved by the Owner/Engineer before acceptance of the first Application for Payment.

C. In order for the Contractor to request progress payments against Lump Sum items, Contractor shall provide a disaggregation or breakdown in sufficient measurable detail that is acceptable to the Owner/Engineer.

D. Measurement

1. Measurement shall be based on the estimated percent complete of each Lump Sum item based on the Schedule of Values, as specified in Section 01370.

E. Payment

1. Payment will be made at the lump sum price proportional to the completion percentages approved by the Owner/Engineer.

1.03 UNIT PRICE ITEMS

A. Quantity and measurement estimates stated in the Schedule of Prices in the Bid Form are estimates for bidding purposes only. Actual payments shall be based on actual quantities installed, in-place, as measured and/or verified by the Owner/Engineer.

B. Unless otherwise provided in the General Conditions, the bid unit prices shall be in effect throughout the contract duration, regardless of variances between the estimated quantities and the actual installed quantities.

C. The Contractor shall make no claim, nor receive any compensation, for anticipated profits, loss of profit, damages, or any extra payment due to any difference between the amounts of work actually completed, or materials or equipment furnished, and the estimated quantities

D. Unless otherwise approved by the Owner/Engineer, any unit quantities exceeded may not be invoiced until the estimated quantity is increased by contract change order.

E. Contractor shall assist Owner/Engineer by providing necessary equipment, workers, and survey personnel as required to measure quantities.

F. Measured quantities shall be rounded to the nearest whole integer, unless the value of the unit price exceeds $100, in which case measured quantities shall be rounded to the nearest half unit.

G. Measurement

1. Measurement for progress payment shall be made by, or approved by, the Owner/Engineer based on the estimated effective quantity installed. The effective quantity installed represents the actual units or quantities installed, adjusted for incomplete elements or components.

2. Unless otherwise provided for in the Schedule of Prices in the Bid Form, unit price items are all-inclusive of all related work, direct and indirect, to provide a complete and functional item. For example, underground water pipe installation would include pipe, trenching, shoring, dewatering, bedding, installation, backfill, testing, flushing, disinfection, and commissioning; including all labor, materials and equipment necessary to furnish, install, clean, test, and place into operation; including permitting, general conditions, overhead and profit.

3. The final measurement shall be based on actual quantities, jointly measured by Contractor and Owner/Engineer, complete, fully, tested and placed into service.

H. Payment

1. Progress payments shall be in accordance with the contract documents based on estimated effective quantities installed, paid at the bid unit price.

2. The final payment shall be based on actual quantities, fully installed, tested and placed into service, paid at the bid unit price.

PART 2 BID ITEMS

2.01 MISCELLANEOUS WORK (PART A)

A. Mobilization/Demobilization and Related Expenses (Item A-1)

1. Method of Measurement. Mobilization, demobilization and related expense shall be a lump sum. This Item is meant for non-recurrent and general expenses related to establishment and close out of the Work.

2. Basis of Payment. Payment for mobilization and demobilization will be made at the lump sum price named. This price shall constitute full payment for mobilization and demobilization, complete as specified. The lump sum price for mobilization and demobilization shall include all costs for obtaining all bonds, permits, and licenses; location and procurement of a staging area/storage yard; moving onto and off of the site of all equipment; furnishing and erecting construction facilities; cleanup; and all preparatory work as required for the proper performance and completion of the project, including all work items not identified in a separate bid item. The Total Price for mobilization and demobilization shall not exceed 5 percent of the total bid price and payment of 66% of this line item shall be made for mobilization and 34% for demobilization.

B. Maintenance and Protection of Traffic (Item A-2)

1. Method of Measurement. Maintenance and Protection of Traffic shall be a lump sum. This Item shall include costs related to traffic control that may be required over the term of the Work for the entire Contract.

2. Basis of Payment. Maintenance and protection of traffic shall be paid for at the contract lump sum price. This price and payment shall be full compensation for all costs associated with labor, equipment and services involved in the preparation of control plans; erection, maintenance, moving, adjusting, cleaning, replacement of damaged or worn devices, and removal of devices; labor for any required flaggers; and all other Items furnished by the Contractor as well as all costs of labor and equipment involved in performing the maintenance of vehicular, bicycle, pedestrian traffic (to include access of grounds maintenance and support staff from Saluda Shoals Park, Shaw Industries, and Dominion Energy, etc.) and all other Items necessary to complete the Work as shown and specified but not included for payment under other Items in the Schedule of Prices.

   a. Payment shall be made as determined by the Owner on a percent complete basis in accordance with the accepted Schedule of Values (Section 01370).

C. Clearing and Grubbing (Item A-3)

1. Method of Measurement. Clearing and grubbing shall be measured as the number of square yards for the Work completed as shown.

2. Basis of Payment. Clearing and grubbing shall be based upon a square yard basis for Work completed as shown. Payment shall be made for full compensation of all labor, equipment and materials required for removing and disposing of all trees, stumps, bushes, shrubs, vegetation, logs, rubbish, and other objectionable material and all other Items necessary to complete the Work as shown and specified but not included for payment under other Bid Items.

D. Dewatering and Drainage (Item A-4)

1. Method of Measurement. Dewatering and Drainage shall be a lump sum. This Item shall include costs related to dewatering all excavations that are required over the term of the Work for the entire Contract.

2. Basis of Payment. Dewatering and Drainage shall be full compensation for all labor, equipment, materials and incidentals necessary to handle ground water and surface water as specified in Section 02140 including but not limited to sinking well points, furnishing, installing and maintaining pumping systems including all pumps, piping, casing and other appurtenances, filter sand required for underdrains or pumping systems, furnishing, installing and maintaining observation wells and all else incidental thereto for which separate payment is not provided under other Bid Items.

    a. Payment shall be made as determined by the Owner on a percent complete basis in accordance with the accepted Schedule of Values (Section 01370).

E. Erosion and Sedimentation Control (Item A-5)

1. Method of Measurement. Erosion and sedimentation control shall be a lump sum. This Item shall include costs related to erosion and sedimentation control that may be required over the term of the Work for the entire Contract.

2. Basis of Payment. Erosion and sedimentation control shall be full compensation for all labor, equipment, materials and incidentals necessary to control erosion as specified in Section 02270, including but not limited to, furnishing, installing, maintaining, and removal of the erosion and sedimentation control devices, silt fences, stone for filtration devices, filter boxes, temporary and permanent seeding, straw mulch, erosion control blankets, stream bypassing, stream crossing and restoration, to include rock cross vanes where shown, and all else incidental thereto for which separate payment is not provided under other Bid Items.

    a. Payment shall be made as determined by the Owner on a percent complete basis in accordance with the accepted Schedule of Values (Section 01370).
    b. Stream crossings shall include temporary dams, bypassing streams and storm water, installing temporary culvert pipes, and all other work necessary for creating access for equipment and personnel to move along the easement and over ditches and creeks during construction.
    c. Stream restoration shall include all work necessary to reinstate the stream and banks as shown on the Drawings.
    d. The notes and details for Erosion and Sedimentation Control, along with stream crossings and restoration, are shown Civil Detail Sheets on the Drawings with drawing number beginning with 200-.

F. Over Excavation of Unsuitable Soils and Refill (Item A-6)

1. Method of Measurement. Over Excavation of Unsuitable Soils and Refill shall be measured on a per cubic yard basis for the number of cubic yards of unsuitable material excavated below the proposed bottom of trench elevation.

    a. Measurement for the excavation required from existing grade to the proposed bottom of trench elevation shall be included in the individual pipe items.

b. Measurement shall be for the number of cubic yards excavated only, not the number of cubic yards of excavated and backfilled material combined.

2. Basis of Payment. Over Excavation of Unsuitable Soils and Refill shall be full compensation for furnishing all the necessary labor, equipment, tools and materials required for excavating (including hand excavation) unsuitable soils below the proposed bottom of trench elevation, furnishing and installing backfill as required to bring the trench elevation back to the proposed bottom elevation, compaction, and all incidental Work required to complete the Work as shown and specified but not included for payment under other Bid Items.

a. No payment will be made for removal and replacement of unsuitable soils resulting from improper excavation, improper dewatering, or accidental over-excavation by the Contractor.

G. Abandonment of Existing Utilities (Item A-7)

1. Method of Measurement. Abandonment of Existing Utilities shall be measured on a linear foot basis for the actual length of each utility line abandoned in place.

2. Basis of Payment. Abandonment of Existing Utilities shall be full compensation for furnishing all the necessary labor, equipment, tools and materials required for abandonment of utilities as shown of the Contract Drawings, cutting pipelines as required, excavation and backfill, removal and disposal of pipe contents, permanent plugging of the pipe, furnishing and placement of flowable fill into the abandoned pipe, and all incidental Work required to complete the Work as shown and specified but not included for payment under other Bid Items.

H. Rock and Boulder Excavation (Item A-8)

1. Method of Measurement. Rock and Boulder Excavation shall be measured on a cubic yard basis for the actual quantity of rock excavated and removed from the trench.

a. When rock is encountered, the material shall be uncovered and the Owner/Engineer notified. The Owner/Engineer will then take cross sections of the rock surface. If the Contractor fails to uncover the ledge, notify the Owner/Engineer and allow ample time for cross sectioning the undisturbed material, the Contractor shall have no right-of-claim to any classification other than that allowed by the Owner/Engineer. Removal of old concrete foundations, if any, shall be classified as rock.

b. Measurement of rock excavation in pipe trenches will extend to the width limits are as follows:

Depth from Ground Surface to Invert of Pipe	Pay Width (Nominal Pipe Diameter)	
	0 to 24-in	over 24-in
0 to 12-ft	5-ft-0-in	D + 3-ft-0-in
12-ft to 20-ft	7-ft-0-in	D + 5-ft-0-in
20-ft to 24-ft	8-ft-0-in	D + 5-ft-0-in

c. Measured widths for depths over 24-ft shall be determined case-by-case consistent with the foregoing chart.

d. Measured depth for rock which is encountered in a trench shall be no less than three feet when removal can be accomplished only by drilling and blasting or by use of jack (air or hydraulic) hammers.

e. Payment for rock removed, using the same or equal equipment as utilized for normal trench excavation, shall be limited to the actual depth removed within the limits established by the contract documents.

f. Measurement for depth shall be from the top of the rock formation to the normal depth of the pipe as shown on the Drawings.

g. The pay limit for rock and boulder removal for manholes shall commence one foot outside the widest dimension of the structure or shall be the maximum connecting trench width, whichever is greater. No allowance will be made for over breakage.

h. Boulders and concrete structures exceeding 1 cu yd in volume when encountered in excavation will be measured for payment. Removal of boulders of whatever size will not be paid for when encountered in borrow areas.

2. Basis of Payment. Payment for rock and boulder excavation will be made for the quantities as determined above at the unit price bid for Item A-11 in the Schedule of Prices. This price and payment shall be full compensation for furnishing all the necessary labor, equipment, tools and materials required for excavation, blasting and disposal of rock and boulders, backfilling and providing borrow for any deficiency of trench backfill and all work incidental thereto, for which payment is not provided under other bid items.

3. No payment will be made under this Bid Item for refill material to replace any deficiency of backfill material.

I. Remove and Replace Asphalt and Gravel Pavement in Non-DOT Streets (Item A-9 and A-10).

1. Method of Measurement. Removal and Replacement of Asphalt and Gravel Pavement in City, County, and Private streets shall be measured on a per square yard basis as actually placed, but not exceeding the limits given below:

Pipe Depth to Invert (ft.)	Trench Pavement Width (ft.)
0-8	8.5
8-12	11.5

12-16	14.5
16-20	17.5
over 20	20.5

2. Basis of Payment. Payment for bituminous concrete pavement and gravel surfaces, complete in place and approved by the Owner/Engineer, will be made for the quantity determined above at the price bid for Item A-11 and A-12 in the Schedule of Prices. This price and payment shall be full compensation for saw cutting trenches and removal of all pavement necessary for pipe installation; cleaning and priming the edges of the existing pavement; furnishing and installing gravel base and preparing the surface for pavement; furnishing and placing tack coat; furnishing, placing and maintaining any required initial pavement; furnishing and maintaining final pavement to the dimensions shown on the Drawings; raising and adjusting manhole covers to final grade as necessary; compaction of all pavement; furnishing and installing all pavement markings; maintaining and repairing damaged pavement throughout the warranty period; and all else incidental thereto for which payment is not provided under other items in the Schedule of Prices.

    a. If the thickness of pavement ordered placed by the Owner/Engineer is greater than that specified, payment will be prorated on the basis of the thickness of material actually ordered placed. No payment will be made for any additional pavement not specifically ordered in writing by the Owner/Engineer.

    b. No additional payment will be made for leveling course if required.

J. Remove and Replace 8-foot Wide Concrete Sidewalk (Item A-11)

1. Method of Measurement. Remove and Replace 8-foot Wide Concrete Sidewalk shall be measured on a square foot basis for the actual amount of sidewalk replaced.

2. Basis of Payment. Remove and Replace 8-foot Wide Concrete Sidewalk shall be full compensation for furnishing all the necessary labor, equipment, tools and materials required for removal and replacement of the concrete pathway shown of the Contract Drawings, including saw cutting, disposal of materials, grading and compacting subgrade, forming, reinforcing, furnishing and placement of concrete sidewalk, and all incidental Work required to complete the Work as shown and specified but not included for payment under other Bid Items.

K. Clean-up and Testing

1. No separate payment shall be made for clean-up and testing, the costs of which shall be included in the item to which it pertains.

L. Trench Excavation and Backfill

1. No separate payment shall be made for trench excavation and backfill, the costs of which shall be included in the bid item to which it pertains. No separate payment shall be made for any unique method or technique required for the Contractor to complete the work in accordance with the Contract Documents or federal, state and local regulations, permits, laws and requirements.

2. No separate payment shall be made for trench sheeting, shoring and bracing, the costs of which shall be included in the bid item to which it pertains. No additional compensation shall be made for completion of all planning, design, engineering fees as well as furnishing, constructing, removal, and disposal of such temporary and/or permanent sheeting, shoring, and bracing as required under the provisions of any permits, laws, regulations and in accordance with the requirements of OSHA.

3. No separate payment will be made for bedding, initial backfill and subsequent backfill. No separate payment will be made for the trench foundation prepared as indicated in Section 02200 and on the Drawings, except for trench stabilization. The costs for bedding, foundation, initial backfill and subsequent backfill shall be included in the item bid for the associated pipeline.

M. Bypass Pumping (Item A-12)

1. Method of Measurement. Measurement for bypass pumping shall be on lump sum basis in accordance with a well-balanced detailed apportionment of the work.

2. Basis of Payment. Bypass pumping shall be full compensation for all labor, equipment, materials and incidentals necessary to bypass sewer as specified in Section 02767, including but not limited to, furnishing, installing, and maintaining sewer flow control equipment (pumps, piping, valves, fuel, maintenance, etc.), and all else incidental thereto for which separate payment is not provided under other Bid Items. Payment shall be made as determined by the Owner on a percent complete basis in accordance with the accepted Schedule of Values (Section 01370).

2.02 SEWER PIPE, MANHOLES AND APPURTENANCES (PART B)

A. Sewer Pipe (Items B-1 through B-17)

1. Method of Measurement

a. Sewer pipe of the type and size specified on the Schedule of Prices (Items B-1 through B-17) will be measured in place on a linear foot basis. Measurement for payment does not signify that the sewer line is accepted.

b. Measurement of sewer pipe for length will be along the horizontal centerline of the pipe with no deduction for fittings and will be to the center of manholes. Measurement for depth will be from the original ground surface, as determined by the Owner/Engineer to the invert of the pipe. Measurement will be to the nearest foot.

2. Basis of Payment

a. Payment for furnishing and installing sewer pipe will be made for the respective quantities as determined above at the unit price bid under Items B-1 through B-17 in the Schedule of Prices. This price and payment shall be full compensation for cutting and removing existing pavement, trench excavation (except rock and boulder excavation), backfilling and compaction as detailed and specified, loaming and seeding, installation of impervious dams, restoring the trench surface to grade, furnishing gravel bedding and encasement, furnishing, laying, jointing, cleaning and testing the pipe, and all incidental work, including driving and removing sheeting and

bracing and all else incidental thereto, for which separate payment is not provided under other items in the Bid Form.

b. Unless specified on the Drawings, pipe material for the 36- and 42-inch gravity shall be DIP or CCFRP. Pipe material shall be consistent from manhole to manhole. Pipe under creeks or within steel casing shall be DIP only.

B. Bore and Jack Steel Casing (Bid Items B-18 and B-19)

1. Method of Measurement: The basis for measurement shall be linear feet, to the nearest whole number, measured along a horizontal plane from the face of the casing to the face of the casing. Installation of the carrier pipe shall be paid separately.

2. Basis of Payment: Payment for bore and jack steel casing shall be made at the quantity authorized, in linear feet, for the specified casing diameter at the unit price indicated on the Schedule of Prices. It shall include all work necessary for the installation of a steel casing at the size indicated, including site preparation, pit excavation, shoring, sheeting and bracing, installing the casing as specified in Section 02450 and on the Drawings, restoration, clean-up and testing.

C. Precast Concrete Manholes (Items B-20 through B-21)

1. Method of Measurement. Precast concrete manholes (Items B-20 through B-21) will be measured in vertical feet from the invert of the lowest pipe of the manhole to the top of the manhole frame.

2. Basis of Payment. Payment for furnishing and installing concrete manholes complete in place will be made for the quantity as above determined at the price per vertical foot bid for Items B-20 through B-21, which price and payment shall be full compensation for all excavation (except rock and boulder), backfilling, for furnishing and installing precast sections and bases, platforms, damproofing, frames and covers, hatches, screened gravel subbase, all forms, reinforcing, concrete and masonry materials, top slabs for shallow manholes if used, leakage testing, and all else incidental thereto, for which separate payment is not provided under other items in the Schedule of Prices.

D. Manhole Drop Connections (Item B-22)

1. Method of Measurement. Manhole Drop Connections as specified in the Schedule of Prices (Item B-22) will be measured in vertical feet from the upper invert of the drop to the lower invert of the drop, as shown on the Drawings, but will not be less than 3-ft for each drop connection.

2. Basis of Payment. Payment for furnishing and installing precast concrete diversion structures complete in place will be made for the quantity as above determined at the price per vertical foot bid for Items B-20 through B-21, which price and payment shall be full compensation for all excavation (except rock and boulder), backfilling, for furnishing and installing precast sections and bases, platforms, damproofing, frames and covers, hatches, screened gravel subbase, all forms, reinforcing, concrete and masonry materials, top slabs for shallow manholes if used, leakage testing, and all else incidental thereto, for which separate payment is not provided under other items in the Schedule of Prices.

E. Precast Concrete Diversion Structures (Item B-23)

1. Method of Measurement. Measurement for Precast Concrete Diversion Structures shall be on the number of structures complete in place.

2. Basis of Payment. Payment for furnishing and installing Manhole Drop Connections will be made for the quantity complete at the price indicated for Bid Item B-23 on the Schedule of Prices. This price and payment shall be full compensation for furnishing and installing the structure, pipe connections, fabricated slide gates, fittings, concrete channel, cutting, securing pipe to inside of structure, epoxy lining, all clamps and fasteners required, and all else incidental thereto for which separate payment is not provided under other items in the Schedule of Prices.

2.03 SEWER REHABILITATION (PART C)

A. Cured-in-Place Pipe – Manhole to Manhole (Items C-1 through C-2)

1. Method of Measurement.

a. Cured-in place pipe (CIPP) shall be measured by the actual number of linear feet of CIPP installed, measured in place along the centerline of the pipe from center of manhole to center of manhole of the various sizes indicated. Measurement shall be to the nearest foot. Only CIPP accepted by the Owner shall be measured. No separate payment shall be made for unclogging service laterals as a result of the operation.

2. Basis of Payment.

a. Cured-in place pipe shall be paid for by the respective quantities, at the sizes defined, as determined above at the Contract unit price bid in the Schedule of Prices. This price and payment will be full compensation for furnishing all materials, labor, tools, equipment and appurtenances required or otherwise necessary to satisfactorily complete the Work including light hydraulic cleaning, pre-television inspection, post-construction television inspection from manhole to manhole, stopping of active leaks that would interfere with the integrity of the liner to be installed, all approved liner repairs, removal and disposal of debris and any other obstructions excluding mechanical heavy cleaning, obtaining water, repairs to private property, public notification, sewer flow control, maintenance of flow in existing sewers with bypass pumping and maintenance of plugs, hydrophilic end seals, acceptance testing, care and protection of all property, and all costs, labor, materials, and equipment incidental thereto, for which separate payment is not provided under other items in the Schedule of Prices.

B. Pre-Rehabilitation CCTV (Item C-5)

1. Method of Measurement.

a. Television inspection of the existing sewer pipe shall be measured in place on a linear foot basis to the nearest foot. Measurement shall be along the horizontal centerline of the pipe with no deductions for manholes and shall be from center of manhole to center of manhole.

b. Pre-rehabilitation CCTV for this item shall only be completed to assess unknown pipe condition and only in areas identified on the Drawings. All pre-rehabilitation CCTV inspection required for pipes already identified for CIPP lining or point repair on the Drawings shall be paid for in the respective rehabilitation Bid Items in the Schedule of Prices.

2. Basis of Payment.

a. Television inspection of the existing sewer pipe shall include, but not be limited to providing all equipment, materials and labor for CCTV inspecting the sewer pipe; maintenance of flow in existing sewers including bypass pumping and plugs; light cleaning and disposal of all debris; creating copies of the inspection on digital video disc (DVD) to be delivered to the Owner/Engineer; creating copies of inspection logs to be delivered to the Owner/Engineer; and all else incidental thereto for which separate payment is not provided under other items in the Bid Form.

C. Mechanical Heavy Sewer Cleaning/Root Removal (Item C-6)

1. Method of Measurement.

a. Mechanical heavy sewer cleaning and root removal shall be measured by the actual number of linear feet of pipe cleaned as approved by the Owner/Engineer. Pipe shall be measured in place along the centerline of the pipe from the center of manhole to center of manhole of each pipe. Measurement shall be to the nearest foot of the actual footage of what was cleaned.

2. Basis of Payment.

a. Mechanical heavy sewer cleaning and root removal of the existing sewer pipe shall be paid for the respective quantities as determined at the Contract unit price bid in the Schedule of Prices. This price and payment shall be full compensation for locating existing manholes; the removal, transportation, and disposal of debris within the sewers in accordance with these Specifications; for obtaining water; maintenance of flow in existing sewers including bypass pumping and plugs necessary for mechanical heavy sewer cleaning and root removal; and all else incidental thereto for which separate payment is not provided for under other items in the Schedule of Prices.

D. Raise Existing Manholes (Item C-4)

1. Method of Measurement. Raise Existing Manholes shall be measured by the actual number of manholes raised.

2. Basis of Payment. Manholes raised shall be paid for the respective quantities as determined above at the Contract unit price bid in the Schedule of Prices. This price and payment shall be full compensation for saw-cutting of pavement and/or concrete; excavation (except for rock and boulder removal); removing the existing cone section; disposal of excavated material and existing manhole section; support of excavation; removal and disposal of the existing manhole frame and cover; installing pre-cast concrete riser sections and top slab, furnishing and installing the new sewer manhole access hatch; furnishing and installing backfill; compaction; sealing the new riser section to the existing riser section; and all

costs, labor, materials, and equipment incidental thereto, for which separate payment is not provided under other items in the Schedule of Prices.

E. Bench and Invert Repair (Item C-8)

1. Method of Measurement.

a. Coating of all manhole inverts with a quick-setting grout shall be measured by the actual number of manholes coated.

2. Basis of Payment.

a. Coating of all manhole inverts with a quick-setting grout shall be paid for at the Contract unit price bid in the Schedule of Prices. This price and payment shall be full compensation for all labor, materials and equipment necessary for cleaning, removal of all debris, application of the coating specified, maintenance of flow in existing sewers including bypass pumping and plugs, and repair as directed by the Owner/Engineer and all incidentals thereto, for which separate payment is not provided under other items in the Schedule of Prices.

F. Sewer Manhole Monolithic Lining (Item C-7)

1. Method of Measurement.

a. Sewer manhole monolithic lining for sealing of existing sewer manholes using monolithic surfacing system, shall be measured in place on a vertical foot basis from the invert of the lowest pipe of the manhole to the top of the manhole and chimney interface.

2. Basis of Payment.

a. Sewer manhole monolithic lining for sealing of existing manholes using monolithic lining system, shall be paid for the quantity as above determined at the Contract unit price bid in the Schedule of Prices. This price and payment shall be full compensation for preparatory cleaning of the manhole walls and invert; sealing pipe connections and stopping active leaks with chemical or cementitious grout; maintenance of flow in existing sewers including bypass pumping and plugs; furnishing and installing the manhole monolithic lining system as specified; reopening all active manhole connections; proper disposal of cleaning solvents; materials testing; environmental protection; final acceptance testing and all else incidental thereto for which separate payment is not provided under other items in the Schedule of Prices.

G. Replace 27-inch Diameter Pipe With 36-inch HDPE Pipe via pipe Bursting (Item C-3)

1. Method of Measurement.

a. Replacement of 27-inch diameter pipe with 36-inch HDPE pipe via pipe bursting, shall be measured in place on a linear foot basis which is satisfactorily installed and accepted by the Owner/Engineer, Measurements shall be from the center-to-center of the manholes for each line along the centerline of the pipe.

2. Basis of Payment.

a. Payment for replacement of 27-inch diameter pipe with 36-inch HDPE pipe via pipe bursting shall be for the quantity as above determined at the Contract unit price bid in the Schedule of Prices. This price and payment shall be full compensation for all labor, materials and equipment necessary for cleaning of the existing sewers; disposal of debris removed; pre- and post CCTV inspection; locating all live and abandoned service taps; sewer preparation and pre-construction inspection; locating and protecting all utilities; rehabilitation of existing sewer pipe using pipe bursting; bypass pumping of wastewater flows; connections to existing sewer main and existing manholes; excavation of any existing concrete encasement; recovery of equipment that reaches a rejection point; repair of existing pipe sags; modifications to manholes necessary to accept new pipe; specified testing; clean-up; complete restoration of areas disturbed by operations; and all else incidental thereto for which separate payment is not provided under other items in the Schedule of Prices.

H. Remove and Replace Manhole Frame and Covers (Items C-9)

1. Method of Measurement.

a. Sewer manhole frames and covers removed from existing sewer manholes and replacement with new sewer manhole frames and covers, shall be measured by the actual number of new sewer manhole frames and covers installed.

2. Basis of Payment.

I. Sewer manhole frame and covers shall be paid for the respective quantities as determined above at the Contract unit price bid in the Schedule of Prices. This price and payment shall be full compensation for saw-cutting of pavement and/or concrete; excavation (except for rock and boulder removal); disposal of excavated material; support of excavation; removal and disposal of the existing manhole frame and cover; furnishing and installing the new sewer manhole frame and cover; furnishing and installing backfill; compaction; furnishing and installing necessary grade rings and brick masonry for proper elevation adjustment; adjusting the new frame and cover to finished grade; and all costs, labor, materials, and equipment incidental thereto, for which separate payment is not provided under other items in the Schedule of Prices.

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 01026
APPLICATION FOR PAYMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This section includes the requirements that the Contractor shall follow for submitting applications for payment.

B. Its noted that the City, at its sole discretion, may authorize to the Engineer to act on its behalf for any or all the of the tasks describe herein.

1.02 RELATED WORK

A. Measurement and payment is included in Section 01025.

B. Schedule of Values are included in Section 01370.

1.03 PROCEDURES FOR SUBMITTING APPLCIATIONS FOR PAYMENT

A. The Contractor shall submit his draft Application for Payment on or before the third day of each month, or another specific day if authorized by the City Construction Administrator (CA). The City will pay to the Contractor the value of the work performed, as approved by the Inspector or CA, less retainage, less the aggregate of previous payments, within 21 days of receipt of final approved Application for Payment. Draft Applications for Payment that are submitted later will require additional time for processing for payment.

B. The City approving authority, usually the CA or Inspector, will review the draft Application for Payment and provide the Contractor with comments within 10 days. The Contractor then shall address all comments and be prepared to submit a final Application for Payment on the established date of the Monthly Construction Progress meeting. Final Applications for Payment that are submitted later will require additional time for processing for payment.

C. The Application for Payment shall be a completed itemized Application for Payment that includes the work completed as of the date the application is submitted, with supporting documentation showing the extents of the work and/or quantities in the request for payment. Supporting documentation shall be in a form such as drawings that represent the actual measurements and dimensions so they can be field verified and/or used in subsequent Applications for Payment. Previous quantities paid shall also be shown in the supporting documentation for comparison purposes and for tracking previous quantities paid and the respective locations at which they were paid.

D. Requests for payment will be made using the Owner's standardized Application for Payment. The Inspector or CA will provide the Contractor a copy of the documents on disc, electronically and/or in hard copy form prior to the first pay request. The Contractor shall reference the project name, purchase order number, description, and Owner's project number on all pay requests.

E. All final requests for payment must be addressed to the City Construction Management Division and mailed directly to the division's office at P.O. Box 147, Columbia, SC 29217.

Four (4) original Application for Payments shall be signed, dated, notarized and submitted for payment. Payments will not be processed from copies.

F. If the Construction Management Team makes any changes prior to payment or rejects payment in its entirety, the Contractor will be mailed a remittance copy reflecting those changes and/or the reasons for rejection and what the Contractor must do before the Application for Payment will be considered.

G. With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.

2. When an application shows completion of an item, submit final of full waivers.

3. Owner reserves the right to designate which entities involved in the Work must submit waivers.

4. Waiver Delays: Submit each Application for Payment with Contractor's waiver of mechanic's lien for construction period covered by the application.

5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to the Owner.

H. Submittal of an itemized Application for Payment and supporting documentation by the Contractor shall indicate that the Contractor has inspected those portions of the work included in the application and has determined and certifies that all portions of the work are in compliance with the Contract Documents and that the quantities submitted for payment are true and accurate.

I. Recommendations for payment will constitute a representation by the City Inspector based on supporting data, documentation, and the Engineer's recommendation that, to the best of the City Inspector's knowledge, information and belief, the work has progressed to the point indicated. However, recommendation for payment does not waive claims for defects, does not constitute acceptance of work not in accordance with the Contract Documents, does not indicate that the work was constructed in accordance with the Contract Documents and does not relieve the Contractor of the responsibility to correct any deficiencies or damaged work that may be found at a later date.

J. If payment is requested on a basis of materials not yet incorporated into the work but which are delivered, suitably stored, and verified by the Inspector, the bill of sale, invoice, or other documentation shall be submitted with the Application for Payment warranting to the City of Columbia that the materials are free and clear of all Liens and evidenced that the materials are covered by appropriate property insurance or other arrangements showing protection of materials. Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation: do not include overhead and profit on stored materials.

3. Provide summary documentation for stored materials. Submit and maintain a Stored Materials Log as provided by the City. Stored materials documentation will indicate the following:

    a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.

    b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

    c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

K. The City of Columbia may withhold, in whole or in part, payments previously made to such extent as may be necessary in the City's opinion to protect the City from loss for which the Contractor is responsible, including loss resulting from acts and/or omissions of the Contractor's employees, subcontractors and their agents and employees, and other persons or entities performing portions of the work for, or on behalf of, the Contractor or any of its subcontractors because of, but not limited to, the following:

1. Defective work not remedied;

2. Third party claims filed or reasonable evidence indicating probable filing or such claims unless security acceptable to the City is provided by the Contractor;

3. Failure of the Contractor to make payments properly to subcontractors or for labor, materials and/or equipment;

4. Reasonable evidence that the work cannot be completed for the unpaid balance of the Contract Sum;

5. Damage to the City or another Contractor;

6. Reasonable evidence that the work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay; or

7. Persistent and repeated failure to carry out the work in accordance with the Contract Documents.

L. City's Right to Withhold Certain Amounts and Make Application Thereof – The Contractor agrees that he will indemnify and hold the City harmless from all claims growing out of the lawful demands of subcontractors, laborers, workmen, mechanics, materialmen, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary,

incurred in the performance of this contract. The Contractor shall, at the City's request, furnish satisfactory evidence that all obligations of nature hereinabove designated have been paid discharged, or waived. If the Contractor fails to do this the City may, after having served written notice on the Contractor, either pay unpaid bills, of which the City has written notice, or withhold from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all lawful claims. When satisfactory evidence is furnished that all liabilities have been fully discharged, payment to the Contractor shall be resumed in accordance with the terms of this Contract. In no event shall the provisions of this paragraph be construed to impose any obligations upon the City to either the Contractor or his surety. In paying any unpaid bills of the Contractor, the City shall be deemed the agent of the Contractor, and any payment so made by the City shall be considered as payment made under the Contract to the Contractor, and the City shall not be liable to the Contractor for any such payment made in good faith.

1.04 PROCEDURES FOR SUBMITTING APPLCIATIONS FOR FINAL PAYMENT

A. The Contractor shall submit the following to the City of Columbia prior to the City releasing final payment:

1. A certified copy of Engineer's Substantial Completion Punch List endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance. Engineer will promptly make such inspection and, when the Engineer finds the Work acceptable under the Contract Documents and the Contract fully performed, the Engineer will promptly issue a final Certificate for Payment stating that to the best of the Engineer's knowledge, information and belief and on the basis of the Engineer's on-site visits and inspections, the Work has been completed in accordance with terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable.

2. In the event Contractor requests an inspection for final acceptance and it is determined that the Work is not ready and additional work is required, Contractor shall reimburse Owner for all additional Engineer fees incurred by Owner as a consequence of such re-inspection, if such re-inspection is necessitated solely by the Contractor's default.

3. An affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the project for which the City or the City's property might be responsible or encumbered (less amounts withheld by the City) have been paid or otherwise satisfied.

4. A certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect and will not be canceled or allowed to expire until at least 30 days' prior written notice has been given to the City.

5. A written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents. Consent of surety, if any, to final payment. Data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the City.

B. The making of final payment and retainage shall constitute a waiver of Claims by the City except those arising from:

1. Liens, claims, security interests or encumbrances arising out of the Contract and unsettled.

2. Failure of the work to comply with the requirements of the Contract Documents.

3. Terms of special warranties required by the Contract Document.

C. Upon completion and final acceptance by the City of all work covered under this Contract, the City will pay to the Contractor the amount remaining to be paid him under the Contract.

END OF SECTION

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SECTION 01035
CHANGE ORDER PROCEDURES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Promptly implement change order procedures.

1. Provide full written data required to evaluate changes.

2. Maintain detailed records of work done on a time-and-material/ force account basis.

B. Contractor shall maintain a Change Order Log. The Log shall include a sequential Change Order number, shall indicate both approved change orders (COs) and potential change orders (PCOs), description of the work, CO or PCO amount, and cumulative contract amounts. The Inspector and/or Engineer shall keep a similar log and the Contractor shall resolve any discrepancies between the Inspector/Engineer log and his log at each monthly Construction Progress Meeting.

1.02 RELATED REQUIREMENTS

A. Applications for Payment are included in Section 01026.

B. Substitutions are included in Section 01300.

C. Project Record Documents are included in Section 01720.

1.03 DEFINITIONS

A. Change Order (CO) – if an amendment to the Contract Documents includes a change in the contract price or the contract time, such amendment must be set forth in a CO. The City and Contractor may amend terms and conditions of the Contract Documents that involve:

1. Performance or acceptability of the work;

2. The design (as set forth in the drawings, specifications, or otherwise) with approval of the Engineer, or

3. Other engineering or technical matters, without the approval of the Engineer.

B. Work Change Directives (WCD) - a WCD will not change the contract price or the contract time but is evidence that the parties expect that the modification ordered or documented by a WCD will be incorporated in a subsequently issued CO. Contractor must submit any PCO seeking an adjustment of the contract price or the contract times, or both, no later than 30 days after the completion of the work set out in the WCD. Owner must submit any claim seeking an adjustment of the contract price or the contract times, or both, no later than 60 days after issuance of the WCD.

C. Field Orders (FO) – The Owner/Engineer may authorize minor changes in the work or interpretations/clarifications of the Contract Documents if the changes or clarifications do not involve an adjustment in the contract price or the contract time and are compatible with the design concept of the project. Such changes will be binding on the City and also on Contractor. if Contractor believes that a FO justifies an adjustment in the contract price or contract time, or both, then before proceeding with the work at issue, the Contractor shall submit a PCO.

D. Request for Proposal (RFP) – the City or Engineer may initiate changes by submitting a RFP to the Contractor.

1.04 PRELIMINARY PROCEDURES

A. Owner or Engineer may initiate changes by submitting a RFP to the Contractor. The City shall provide the Contractor with a standard RFP request form. The response to the RFP by the Contractor shall include:

1. Detailed description of the change and its associated cost.

2. Products required and location of the change.

3. Supplementary or revised Drawings and Specifications.

4. The projected time span for making the change and a specific statement as to whether overtime work is, or is not, authorized.

5. A specific period of time during which the requested price will be considered valid.

6. Such request is for information only and is not an instruction to execute the changes, nor to stop work in progress.

B. Contractor may initiate a PCO by submitting a written notice to Engineer, containing:

1. Description of the proposed changes.

2. Statement of the reason for making the changes.

3. Statement of the effect on the Contract Sum and the Contract Time with supporting documentation.

4. Statement of the effect on the work of separate contractors.

1.05 WORK DIRECTIVE CHANGE AUTHORIZATION

A. In lieu of a RFP, Owner/Engineer may issue a work directive authorization for Contractor to proceed with a change for subsequent inclusion in a Change Order.

B. Authorization will describe changes in the work, both additions and deletions, with attachments of revised Contract Documents to define details of the change and will designate the method of determining any change in the Contract Sum and any change in Contract Time.

C. Owner and Engineer will sign and date the Work Directive Change Authorization as authorization for the Contractor to proceed with the changes.

D. Contractor may sign and date the Work Directive Change Authorization to indicate agreement with the terms therein.

1.06 DOCUMENTATION OF PROPOSALS AND CLAIMS

A. Support each quotation for a lump-sum proposal and for each unit price which has not previously been established, with sufficient substantiating data to allow Owner/Engineer to evaluate the quotation.

B. On request, provide additional data to support time and cost computations including:

1. Labor required.

2. Equipment required.

3. Products required.

a. Recommended source of purchase and unit cost.

b. Quantities required.

4. Taxes, insurance and bonds.

5. Credit for work deleted from Contract, similarly documented.

6. Overhead and profit.

7. Justification for any change in Contract Time.

C. Support each claim for additional costs for work done on a time-and-material/force account basis with the following documentation:

1. Name of the Owner's authorized agent who ordered the work and date of the order.

2. Dates and times work was performed and by whom.

3. Time record, summary of hours worked and hourly rates paid.

4. Receipts and invoices for:

a. Equipment used, listing dates and times of use.

b. Products used, listing of quantities.

c. Subcontracts.

1.07 PREPARATION OF CHANGE ORDERS

A. Contractor will prepare and submit a PCO to the Inspector and/or Engineer.

B. The City Construction Administrator (CA) or Inspector will negotiate the PCO. At the City's sole discretion this task may be delegated to the Engineer.

C. Engineer will add and track progress of PCO from 1st receipt through to final determination on a PCO/CO log which will be reconciled monthly with the Contractor's PCO/CO log.

D. PCO will describe changes in the work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.

E. PCO will provide an accounting of the adjustment in the Contract sum and in the Contract time.

F. CA will determine if PCO will become CO and prepare City CO form and submit to City for the certification process.

G. City performs CO certification process which may include approval by the Assistant City Engineers for Design and Construction, City Engineer, Compliance, and Finance Department, and possibly the City manager and City Council.

H. City receives executed CO and issues hard copy notification to Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01045
CUTTING, CORING, AND PATCHING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section covers the cutting, coring, rough and finished patching of holes and openings. Holes and opening maybe in existing construction, or in parts of new construction. Procedures for cutting and patching will be the same for either condition.

B. All cutting, coring, and rough patching shall be performed by the trade requiring the opening.

C. Provide all cutting, filling and patching, including excavation and backfill, required to complete the work or to:

1. Make material parts fit together properly.

2. Uncover portions of the work to provide for installation of ill-timed or improperly scheduled work.

3. Remove and replace defective work.

4. Remove and replace work not conforming to requirements of Contract Documents.

5. Remove samples of installed work as specified for testing.

6. Provide penetrations of structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit.

7. Provide penetrations of non-structural surfaces and materials for installation of piping, ductwork, equipment and electrical conduit. The determination of what is a nonstructural surface or material shall be made by the Engineer.

8. Remove, install, or relocate materials or equipment.

1.02 RELATED WORK

A. Summary of Work is included in Section 01010.

B. Site work is included in Division 02.

C. Concrete is included in Division 03.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, a written request prior to executing any cutting or alteration which is not shown or detailed on the Contract Documents which affects or requires:

1. Cutting structural members.

2. Holes drilled in beams or other structural members.

3. Work of the Owner or any separate contractor.

4. Structural value or integrity of any element of the project.

5. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.

6. Efficiency, operational life, maintenance or safety of operational elements.

7. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Description of affected work.

2. The reason for cutting, alteration or excavation.

3. Effect on work of Owner or any separate contractor, or on structural or weatherproof integrity of project.

4. Description of proposed work:

a. Method and extent of cutting, patching, alteration, or excavation.

b. Trades who will execute the work.

c. Products proposed to be used.

d. Extent of refinishing to be done.

5. Alternatives to cutting and patching.

6. Confirmation of coordination with any separate contractor whose work will be affected.

7. Related shutdown requests if required to do the work.

8. Request for hot work permission if required to do the work.

C. Submit written notice to the Owner/Engineer designating the date and the time the work will be completed.

D. When a written request is required, do not proceed with the work until a written notice to proceed is received from the Owner/Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with specifications and standards for each specific product involved. Where there is no equivalent specification, the Contractor shall notify the Owner/Engineer who will provide a specification for the materials to be used.

B. Concrete and grout for rough patching shall be as specified in Divisions 3.

C. Materials for finish patching shall be equal to those of adjacent construction. Where existing materials are no longer available, use materials with equivalent properties and that will provide the same appearance. The materials are to be approved by the Owner/Engineer prior to their use.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect existing conditions of project, including elements subject to damage or to movement during cutting and patching.

B. After uncovering work, inspect conditions affecting installation of products, or performance of work.

C. Report unsatisfactory or questionable conditions to the Owner/Engineer in writing; do not proceed with work until further instructions have been received.

3.02 PREPARATION

A. Provide adequate temporary support as necessary to assure structural value or integrity of affected portion of work.

B. Protect surrounding materials and equipment prior to starting work.

C. Contain and control cooling liquids and slurry produced by the cutting and coring operations.

D. When the cutting or coring will result in the structure or equipment being exposed, provide adequate weather protection.

E. Provide dewatering for excavation work in accordance with Section 02140.

3.03 PERFORMANCE

A. Execute cutting and demolition by methods which will prevent damage to other work and will provide proper surfaces to receive installation of repairs.

B. Execute excavating and backfilling by methods which will prevent settlement or damage to other work. When excavating in close proximity to piping, duct banks or other items subject to damage, use hand excavation.

C. All equipment and workplace safety shall conform to OSHA standards and applicable Contract Specifications and building codes.

D. Where possible, employ original installer or fabricator to perform cutting and patching for:

1. Weather-exposed or moisture-resistant elements.

2. Sight-exposed finished surfaces.

E. Execute fitting and adjustment of products to provide a finished installation to comply with specified products, functions, tolerances and finishes.

F. Restore work which has been cut or removed; install new products to provide completed work in accordance with requirements of Contract Documents.

G. Refinish entire surfaces as necessary to provide an even finish to match adjacent finishes:

1. For continuous surfaces, refinish to nearest intersection.

2. For an assembly, refinish entire unit.

H. Remove rubble and excess patching materials from the premises.

3.04 CORING

A. All coring shall be performed in such a manner as to limit the extent of patching. Locate the rebar before coring to minimize cut throughs

B. Coring shall be performed with an approved non-impact rotary tool with diamond core drills.

C. Size of holes shall be suitable for pipe, conduit, sleeves, equipment or mechanical seals to be installed.

D. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

E. Fit to pipes and other penetrations in tanks to be water tight using seals or other methods defined in the specifications.

F. All holes cut through concrete and masonry walls, slabs or arches shall be core drilled unless otherwise approved. All work shall be performed by mechanics skilled in this type of work.

G. If holes are cored through floor slabs they shall be drilled from below where possible. If holes are drilled from above, provide protection and containment below the area being drilled to catch the plug and contain liquid and slurry.

3.05 CUTTING

A. All cutting shall be performed in such a manner as to limit the extent of patching.

B. Fit work to minimize space to pipes, sleeves, ducts, conduit and other penetrations through surfaces.

C. Cutting shall be performed with a concrete saw and diamond saw blades of proper size.

D. Provide for control of slurry generated by sawing operation on both sides of wall and from below if cutting a floor.

E. When cutting a reinforced concrete wall or floor, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure. Cut shall be made so that steel neither protrudes nor is recessed from face of the cut.

F. Adequate bracing of area to be cut shall be installed prior to start of cutting. Check area during sawing operations for partial cracking and provide additional bracing as required to prevent a partial release of cut area during sawing operations.

G. Provide equipment of adequate size to remove cut panel.

H. Saw cut concrete and masonry prior to breaking out sections.

I. Install work to minimize the amount of cutting and patching.

J. All cutting of structural members shall be done in a manner directed by the Owner/Engineer.

K. When existing conduits or pipe sleeves are cut off at the floor line or wall line, they shall be filled with grout or suitable patching material.

3.06 PATCHING

A. Rough patching shall be such as to bring the cut or cored area flush with existing construction unless otherwise shown.

B. Finish patching shall match existing surfaces as approved.

C. Patching shall be of the same kind and quality of material as was removed.

D. The completed patching work shall restore the surface to its original appearance or better.

E. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed to include the joint between the existing material and the patch.

3.07 PROTECTION

A. Provide devices and methods to protect other portions of project from damage.

B. Provide protection from elements for that portion of the project which may be exposed by cutting and patching work.

C. Maintain excavations free from water.

D. Equipment damaged during cutting and patching shall be replaced or repaired at the Owner/Engineer's sole discretion and at the expense of the Contractor.

E. Repaint any damage to factory applied paint finishes using touch-up paint. The damaged section shall be repainted in accordance with appropriate specifications at the expense of the Contractor doing the work.

F. Slurry or tailings resulting from coring or cutting operations shall be contained and vacuumed or otherwise removed from the area following drilling or cut.

G. Equipment and utilities shall be protected against mechanical and water damage during cutting and patching. Provide protective covers or use other means such as temporary relocation to protect equipment that is at risk of damage from the cutting and patching.

END OF SECTION

SECTION 01046
CONTROL OF WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section is intended to ensure that the Contractor provides adequate labor, materials, and equipment to complete the construction with minimum disturbance to the public, private land, existing infrastructure, and other private property. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.

1.02 RELATED WORK

A. Section 01570, Maintenance and Protection of Traffic

B. Section 02050, Demolition and Modifications

C. Section 02767, Sanitary Sewer Flow Control

1.03 PLANT (NOT USED)

1.04 PRIVATE LAND

A. Do not enter or occupy private land outside of easements, except by written permission of the land owner.

1.05 PIPE LOCATIONS

A. Existing pipelines are located substantially as indicated on the Drawings. The Owner/Engineer reserves the right to make such modifications in new pipeline locations as may be found desirable to avoid interference with existing structures or for other reasons. Where fittings are noted on the Drawings, such notations are for the Contractor's convenience and does not relieve him from laying and jointing differently or for providing and installing additional items where required.

1.06 OPEN EXCAVATIONS

A. Adequately safeguard all open excavations by providing temporary barricades, caution signs, lights and other means to prevent accidents to persons and damage to property. Provide suitable and safe bridges and other crossings for accommodating travel by pedestrians and workmen. Remove bridges provided for access during construction when no longer required. The length or size of excavation will be controlled by the particular surrounding conditions but shall always be confined to the limits indicated in the Contract Documents. If the excavation becomes a hazard, or if it excessively restricts traffic at any point, the Owner/Engineer may require special construction procedures such as limiting the length of the open trench, prohibiting stacking excavated material in the street and/or requiring that the trench shall not remain open overnight.

B. Take precautions to prevent injury to the public due to open trenches. Provide adequate light at all trenches, excavated material, equipment, or other obstacles which could be dangerous to the public at night.

1.07 TEST PITS

A. Excavate test pits as the Contractor deems it necessary, to locate underground pipelines or structures in advance of the construction. Test Pits conducted by the Contractor strictly for facilitating construction shall not be paid for separately. Backfill test pits immediately after their purpose has been satisfied and restore and maintain the surface in a manner satisfactory to the Owner/Engineer.

1.08 MAINTENANCE OF PEDESTRIAN TRAFFIC

A. Contractor shall note that a portion of the Work is in the Saluda Shoals Park, a heavily used facility with pathways for walkers, joggers, and bicyclists.

B. Coordinate with Irmo Chapin Recreation Commission for development of pathway closure and detour plan. Contractor shall be prepared to assist with minor gravel extensions of the pathway to divert pedestrian traffic.

C. Where the pathway is closed for construction activities, the Contractor shall establish barricades and warning signs directing traffic away from the construction site. Ensure any open excavations are encircled with orange safety fence at the end of each work day to deter entry to the area.

1.09 MAINTENANCE OF TRAFFIC

A. Traffic control, detours and signage shall be provided as shown on the Contract Documents and as specified in Section 01570.

B. Unless permission to close a street is received in writing from the proper authority, place all excavated material so that vehicular and pedestrian traffic may be maintained at all times. If the construction operations cause traffic hazards, Contractor shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Owner/Engineer.

C. Take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. Be fully responsible for damage or injuries whether or not police protection has been provided.

1.10 NOISE CONTROL

A. Definitions – The following words, terms and phrases, when used in this section, shall have the meanings described below:

1. *Decibel* is a unit of measurement of intensity of sound (the sound pressure level).

2. *Octave band* is a means of dividing the range of sound frequencies into octaves, in order to classify sound according to pitch.

3. *Octave band filter* means an instrument, standardized by the American Standards Association, used in conjunction with a sound level meter to take measurements in specific octave bands.

4. *Sound level meter* means an instrument, standardized by the American Standard Association, used for measurement of the intensity of sound and calibrated in decibels.

B. Measurement of Sound level

1. For the purpose of measuring the intensity and frequencies of sound, sound level meters and octave band filters may be directed by the Owner if believed that the Contractor is exceeding noise limitations. The Contractor shall provide the metering equipment. In the enforcement of this section, noise produced by the operation of motor-driven vehicles, stationary units, flying objects or other transportation facilities shall be included in the determination of the maximum decibel levels permitted.

2. Sound of short duration, from forge hammers, punch presses and metal shears, etc. which cannot be measured accurately with the sound level meter, shall be measured with an impact noise filter as manufactured by the General Radio Company, or its equivalent, in order to determine the peak value of the impact. For sounds so measured, the sound pressure level set forth in Table 1 may be increased by six decibels.

3. Maximum Permitted Sound Levels – The Contractor shall ensure all his operations at all times are in compliance with the sound pressure levels delineated in Table 1.

TABLE 1. MAXIMUM PERMITTED SOUND PRESSURE LEVEL (IN DECIBELS)

Octave Band (CYCLES PER SECOND)	**Sound Pressure Level (Decibels)**	
	Residential Areas	**Commercial Areas**
0 - 75	65	79
75 - 149	60	74
150 - 299	55	66
300 - 599	55	59
600 – 1,199	45	53
1,200 – 2,399	45	47
2,400 – 4,799	40	41
4,800 – and over	40	39

1.11 CARE AND PROTECTION OF PROPERTY

A. Be responsible for the preservation of all public and private property and use every precaution necessary to prevent damage thereto. If any direct or indirect damage is done to public or private property by or on account of any act, omission, neglect, or misconduct in the execution of the work on the part of the Contractor, restore such property to a condition similar or equal to that existing before the damage was done, or make good the damage in other manner acceptable to the Owner/Engineer.

B. The Contractor shall keep trenches and excavated areas as well as the site construction areas free from water. The Contractor shall remove all water, including rain water, encountered during trench and sub-structure work by pumps, drains, and other approved methods. Additional dewatering requirements are specified in Section 02140.

1.12 PROTECTION AND RELOCATION OF EXISTING STRUCTURES AND UTILITIES

A. Assume full responsibility for the protection of all buildings, structures, and utilities, public or private, including poles, signs, services to buildings, utilities in the street, gas pipes, water pipes, hydrants, water works, storm drainage, sewer mains, telephone, fiber optics, electric and telephone cables, power lines & power poles, sprinkler systems, private out-buildings such as sheds, and other utilities whether or not they are shown on the Drawings. Carefully support and protect all such structures and utilities from injury of any kind. Immediately repair any damage resulting from the construction operations at no additional cost to the Owner.

B. Assistance will be given the Contractor in determining the location of existing services. Existing underground utilities shown on the plans are based on record drawings provided by the City and field investigations. The City of Columbia and its agents, including the Engineer, do not warrant that they are complete or entirely correct. The Contractor shall bear full responsibility for obtaining all locations of underground structures and utilities and is responsible for locating and marking existing utilities including (including existing water services, drain lines, sewers, valves, boxes, drainage structures, irrigation lines and heads within the Construction limits before any construction activity.

C. The Contractor shall locate these and other possible unknown utility lines by use of an electronic pipe finder, or other means he may prefer, and shall excavate and expose all existing underground lines in advance of any excavation work under this contract. When the Contractor has located all utilities, he shall be responsible for planning and coordinating the required work around the existing utilities

D. Contractor shall coordinate location of the utilities with the owners of record for each utility including by not limited to: water, sanitary sewer, gas, electric, telephone, storm drainage systems, service lines, and any other buried utility or buried conduit systems prior to any construction. Contractor shall verify actual location and depth or all utilities prior to any construction.

E. The Contractor is responsible for exact location of all utilities within and adjacent to the project areas. The Contractor shall be solely responsible and liable for any damage (i.e. such as cutting or disturbing, etc.) to any utilities resulting from or incident to the Contractor's performance of these projects. The Contractor shall be responsible for notifying appropriate companies to protect or move the affected facilities, if any of the specified work is in the area of these affected facilities.

F. Contractor shall coordinate the removal and relocation of existing utilities with their respective owner and provide temporary services as needed until new services can be installed, tested and accepted. This includes but is not limited to Electric, Telephone, Gas, Power Lines, Power Poles, Power Meters, Light Poles & Controls, etc. at no additional cost to the Owner.

G. The power and phone companies may require that all poles within 5 feet of construction be held in place during construction by their own forces, and will bill time and expenses. These costs shall be included in the unit cost of pipe and no additional cost will be considered. The

Contractor is advised to familiarize himself with the proposed routing and location of utility poles before the submittal of bid. All of the above costs, including potential repair should any utility be damaged during construction, shall be the responsibility of the Contractor.

H. The Contractor is responsible for maintaining all existing utilities to the users along the project corridor. The Contractor shall provide the method for maintaining service to the Owner for approval prior to the start of any construction. This includes any costs associated with bracing, temporarily relocating, locating, and monitoring of these facilities. The payment for maintaining utilities service shall be included in the price for water and sewer pipe. No separate payment will be made.

I. The flow in all sewers, drains, and watercourses encountered shall be maintained by the Contractor whenever such sewers, watercourses and drains are disturbed or destroyed during the construction of the work. They shall be restored by the Contractor at his expense with the same size pipe, or as directed by the Owner/Engineer. This includes pipes labeled to be restored by the Contractor on the Contract Drawings.

J. Contractor to coordinate with and submit to the Owner/Engineer a plan before excavating or sheet piling near existing utilities to ensure that the Owner/Engineer is aware of the construction activities, and has given authorization for the construction methods to be utilized in the area.

K. The Contractor will notify all utility companies in writing at least 72 hours (excluding Saturdays, Sundays and Legal holidays) before excavating in any public way. Also contact utility location services, telephone [811] at least 72 hours prior to start of work.

L. Coordinate the removal and replacement of traffic loops and signals, if required for the performance of the work, at no additional cost to the Owner.

1.13 REMOVAL OF AND MOVEMENT OF OBSTRUCTIONS

A. The Contractor is responsible for the removal of obstructions located within the work area. This may include storm drainage lines, storm drainage boxes and structures, fencing, any items called to be demolished and removed, and any other items requiring moving. There shall be no separate payment for this item. All costs associated with the removal of obstructions shall be included in other bid items, even if specifically called for on the plans to be moved temporarily.

B. See also Section 02050 for additional requirements.

1.14 WATER FOR CONSTRUCTION PURPOSES

A. In locations where public water supply is available, the Contractor may be allowed to use water for construction purposes. In order to use water from a fire hydrant, the Contractor shall apply for a temporary hydrant meter. The City of Columbia shall waive all fees for such application, for this project, however, the Contractor will be required to pay usage fees.

B. The express approval of the Owner shall be obtained before water is used. Waste of water shall be sufficient cause for withdrawing the privilege of use. Hydrants shall only be operated under the supervision of the Owner's personnel.

C. The contractor shall maintain signs reading "UNTESTED WATER! DO NOT DRINK!" at all points from which untested water is drained or flushed from the new construction. Signs of an approved size may be furnished by the contractor or he may obtain them from the City upon deposit of $10.00 per sign. When the signs are returned in acceptable condition, the $10.00 will be refunded by the City.

1.15 MAINTENANCE OF FLOW

A. Provide for the flow of sewers, drains and water courses interrupted during the progress of the work. Discuss the entire procedure of maintaining existing flow with the Owner/Engineer well in advance of the interruption of any flow and provide a written plan and map of the proposed maintenance.

B. Contractor is required to submit By-Pass pumping requirements including a pump around plan submittal. See also Section 02767 for additional requirements.

1.16 RESTORATION

A. Where construction is called for through grassed areas, whether in City or private property, the sod shall be neatly cut, removed and carefully stored and kept watered until it is replaced by the Contractor. All grassed areas shall be replaced and Contractor is solely responsible for adequately watering the new sod 3 times a week for the first 2 weeks once sod is replaced. Topsoil underlying grassed areas, and all topsoil disturbed on private property, shall be removed for its full depth and stockpiled separate from the remainder of the material removed from the trench. The topsoil removed shall be replaced by the Contractor after the trenches have been backfilled. All trees and shrubbery interfering with the work or which may be damaged in pursuance of the work should be carefully removed, heeled and replaced by the Contractor as described in Section 01571. It is the practice of the City to permit property owners to extend their terraces, lawns, shrubbery and other plantings into the right-of-way. Where any such terraces, lawns, shrubbery or other plantings will be disturbed by the Contractor’s equipment or by the trenching or laying of pipe lines, the Contractor will be required to remove, maintain in suitable condition, and replace all topsoil, sod, shrubbery and other things that may interfere with or by damaged by the work. Seeding such areas is unacceptable and shall be considered temporary until sodding can be accomplished.

B. As work progresses, disturbed areas shall be completely restored at a rate consistent with the rate of utility installation. There shall never be any more than 400 linear feet of unrestored trench from pipe installation, as measured along the trench line. All work in this area must be completed including the reestablishment of permanent services, closing of all excavated pits, restoration of pavement, shoulders, ditches, etc. and restoration of grassed and shrubbery areas prior to continuation of project. This distance shall not be exceeded without prior approval of the Owner/Engineer.

C. The Contractor shall clean up daily and dispose of all surplus materials and refuse, rubbish, scrap materials, false work, temporary structures, foundations and debris of every nature caused by his operations. The site of the work shall present a neat, orderly and workmanlike appearance at all times.

D. There will be no direct payment for restoration and cleanup. All costs associated with restoration shall be included in the pipe unit prices as indicated in the Schedule of Values.

1.17 ABANDONMENT OF EXISTING UTILITIES

A. All contents of each pipe to be abandoned shall be pumped out to a suitable holding tank, truck or container and all contents disposed of in a manner and at a location acceptable to the Owner/Engineer.

B. Where specified on the plans, Contractor shall abandon existing utilities in place unless called for removal. Contractor shall plug each pipe to be abandoned with a concrete plug and fill existing utilities with flowable fill or other approved material as approved by the Owner/Engineer. Flowable fill shall be pumped in. Manholes shall be filled to the top.

C. Existing water mains to be abandoned shall be abandoned in the sequence described on the Contract Documents. Contractor to submit a detailed abandonment plan for water mains for the entire project, including sequencing and abandonment procedures, based on the construction schedule. This plan must be approved by the City before proceeding with the abandonment of any existing water utilities on the project. Utilities to be abandoned shall be abandoned in accordance with SCDOT and City of Columbia requirements.

D. All costs associated with this item, including flowable fill, shall be included in Abandonment of Existing Utilities Bid Item.

1.18 DUST CONTROL

A. Maintain all excavations, embankments, stockpiles, access roads, building sites, waste areas, borrow areas and all other work areas within or without the project boundaries free from dust which could cause standards for air pollution to be exceeded and which would cause a hazard or nuisance to others. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

B. Dust control shall be generally accomplished by the use of water; however, the use of calcium chloride may be used when necessary to control dust nuisance.

C. Calcium chloride shall conform to AASHTO M144, Type I except the requirements for "total alkali chlorides" and other impurities shall not apply.

D. Methods of controlling dust shall meet all air pollutant standards as set forth by Federal and State regulatory agencies and conform to South Carolina DHEC.

1.19 EROSION CONTROL

A. Erosion control shall also follow the requirements of Section 02270

B. Provide positive means of erosion and sediment control such as, but not limited to, shallow ditches to divert runoff around active construction areas and to carry off surface water, siltation basins, hay check dams, mulching, jute netting and other equivalent techniques. Flow of surface water into excavated areas shall be prevented. Water resulting from dewatering of excavated areas shall be filtered using appropriate best management practices (BMPs) prior to discharge to ditches around construction area. At the completion of the Work, ditches shall be backfilled and the ground surface restored to original condition.

1.20 PROTECTION OF STREAMS AND SURFACE WATERS

A. Take precautions to prevent, or reduce to a minimum, damage to any stream or surface water from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near streams and surface waters. Water that has been used for washing or processing, or that contains oils or sediments, and stormwater that will reduce water quality of receiving waters, shall not be directly returned to streams or other surface waters. Divert such waters through a settling basin, filter or appropriate Best Management Practice before being directed into streams or surface waters.

B. Do not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.

C. Take preventative measures to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by the Owner/Engineer. Submit two copies of approved contingency plans to the Owner/Engineer for information purposes only.

D. Water being flushed from potable water structures or pipelines after disinfection in accordance with the current version of the American Water Works Association Standard C651, that contains a chlorine (Cl_2) residual after a contact time of 24 hours, shall be treated with a dechlorination solution if the flush water is released to a surface water or stormwater system. The dechlorination method shall be approved by the Owner/Engineer, prior to discharge. There is no Cl_2 residual limitation for a discharge to the sewer.

1.21 PROTECTION OF LAND RESOURCES AND TREES

A. Restore land resources within the project boundaries and outside the limits of permanent work to a condition that, after completion of clean-up, will approximate pre-construction conditions, appear to be natural, and not detract from the appearance of the project. Confine all construction activities to areas shown on the Contract Drawings. Complete project restoration activities depicted on Contract Drawings shall be implemented.

B. Trees shall not be disturbed unless specifically indicated for removal in the Contract Documents. Contractor shall take all measures necessary to protect trees and tree root zones during construction. Contractor is required to notify the Owner/Engineer and the City of Columbia Forestry Department of any damage to trees during construction for a decision on the extent of repair and/or if replacement is necessary. Trees may be removed only after written approval is obtained from the City. Tree branches shall be temporarily tied back, where appropriate, to minimize damage. Cost of tree protection, replacement, repair, and removal shall be at the contractor's expense. The costs associated with tree protection, replacement, repair, and removal shall be included in the appropriate Bid Item.

C. Pruning of Trees to remain shall have only deadwood pruning and pruning only necessary for clearance of structures should be conducted. Requests for pruning to resolve conflicts with improvements and/or construction equipment shall be made in writing to City of Columbia Forestry Department. City arborists only shall complete needed pruning. No fertilizer should be applied to trees in the project area prior to construction.

D. Outside of areas requiring earthwork for the construction of the new facilities, do not deface, injure, or destroy trees or shrubs, nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage. Where special emergency use is permitted, first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.

E. Before beginning operations near them, protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping or other operations, by installing boards, planks, or poles around trunks to protect against damage. Monuments and markers shall be protected similarly.

F. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Owner/Engineer will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of. If requested by the Owner/Engineer or Owner, a SC certified arborist shall conduct an inspection of damaged trees and submit recommendations for any tree repair to the Contractor. Should the services of a certified arborist be required due to tree damage caused by the Contractor, the cost for the certified arborist shall be the responsibility of the Contractor and not reimbursed by the Owner.

1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1-in in diameter shall be coated as soon as possible with an approved tree wound dressing unless otherwise directed by the Owner/Engineer. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.

2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and are beyond saving in the opinion of the Owner/Engineer, shall be immediately removed and replaced.

G. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner, and in compliance with applicable federal, state and local regulations.

1.22 PROTECTION OF AIR QUALITY

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

B. Provide systems for control of atmospheric pollutants.

1. Prevent toxic concentrations of chemicals.

2. Prevent harmful dispersal of pollutants into the atmosphere.

1.23 POLLUTION CONTROL DURING CONSTRUCTION

A. Maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out, or until the material concerned has become stabilized to the extent that pollution is no longer being created.

B. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations.

C. Provide equipment and personnel, perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.

1. Contaminated soils and liquids shall be stored, transported, and disposed of in accordance with local, State, and federal regulations and this contract.

D. Care shall be taken to prevent, or reduce to a minimum, damage to any water resource from pollution by debris, sediment or other material, or from the manipulation of equipment and/or materials in or near such waters. Water that has been used for washing or processing, or that contains oils or sediments that will reduce water quality shall be diverted through an oil/water separator or filter before being discharged.

E. No materials shall be dispersed or stockpiled in any wetland area. No excavated materials or materials to be used in backfilling shall be deposited within 100 feet of any watercourse, wetland area, or drainage facility without prior approval from the Owner/Engineer and regulatory agencies.

F. The storage of fuel oil and refueling of equipment shall be restricted to designated areas approved by the Owner/Engineer and appropriate regulatory agencies.

G. The removal and disposal of fuel, lubricants, grease, and other operating fluids from equipment designated for demolition or to be removed shall be done in accordance with current federal, state, and local regulations.

H. Contractor shall not locate his storage of equipment and materials within 100 feet of wetland boundaries or floodplains.

I. All debris and excess material will be disposed of outside the boundaries of wetland or floodplain areas in an environmentally sound manner as determined by the federal, state, and local regulations.

J. Take special measures to prevent harmful substances from entering public waters.

1. Prevent disposal of wastes, effluents, chemicals, or other such substances adjacent to streams, or in sanitary or storm sewers.

K. All Contractor’s equipment used during construction shall conform to all current federal, state and local laws and regulations.

1.24 CLEAN UP AND DISPOSAL OF EXCESS MATERIAL

A. During the course of the work, keep the site of operations as clean and neat as possible. Dispose of all residue resulting from the construction work and, at the conclusion of the work, remove and haul away any surplus excavation, broken pavement, lumber, equipment, temporary structures and any other refuse remaining from the construction operations and leave the entire site of the work in a neat and orderly condition.

B. In order to prevent environmental pollution arising from the construction activities, comply with all applicable Federal, State and local laws and regulations concerning waste material disposal, as well as the specific requirements stated in this Section and in other related sections.

C. Disposal of excess excavated material in wetlands, stream corridors and plains is strictly prohibited even if the permission of the property owner is obtained. Any violation of this restriction by the Contractor or any person employed by him will be brought to the immediate attention of the responsible regulatory agencies, with a request that appropriate action be taken against the offending parties. The Contractor will be required to remove the fill and restore the area impacted at no additional cost to the Owner.

END OF SECTION

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SECTION 01050
PROJECT CONTROLS (SURVEYING)

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Provide and pay for field engineering services required for project; including but not limited to:

1. Survey work required for project controls and layout.

2. Certified as-built surveys specified herein.

3. Certified as-built survey data to support record drawings as specified in Section 01720.

B. Retain the services of a registered land surveyor licensed in the state of South Carolina:

1. Identify existing control points and property line corners indicated on the Drawings.

2. Verify and record all existing structure locations in the vicinity of, or adjacent to, the proposed Work.

3. Maintain an accurate record of locations of all new buried piping and existing buried piping and other buried existing facilities (conduits, and structures) encountered and/or relocated during construction of the Work.

C. There shall be no direct payment for this item, the cost of which shall be included in the Miscellaneous Work – General Requirements Bid Item.

1.02 RELATED WORK

A. Record Drawings are included in Section 01720

B. Contract Closeout is included in Section 01740

1.03 SUBMITTALS

A. Submit, to the Engineer, the name, address and state of registration and license number of proposed registered land surveyor. Show minimum of 5 years of experience on similar sized project.

B. On request of the Owner/Engineer, submit documentation to verify accuracy of field engineering work.

1.04 QUALIFICATIONS OF SURVEYOR

A. Registered land surveyor, licensed in South Carolina. Show minimum of 5 years of experience on similar sized project.

1.05 SURVEY REFERENCE POINTS

A. Existing basic horizontal and vertical control points for the project are those designated on Drawings.

B. Locate and protect control points prior to starting site work and preserve all permanent reference points during construction.

1. Make no changes or relocations without prior written notice to and approval by the Owner/Engineer.

2. Report to the Owner/Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

3. Require the registered surveyor to correctly replace project control points which may be lost or destroyed. Establish replacements based on original survey control.

4. Coordinates on the plans are based on South Carolina State Plane Coordinate System: NAVD 88 Vertical Control and NAD 83 Horizontal Control unless otherwise noted. The data collection methods used for this project may be survey grade, mapping grade GPS equipment and/or a combination of both.

1.06 PROJECT SURVEY REQUIREMENTS

A. For work contained to an individual site or property, etablish a minimum of two permanent bench marks on site, referenced to data established by survey control points.

B. For pipeline projects, establish one permanenet bench mark for every mile of new pipe.

1. Record locations, with horizontal and vertical data, on the as-built Drawings.

2. Permanent benchmarks shall be installed and spaced for convenient reference and used at locations along the pipeline route.

3. Benchmarks shall be installed to National Geodetic Survey standards and shall include horizontal and vertical data, as well as the installation date.

C. Establish lines and levels; locate and lay out:

1. Site improvements

a. Stakes for grading, fill and topsoil placement.
b. Utility slopes and invert elevations.
c. Sidewalks, pavement, fencing, storm drainage facilities, and other finish surface work.

2. Batter boards for structures.

3. Building foundation, column locations and floor levels.

4. Controlling lines and levels required for mechanical and electrical trades.

D. If lines, levels or layouts are lost or destroyed, or if required by the Owner/Engineer, verify layouts by same methods.

E. Establish all lines and grades prior to construction of line work for all forcemains, transmission mains, storm drainage piping, gravity sewers and other new utility lines at 100-ft increments, at defined breaks in grade, and at manholes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 RECORDS

A. Maintain a complete, accurate log of all control and survey work as it progresses.

B. Update the project as-built survey on a monthly basis.

C. Maintain an accurate record of new and existing piping, conduit and structure changes, revisions, relocations, and modifications.

D. At the end of the project, submit the following:

1. Two signed and sealed prints of all required as-built survey information.

2. Digital file of all surveyed control points, including elevations, for downloading into the City's GIS.

END OF SECTION

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SECTION 01170
SPECIAL PROVISIONS

PART 1 GENERAL

1.01 GENERAL

A. These special provisions are established for the benefit of the City of Columbia. Any discrepancies or ambiguities within these special provisions shall be interpreted to the best interest of the City of Columbia. Contractor forfeits all claims to misinterpretation of special provisions if no documented inquiry exists with the City of Columbia regarding special provision(s) in question.

B. There will be no additional cost to the City of Columbia due to any postponement of construction. An extension of the contract time will be considered by the City of Columbia; however, extensions will be approved on a case by case basis.

C. In the event of a dispute between the contractor and the City of Columbia during construction, the contractor shall convey their concerns to the City of Columbia Construction Manager. If the contractor feels that their requests or concerns have not been appropriately considered, Contractor shall make a request in writing to Assistant City Engineer for Construction for resolution. Failure to comply with this provision could forfeit contractor's ability to be awarded future City of Columbia projects.

D. All work shall be completed by individuals skilled in the type of work involved. When new work adjoins or connects to existing work, the latter shall be altered as necessary and connected in a substantial and approved workman-like manner. All work shall match as nearly as practical to existing, adjoining and/or adjacent similar work. All existing work which is to remain that is moved, disturbed, or damaged by the contractor's operation shall be replaced and restored properly to "as good or better" condition at no cost to the owner.

E. Contractor is responsible for providing traffic control in compliance with South Carolina Department of Transportation (SCDOT) specifications, maintaining a proper safe work environment, repair of all private and/or public properties to "as good or better" condition than that which existed prior to construction, providing and maintaining access to all private and public properties impacted by the work, disposing of all applicable waste material, and having a representative on call twenty-four hours per day to handle emergencies that may develop during construction.

F. The contractor shall provide all equipment, labor, materials, supplies, and resources required to complete the work. Any damaged materials, new or existing, will be replaced by the contractor at their expense. All work shall comply with the plans and specifications included as a part of these contract documents.

G. The selected Contractor shall notify the Owner, in writing, of any comments and/or concerns regarding the work prior to the issuance of the notice to proceed of mobilization to the job site.

1.02 DOCUMENT MANAGEMENT

A. The Clean Water 2020 Program has developed a document management system that will be utilized as a part of this project.

B. The Contractor shall upload project related documents to the Clean Water 2020 SharePoint site, to include outreach plans, bonds and insurance, pay applications, schedules, site management information, meeting agendas/minutes, change orders, RFIs, submittals, work change directives, work summary logs, general correspondence, photos, and other project related information.

C. The Contractor shall appoint employee(s) that will be responsible for accessing the document management site. These individuals should coordinate with the Clean Water 2020 program for training and access credentials.

D. An Excel spread sheet titled “Contractor Work Summary” will be given to the Contractor at the pre-construction meeting and the Contractor shall submit this filled in spreadsheet for the cumulative work completed with each pay application.

1.03 INSURANCE

A. Insurance requirements are specified in the Instructions to Bidders, Part 14, and are amended or supplemented as follows:

1. Builders' Risk Insurance is not required for this project.

2. The Engineer shall be named as an additional insured on the Commercial General Liability, Excess Liability and Comprehensive Automotive Liability policies.

3. Provide a Waiver of Subrogation in favor of the Owner and the Engineer for the Commercial General Liability, Excess Liability, Comprehensive Automotive Liability and Workman’s Compensation policies.

1.04 PROJECT COMPLETION TIME

A. The Contractor shall substantially complete the project within 455 consecutive calendar days and fully complete the project within 515 consecutive calendar days from the date of commencement.

B. Substantial Completion – The time at which the Work has progressed to the point where, in the opinion of the Owner/Engineer, the Work is sufficiently complete, in accordance with the Contract, so that the Work can be utilized for the purposes for which it is intended. Liquidated damages may be assessed for Contractor’s failure to meet the Substantial Completion date.

C. Final Completion – The time at which the Work has been fully completed to include demolition of existing facilities, completion of punch list items, paving, final sitework and landscaping, paving, and full demobilization and all else required by the Contract. Liquidated damages may be assessed for Contractor’s failure to meet the Final Completion date.

1.05 LIQUIDATED DAMAGES

A. The Contractor recognizes that the Owner will suffer financial loss if the Work is not completed within either or both the time of Substantial Completion and the time of Final Completion. The Contractor also recognizes the delay, expense, and difficulty to both parties involved of proving or contesting the amount of those losses. Instead of requiring proof of those losses, it is agreed that the Contractor shall be liable for and pay the following amounts to the Owner under Owner's damages as liquidated damages and not as a penalty.

Completion Milestone Date	Liquidated Damages (per calendar day)
Date of Substantial Completion	$1,000.00
Date of Final Completion	$500.00

B. Liquidated damages will be assessed for the above listed amounts for each and every calendar day the Work remains incomplete beyond the date of Substantial Completion and the date of Final Completion, either date being independent of the other.

1.06 SUPERVISION

A. The work shall be conducted under the general direction of the Owner and will be inspected by his appointed representatives. The Owner through his representatives will maintain a record of work done and see that the location and limit marks are kept in proper order. The presence of the Owner's representative(s) shall not relieve the Contractor of responsibility for the proper execution of the work.

B. The Contractor shall furnish at his own expense such labor, organization and materials as may be reasonably necessary in inspecting and supervising the work. Should the Contractor refuse, neglect, or delay compliance with this requirement, the specified facilities may be furnished and maintained by the Owner and the cost thereof deducted from any amounts due, or to become due, the Contractor.

C. The work shall be entirely under the control of the Owner, and the Owner or his authorized representative(s) shall have access to the same at all times.

1.07 SPARE PARTS

A. Where spare parts are specified in the technical sections, furnish all spare parts recommended by the manufacturer or system supplier for one year of service. In addition, furnish all spare parts itemized in each Section.

B. Collect and store all spare parts in an area to be designated by the Owner/Engineer. Furnish an inventory listing of all spare parts, the equipment they are associated with, the name and address of the supplier and the delivered cost of each item. Copies of actual invoices for each item shall be furnished with the inventory to substantiate the delivery cost.

C. Spare parts shall be packed in cartons, properly labeled with indelible markings with complete descriptive information including manufacturer, part number, part name and equipment for which the part is to be used and shall be properly treated for one year of storage.

D. All grease, oil and fuel required for testing of equipment shall be furnished with the respective equipment. The Owner shall be furnished with a one-year supply of required lubricants including grease and oil of the type recommended by the manufacturer with each item of equipment supplied.

E. Any special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation and maintenance of any equipment shall be furnished with the respective equipment. Tools shall be furnished in heavy steel tool boxes complete with lock and duplicate special keys.

1.08 ADVERSE WEATHER CONDITIONS

A. In the event of temporary suspension of work or during inclement weather, or whenever the Construction Administrator shall direct, the contractor will, and will cause his subcontractors to protect carefully his and their work and materials against damage or injury from the weather. If, in the opinion of the Construction Administrator, any work or materials damaged or injured by reasons of failure of the Contractor or his subcontractors to protect their work, such materials shall be removed and replaced at the expense of the Contractor.

B. The Owner has reviewed weather data available from the National Oceanic and Atmospheric Administration (NOAA) station at the Columbia Metropolitan Airport and determined a Standard Baseline of average climatic range for the project site.

1. Standard Baseline shall be regarded as the normal and anticipatory number of calendar days for each month during which construction activity shall be expected to be prevented and suspended by cause of precipitation in excess of one-tenth inch (0.01”) liquid measure. Suspension of construction activity for the number of days each month as listed is the Standard Baseline is included in the Work and is not eligible for extension of Contract Time.

2. Standard Baseline (based upon precipitation in excess of one-tenth inch liquid measure) established for this contract as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
8	6	7	5	6	7	8	7	5	4	4	6

C. Adverse Weather is defined as the occurrence of one or more of the following conditions which prevents exterior construction activity or access to the site within twenty-four (24) hours:

1. Precipitation (rain, snow, or ice) in excess of on-tenth inch (0.10”) liquid measure.

2. Temperatures which do not rise above 32 degrees f by 10:00AM.

3. Sustained wind in excess of twenty-five (25) MPH

4. Standing snow in excess of one inch (1.00”)

5. Any day the Owner has requested no work to be performed.

D. A Weather Delay Day may be counted if adverse weather prevents work on the project for fifty percent (50%) or more of the Contractor's scheduled work day, including a weekend day or holiday if Contractor has scheduled construction activity that day.

E. Adverse Weather may include "dry-out" or "mud" days, as determined by the Construction Administrator such as:

1. If the Contractor's activity is limited to approximately 50% of the Contractor's activity before the Adverse Weather occurrence, then one-half (1/2) a weather delay day will be counted. For example, if the Contractor is disking excavation and embankment areas to dry in situ moisture in the soils or hauling and placing unclassified excavation or borrow material to embankment before an Adverse Weather occurrence, but is able to continue disking excavation and embankment areas or placing unclassified excavation or borrow material, one-half (1/2) a Weather Delay Day will be allowed.

2. If the Contractor's activity is limited to minor activity when compared to the Contractor's activity before the Adverse Weather occurrence, then one (1) weather delay day will be counted. For example, if the Contractor is disking excavation and embankment areas to dry in situ soils, hauling borrow material to embankment before an Adverse Weather occurrence, but is only able to disk excavation and embankment areas to dry them due to the Adverse Weather occurrence, one (1) Weather Delay Day will be allowed.

F. If the Contractor is able to only perform disking operations to dry excavation and embankment areas due to in situ moisture in the soil, this is not considered an Adverse Weather occurrence or a Weather Delay Day and is considered to be a part of normal construction activities whether any other work can be performed or not.

G. All weather data used to determine Adverse Weather for the project site during the course of work shall be data from NOAA station at the Columbia Metropolitan Airport. Therefore, the contractor shall on a monthly basis submit to the Construction Administrator a summary showing Adverse Weather incurred for the month and the supporting documentation from NOAA station at the Columbia Metropolitan Airport confirming the Adverse Weather experienced. Failure to submit on a monthly basis forfeits the Contractor's rights to further adverse weather claims.

H. In the event of temporary suspension of work or during inclement weather, or whenever the Owner/Engineer shall direct, the Contractor and subcontractors shall provide an enclosure or special protection from weather and will cause his subcontractors to protect carefully his and their work and materials against damage or injury from the weather without additional cost to the City. If, in the opinion of the Owner/Engineer, any work or materials are damaged or injured by reason of failure of the Contractor or his subcontractors to protect their work, such materials shall be removed and replaced at the expense of the Contractor. Partial payments under the contract will not relieve the Contractor from this responsibility. When materials and work at the site which have been partly paid for are not adequately protected by the Contractor, such materials will be protected by the City at the expense of the Contractor, and no further partial payment will be made thereon.

1.09 EMERGENCY RESPONSE

A. The Contractor shall at all times (including nights, weekends or holidays) have a responsible person available to act in case of emergency repairs whom the Owner may contact. Upon

notification of any emergency work necessary, the Contractor's representative shall immediately take steps to make such repairs as may be required.

B. In case of any emergency which threatens loss or injury of property and/or safety or life, the Contractor will be allowed to act, without previous instructions from the Engineer, in a diligent manner. He shall notify the Owner/Engineer immediately thereafter. Any claim for compensation by the Contractor due to such extra work shall be promptly submitted for approval.

C. Where the Contractor has not taken action, but has notified the Owner/Engineer of an emergency threatening injury to persons or damage to the work or any adjoining property that is not in any way related or due to the Contractor's work, negligence or performance, he shall act as instructed or authorized by the owner/Engineer.

1.10 PROTECTION OF MATERIAL, WORK AND PROPERTY; AND INJURIES TO PERSONS AND PROPERTY

A. The Contractor shall at all times take reasonable and proper precautions to protect and safeguard the City's, public and private property, including his own work and all materials of every description both before and after use in the work, from damage or injury or loss in connection with this contract.

B. The Contractor shall at all times take reasonable and proper precautions to protect and safeguard persons and animals, and must maintain public safety during execution of this contract.

C. The Contractor shall furnish, erect, install and maintain all necessary temporary works which shall include, but not be limited to, barricades, fences, railings, warning signs, traffic control devices and lights for protection of his work and excavations at night. A sufficient number of lights shall be placed about the work and shall be kept burning from twilight to sunrise. Barricades, warning signs, traffic control devices and other safety devices shall meet the requirements of OSHA, South Carolina Department of Transportation and City of Columbia requirements. No work will commence until the Contractor has secured approval from the agency responsible for the right-of-way in which construction is proposed.

D. The Contractor shall be held responsible for all injuries to persons and animals and for all damages to the property of the Owner or others caused by or resulting from the negligence of himself, his employees or his agents, during the progress of or in connection with the prosecution of the work, whether within the limits of the work under the contract proper or as extra work.

E. The Contractor must, as far as practical and consistent with good construction, permit access to private and public property and leave fire hydrants, catch basins, streets, etc., free from encumbrances.

F. The Contractor must restore, replace or make good at his own expense, unless such was caused directly by errors contained in the Contract, by the City, or its duly authorized representatives, any and all damage, loss, or injury to persons, animals, and/or property caused by any negligence of omission or commission on his part or on the part of his agent, including sidewalks, curbing, sodding, pipes, conduits, sewers, buildings, fences, retaining walls, tanks, power lines, or any other private or public property to a condition of equal or better comparison to the condition of the property when he entered upon the work.

G. In case of failure on the part of the Contractor to restore such property or make good such damage, the Owner may upon forty-eight (48) hours' notice proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any money due or which may become due under this contract.

H. The Contractor shall indemnify and hold harmless the Owner or the Engineer acting in behalf of the Owner from all suits and actions that may be brought against it by reason of any injury, or alleged injury, to the person or property of another resulting from negligence or carelessness in the execution of the work, or on account of any negligent act or omission, or improper methods or means of construction on the part of the Contractor, his representatives, or employees.

1.11 ADDITIONAL SERVICES AFTER PROJECT FINAL COMPLETION

A. Equipment and system suppliers shall provide additional services after project final completion for the following equipment and systems:

1. Each supplier shall provide a five (5) year service contract to the Owner. Service contracts shall be submitted with Section 01300. Service contracts shall commence upon substantial completion of the project. Services provide under the contract shall be in addition to Contractor and supplier warranty services.

2. The services contract basic services shall include four (4) quarterly visits, plus one (1) troubleshooting visit per year. A schedule of visits shall be included in the service contract. Quarterly site visits shall be confirmed one (1) week in advance with the Owner. Troubleshooting visits shall be within 48 hours of the Owner's request.

3. Within two (2) weeks of any site visit, supplier shall provide Owner with a written service report detailing all findings and recommendations, along with quotation for any additional service work required.

B. The additional services for the fabricated slide gates on the diversion structures shall be added to the current service contract between vendor/manufacturer's representatives and the City of Columbia. All service providers shall provide written notice two weeks in advance of scheduling the services. City staff shall be present at all times when service representative(s) are onsite.

C. Total Bid Amounts and Contractor payment to equipment suppliers shall include cost of these additional services. No additional payments will be made to the supplier by the Owner for basic services during the period of the contract.

1.12 COLUMBIA DISADVANTAGED BUSINESS ENTERPRISE (CDBE) PROGRAM

A. All Contractors submitting a bid for this project are required to comply with the terms and conditions of the Columbia Disadvantaged Business Enterprise (CDBE) Program.

B. The bidder (prime contractor) is required to designate a minimum of 10% of the total contract amount to CDBE-qualified enterprises or provide documentation of good faith efforts, as defined in the CDBE guidelines, if the 10% goal has not been achieved.

C. All Contractors submitting a bid for this project shall complete the Business Information Records for Subcontractors (CDBE) form contained in the contract documents. Any proposed

changes in the list shall be submitted in writing to the Owner prior to the initiation of any action, as indicated on the form.

END OF SECTION

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 SCOPE OF WORK AND REQUIREMENTS

A. The City Construction Administrator (CA), unless delegated to the Engineer, shall schedule and administer the Pre-Construction Conference and monthly Construction Progress Meetings throughout progress of the work. The CA shall prepare meeting minutes of these meetings and distribute. The Contractor shall:

1. Assist with preparation of agenda for all meetings.

2. Make physical arrangements for meetings, except for the Pre-Construction Conference which shall be at a place and time dictated by the CA.

3. Distribute updated color copies (if applicable) of all schedules & Logs (i.e. Submittal Schedule, submittal Log, RFI Log, etc.)

4. Attend all meetings.

B. Ensure appropriate representatives of Contractor, subcontractors, utility owners, and suppliers attend meetings as necessary to act on behalf of the entity each represents.

C. Ascertain that work is expedited consistent with Contract Documents and construction schedules.

D. There shall be no direct payment for this item, the cost of which shall be included in the Miscellaneous Work – General Requirements Bid Item.

1.02 RELATED REQUIREMENTS

A. Construction Schedules are included in Section 01310.

B. Shop Drawings, Working Drawings and Samples are included in Section 01300.

C. Project Record Documents are included in Section 01720.

D. Operating and Maintenance Data is included in Section 01730.

E. Project Close-Out is included in Section 01740.

1.03 PRE-CONSTRUCTION CONFERENCE

A. Attend a Pre-Construction Conference before and/or no later than 15 Calendar days after date of Notice to Proceed.

B. Location: A central site, convenient for all parties, designated by the Owner.

C. Attendance

1. Owner's Representative.
2. Engineer and his/her professional consultants.
3. Contractor's Superintendent.
4. Major Subcontractors.
5. Major suppliers.
6. Utilities
7. City CA
8. City Inspector.
9. Others as appropriate.

D. Agenda and Tracking Logs

1. The City CA will distribute the agenda prior to the day of the meeting and the Contractor shall be asked to add items of particular interest or concern to that agenda.
2. The Engineer shall have prepared a list of required shop drawing submittals, a list of required testing procedures (field tests, shop tests, and performance tests), a list of required warranties, and a list of required material samples and distribute these lists to all parties at or prior to the Pre-Construction Conference. These lists shall be maintained by both the Engineer and Contractor throughout the project duration and reconciled at each Monthly Construction Progress Meeting.

1.04 WEEKLY PLANNED WORK MEETINGS

A. Schedule and attend regular weekly planned work meetings following the first Monthly Construction Progress Meeting. Weekly planned work meetings provide members of the project team the opportunity to monitor the project on a less formal, but more frequent basis. Frequency of these meetings may be modified based on the complexity of the project and on projected need as jointly determined by the CA and Contractor.

B. The participants will discuss the planned week’s work for the project and any key issues that may affect the progress of the project. The Contractor shall meet weekly with the City’s CA / Inspector to discuss the planned week’s work for the project and any key issues required to progress the project.

C. These meetings will be held in the Project field office of the Contractor, and chaired by the Contractor. The Inspector will be in attendance and the CA on an as needed basis. The topics for discussion should include specific work elements that are occurring each week. The Contractor should document minutes of the meetings and disseminate weekly.

1.05 MONTHLY CONSTRUCTION PROGRESS MEETINGS

A. Schedule and attend regular monthly progress meetings every 30 Calendar days with the first meeting 30 Calendar days after the Pre-Construction Conference.

B. Location of the meetings: Project field office of Contractor or Engineer.

C. Attendance

1. City CA and Inspector

2. Engineer and his/her professional consultants as needed.

3. Subcontractors as appropriate to the agenda.

4. Suppliers as appropriate to the agenda.

5. Others as appropriate.

D. Suggested Agenda

1. Review, approval of minutes of previous meeting.

2. Review of work progress since previous meeting.

3. Field observations, problems and conflicts.

4. Problems which impede Construction Schedule.

5. Review of off-site fabrication, delivery schedules.

6. Corrective measures and procedures to regain projected schedule.

7. Revisions to Construction Schedule.

8. Progress and schedule for succeeding work period.

9. Review submittal schedules;

10. Reconciliation of all submittal, RFI, and testing logs, etc.

11. Maintenance of quality standards.

12. Pending changes and substitutions.

13. Other business.

1.06 SPECIALTY COORDINATION MEETINGS

A. Schedule and attend any special meetings called by the City, Engineer or Contractor to assist in coordination or execution of the Work. Prepare agenda and meeting minutes along with documentation of all decisions reached or direction given.

B. Invite subcontractors, utility owners, and/or suppliers as may be appropriate for such meetings.

1.07 CLOSE-OUT MEETING

A. Schedule and attend a Project Close-Out Meeting in accordance with Section 01740. Comply with all requirements of Section 01740 prior to scheduling the meeting.

B. With approval of the City CA, the Close-Out Meeting may be held in conjunction with the final Monthly Construction Progress Meeting provided all requirements of Section 01740 are complied with in advance.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes the requirements for compiling, processing and transmitting submittals required for execution of the project. Submittals are categorized into two types, Action Submittals and Informational Submittals, as follows:

1. Action Submittals: Written and graphic information submitted by the Contractor that requires the Owner/Engineer's approval. The following are examples of action submittals, which may or may not be required for this project per the Contract Documents:

    a. Shop drawings (including working drawings, valve schedules, and product data)
    b. Samples
    c. Operation & maintenance manuals
    d. Equipment and performance test results required by the Contract Documents
    e. Site Usage Plan (Contractor's staging and material laydown area)
    f. Schedule of values
    g. Equipment delivery schedule
    h. Applications for Payment
    i. Requests for Information (RFI)
    j. Requests for Information Log
    k. Substitutions Log
    l. Submittal / Shop Drawings Log
    m. Owner Selected Items Log
    n. Record Drawings

2. Informational Submittals: Information submitted by the Contractor that does not require the Owner/Engineer's approval. The following are examples of informational submittals, which may or may not be required for this project per the Contract Documents:

    a. Shop Drawing Schedule
    b. Construction Schedule
    c. Statements of Qualifications
    d. Health and Safety Plans
    e. Fire Safety Program
    f. Construction Photography and Videography
    g. Work Plans
    h. Excavation/Sheet Piling Plans
    i. Moisture and Mold Control Plan
    j. Dust and HVAC Control Plan
    k. Maintenance of Flow Plan
    l. Maintenance of Traffic Plans
    m. Outage Requests
    n. Proposed Testing Procedures
    o. Vendor Training Outlines/Plans

p. Any equipment or structure designed by a vendor authorized Owner/Engineer.
q. Warranties and Bonds

3 There will be no direct payment for this work, the cost of which shall be included in other bid items.

1.02 RELATED WORK

A. Operation and Maintenance manuals are included in Section 01730.

B. Contract closeout submittals are included in Section 01740.

C. Warranties and Bonds are included in Section 01735.

D. Construction Photos are included in Section 01320.

E. Applications for Payment are included in Section 01026

F. Construction Schedules are included in Section 01310.

G. Project Controls (Surveying) 01050.

H. Project Record Documents are included in Section 01720.

1.03 CONTRACTOR'S RESPONSIBILITIES

A. All submittals shall be clearly identified as follows:

1. Date of Submission.

2. Project Number.

3. Project Name.

4. Contractor Identification.

a. Contractor.
b. Supplier.
c. Manufacturer.
d. Manufacturer or supplier representative.
e. Identification of the Product.

5. Reference to Contract Drawing.

6. Reference to specification section number, page and paragraph(s).

7. Reference to applicable standards, such as ASTM or other industry standard numbers.

8. Contractor's Certification statement.

9. Identification of deviations from the Contract Documents, if any.

10. Reference to previous submittal (for resubmittals).

B. Submittals shall be clear and legible, and of sufficient size for legibility and clarity of the presented data.

C. Contractor shall maintain a log of all submittals. The submittal log shall be kept accurate and up to date. This log shall be submitted for review prior to the first submittal request for approval and reconciled with a similar log being kept by the Inspector or Owner/Engineer on a monthly basis at the Construction Progress meetings. This log should include the following items (as applicable):

1. Description.

2. Submittal Number.

3. Date transmitted to the Owner/Engineer.

4. Date returned to Contractor (from Owner/Engineer).

5. Status of Submittal (Approved/Not Approved/etc.).

6. Date of Resubmittal to Owner/Engineer and Return from Owner/Engineer (if applicable and repeat as necessary).

7. Date material released for fabrication.

8. Projected (or actual) delivery date .

D. Contractor shall utilize the following submittal identification numbering system:

1. The first character shall be a D, S, M or I which represents Shop Drawing (including working drawings and product data), Sample, Manual (Operating & Maintenance) or Informational, respectively.

2. The next five digits shall be the applicable Section Number.

3. The next three digits shall be the sequential number of each separate item or drawing submitted under each Specification Section, in the chronological order submitted, starting at 001.

4. The last character shall be a letter, A to Z, indicating the submission (or resubmission) of the same submittal, i.e., "A" = 1st submission, "B" = 2nd submission, "C" = 3rd submission, etc.

5. A typical submittal number would be as follows:

a. D-03300-008-B.
b. D = Shop Drawing (03300) = Section for Concrete.
c. 008 = the eighth different submittal under this Section.
d. B = the second submission (first resubmission) of that particular shop drawing.

E. Variances

1. Notify the Owner/Engineer in writing, at the time of submittal, of any deviations in the submittals from the requirements of the Contract Documents.

2. Notify the Owner/Engineer in writing, at the time of re-submittal (resubmission), of all deviations from previous submissions of that particular shop drawing, except those deviations which are the specific result of prior comments from the Owner/Engineer.

3. This notice shall be both a written communication separate from the shop drawing and/or submittal; and, in addition, by a specific notation made on each shop drawing or submittal for review and approval of each such variation.

4. "OR EQUAL" Items

   a. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains specifically states that no like, equivalent, or “or-equal” item, or no substitution is permitted, other items of material, products or equipment of other Suppliers may be submitted to the City for review under the circumstances described below:

   b. If in the Owner/Engineer’s discretion an item of material, product or equipment proposed by the Contractor is functionally equal to that named and sufficiently similar so that no change in related work will be required, it may be considered by the Owner/Engineer as an “or-equal” item. The review and approval of the proposed item may, in the Owner/Engineer’s sole discretion, be approved. For the purposes of this specification, a proposed item of material, product or equipment may be considered functionally equal to an item so named if it is determined that all of the following are met:

      1) It is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics,
      2) It will reliably perform its intended function and achieve the results imposed by the design concept of the completed Project as a functioning whole,
      3) Provide a record of performance and availability of responsive service,
      4) The Contractor certifies that, if approved and incorporated into the Project, there will be no increase in Contract time or cost, and it will conform substantially to the detailed requirements of the item shown in the Contract Documents.

5. Substitute Items:

   a. If in the Owner/Engineer’s discretion, an item of material, product or equipment proposed by the Contractor does not qualify as an “or-equal” item under the above Section, they will consider a proposed substitute item. The Contractor shall submit sufficient information to allow the Owner/Engineer to determine that the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute thereof. Requests for review of proposed substitute items of material, product or equipment will not be accepted by the Owner/Engineer from anyone other than the Contractor.

b. The Contractor shall request to use substitute materials, products and/or equipment in writing and shall provide the Owner/Engineer certification that the proposed substitute will:

1) Perform the functions and achieve the results called for in the plans and the design.
2) Be similar in substance to that specified.
3) Be suited to the same use in the same conditions as that specified.

c. The Contractor shall:

1) State the extent, if any, to which the use of the proposed substitute will prejudice the Contractor's achievement of project completion.
2) State whether or not the use of the proposed substitute item in the work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with the City for other work on the Project) to adapt the design to the proposed substitute item.
3) State whether or not incorporation or use of the proposed substitute item in connection with the work is subject to payment of any license or other fee.
4) Identify all variations and differences of the proposed substitute item from that specified.
5) Identify available Engineering, sales, maintenance, repair and replacement services.
6) Prepare an itemized estimate of the cost or credits that will result directly or indirectly from the use of the proposed item, including cost of redesign and claims of other Contractors affected by any resulting changes.

F. Action Submittals

1. General
a. Shop drawings, working drawings, and product data sheets 11-in x 17-in and smaller shall be bound together in an orderly fashion and bear the below Certification Statement on the cover sheet. The transmittal cover sheet for each identified shop drawing shall fully describe the packaged data and include a listing of all items within the package and include a place for the Owner/Engineer's stamp.

b. The review and approval of shop drawings, working drawings, product data, or samples by the Owner/Engineer shall not relieve the Contractor from the responsibility for the fulfillment of the terms of the Contract. All risks of error and omission are assumed by the Contractor and the Owner/Engineer will have no responsibility therefore.

c. Submittals that are acceptable will be reviewed and returned with comments/notes to the contractor in a timely manner after receipt. The need for re-submittals will not be a basis for an extension of contract time for the Contractor.

d. The Contractor shall not receive time extensions or additional cost for expired certifications and/or delays to submittal reviews and approvals.

e. Project work, materials, fabrication, and installation shall conform to approved shop drawings (including working drawings and product data) and applicable samples.

f. No portion of the work requiring a shop drawing (including working drawings and product data) or sample shall be started, nor shall any materials be fabricated or installed before approval of such item. Procurement, fabrication, delivery or installation or products or materials that do not conform to approved shop drawings shall be at the Contractor's risk. Furthermore, such products or materials delivered or installed without approved shop drawings, or in non-conformance with the approved shop drawings will not be eligible for progress payment until such time as the product or material is approved or brought into compliance with approved shop drawings. Neither Owner/Engineer will be liable for any expense or delay due to corrections or remedies required to accomplish conformity.

2. Professional Owner/Engineer (P.E.) Certification Form

a. If specifically required in any of the technical Specification Sections, submit a Professional Owner/Engineer (P.E.) Certification for each item required, using the form appended to this Section.

3. Contractor's / Subcontractor Certification and additional Requirements

a. Each shop drawing, working drawings, product data, and sample shall have affixed to it the following Certification Statement:

1) "Certification Statement: by this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements."

4. Shop Drawings, Working Drawings, Product Data and Samples.

a. Shop Drawings.

1) Shop drawings as defined in the General Conditions, and as specified in individual Sections may include, but are not necessarily limited to, custom prepared data such as fabrication and erection/installation (working) drawings, scheduled information, setting diagrams, actual shop work manufacturing instructions, custom templates, valve schedules, wiring diagrams, coordination drawings, equipment inspection and test reports, and performance curves and certifications, as applicable to the work.

2) Prior to the beginning of construction, the Contractor shall submit (6) copies of each submittal and/or shop drawing for the City of Columbia’s use; Contractor shall provide additional copies as needed for their records. Submittal and shop drawing review shall be limited to general design requirements only and shall not relieve the Contractor from responsibility for errors and/or omissions or responsibility for resulting consequences due to deviations from the Contract Documents. Changes shall not be made to any submittal after it has been

reviewed; a new submittal must be presented for review and approval if changes are requested.

3) Contractor shall verify all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and coordinate each item with other related shop drawings and the Contract requirements.

4) All details on shop drawings shall clearly show the relation of the various parts to the main members and lines of the structure and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the drawings before being submitted.

5) All shop drawings submitted by subcontractors and vendors shall be reviewed by the Contractor. Contractor shall confirm, materials, dimensions, catalog numbers, technical data and performance criteria; and shall coordinate with other related shop drawings and the Contract requirements. In addition, Contractor shall confirm existing field conditions and dimensions and assure that the submittal is coordinated and compatible with existing conditions. Submittals directly from subcontractors or vendors will not be accepted by the Owner/Engineer.

6) The Contractor shall be responsible the accuracy of the subcontractor's or vendor's submittal; and, for their submission in a timely manner to support the requirements of the Contractor's construction schedule. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor or vendor to correct, before submission to the Owner/Engineer. All shop Drawings shall be approved by the Contractor.

7) Delays to construction due to the untimely submission of submittals will constitute inexcusable delays, for which Contactor shall not be eligible for additional cost nor additional contract time. Inexcusable delays consist of any delay within the Contactor's control.

8) Submittals for equipment specified under Divisions 11, 13, 14, 15 and 16 shall include a listing of installations where identical or similar equipment manufactured by that manufacturer has been installed and in operation for a period of at least five years or as otherwise specified in other specification sections.

9) The Contractor shall attach current documentation, certifications, the current Approval List published by SCDOT, etc. to appropriate submittals for review and approval by the Owner/Engineer. Submittals are required for materials, plants, etc. that are required to be certified and/or approved by the South Carolina Department of Transportation (SCDOT). Failure of the Contractor to attach the proper documentation to the submittals may result in delays of reviews and approvals.

10) The Contractor shall be responsible for providing updated certifications/approvals prior to expiration of such. Uncertified and/or unapproved Contractors, materials, plants, etc. shall not participate in or perform

work on this project until such time as documentation is provided to the Owner/Engineer showing recertification and/or approval.

b. Working Drawings

1) Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be prepared and submitted for review and approval by the Owner/Engineer prior to installing such work. Installation drawings shall be to-scale and shall be fully dimensioned.

2) Piping working drawings shall show the laying dimensions of all pipes, fittings, valves, as well as the equipment to which it is being connected. In addition, all pipe supports shall be shown.

3) Equipment working drawings shall show all equipment dimensions, anchor bolts, support pads, piping connections and electrical connections. In addition, show clearances required around such equipment for maintenance of the equipment.

4) Electrical working drawings shall show conduits, junction boxes, disconnects, control devices, lighting fixtures, support details, control panels, lighting and power panels, and Motor Control Centers. Coordinate all locations with the Contract Documents and the Contractor's other working drawings.

c. Product Data

1) Product data, as specified in individual Specification Sections, include, but are not limited to, the manufacturer's standard prepared data for manufactured products (catalog data), such as the product specifications, installation instructions, availability of colors and patterns, rough-in diagrams and templates, product photographs (or diagrams), wiring diagrams, performance curves, quality control inspection and reports, certifications of compliance (as specified or otherwise required), mill reports, product operating and maintenance instructions, recommended spare parts and product warranties, as applicable.

2) The product data shall also include the manufacturer’s recommendations for the repair of damaged materials, along with a list of all replaceable parts with Suppliers contact information.

d. Samples

1) Furnish, samples required by the Contract Documents for the Owner/Engineer's approval. Samples shall be delivered to the Owner/Engineer as specified or directed. Unless specified otherwise, provide at least two samples of each required item. Materials or equipment for which samples are required shall not be used in the work unless and until approved by the Owner/Engineer.

2) Samples specified in individual Specification Sections, include, but are not limited to: physical examples of the work (such as sections of manufactured or fabricated work), small cuts or containers of materials, complete units of repetitively-used products, color/texture/pattern swatches and range sets,

specimens for coordination of visual effect, graphic symbols, and other specified units of work.

3) Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify and Contract Requirements.

4) Approved samples not destroyed in testing shall be sent to the Owner/Engineer or stored at the site of the work. Approved samples of the hardware in good condition will be marked for identification and may be used in the work. Materials and equipment incorporated in work shall match the approved samples. Samples which fail testing or are not approved will be returned to the Contractor at his expense, if so requested at time of submission.

5. Operation and Maintenance Data

   a. Operation and maintenance data shall be submitted in assembled manuals as specified in Section 01730. Such manuals shall include detailed instructions for Owner personnel on safe operation procedures, controls, start-up, shut-down, emergency procedures, storage, protection, lubrication, testing, trouble-shooting, adjustments, repair procedures, and other maintenance requirements.

6. Payment Application Format

   a. The City shall provide the Contractor an Application of Payment form at the Pre-Construction Meeting. This form shall be used for all monthly Applications for Payment unless otherwise directed by the City.

   b. See also Specification Section 01026.

7. Site Usage

   a. Submit a proposed site staging plan, including but not limited to the location of office trailers, storage trailers and material laydown. Such plan shall be a graphic presentation (drawing) of the proposed locations; and, shall include on-site traffic modifications, and temporary utilities, as may be applicable

8. Request for Information (RFI) – All RFI's will be submitted on the form mutually agreed upon by the Contractor and Owner/Engineer.

9. Construction Site Weekly Reports shall be provided on all projects in excess of $100,000 and shall be submitted to Owner/Engineer. Each report shall contain:

   a. List of subcontractors at Project site.
   b. Approximate count of personnel at Project site.
   c. Equipment at Project site.
   d. Material deliveries.
   e. High and low temperatures and general weather conditions, including presence of rain or snow.
   f. Accidents.
   g. Meetings and significant decisions.

h. Unusual events.
i. Stoppages, delays, shortages, and losses.
j. Meter readings and similar recordings.
k. Emergency procedures.
l. Orders and requests of authorities having jurisdiction.
m. Change Orders received and implemented.
n. Construction Change Directives received and implemented.
o. Services connected and disconnected.
p. Equipment or system tests and startups.
q. Partial completions and occupancies.
r. Substantial Completions authorized.

10. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

    a. Material stored prior to previous report and remaining in storage.
    b. Material stored prior to previous report and since removed from storage and installed.
    c. Material stored following previous report and remaining in storage.

11. Moisture-Protection Plan: As needed and as changes are implemented, submit a report that describes procedures and controls for protecting materials and construction from water absorption and damage.

    a. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
    b. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
    c. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

12. Dust and HVAC Control Plan: If required by the Contract Documents, submit coordination drawing and narrative that indicates the dust and HVAC control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:

    a. Locations of dust-control partitions at each phase of work.
    b. HVAC system isolation schematic drawing.
    c. Location of proposed air-filtration system discharge.
    d. Waste handling procedures.
    e. Other dust-control measures.

13. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

G. Informational Submittals

1. Shop Drawing Schedule

   a. Prepare and submit a schedule indicating when shop drawings are required to be submitted to support the as-planned construction schedule. The submittal schedule shall allow sufficient time for preparation and submittal, review and approval, and fabrication and delivery to support the construction schedule.

   b. Shop Drawing Schedule is to include any specified materials that has to be ordered very early due to long lead time.

2. Construction Schedule

   a. Prepare and submit construction schedules and monthly status reports as specified.

3. Statements of Qualifications

   a. Provide evidence of qualification, certification, or registration, as required in the Contract Documents, to verify qualifications of licensed land surveyor, professional Engineer, materials testing laboratory, specialty subcontractor, technical specialist, consultant, specialty installer, and other professionals.

4. Health & Safety Plans

   a. When specified, prepare and submit a general company Health and Safety Plan (HSP), modified or supplemented to include job-specific considerations.

5. Fire Safety Program

   a. Include Ingress & Egress Sketch and Plan showing how fire trucks will access site throughout construction phases. Should show specific hydrant(s) that are to be used.

6. Work Plans

   a. Prepare and submit copies of all work plans needed to demonstrate to the Owner that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.

7. Excavation/Sheet Piling Near Existing Utilities Plan

   a. Contractor to coordinate with and submit to the Owner/Engineer a plan before excavating or sheet piling near existing utilities to ensure that the Owner/Engineer is aware of the construction activities, and has given authorization for the construction methods to be utilized in the area.

8. Maintenance of Flow Plan

   a. The Contractor shall maintain existing, uninterrupted flow in sewers, drains, water courses and provide a written plan & map of “proposed maintenance of flow” to Owner/Engineer.

9. Maintenance of Traffic Plans

    a. Prepare maintenance of traffic plans where and when required by the Contract Documents and by local ordinances or regulations. If Contractor is not already knowledgeable about local ordinances and regulations regarding maintenance of traffic requirements, become familiar with such requirements and include all costs for preparation and submittal of traffic management plans and all associated costs for permits and fees to implement the traffic management plan, in the bid amount. In addition, unless a supplemental payment provision is provided in the bid form, include the cost of police attendance, when required.

10. Outage Requests

    a. Provide sufficient notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities. Unless specified otherwise elsewhere, a minimum of seven calendar days' notice shall be provided.

11. Proposed Testing Procedures

    a. Prepare and submit testing procedures it proposes to use to perform testing required by the various technical specifications.

12. Test Records and Reports

    a. Provide copies of all test records and reports as specified in the various technical specifications.

13. Vendor Training Outlines/Plans

    a. At least two weeks before scheduled training of Owner's personnel, provide lesson plans for vendor training in accordance with the specification for O&M manuals.

14. Water Main Testing Plan

    a. Submit a schedule plan for testing water mains. Identify where blow-off valves will be located, and any sections of water main line separated, sample points.

15. Test and Start-up Reports

    a. Manufacturer shall perform all pre-start-up installation inspection, calibrations, alignments, and performance testing as specified in the respective Specification Sections. Provide copies of all such test and start-up reports.

16. Certifications

    a. Provide various certifications as required by the technical specifications. Such certifications shall be signed by an officer (of the firm) or other individual authorized to sign documents on behalf of that entity. Certifications may include, but are not limited to:

        1) Welding certifications and welders qualifications

2) Certifications of Installation, Testing and Training for all equipment
3) Material Testing reports furnished by an independent testing firm
4) Certifications from manufacturer(s) for specified factory testing
5) Certifications required to indicate compliance with any sustainability or LEEDS accreditation requirements indicated in the Contract Documents

17. Record Drawings

    a. No later than Substantial Completion, submit a record of all changes during construction not already incorporated into drawings – in accordance with Specification section 01720.

18. Manufacturer's Guaranty/Warranty/Bonds

    a. Contractor to provide a list at the Preconstruction conference of all Warranties deemed to start before Substantial Completion.

    b. Assemble a booklet or binder of all warranties and bonds as specified in the various technical specifications and in accordance with the specification on Warranties and Bonds; and provide two originals to the Owner/Engineer.

19. As-Built Surveys

    a. Engage the services of a licensed land surveyor in accordance with the Project Controls (Surveying) specification. Prior to Final Completion, provide an as-built survey of the constructed facility, as specified.

20. Contract Close-Out Documents

    a. Submit Contract documentation as indicated in the specification for Contract Close-out.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Provide an initial submittal schedule at the Pre-Construction conference for review by Owner/Engineer. Incorporate comments from Owner/Engineer into a revised submittal schedule.

B. Maintain the submittal schedule and provide sufficient copies for review by Owner/Engineer. An up-to-date submittal schedule shall be provided at each project progress meeting.

3.02 TRANSMITTALS

A. Prepare separate transmittal sheets for each submittal. Each transmittal sheet shall include at least the following: the Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.

B. Submittals shall be transmitted or delivered directly to the office of the Owner/Engineer, as indicated in the Contact Documents or as otherwise directed by the Owner/Engineer.

C. Provide copies of transmittals forms or cover letters (without attachments) directly to the Inspectors.

3.03 PROCEDURES

A. Action Submittals

1. Contractor's Responsibilities

a. Coordination of Submittal Times: Prepare and transmit each submittal sufficiently in advance of performing the related work or other applicable activities, or within the time specified in the individual work of other related Sections, so that the installation will not be delayed by processing times including disapproval and resubmittal (if required). Coordinate with other submittals, testing, purchasing, fabrication, delivery and similar sequenced activities. Extensions to the Contract Time will not be approved for the Contractor's failure to transmit submittals sufficiently in advance of the Work.

b. The submittals of all shop drawings (including working drawings and product data) shall be sufficiently in advance of construction requirements to allow for possible need of re-submittals, including review time for the Owner/Engineer.

c. No less than 30 calendar days will be required for Owner/Engineer's review time for shop drawings and O&M manuals involving only one Owner/Engineering discipline. No less than 45 calendar days will be required for Owner/Engineer's review time for shop drawings and O&M manuals that require review by more than one Owner/Engineering discipline. Resubmittals will be subject to the same review time.

d. Submittals of operation and maintenance data shall be provided within 30 days of approval of the related shop drawing(s).

e. Before submission to the Owner/Engineer, review shop drawings as follows:

1) make corrections and add field measurements, as required
2) use any color for its notations except red (reserved for the Owner/Engineer's notations) and black (to be able to distinguish notations on black and white Documents)
3) identify and describe each and every deviation or variation from Contract documents or from previous submissions, except those specifically resulting from a comment from the Owner/Engineer on a previous submission
4) include the required Contractor's Certification statement
5) provide field measurements (as needed)
6) coordinate with other submittals
7) indicate relationships to other features of the Work
8) highlight information applicable to the Work and/or delete information not applicable to the Work

f. Submit the following number of copies:

1) Shop drawings (including working drawings and product data) – Submit no fewer than six.
2) Samples – three
3) Site Usage Plan – three copies
4) Schedule of values – four copies
5) Payment application format – six copies

g. If Contractor considers any correction indicated on the shop drawings to constitute a change to the Contract Documents, provide written notice thereof to the Owner/Engineer immediately; and do not release for manufacture before such notice has been received by the Owner/Engineer.

h. When the shop drawings have been completed to the satisfaction of the Owner/Engineer, carry out the construction in accordance therewith; and make no further changes therein except upon written instructions from the Owner/Engineer.

2. Owner/Engineer's Responsibilities

a. Owner/Engineer will not review shop drawings (including working drawings and product data) that do not include the Contractor's approval stamp and required certification statement. Such submittals will be returned to the Contractor, without action, for correction.

b. Partial shop drawings (including working drawings and product data) will not be reviewed. If, in the opinion of the Owner/Engineer, a submittal is incomplete, that submittal will be returned to the Contractor for completion. Such submittals may be returned with comments from Owner/Engineer indicating the deficiencies requiring correction.

c. If shop drawings (including working drawings and product data) meet the submittal requirements, Owner/Engineer will forward copies to appropriate reviewer(s). Otherwise, noncompliant submittals will be returned to the Contractor without action - with the Owner/Engineer retaining one copy.

d. Submittals which are transmitted in accordance with the specified requirements will be reviewed by the Owner/Engineer within the time specified herein. The time for review will commence upon receipt of submittal by Owner/Engineer.

3. Review of Shop Drawings (Including Working Drawings and Product Data) and Samples

a. The review of shop drawings, working drawings, data and samples will be for general conformance with the design concept and Contract Documents. They shall not be construed:

1) as permitting any departure from the Contract requirements

2) as relieving the Contractor of responsibility for any errors, including details, dimensions, and materials

3) as approving departures from details furnished by the Owner/Engineer, except as otherwise provided herein

b. The Contractor remains responsible for details and accuracy, for coordinating the work with all other associated work and trades, for selecting fabrication processes, for techniques of assembly, and for performing work in a safe manner.

c. If the shop drawings (including working drawings and product data) or samples as submitted describe variations and indicate a deviation from the Contract requirements that, in the opinion of the Owner/Engineer are in the interest of the Owner and are so minor as not to involve a change in Contract Price or Contract Time, the Owner/Engineer may return the reviewed drawings without noting an exception.

d. Only the Owner/Engineer will utilize the color "RED" in marking submittals.

e. Shop drawings will be returned to the Contractor with one of the following codes.

1) Code 1 – "APPROVED" – This code is assigned when there are no notations or comments on the submittal. When returned under this code the Contractor may release the equipment and/or material for manufacture.

2) Code 2 - "APPROVED AS NOTED" - This code is assigned when a confirmation of the notations and comments IS NOT required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product.

3) Code 3 - "APPROVED AS NOTED/CONFIRM" - This combination of codes is assigned when a confirmation of the notations and comments is required by the Contractor. The Contractor may release the equipment or material for manufacture; however, all notations and comments must be incorporated into the final product. This confirmation shall specifically address each omission and nonconforming item that was noted. Confirmation is to be received by the Owner/Engineer within 15 calendar days of the date of the Owner/Engineer's transmittal requiring the confirmation.

4) Code 4 - "APPROVED AS NOTED/RESUBMIT" - This combination of codes is assigned when notations and comments are extensive enough to require a resubmittal of the entire package. This resubmittal is to address all comments, omissions and non-conforming items that were noted. Resubmittal is to be received by the Owner/Engineer within 30 calendar days of the date of the Owner/Engineer's transmittal requiring the resubmittal.

5) Code 5 – "NOT APPROVED" – This code is assigned when the submittal does not meet the intent of the contract documents. The Contractor must resubmit the entire package revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the contract documents.

6) Code 6 – "COMMENTS ATTACHED" – This code is assigned where there are comments attached to the returned submittal, which provide additional data to aid the Contractor.

7) Code 7 – "RECEIPT ACKNOWLEDGED (Not subject to Owner/Engineer's Review or Approval)" – This code is assigned to acknowledge receipt of a submittal that is not subject to the Owner/Engineer's review and approval, and is being filed for informational purposes only. This code is generally used in acknowledging receipt of means and methods of construction work plans, field conformance test reports, and health and safety plans.

8) Codes 1 through 5 designate the status of the reviewed submittal. Code 6 indicates that some or all of the Owner/Engineer's comments are included in an attachment.

f. Repetitive Reviews: Shop drawings, O&M manuals and other submittals will be reviewed no more than twice at the Owner's expense. All subsequent reviews will be performed at the Contractor's expense. Reimburse the Owner for all costs invoiced by Engineer for the third and subsequent reviews.

4. Electronic Transmission

a. Action Submittals may be transmitted by electronic means provided the following conditions are met:

1) The above-specified material shall include a transmittal form with specified numbering configuration.

2) All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the Contactor, and the Contractor's Certification.

3) The submittal contains no pages or sheets larger than 11 x 17 inches.

4) With the exception of the transmittal sheet, the entire submittal is included in a single file.

5) The electronic files are PDF format (with printing enabled).

6) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least two hard-copy originals to the Owner/Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

B. Informational Submittals

1. Contractor's Responsibilities

a. Number of copies: Submit three copies, unless otherwise indicated in individual Specification sections

b. Refer to individual technical Specification Sections for specific submittal requirements.

2. Owner/Engineer's Responsibilities

   a. The Owner/Engineer will review informal submittals, schedules, and information and determine if acceptable, however, acceptance will not impose responsibilities on the the Owner/Engineer or interfere with or relieve the Contractor from the Contractor's full responsibilities.

   b. The Owner/Engineer will review each informational submittal within 14 Calendar days. If the informational submittal complies with the Contract requirements, Owner/Engineer will file for the project record and transmit a copy to the Owner. Owner/Engineer may elect not to respond to Contractor regarding informational submittals meeting the Contract requirements.

   c. If an informational submittal does not comply with the Contract requirements, Owner/Engineer will respond accordingly to the Contractor within 14 Calendar days. Thereafter, the Contractor shall perform the required corrective action, including retesting, if needed, until the submittal, in the opinion of the Owner/Engineer, is in conformance with the Contract Documents.

3. Electronic Transmission

   a. Informational submittals may be transmitted by electronic means providing all of the following conditions are met:

      1) The above-specified material shall include a transmittal form with specified numbering configuration.

      2) All other requirements specified above have been met including, but not limited to, coordination by the Contractor, review and approval by the Contactor, and the Contractor's Certification.

      3) The submittal contains no pages or sheets larger than 11 x 17 inches.

      4) With the exception of the transmittal sheet, the entire submittal is included in a single file.

      5) The electronic files are PDF format (with printing enabled).

      6) For Submittals that require certification, corporate seal, or professional embossment (i.e., P.E.s, Surveyors, etc.) transmit at least two hard-copy originals to the Owner/Engineer. In addition, provide additional photocopied or scanned copies, as specified above, showing the required certification, corporate seal, or professional seal.

END OF SECTION

P.E. CERTIFICATION FORM

The undersigned hereby certifies that he/she is a professional Engineer registered in the State of South Carolina and that he/she has been employed by

_____ to design
(Company Name)

_____
(Insert P.E. Responsibilities)

In accordance with Specification Section _____ for the

_____.
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and P.E. stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the City of Columbia, South Carolina or Owner's representative within seven days following written request therefor by the Owner.

_____	_____
P.E. Name	Company Name
_____	_____
Signature	Signature
_____	_____
P.E. Registration Number	Title

_____
Address

_____
Address

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SECTION 01310
CONSTRUCTION SCHEDULING

PART 1 GENERAL

1.01 PROGRAM DESCRIPTION

A. A Critical Path Method (CPM) construction schedule shall be used to control the Work and to provide a basis for determining job progress. The construction schedule shall be prepared and maintained by the Contractor. All work shall be done in accordance with the established CPM schedule. The Contractor and all subcontractors shall cooperate fully in developing the construction schedule and in executing the work in accordance with the CPM schedule.

B. The construction schedule shall consist of a computerized CPM network (diagram of activities) presented in a time-scaled graphic (print-out) with reports, as specified herein.

C. There shall be no direct payment for this Work, the cost of which shall be included in the Miscellaneous Work – General Requirements Bid Item.

1.02 QUALIFICATIONS

A. The Contractor shall have the capability of preparing and utilizing the specified CPM schedule, or engage the services of a specialized scheduling professional to do so. At the Pre-Construction Conference, provide a résumé or qualifications statement for the individual within the Contractor's organization, or the outside consultant, who is being proposed as the responsible party for development and maintenance of the CPM schedule. The résumé or qualifications statement shall demonstrate that the proposed responsible party has successfully developed and maintained CPM schedules for at least three construction projects of the same size or greater than this project. The proposed responsible party for the CPM schedule is subject to approval by the Owner/Engineer. If the proposed responsible party for the CPM schedule is not approved, Contractor shall resubmit a more-appropriate candidate within 5 days for approval.

1.03 SUBMITTALS

A. Contractor shall submit Interim, Preliminary, Baseline (also known as "as-planned") CPM schedules, revisions, and Monthly Status Reports, all including graphics, reports, and narratives, and an as-built schedule, as specified herein.

PART 2 PRODUCTS

2.01 SOFTWARE

A. Unless otherwise approved by the Owner/Engineer, the computer-based schedule shall be generated using Microsoft Project 2010 or higher or Oracle-Primavera P6 Professional Project Management Software Release 8.3 or higher.

B. If the Contractor wants to pursue the use another scheduling software (other than what is stated above) they need to submit a written request within 5 days of award of contract to the Owner/Engineer justifying their intended scheduling software selection providing 3 examples of where they have used the scheduling software on similar dollar and length of time projects within the last 3 years.

2.02 NETWORK REQUIREMENTS

A. Each schedule submittal shall contain and display the following identifying information:

1. Project Title, Owner's Contract Number, and the Project Number

2. Contractor's name

3. All Contract milestones, as specified

4. The project calendar(s) (including work week and holidays)

5. Type of submittal (e.g., Interim, Preliminary, Baseline or Monthly Current Update Period)

6. Page number and total page count

7. Data date and run (print) date and time

8. Schedule File Name

B. The network of activities shall show the order and inter-dependence of activities; and, show the sequence in which the work is to be accomplished, as planned by the Contractor. The basic concept of a network analysis diagram shall be followed to show how each activity is dependent on preceding activities (predecessors) and following activities (successors).

C. All activities shall be sufficiently identified and/or described so that the scope of work of each activity is clear. All work tasks shall be broken down into appropriate scopes and durations to facilitate monitoring progress within a given month. Unless otherwise approved by the Owner/Engineer, no activities shall have durations of more than one month; except for off-site activities such as procurement and delivery of materials and equipment - or administrative or management (Level of Effort (LOE)) activities that span the project duration that do not reflect earned progress.

D. Network activities shall be organized (grouped) by phases (or stages), physical areas, buildings, elevations, or other portions of the project.

E. Separate network activities shall be provided for subcontractors.

F. The number of network activities, sufficiency of description, and level of breakdown shall be subject to the Owner/Engineer's review and approval to confirm conformance with the specified requirements.

G. The format of the schedule network graphic shall be a time-scaled logic diagram - with a list of network activities and the specified data fields presented adjacent to the graphic display.

H. The following general requirements also apply to the network diagram.

1. The Critical Path (the sequence of project network activities that add up to the longest overall duration and thereby determines the shortest time possible to complete the project) shall be identified - preferably in 'red'.

2. Unless otherwise approved by the Owner/Engineer, the Contractor's work schedule shall be based on 'normal work week' as defined in the Contract Documents – (typically 40 hours per week, consisting of five 8-hour days).

3. The graphics shall indicate the calendar(s) on which activity durations are based (i.e., 5-day workweek or 7 calendar day week). When multiple calendars or work weeks are used, the graphics shall clearly indicate which calendars are used where.

4. The project calendar shall include exclusions for holidays observed by the Contractor and those indicated in the Contract Documents.

I. Each network activity shall have the following information (fields) listed alongside the activity on the graphic display.

1. Activity ID – a manually assigned designation (numeric or alphanumeric). The Contractor should use a logical approach to assigning identification to network activities to facilitate grouping (sorting) of activities.

2. Activity Description needs to include an Action verb, Element, and Demarcation Points (for example: Excavate 6” CPVC Line from Sta14+15 to 16+01)

3. Original Duration – including allowances for adverse weather interruptions – normal for the project location, as defined in the Contract Documents.

4. Percent complete – the Contractor's estimated physical percent complete for each network activity as of the data date for the respective report.

5. Remaining Duration - a calculated value based on Original Duration of each network activity.

6. Early Start Date

7. Early Finish Date

8. Late Start Date

9. Latest Finish Date

10. Total Float

2.03 SUBMITTAL REQUIREMENTS

A. Each schedule submittal shall include the following elements:

1. Graphics – unless otherwise approved by the Owner/Engineer, the network graphics shall consist of 4 copies on 11X17 single sided sheets; including a list of activities and the specified data fields.

2. Narrative
   a. The Narrative shall consist of a written report by the Contractor providing an overview of the schedule – specific to each submittal.

b. The Narratives for developmental submittals, i.e., Interim and Preliminary, shall describe the Contractor's approach to executing the project Work.
c. The Narrative for the Baseline Schedule shall:
   1) explain key activities and assumptions on which the schedule is based;
   2) describe the Critical Path;
   3) discuss key deliveries that might adversely affect the project schedule; and,
   4) explain the Contractor's approach to adverse weather interruptions – normal for the project location. Normal weather shall mean seasonally average weather conditions, as recorded by NOAA.
d. The Narratives provided with Monthly Status Reports (updates) shall also identify:
   1) any changes the Contractor has made to the CPM logic (including any added, modified or deleted activities,
   2) any delays that have been encountered, and
   3) remedial actions or recovery steps the Contractor will employ to arrest and/or recover from such delays.

B. Reports

1. The following reports are required to be submitted with Baseline Schedule, when a major revision is made to the schedule, and when requested by the Owner/Engineer.
   a. Activity – a report listing all network activities, sorted by activity ID
   b. Early Start – a report listing all network activities, sorted by Early Start date
   c. Total Float – a report listing all network activities, sorted by Total Float (ascending from low to high).
   d. Predecessor/Successor – a report of all activities, sorted by Activity ID that lists all predecessor and successor activities for each network activity.

2.04 ACCEPTABILITY

A. The Contractor shall submit the CPM schedule submittals, as specified, and resubmit as needed, until they are in compliance with Contract requirements.

B. The Owner/Engineer's review of the Contractor's construction schedule submittals will only be for conformance with the Contract requirements – including but not limited to contract time and work sequences specified in the Contract Documents. The Owner/Engineer's review of the schedule shall not include the Contractor's means and methods of construction or safety. The Owner/Engineer's concurrence, acceptance, or approval of the Contractor's schedule submittals will not relieve the Contractor from responsibility for complying with the Contract Scope, Contract Time or any other contract requirement. Any indication of concurrence, acceptance, or approval of the Contractor's schedule will only indicate a general conformance with the Contract requirements.

C. Concurrence, acceptance, or approval of the Contractor's CPM schedule by the Owner/Engineer in no way makes the Owner/Engineer an insurer of the CPM schedule's success, nor liable for time or cost overruns resulting therefrom.

D. Failure to include any element of work required for the performance of this Contract will not excuse the Contractor from completing all Work required within the Contract completion date(s), notwithstanding the review of the network by the Owner/Engineer.

E. CPM schedules that contain activities with negative float, or which extend beyond the contract completion date, will not be acceptable.

F. Except where earlier completions are specified, CPM schedules which show completion of all work prior to the contract completion date may be indicated; however, in no event shall they constitute a basis for claim for delay by the Contractor.

PART 3 EXECUTION

3.01 IMPLEMENTATION SCHEDULE

A. Interim Schedule

1. Within 15 days following the receipt of the Notice to Proceed, submit an Interim Schedule indicating the planned operations during the first 60 calendar days after Notice to Proceed. In addition, the Contractor shall indicate its general approach for the balance of the project.

2. While the Preliminary schedule is being developed, the Contractor shall update the Interim schedule on a monthly basis – indicating actual progress - until the Preliminary schedule is submitted.

B. Preliminary Schedule

1. Within 30 days following the receipt of Notice to Proceed, submit a proposed Preliminary Schedule. The Preliminary Schedule shall consist of a draft computer-generated CPM-schedule showing the entire Scope of Work. The Preliminary Schedule shall not include any actual progress earned during development of the schedule (i.e., as of the Notice to Proceed).

2. Within 5 days of submittal of the Preliminary Schedule, meet with the Owner/Engineer to discuss the review comments.

3. Once the Preliminary Schedule is submitted, Contractor shall discontinue updating the Interim Schedule. Provide monthly updates of the Preliminary Schedule until concurrence, acceptance, or approval of the Baseline Schedule.

C. Baseline (as-planned) Schedule

1. With 10 days of the review meeting on the Preliminary Schedule submittal, the Contractor shall incorporate the Owner/Engineer's comments into the network and submit a Baseline Schedule. Resubmit the Baseline Schedule, as required until it is deemed acceptable as stated in Paragraph 2.04, above.

2. Upon concurrence, acceptance, or approval of the Contractor's initial Baseline Schedule, statused as of the Notice to Proceed date, it shall be recognized as the basis against which the Contractor's progress shall be measured.

D. Monthly Status Reports

1. Monthly Status Reports shall include updated graphics and a narrative. In addition, if requested by the Owner/Engineer, Contractor shall provide copies of one or more of the standard reports listed in Paragraph 2.03.B.

2. The Contractor shall provide Monthly Status Reports (schedule updates) commencing approximately 30 days after submission of the Interim Schedule. Unless approved otherwise by the Owner/Engineer, the Monthly Status Reports shall be statused as of the end of each calendar month.

3. While the Preliminary Schedule is being developed, the Contractor shall update the Interim schedule on a monthly basis – indicating actual progress - until the Preliminary Schedule is submitted.

4. While the Baseline Schedule is being developed, the Contractor shall update the Preliminary Schedule on a monthly basis – indicating actual progress - until concurrence, acceptance, or approval of the Baseline Schedule.

5. Once the initial Baseline Schedule is complete, Monthly Status Reports shall be based on the Baseline Schedule.

E. As-Built Schedule

1. Upon achieving Substantial Completion, the Contractor shall submit an as-built schedule, showing all activities from the Notice to Proceed through Substantial Completion. In addition, provide the reports listed in Paragraph 2.03.B. A Narrative is not required.

3.02 DELIVERABLES

A. Unless approved otherwise by the Owner/Engineer, the Contractor is to provide an electronic copy of the file (for P6 .XER or XML Format) and PDF copies of all submittal reports, and 4 hard copies of all submittals will be printed in color on 11 X 17 single sided sheets which may be divided into as many separate sheets as required.

3.03 PROGRESS REPORTING

A. Progress under the approved CPM schedule shall be reported monthly by the Contractor by submitting a Monthly Status Report. Unless otherwise approved by the Owner/Engineer, the Contractor shall meet monthly with the Owner/Engineer, to jointly evaluate the status of each network activity. Each activity shall be updated to reflect the actual progress (physical percent complete) and the actual dates activities were started and completed, as applicable.

B. The Monthly Status Report shall include an update of the computer-generated network graphics and a Narrative report. The Narrative shall include:

1. A description of the progress during the reporting period in terms of completed activities

2. A summary of the Critical Path

3. A description or explanation of each delays to network activities

4. A description of problem areas, current and anticipated delaying factors and their anticipated effect on the performance of other activities and completion dates

5. An explanation of corrective action taken or proposed.

6. A schedule look-ahead, time-scaled logic diagram that shows the last 4 weeks prior to the data date and the next 6 weeks after the data date sorted by work area and early start.

7. This report, as well as the CPM Status Report, will be discussed at each progress meeting.

3.04 RESPONSIBILITY FOR SCHEDULE COMPLIANCE

A. Whenever it becomes apparent from the current CPM schedule and CPM Status Report that delays to the critical path have resulted and the contract completion date will not be met, or when so directed by the Owner/Engineer, take some or all of the following actions at no additional cost to the Owner. Submit to the Owner/Engineer for approval, a written statement of the steps intended to take to remove or arrest the delay to the critical path in the approved schedule.

1. Increase construction manpower in such quantities and crafts,

2. Increase the number of working hours per shift, shifts per day, working days per week,

3. Increase the amount of construction equipment, and/or

4. Reschedule activities to maximize the concurrence of activities and comply with the revised schedule.

B. If when so requested by the Owner/Engineer, failure to submit a written statement of the steps intended to take or should fail to take such steps as approved by the Owner/Engineer, the Owner/Engineer may direct the Contractor to increase the level of effort in man-power (trades), equipment and work schedule (overtime, weekend and holiday work, etc.) to be employed by the Contractor in order to remove or arrest the delay to the critical path in the approved schedule and the Contractor shall promptly provide such level of effort at no additional cost to the Owner.

3.05 ADJUSTMENT OF CONTRACT SCHEDULE AND COMPLETION TIME

A. If the Contractor wants or needs to make changes in his/her execution of the construction schedule that would affect the approved CPM schedule, he/she shall notify the Owner/Engineer in writing stating what changes are proposed and the reasons for the changes. If the Owner/Engineer approves such changes, the Contractor shall revise and submit a revised schedule for approval - without additional cost to the Owner. The CPM schedule shall be adjusted by the Contractor only after prior approval of his/her proposed changes. Adjustments may consist of changing portions of the activity sequence, activity durations, division of approved activities, or other adjustments as may be approved by the Owner/Engineer; however, the addition of extraneous, non-working activities and activities that add unapproved restraints to the CPM schedule will not be allowed.

B. Shop drawings that are not approved on the first submittal will require the addition of network activities for the resubmittals.

C. Equipment that does not pass the specified tests will require the addition of network activities for the retesting.

D. Total float in the approved CPM network belongs to the project; i.e., either the Owner or Contractor may take advantage of available total float on a first-come, first-served basis. Therefore, without obligation to extend either the overall completion date, or any intermediate completion dates set out in the CPM network, the Owner may initiate changes to the work or delay work that absorb available total float existing at the time of the change or delay. Owner initiated changes or delays that affect the Critical Path on the approved CPM network shall be the sole grounds for extending (or contracting) contract completion dates or fixed milestones.

3.06 COORDINATING SCHEDULES WITH OTHER CONTRACT SCHEDULES (NOT USED)

END OF SECTION

SECTION 01320
CONSTRUCTION PHOTOGRAPHS AND VIDEO RECORDING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to provide photographic documentation and video taping of the Project as specified herein.

B. There shall be no direct payment for this Work, the cost of which shall be included in the Miscellaneous Work – General Requirements Bid Item.

C. Work includes administrative and procedural requirements for the following:

1. land-based preconstruction photographs.

2. land-based periodic construction photographs.

3. land-based final completion construction photographs.

4. Preconstruction video recordings.

5. Periodic construction video recordings.

1.02 RELATED WORK

1. Submittal procedures are included in Section 01300.

2. Project Record Documents are included in Section 01720.

1.03 REFERENCES

A. Not Used.

1.04 SUBMITTALS

A. Key Plan: Submit key plan of Project site and/or buildings with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction if applicable.

B. Digital Photographs land-based: Submit image files within seven days of taking photographs.

1. File Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.

2. Submit digital photographs in data disc format acceptable to Engineer.

a. Full-size (12-cm / 4.7-inch diameter) CD-R, DVD-R and DVD+R single-use recordable discs are acceptable as are USB drives.

b. Package each disc in a hard plastic case, clearly and indelibly labeled using self-adhesive labels specifically designed for labeling of discs. Include on the label the project name, project number, and the time period covered by the photographs contained on the disc.

3. Identification: Provide the following information with each image description in file metadata tag:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer and/or City Construction Administrator.
d. Name of Contractor.
e. Date and time photograph was taken.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Construction Photographs land-based: Submit two prints of each photographic view within seven days of taking photographs.

1. Format: 8-by-10-inch (203-by-254-mm) smooth-surface matte prints on single-weight, commercial-grade photographic paper;

2. Identification: On back of each print, provide an applied label or rubber-stamped impression with the following information:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer and/or City Construction Administrator.
d. Name of Contractor.
e. Date and time photograph was taken if not date stamped by camera.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
g. Unique sequential identifier keyed to accompanying key plan.

D. Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings in digital video disc format acceptable to.

a. Full-size (12-cm / 4.7-inch diameter) CD-R, DVD-R and DVD+R single-use recordable discs are acceptable as are USB drives.

b. Package each disc in a hard-plastic case, clearly and indelibly labeled using self-adhesive labels specifically designed for labeling of discs. Include on the label the project name, project number, and the time period covered by the photographs contained on the disc.

2. Identification: With each submittal, provide the following information:
a. Name of Project.
b. Name and contact information for videographer.

c. Name of Engineer and/or City Construction Administrator.
d. Name of Contractor.
e. Date video recording was recorded.
f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
g. Weather conditions at time of recording.

1.05 USAGE RIGHTS

A. Obtain and transfer copyright usage rights from photographer and/or videographer or Contractor to Owner for unlimited reproduction of photographic documentation.

PART 2 PRODUCTS

2.01 PHOTOGRAPHIC MEDIA

A. Digital Photographs:

1. Provide digital photographs produced by a dedicated, fixed- or interchangeable-lens digital camera. Images made with cell phones, tablets, webcams, and wearable cameras are not acceptable.

2. Digital Camera: Have a minimum image resolution of 8 megapixels, and produce images in JPEG (.JPG) format with image dimensions of not less than 3200 by 2400 pixels.

3. Include date and time in file name for each image.

B. Digital Video Recordings:

1. Provide video recordings made with a dedicated digital video camera specifically made for video recordings. Video recordings made with cell phones, tablets, webcams, and wearable cameras are not acceptable.

2. Digital Video Camera: Have a minimum resolution of 720p (1280 x 720, progressive).

3. Provide video recordings in a common digital video format such as .MP4 or .WMV. The minimum resolution of all video files shall be 720p (1280 x 720, progressive).

PART 3 EXECUTION

3.01 CONSTRUCTION PHOTOGRAPHS

A. General

1. Engage a qualified photographer to take construction photographs.

2. Take photographs that clearly show the Work. Exhibit correct exposure and focus, accurate color balance, maximum depth of field, minimal optical distortion, and minimal noise. Photographs that, in the Owner/Engineer’s opinion, do not meet these quality criteria will not be accepted and shall be re-taken at no additional cost to the Owner.

3. Maintain key plan with each set of construction photographs that identifies each photographic location.

4. Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

5. Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted.

B. Preconstruction Photographs

1. Before commencement of any excavation, demolition, or start of any construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points. Take additional photographs as specifically as directed by the Owner/Engineer.

2. Flag excavation areas and construction limits before taking construction photographs.

3. Take photographs to show existing conditions, including roadways, parking lots, driveways, walkways, etc., adjacent to property before starting the Work.

4. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

5. Take photographs as required to record existing settlement or cracking of adjacent structures, pavements, and improvements.

6. The exact number of photographs will depend on the complexity of the project and the density of the surrounding area. The Contractor shall ensure an adequate number of photographs are taken to properly document the above existing conditions.

C. Periodic Construction Photographs

1. Take photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

2. From time to time, the Owner/Engineer may instruct Contractor to take additional photographs from select vantage points and directions to show the status of construction and progress since last photographs were taken.

D. Final Completion Construction Photographs

1. Take photographs after date of Substantial Completion for submission as project record documents as required by Section 01720.

2. The exact number of photographs will depend on the complexity of the project and the density of the surrounding area, but in general should be at the same locations of the Preconstruction photographs. The Contractor shall ensure an adequate number of photographs are taken to properly document the above existing conditions.

3.02 CONSTRUCTION VIDEO RECORDINGS

A. Engage a qualified videographer to record construction video recordings.

B. Video Recordings:

1. Produce bright, clear, sharp pictures with accurate colors and free from distortion, excessive shake, or any other form of picture imperfection. The audio track of each video recording shall reproduce precise and concise explanatory notes by the camera operator with proper volume, clarity and freedom from distortion and interference. Video recordings that, in the Engineer's opinion, do not meet these quality criteria will not be accepted and shall be re-recorded at no additional cost to the Owner.

2. Mount camera on tripod before starting recording unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.

C. Narration: Describe scenes on video recording by audio narration by microphone while video recording. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.

2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.

D. Preconstruction Video Recording: Before commencement of any excavation, demolition, or start of any construction, take video recording of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by the Engineer or City Inspector. Contractor shall give Engineer or Inspector 48 hours' notice prior to recording video and the Engineer and Inspector shall be present for the recording.

1. Flag excavation areas and construction limits before recording construction video recordings.

2. Show existing conditions, including all roadways, parking lots, driveways, walkways, etc., adjacent to Project site before starting the Work.

3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of excavation, demolition, or any construction.

4. Show protection efforts by Contractor.

E. Final Completion Construction Video: Take video recording after date of Substantial Completion of the same area videoed prior to Construction and submit as project record documents.

END OF SECTION

SECTION 01370
SCHEDULE OF VALUES

PART 1 GENERAL

1.01 REQUIREMENTS INCLUDED

A. Submit a Schedule of Values allocated to the various lump sum portions of the work, within 21 days after the effective date of the Agreement.

B. Upon request of the Owner/Engineer, support the values with data which will substantiate their correctness.

C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.

1.02 RELATED REQUIREMENTS

A. Application for Payment is included in Section 01026.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES

A. Type schedule on an 8-1/2-in by 11-in or 8-1/2-in by 14-in paper. Contractor's standard forms and automated printout will be considered for approval by the Owner/Engineer upon Contractor's request. Identify schedule with:

1. Title of Project and location.

2. Engineer and Project number.

3. Name and Address of Contractor.

4. Contract designation.

5. Date of submission.

B. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. Identify each line item with the number and title of the respective Section.

D. For each major line item, list sub-values of major products or operations under the item.

E. For the various portions of the work:

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

2. For items on which progress payments will be requested for stored materials, break down the value into:

a. The cost of the materials, delivered and unloaded, with taxes paid. Paid invoices are required for materials upon request by the Engineer.

b. The total installed value.

F. The sum of all values listed in the schedule shall equal the total Contract Sum. If the schedule is specific to an individual lump sum bid item such as Miscellaneous Work – General Requirements, the total shall equal the total bid item amount.

1.04 SUBSCHEDULE OF UNIT MATERIAL VALUES

A. Submit a sub-schedule of unit costs and quantities for:

1. Products on which progress payments will be requested for stored products.

B. The form of submittal shall parallel that of the Schedule of Values, with each item identified the same as the line item in the Schedule of Values.

C. The unit quantity for bulk materials shall include an allowance for normal waste.

D. The unit values for the materials shall be broken down into:

1. Cost of the material, delivered and unloaded at the site, with taxes paid.

2. Copies of invoices for component material shall be included with the payment request in which the material first appears.

3. Paid invoices shall be provided with the second payment request in which the material appears or no payment shall be allowed and/or may be deleted from the request.

E. The installed unit value multiplied by the quantity listed shall equal the cost of that item in the Schedule of Values.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes general requirements related to the Contractor's responsibility for quality control involving inspections, testing, and certifications. Testing includes both shop tests (those provided by the manufacturer prior to shipment of equipment to the site) and field tests (performance tests of installed equipment and in-situ testing of materials by a state-certified laboratory). Specific requirements are also included in the individual technical sections.

B. There shall be no direct payment for this Work, the cost of which shall be included in the Miscellaneous Work – General Requirements Bid Item.

C. This Section includes the following:

1. Inspections.

2. Quality Assurance – Control of Installation.

3. Inspecting and Physical Testing Laboratory Services.

4. Equipment Calibration.

D. Unless otherwise indicated, only new materials shall be incorporated in the Work. All materials furnished by the Contractor to be incorporated in the Work shall be subject to the inspection and approval of the Owner and the Engineer. No material shall be processed for, or delivered to the Site without prior approval by the Owner/Engineer.

E. All materials of construction, supplies and parts, particularly those upon which the strength and durability of the structure may depend, shall be subject to inspection and testing to establish conformance with specifications and suitability for uses intended.

F. All materials, parts and equipment furnished and incorporated in the work shall be of high grade materials, free from defects and imperfections, and of recent manufacture. Workmanship shall be of the highest grade and in accordance with the best modern standard of practice.

G. When required, all tests shall be made in the presence of the Owner/Engineer. Where not required, sworn statements or test results shall be furnished by the Contractor within 7 days of completion of tests.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Specific testing and inspection requirements are also specified in the individual Technical Specifications.

C. Where standard published specifications of recognized authorities or organizations are specified, the latest revision of such specification at the time the work is executed shall govern, unless otherwise authorized or directed.

1.03 SUBMITTALS

A. The Contractor is responsible for providing the Owner/Engineer a copy of the proposed Quality Control and Quality Acceptance Program for review and for maintaining such program for the duration of the project within 30 days of Notice to Proceed.

B. The Contractor shall provide the Owner/Engineer copies of the Contractor-selected South Carolina Department of Transportation Certified material testing laboratories

C. The Contractor shall provide the Owner/Engineer copies of current organizational chart including names, telephone numbers and current certifications of personnel responsible for the Quality Control Program, testing, inspection, etc. on the project. All tests performed shall be under the supervision of certified personnel or it may result in nonpayment, delay and/or reduction in payment for the material of concern.

D. Where the specifications call for certified copies of mill or shop tests to establish conformance with the specifications, it shall be the responsibility of the Contractor to assure the delivery of such certifications to the Owner/Engineer.

E. Transcripts or certified shop test reports including all test results shall be submitted for review to the Owner/Engineer and approved prior to delivery of any equipment to the site. The testing shall have been performed by an approved independent testing facility within the previous six months. Transcripts of test results shall be accompanied by a certificate in the form of a letter from the manufacturer or supplier certifying that the tested material meets the specified requirements and is of the same type, quality, manufacturer, and make as that specified.

F. The Contractor shall submit signed and certified written reports of each field inspection, test, or similar quality control and quality assurance service performed to the Owner/Engineer within seven (7) working days of the performed service. All original final written reports shall be turned over to the Owner/Engineer at substantial completion of the project. Written reports and attached forms of each field inspection, test or similar service shall be complete and accurate, shall specify the test locations, shall specify the tests performed, shall include the methods used to perform the test and shall be signed, stamped and dated by the certified person of the state-certified laboratory or testing firm. Reports shall also include:

1. Date of issue.

2. Project title and number.

3. Name, address, and telephone number of testing laboratory or firm.

4. Dates and locations of samples and tests or inspections.

5. Names of individuals making the inspection or test.

6. Designation of the Work and test method.

7. Identification of product or material and Specification Section.

8. Complete inspection of test data.

9. Test results and an interpretation of test results.

10. Ambient conditions at the time of sample taking and testing.

11. Comments or professional opinion on whether inspected or tested Work complies with requirements.

12. Name and signature of laboratory inspector.

13. Recommendations on retesting.

1.04 INSPECTIONS

A. The Engineer and the Owner shall have the right to inspect all material and equipment at all stages of collection and processing, and shall be allowed access to the site and to the Contractor's and supplier's facilities to conduct such inspections. Onsite work shall be subject to continuous inspection. Inspection by the Engineer or the Owner shall not release the Contractor from responsibility or liability with respect to material. The Engineer or the Owner will supply the Contractor a minimum of 24 hours' notice prior to unscheduled offsite inspections.

B. No materials or finished articles shall be incorporated in the work until such materials and finished articles have passed any required tests. The Contractor shall promptly segregate and remove rejected material or finished articles from the site of the work. Failure to condemn the material on preliminary inspection shall not be grounds for acceptance if defects are found later.

C. When local codes or laws require approval and inspection of the work by other agencies or organizations, the Contractor shall obtain such approval and submit one signed original and three copies of the approval to the Owner/Engineer.

D. The Owner/Engineer shall have the right to mark rejected materials to distinguish them as such.

E. The Contractor shall furnish the inspector with the necessary facilities and assistance for carrying out his duties. The work and materials shall be supervised by the Owner/Engineer and the inspectors to obtain the finished product in accordance with the Contract Documents. The City shall not assume any liabilities of the Contractor or relieve him of any of his obligations.

F. The Owner/Engineer shall determine the quality and quantity of the several kinds of work and materials which are included in this contract. He shall answer all questions relating to lines, levels and dimensions of the work, and interpretations of the plans and specifications.

G. The Owner/Engineer shall be the final judge of the quality and suitability of the work and materials. Should they fail to meet his approval and/or do not conform to the requirements of the Contract Documents, upon notice from the Owner/Engineer, they shall be removed from the work, forthwith reconstructed, made good, replaced and/or corrected by the Contractor at his own expense. Rejected materials shall immediately be removed from the site. If, in the opinion of the Owner/Engineer, it is undesirable to replace any defective or damaged materials or to reconstruct or correct any portion of the work injured or not performed in accordance with the

Contract Documents, the compensation to be paid to the Contractor hereunder shall be reduced by such amount that, in the judgment of the Owner/Engineer, shall be equitable.

H. The testing and approval of materials by the laboratory, or laboratories, shall not relieve the Contractor of his obligations to fulfill his contract and guarantee workmanship and materials. The Contractor may, at his option, and at his own expense, cause such other test to be conducted as he may deem necessary to assure suitability, strength and durability of any material or finished article.

1.05 QUALITY ASSURANCE – CONTROL OF INSTALLATION

A. The Contractor shall monitor quality control over suppliers, products, services, site conditions, and workmanship, to produce work of specified quality.

B. The Contractor shall comply with manufacturers' instructions, including complying with each step, in-sequence.

C. The Contractor shall examine the areas and conditions where work is to be performed and notify the Owner/Engineer of conditions detrimental to the proper and timely completion of the Work. The Contractor shall not proceed with the work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Owner/Engineer.

D. The Contractor shall request clarification from Owner/Engineer should manufacturers' instructions conflict with Contract Documents. The clarification shall be received prior to proceeding.

E. The Contractor shall comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. Work shall be performed by persons qualified to produce workmanship of specified quality.

G. All tests performed shall be under the supervision of certified personnel or it may result in nonpayment, delay and/or reduction in payment for the material of concern.

1.06 INSPECTING AND PHYSICAL TESTING LABORATORY SERVICES

A. The Contractor shall contract with an independent Subcontractor, upon review and acceptance by the Owner and the Engineer, to perform laboratory testing as required by these Specifications and as required by the Owner.

B. The independent testing firm(s) shall have performed previous similar work in a satisfactory manner, be an approved subcontractor, and specialize in the types of inspections and tests to be performed. Testing firm(s) shall be authorized by authorities having jurisdiction to operate in the State of South Carolina. The Contractor shall include the costs of this service in his bid.

C. The Contractor shall provide labor and materials and necessary testing facilities at the site as required by Specifications and the independent laboratories. The Contractor shall cooperate with the Owner and the Engineer and the independent laboratory and shall provide the testing firm with at least 24 hours’ notice prior to specified testing.

D. Inspecting, testing, and source quality control may occur on or off the project site. Offsite inspecting or testing shall be performed as required by the Engineer or the Owner.

E. The Contractor shall be responsible for scheduling and coordinating inspections, tests, and similar activities with minimum delay to project.

F. The Contractor shall manage and coordinate all material testing and sequencing of activities to avoid the necessity of removing and replacing construction work to accommodate inspections and tests. The Contractor is responsible for scheduling times for inspections, testing, taking samples, and similar activities and shall be responsible for ensuring all tests are performed in accordance with the Contract Documents and South Carolina Department of Transportation Standard Specifications for Highway Construction, latest edition and the supplemental specifications.

1.07 EQUIPMENT CALIBRATION

A. All field test equipment will be kept under control of the Contractor's testing Subcontractor. The testing Subcontractor will be fully trained in the use of equipment, test procedures, and interpretations of results for each piece of test equipment. A copy of calibration certification will be kept by the testing Subcontractor and supplied to the Owner/Engineer.

B. Calibration of nuclear-density gauges shall conform to the frequencies and methods outlined in ASTM D2922 and D3017. Unstable or erratic gauges shall not be used in density testing and shall be immediately removed from the site.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01490
MOBILIZATION/DEMOBILIZATION

PART 1 GENERAL

1.01 MOBILIZATION

A. As required for the proper performance and completion of the Work, mobilization shall include, but not be limited to, the following principal items:

1. Move onto the site all Contractor's equipment required for the first month's operation.
2. Install temporary construction power, wiring, and lighting facilities.
3. Provide and furnish field office trailers for Contractor and Engineer.
4. Provide on-site sanitary facilities and potable water facilities.
5. Arrange for and erect Contractor's work and storage yard.
6. Submit all required insurance certificates and bonds.
7. Obtain all required permits.
8. Post all OSHA, SCDHEC, Department of Labor, and all other required notices.
9. Erect all required Project signs.
10. All construction areas within the project area have been video recorded prior to any work.
11. The Engineer is satisfied that responsive and responsible progress on the Contract Work is under way.

B. PAYMENT FOR MOBILIZATION

1. The Contractor's attention is directed to the condition that no payment for mobilization, or any part thereof, will be approved for payment under the Contract until all mobilization items listed above have been satisfactorily completed as specified.

1.02 DEMOBILIZATION

A. As required for the proper performance and completion of the Work, demobilization shall include, but not be limited to, the following principal items:

1. Remove Contractor's and Engineer’s field offices and trailer used for storage, if applicable.
2. Remove all temporary power and utility lines.
3. Remove any temporary roadways and parking areas.
4. All areas disturbed during construction are seeded per the Contract Documents.

5. Remove contract signs.

6. All construction areas within the project area have been videotaped after construction, including final restoration, is completed.

7. Meet with Engineer and Owner on site and have the site approved and acceptable as is.

8. Completed all items and submitted all documents required for Close out as specified in Sections 01720 and 01740.

B. Demobilization activities must be completed prior to the final application for payment in accordance with Section 01026.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, equipment, materials, and incidentals necessary and provide separate temporary facilities for the Contractor's use and the Engineer's use, as specified herein and as shown on the drawings.

B. Operate and maintain temporary facilities for the duration of the project and as directed by the Owner/Engineer.

C. There shall be no direct payment for this Work, the cost of which shall be included in the Miscellaneous Work – General Requirements Bid Item.

1.02 RELATED WORK

A. Control of Work is included in Section 01046.

B. Submittals are included in Section 01300.

1.03 SUBMITTALS

A. Submit shop drawings and product data, in accordance with Section 01300, showing materials of construction and details of installation for:

1. Site Plan: Show the proposed locations for temporary facilities including offices, temporary utilities, storage containers/buildings, vehicle access and parking areas, material laydown and staging areas, temporary fencing, fire truck ingress/egress, hydrant(s) to use, and other security measures.

2. Engineer's Field Office: Dimensioned floor plan, office systems, furnishings, and equipment.

3. Temporary Fence: Layout drawings which indicate dimensions, access to fire hydrants, gate locations and opening sizes, and other site-specific requirements. Fence needs to be constructed so it does not interfere with construction. If fencing needs to be relocated due to construction phase, the contractor will be responsible for relocation and cost associated with the relocation.

4. Project Sign, if required: Layout, dimensions, graphics, and wording.

B. Submittals shall be received by the Engineer no later than the date of the Preconstruction Conference.

1.04 QUALITY ASSURANCE

A. Temporary facilities shall comply with all applicable state and local ordinances, codes and regulations.

B. Coordinate with authorities having jurisdiction to inspect (and test if required) temporary facilities.

C. Obtain all required permits for temporary facilities.

1.05 DEFINITIONS

PART 2 PRODUCTS

2.01 MATERIALS

A. Temporary Fence: Fabric shall be No. 9 gauge galvanized wire woven in 2-in diamond mesh with top and bottom twisted selvage. Intermediate and terminal posts shall be galvanized steel H or pipe, minimum 2-3/8-in OD line posts, 2-7/8-in OD corner and pull posts, and 1-5/8-in OD top rails.

B. Project Sign, if required: Plywood shall be A-A EXT-APA grade, 1-in thick. Posts and braces shall be pressure treated lumber.

2.02 EQUIPMENT

A. Fire Extinguishers: Provide portable, UL-rated with class and extinguishing agent required by locations and classes of fire exposure. Provide at least one for each trailer/office. Provide hand-carried, portable UL-rated, class “A” fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class “ABC” dry chemical extinguishers or a combination of extinguishers of NFPA recommended classes for the exposures.

B. Temporary Heat: Provide vented, self-contained, liquid propane gas or fuel oil heaters with individual space thermostatic control. Equipment shall be listed and labeled for type of fuel consumed and marked for intended use. Provide temporary heating units that have been tested and labeled by UL, FM, or I another recognized trade association related to the type of fuel being consumed.

2.03 ENGINEER'S FIELD OFFICE (NOT USED)

PART 3 EXECUTION

3.01 CONTRACTOR'S FIELD OFFICE (NOT USED)

3.02 TEMPORARY POWER AND LIGHT

A. Contractor shall furnish temporary light and power, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the project needs. Make all necessary arrangements with the local electric company for temporary electric service and pay all expenses in connection therewith.

B. Provide connections to existing facilities sized to provide service required for power and lighting. Contractor shall pay the costs of power used.

C. Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 Volt plugs into higher voltage outlets. For connection of power tools and equipment, provide outlets equipped with ground-fault circuit interrupters, reset button and pilot light.

D. Provide grounded extension cords. Use heavy duty cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if more than one length is required.

E. Provide general service incandescent lamps as required for adequate illumination. Provide guard cages or tempered glass enclosures where exposed to breakage. Provide exterior fixtures where exposed to moisture.

3.03 TEMPORARY AIR, STEAM AND WATER

A. Provide all air, steam and water, including temporary piping and appurtenances required for cleaning and testing pipelines and equipment. Remove temporary piping and appurtenances upon approval of equipment being tested.

B. In order to use water from a fire hydrant, the Contractor shall apply for a temporary hydrant meter. The City of Columbia shall waive all fees for such application for this project. However, the Contractor shall be responsible for all water usage fees.

3.04 SANITARY FACILITIES

A. Provide self-contained, single occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed in a fiberglass or other approved non-absorbent shell.

3.05 CONSTRUCTION AIDS

A. Provide temporary elevators, hoists, cranes, scaffolding and platforms as necessary to perform the Work. Provide temporary stairs where ladders are not adequate. Protect permanent stairs from damage from construction operations.

3.06 VEHICLE ACCESS AND PARKING

A. Provide temporary access roads, parking areas, traffic control devices and staging areas as approved by the Engineer and Owner.

B. Provide minimum 12-ft by 24-ft by 6-in deep dense graded crushed stone or paved parking area adjacent to Engineer's field office for exclusive use by the Engineer for the duration of the project.

C. Clear snow and ice from all drives, walks, and stairs to maintain safe vehicle and pedestrian access to the site and facilities as directed by the Engineer.

3.07 TEMPORARY FENCE

A. Provide temporary fence as shown on the Drawings, as specified herein, and as the Contractor requires for site security.

1. Provide 6-ft high chain link fence with at least two vehicle and two pedestrian access gates. Gates shall be equipped with locking hardware and padlocks. Furnish two sets of keys to Engineer and Owner. Coordinate with local first responders for access during non-work hours.

2. Fence installation shall comply with ASTM F567. Post spacing shall not exceed 8-ft on center. Posts shall be set plumb in concrete footings.

3. Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.

4. Extent of Fence: As required to secure construction operations in order to limit access and maintain safety and to secure materials stored on site.

5. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

6. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

7. Add Pedestrian Safety Walkway protection with temporary roof when be needed to protect from falling objects.

8. Perform daily inspections of fence and immediately repair or replace damaged or compromised sections and as directed by the Engineer.

3.08 WASTE MANAGEMENT

A. Provide covered dumpster, minimum 4-cubic yards, dedicated for field office waste. Provide separate covered dumpster of adequate size for construction debris. Empty dumpsters on a regular basis and as directed by the Engineer. Dumpsters shall not exceed their capacities at any time.

3.09 PROJECT SIGNS

A. Furnish and install the project signs indicated in the Contract Documents. Signs shall be placed as directed by the Engineer; and, shall remain maintained in good condition for the life of the construction period.

B. Remove signs at final acceptance, unless otherwise directed.

3.10 REMOVAL AND RESTORATION

A. Remove each temporary facility completely when need for its service has ended and as approved by the Engineer. Coordinate removal of temporary facilities with authorities having jurisdiction.

END OF SECTION

SECTION 01570
MAINTENANCE AND PROTECTION OF TRAFFIC

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to provide a traffic control plan, implement and maintain all traffic control measures, and construct and remove temporary access roads and ways.

B. No individual measurement will be made for temporary construction signs, traffic cones, drums, warning lights, arrow boards, message signs, flaggers, or construction barricades. These items and all costs associated with traffic control shall be included in the lump sum Bid Item for Maintenance and Protection of Traffic.

1.02 SUBMITTALS

A. Submit in accordance with Section 01300:

1. A temporary traffic control plan(s) covering the entire project and extending throughout the life of the project.

2. Layout of all proposed temporary access roads, driveways and parking areas which the Contractor will construct for the project.

PART 2 PRODUCTS (NONE THIS SECTION)

PART 3 EXECUTION

3.01 GENERAL

A. If traffic control plans are provided in the Contract Document, the Contractor shall implement the traffic control plans in accordance with the SCDOT standard specifications, the Manual on Uniform Traffic Control Devices (MUTCD), and all addenda to date. All proposed changes to traffic control plans shall first be approved by the City of Columbia, SCDOT, and/or Richland County before implementation. The Contractor may implement traffic control only after receiving approval from the Owner/Engineer. The Owner/Engineer will not be responsible for delays to the Contractor due to his failure to abide by this requirement.

B. If specific traffic control plans are not provided in the Contract Documents, the Contractor shall develop the plans submit them to the Owner/ Engineer for review. Plans shall include the following restrictions:

1. Unless permission to close a street is received in writing from the proper authority, all excavated material shall be placed so that vehicular and pedestrian traffic may be maintained at all times. If the Contractor's operations cause traffic hazards, he/she shall repair the road surface, provide temporary ways, erect wheel guards or fences, or take other measures for safety satisfactory to the Owner/Engineer.

2. Detours around construction will be subject to the approval of the Owner/Engineer. Where detours are permitted, the Contractor shall provide all necessary barricades and signs as required to divert the flow of traffic and shall provide flagmen at all times and places necessary. While traffic is detoured the Contractor shall expedite construction operations and periods when traffic is being detoured will be strictly controlled by the Owner.

3. The Contractor shall take precautions to prevent injury to the public due to open trenches. Night watchmen may be required where special hazards exist, or police protection provided for traffic while work is in progress. The Contractor shall be fully responsible for damage or injuries whether or not police protection has been provided.

4. The Contractor shall provide flaggers near all or any areas of this project where construction and/or equipment create a "blind spot" for oncoming or turning traffic.

3.02 CONTROL MEASURES

A. The Contractor is responsible for furnishing, installing and maintaining all signs, construction barricades, supplemental warning lights, cones, drums, flashing arrow boards, arrow boards with truck-mounted attenuators, changeable message signs, truck-mounted "Prepare to Stop" signs, temporary concrete barriers and pavement markings as required through the duration of the project in accordance with the MUTCD, the SCDOT Standard Specifications for Highway Construction, and the technical specifications. All traffic control devices shall be kept operational when in use and all signs shall be kept legible and plumb day and night during their use.

B. In the event the Owner/Engineer finds Traffic Controls are not being provided as outlined, then the Contractor will be notified. If the condition is not promptly corrected, then all work shall be suspended until such conditions are corrected.

C. The Contractor shall provide individuals who are properly trained in traffic control practices. The job duties of these individuals shall be restricted to providing quality assurance of the traffic control installation. The Contractor shall have a person in charge of the traffic control on the job site at all times when construction activities are in progress.

D. Maintenance of traffic control devices shall be performed in accordance with these Specifications and as deemed necessary by the Owner/Engineer. When maintenance of traffic control devices is required, the Contractor shall give the Owner/Engineer a prior notification before conducting any maintenance activities. Traffic control maintenance performed without proper notification may be rejected by the Owner/Engineer. Also, traffic control maintenance performed without proper notification or which fails to meet required performance levels due to poor workmanship and/or factory defects shall be rejected and corrected at the Contractor's expense.

E. The Contractor shall notify property owners, in writing, at least seven (7) business days in advance of any inconvenience, which will be caused to each owner due to construction. The Contractor's contract name and telephone number shall be included in the written notice. The Contractor shall not cut off access to any more driveways than is absolutely necessary, at any given time.

F. The Contractor shall be responsible for the immediate removal of such traffic hazards as mud, debris, loose stone, and trash as may be washed or spilled on the traveled roadway as a result of the construction work.

G. Storage of material and equipment will not be permitted within 15 feet of a travel lane unless in an area protected by guardrail or temporary concrete barrier.

H. All construction exposed to pedestrian traffic including shall comply with all requirements as set forth by the most recent version of the American with Disabilities Act and the MUTCD.

3.03 ACCESS ROADS, DRIVEWAYS AND PARKING AREAS

A. Contractor shall construct temporary access roads, driveways and parking areas where shown on the Drawings or as shown on the Contractor's approved plans at no additional cost to the Owner. These shall be included in the in the lump sum for Traffic Control Bid Item.

B. Public streets, roads and drives used by the Contractor for access to and from the site shall be protected from damage in excess of that caused by the normal traffic of vehicles used in connection with construction work. Any such damage done shall be repaired immediately to the satisfaction of the Owner/Engineer, and left in good condition at the end of the construction period.

C. The Contractor shall restore all existing dirt and/or gravel roads, driveways, and parking areas disturbed during the installation of the work to their preconstruction conditions, or better, unless otherwise indicated. Temporary roads and drives constructed by the Contractor for his use shall be removed and surface restored to original condition unless otherwise directed by the Owner/Engineer. No additional payment will be made for this work.

D. Where the Work is not accessible from existing roads or streets, the Contractor shall prepare necessary roads and grade or otherwise smooth irregular terrain, along the right-of-way and/or easement, so that equipment may be moved to and operated on and along the site. Any work done under the foregoing requirements will be subject to the Owner/Engineer's approval. Easements and/or permissions to construct such roads must be in the possession of the Contractor.

END OF SECTION

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SECTION 01600
DELIVERY, STORAGE AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies the general requirements for the delivery handling, storage and protection for all items required in the construction of the work. Specific requirements, if any, are specified within individual technical sections.

B. All materials furnished by the Contractor shall be delivered, handled, and distributed at the site by the Contractor as recommended by the manufacturer. No materials will be furnished by the Owner unless otherwise noted.

C. There shall be no direct payment for these items, the cost of which shall be included in other bid items.

1.02 TRANSPORTATION AND DELIVERY

A. Equipment delivery schedule – The Contractor shall also prepare a schedule of anticipated shipping dates for materials and equipment. It is intended that equipment and materials be so scheduled as to arrive at the job site just prior to time for installation to prevent excessive materials on hand for inventory and the necessity for extensive storage facilities at the job site. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Owner/Engineer.

B. Transport and handle items in accordance with manufacturer's instructions.

C. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.

D. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.

E. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.

F. Provide necessary equipment and personnel to unload all items delivered to the site.

G. Promptly inspect shipment to assure that products comply with requirements, quantities are correct and items are undamaged. For items furnished by others (i.e., Owner, other Contractors), perform inspection in the presence of the Owner/Engineer. Notify Owner/Engineer verbally, and in writing, of any problems.

H. If any item has been damaged, including pipe and fitting linings, coatings, etc., such damage shall be repaired at no additional cost to the Owner as recommended by the manufacturer or replaced with new materials as required by the Owner/Engineer.

I. When distributing materials for pipeline projects, materials shall be unloaded opposite or near the place where it is to be laid in the trench.

1.03 STORAGE AND PROTECTION

A. Store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Storage instruction shall be studied by the Contractor and reviewed with the Owner/Engineer. Instruction shall be carefully followed and a written record of this kept by the Contractor. Arrange storage to permit access for inspection.

B. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

C. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in a manner to reduce breakage, cracking and spalling to a minimum.

D. All mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) shall be stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Owner/Engineer. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer.

1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

2. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding". Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.

3. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.

4. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

E. All paint and other coating products shall be stored in areas protected from the weather. Follow all storage requirements set forth by the paint and coating manufacturers.

END OF SECTION

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SECTION 01720
PROJECT RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE

A. The Contractor shall keep and maintain, at the job site, a copy of submittals and contract documents, marked up to indicate all changes made during the course of a project for field use, as specified herein.

B. Contractor shall keep and maintain and submit to the Owner/Engineer all required as-built drawings and specs, construction photographs, survey control, warranties/bonds, schedules, shop drawings and other submittals, testing results, and all else specified herein.

1.02 RELATED REQUIREMENTS

A. Contract close-out submittals are included in Section 01740.

B. Warranties and bonds are included in Section 01735.

C. As-built construction schedules are included in Section 01310.

D. As-built surveys are included in Section 01050.

E. Record shop drawings are included in Section 01300.

F. As-built construction photographs are included in Section 01320.

1.03 REQUIREMENTS INCLUDED

A. Contractor shall maintain a record copy of the following documents, marked up to indicate all changes made during the course of a project:

1. Contract Drawings - A full set of plans shall be on site and regularly “red lined” with record drawing data. Plans should reflect up to date construction that parallels current Application for Payment quantities.

B. Contractor shall assemble copies of the following documents for turnover to the Owner/Engineer at the end of the project, as specified.

1. All Field Orders, Change Orders, Design Modifications, and RFIs

2. All Field Test records

3. All Permits and permit close-outs (final approvals)

4. Certificate of Occupancy, Permit to Operate, or Certificate of Completion, as applicable

5. Certificates of Compliance for materials and equipment

6. All Record Shop Drawings

7. All Final Submittal logs

8. Final change order and potential change order logs.

9. Construction photographs

10. Final Survey and Control

11. All Samples

12. All required Warranties/ Bonds

C. RECORD DRAWINGS

1. The Contractor shall annotate (mark-up) the Contract Drawings to indicate all project conditions, locations, configurations, and any other changes or deviations that vary from the original Contract Drawings. This requirement includes, but is not limited to, buried or concealed construction, and utility features that are revealed during the course of construction. Special attention shall be given to recording the locations (horizontal and vertical) and material of all buried utilities that are encountered during construction – whether or not they were indicated on the Contract Drawings. The record information added to the drawings may be supplemented by detailed sketches, if necessary, clearly indicating, the WORK, as constructed.

2. These annotated Contract Drawings constitute The Contractor's Record Drawings and are actual representations of as-built conditions, including all revisions made necessary by change orders, design modifications, requests for information and field orders.

3. The annotated Contract Drawings shall include at least three actual dimensions from permanent markers, accurately locating all underground piping, bends, fittings, valves, structures, or appurtenances. Detailed sketches are acceptable for improved clarity and should be permanently affixed to the relevant Contract Drawing.

4. All original Contract Drawings shall be included with the (Mark-up) set of Drawings. Submit two copies of mark-ups and electronic PDF files to the City.

5. Record drawings shall be accessible to the Owner and Engineer at all times during the construction period.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

A. Store documents and samples in Contractor's field office apart from documents used for construction.

1. Provide files and racks for storage of the record documents.

2. Provide locked cabinet(s) or secure storage space for storage of samples.

B. File documents and samples in accordance with Construction Specifications Institute (CSI) format.

C. Maintain documents in a clean, dry, legible, condition and in good order. Do not use record documents for construction purposes.

D. Make documents and sample available for inspection by the Engineer or Owner at all times.

3.02 MARKING METHOD

A. Use the color Red (indelible ink) to record information on the Drawings and Specifications,

B. Label each document "PROJECT RECORD" in neat large printed letters.

C. Unless otherwise specified elsewhere, notations shall be affixed to hardcopies of documents.

D. Record information contemporaneously with construction progress.

E. Legibly mark drawings with as-built information:

1. Elevations and dimensions of structures and structural elements.

2. All underground utilities (piping and electrical), structures, and appurtenances
   a. Changes to existing structure, piping and appurtenance locations.
   b. Record horizontal and vertical locations of underground structures, piping, utilities and appurtenances, referenced to permanent surface improvements.
   c. Record actual installed pipe material, class, size, joint type, etc.

3.03 RECORD INFORMATION COMPILATION

A. Do not conceal any work until the required information is acquired.

B. Items to be recorded include, but are not limited to:

1. Location of internal utilities and appurtenances concealed in the construction – referenced to visible and accessible features.

2. Field changes of dimensions and/or details
   a. Interior equipment and piping relocations.
   b. Architectural and structural changes, including relocation of doors, windows, etc.
   c. Architectural schedule changes.

C. Changes made by Field Order, Change Order, design modification, and RFI.

D. Details not indicated on the original Contract Drawings.

E. Specifications - legibly mark each Section to record:

1. Manufacturer, trade name, catalog number, and Supplier of each product and item of equipment actually installed.

2. Changes made by Field Order, Change Order, RFI, and approved shop drawing.

3.04 SUBMITTAL

A. Upon substantial completion of the Work and prior to final acceptance, the Contractor shall finalize and deliver two complete sets of Record Drawings to the Owner/Engineer conforming to the construction records of the Contractor. The set of drawings shall consist of corrected and annotated drawings showing the recorded location(s) of the work. Record Drawings shall be in the form of a set of prints with annotations carefully and neatly superimposed on the drawings in red.

B. The information submitted by the Contractor into the Record Drawings and Record Documents will be assumed to be correct, and the Contractor shall be responsible for the accuracy of such information, and shall bear the costs resulting from the correction of incorrect data.

C. Contractor shall place a certification statement and signature on the Record Drawings certifying that "All locations of piping, structures, and appurtenances are accurately shown and dimensioned on these record Drawings."

D. Delivery and Approval of Record Drawings and Record Documents to the Owner/Engineer will be a prerequisite to Final payment.

E. The Contractor shall maintain a copy of all books, records, and documents pertinent to the performance under this Agreement for a period of five years following completion of the contract.

END OF SECTION

SECTION 01730
OPERATION AND MAINTENANCE MANUALS AND VENDOR TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section includes general procedural requirements for compiling and submitting operation and maintenance manuals and data required to complete the project.

B. Specific requirements for operation and maintenance manuals and data are included in the individual technical specifications.

1.02 RELATED WORK

A. Submittals are included in Section 01300.

B. Contract closeout is included in Section 01740.

C. Warranties and Bonds are included in Section 01735.

D. CMMS integration is included in Section 01980.

1.03 OPERATING MANUALS

A. Provide specific operation and maintenance instructions for all electrical, mechanical, and instrumentation & controls equipment furnished under various technical specifications Sections.

B. Separate manuals shall be provided for each type of equipment, or each Section number. Each manual shall contain the following:

1. Format and Materials shall include:

a. Commercial quality three ring binders with durable and cleanable plastic covers

b. Maximum ring width capacity: 3 inches

c. When multiple binders are used, correlate the data into related consistent groupings/volumes.

d. Identify each volume on the cover and spine with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". Include the following:

1) Title of Project.

2) Identify the general subject matter covered in the manual.

3) Identify structure(s) and/or location(s), of the equipment provided.

4) Specification Section number.

e. 20 lb. loose leaf paper, with hole reinforcement

f. Page size: 8-1/2 inch by 11-inch

g. Provide heavy-duty section separators, matching the table of contents, for each separate product, each piece of operating equipment, and organizational sections of the manual.

h. Provide reinforced punched binder tab; bind in with text.

i. Reduce larger drawings and fold to the size of text pages - but not larger than 11 inches x 17 inches - or provide a suitable clear plastic pocket (with drawing identification) for such folded drawings/diagrams.

2. Contents: Prepare a table of contents/Index, divided into sections reflective of the major components provided. Specific description of each system and component shall be identified in three parts as follows:

a. Part 1: Directory

1) Name, address, telephone number(s) and e-mail address(es) of vendor(s) and local service representative(s) of manufacturer or supplier, Contractor, Subcontractors, and major related equipment suppliers.

b. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. Identify the following:

1) Significant design criteria.

2) List of equipment.

3) Parts list for each component.

4) Specific on-site operating instructions (including starting and stopping procedures).

5) Project specific operational procedures and recommended log sheet(s).

6) Maintenance instructions for equipment and systems.

7) Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

8) Safety considerations.

9) Manufacturer's operating and maintenance instructions – specific to the project.

10) Copy of each wiring diagram.

c. Part 3: Project documents and certificates, including the following:

1) Air and water balance reports.

2) Certificates.

3) Copy of approved shop drawing(s) and Contractor's coordination/layout drawing(s).

4) List of spare parts and recommended quantities.

5) Product Data: Mark each sheet to clearly identify specific products and component parts and data applicable to installation. Delete inapplicable information.

6) Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

7) Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified.

8) Warranties and Bonds, as specified in the General Conditions.

3. Transmittals

a. Prepare separate transmittal sheets for each manual. Each transmittal sheet shall include at least the following: Contractor's name and address, Owner's name, project name, project number, submittal number, description of submittal and number of copies submitted.

b. Submittals shall be transmitted or delivered directly to the office of the Owner/Engineer, as indicated in the Contact Documents or as otherwise directed by the Owner/Engineer.

c. Provide copies of transmittals (only, i.e., without copies of the respective submittal) directly to the Owner/Engineer.

C. Manuals for Equipment and Systems - In addition to the requirements listed above, for each System, provide the following:

1. Overview of system

a. Description of unit or system and component parts

b. Identify function, normal operating characteristics and limiting conditions.

c. Include legible performance curves, with engineering data and tests.

d. Complete nomenclature and commercial number of replaceable parts.

2. Panel board circuit directories including electrical service characteristics, controls and communications and color-coded wiring diagrams as installed.

3. Wiring Diagrams as Installed

4. Operating procedures: include start-up, break-in and routine normal operating instructions and sequences; regulation, control, stopping, shut-down and emergency instructions; and summer, winter and any special operating instructions.

5. Maintenance Requirements:

    a. Procedures and guides for trouble-shooting; disassembly, repair, and reassembly instructions.

    b. Alignment, adjusting, balancing and checking instructions.

    c. Servicing and lubrication schedule and list of recommended lubricants.

    d. Manufacturer's printed operation and maintenance instructions.

    e. Sequence of operation by instrumentation and controls manufacturer.

    f. Original manufacturer's parts list, illustrations, assembly drawings and diagrams required for maintenance.

    g. Control diagrams by controls manufacturer as installed (as-built).

    h. Contractor's coordination drawings, with color coded piping diagrams, as installed (as-built).

    i. Charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams. Include equipment and instrument tag numbers on diagrams.

    j. List of original manufacturer's spare parts and recommended quantities to be maintained in storage.

    k. Test and balancing reports, as required.

    l. Additional Requirements as specified in individual product specification.

    m. Design data for systems engineered by the Contractor or its Suppliers.

D. Electronic Transmission of O&M Manuals

1. Unless otherwise approved by the Owner/Engineer, O&M manuals may be transmitted by electronic means including CD-ROM or USB flash drive. Electronic O&M manuals shall meet the following conditions:

    a. The above-specified transmittal form is included.

b. All other requirements specified above have been met, including, but not limited to, coordination by the Contractor, review and approval by the Contactor.

c. The submittal contains no pages or sheets large than 11 x 17 inches.

d. With the exception of the transmittal sheet, the entire submittal is included in a single file.

e. Files are Portable Document Format (PDF) – with the printing function enabled.

f. All scanned manufacturer's O&M manuals must be quality checked after scanning to ensure the page are not crooked and all information is legible.

2. When electronic copies are provided, transmit two hard copy (paper) originals to the Owner/Engineer with an electronic copy on CD-ROM.

3. The electronic copy of the O&M manual must be identical in organization, format and content to the hard copies of the manual.

4. The electronic O&M Manual must be bookmarked identically to the paper manual table of contents to allow quick access to information. Electronic submittals that require extensive scrolling will not be accepted. The document must be indexed and searchable.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL SCHEDULE

A. Operation and maintenance manuals shall be delivered directly to the office of the Owner/Engineer, as follows:

1. Provide preliminary copies of each manual to the office of the Owner/Engineer, no later than 30 days following approval of the respective shop drawings.

2. Provide final copies of each completed manual prior to testing.

3. Provide a letter that grants the Engineer and Owner to the limited right to use and reproduce each manual (in it its entirety or any portion thereof) from the respective equipment manufacturer(s). Such limited right shall allow the Engineer and Owner to use each manual or and portion thereof for:

a. The potential assembly of a comprehensive facility operation and maintenance manual for the sole benefit of the Owner; and, supplemental training of the Owner's personnel and operators, over and above the required vendor's training, regarding operation of the facility as a system.

B. The Owner/Engineer will review Operation and Maintenance manuals submittals for operating equipment for conformance with the requirements of the applicable specification Sections.

C. If during test and start-up of equipment, any changes were made to the equipment, provide two hard copies of as-built drawings or any other amendments for insertion, by the contractor, in the previously transmitted final manuals. In addition, provide one revised electronic version including the as-built drawings and any other amendments. The manuals shall be completed, including updates, if any, within 30 days of start-up and testing of the facility.

3.02 VENDOR TRAINING/INSTRUCTIONS (TO OWNER'S PERSONNEL) (NOT USED)

END OF SECTION

(Attached is referenced in this specification in section 3.01.B)

O&M Manual Review Checklist

Submittal No.: _____

Project No.: _____

Manufacturer: _____

Equipment Submitted: _____

Specification Section: _____

Date of Submittal:

	General Data	
1.	Are the area representative's name, address, e-mail address and telephone number included?	
2.	Is the nameplate data for each component included?	
3.	Are all associated components related to the specific equipment included?	
4.	Is non-pertinent data crossed out or deleted?	
5.	Are drawings neatly folded and/or inserted into packets?	
6.	Are all pages properly aligned and scanned legibly?	
7.	Is the .PDF document bookmarked according to the table of contents?	
	Operations and Maintenance Data	
8.	Is an overview description of the equipment and/or process included?	
9.	Does the description include the practical theory of operation?	
10.	Does each equipment component include specific details (design characteristics, operating parameters, control descriptions, and selector switch positions and functions)?	
11.	Are alarm and shutdown conditions specific to the equipment provided on this project clearly identified? Does it describe possible causes and recommended remedies?	
12.	Are step procedures for starting, stopping, and troubleshooting specific to the equipment provided included?	
13.	Is a list of operational parameters to monitor and record specific to the equipment provided included?	
14.	Is a proposed operating log sheet specific to the equipment provided included?	
15.	Is a spare parts inventory list included for each component?	
16.	Is a lubrication schedule for each component specific to the equipment provided included - or does it clearly state “No Lubrication Required"?	
17.	Is a maintenance schedule for each component specific to the equipment provided included?	
18..	Is a copy of the warranty information included?	

Review Comments

Is the submittal fully approved (yes/no)? _____

If not, the following points of rejection must be addressed and require resubmittal by the Contractor:

Item No.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14, _____
15. _____

Reviewed By: _____ Date: _____

Legend

1 = OK

2 = Not Adequate

3 = Not Included

Note: This submittal has been reviewed for compliance with the Contract Documents.

SECTION 01735
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies general administrative and procedural requirements for warranties and bonds required by the Contract Documents, including manufacturer's standard warranties on products and special warranties.

1.02 RELATED WORK

A. Refer to Conditions of Contract for the general requirements relating to warranties and bonds.

B. General closeout requirements are included in Section 01740.

C. Specific requirements for warranties for the work and products and installations that are specified to be warranted are included in the individual Sections.

1.03 SUBMITTALS

A. Submit written warranties to the Owner prior to Substantial Completion. If the Certificate of Substantial Completion designates a commencement date for warranties other than the date of Substantial Completion for the work, or a designated portion of the work, submit written warranties upon request of the Owner.

B. When a designated portion of the work is completed and occupied or used by the Owner, by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Owner within [15] days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner for approval prior to final execution.

D. Refer to individual Sections for specific content requirements, and particular requirements for submittal of special warranties.

E. When operating and maintenance manuals are required for warranted construction, provide additional copies of each required warranty, as necessary, for inclusion in each required manual.

F. The Engineer shall provide a list of all required Warranties to the Contractor at the time of the Pre-Construction Conference. The Contractor shall verify that all warranties on that list have been submitted to the Owner prior to Substantial Completion. The Contractor is required to submit all warranties requested in the Contract Documents, whether or not the Engineer has included the warranty on the list.

1.04 WARRANTY REQUIREMENT

A. Related Damages and Losses: When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

B. Reinstatement of Warranty: When work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that work covered by a warranty has failed, replace or rebuild the work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether the Owner has benefited from use of the work through a portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to the Owner are in addition to implied warranties, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.

E. Rejection of Warranties: The Owner reserves the right to reject warranties and to limit selections to products with warranties not in conformance with requirements of the Contract Documents.

F. For a period of at least one year after the date of substantial completion of the contract the contractor warrants the fitness and soundness of all work done and materials and equipment put in place under the contract. Neither the, certificate of substantial completion, certificate of final acceptance, payment of the final application for payment, nor any provision in the Contract Documents, not partial or entire occupancy of the premises by the City shall constitute an acceptance of work not done in accordance with the Contract Documents, nor relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship.

G. The Contractor shall remedy any defects in the work and pay for any damage to work resulting therefrom, which shall appear within a period of one year from the date of final acceptance of the work ***unless a longer period is specified***. The City will give notice of observed defects with reasonable promptness."

H. The one-year warranty descried herein shall be in addition to all other warranties required in the Contract Documents. The one-year warranty extended herein shall not limit, alter or prejudice any other right or remedy available to the Owner under the Contract Documents or granted by law. All of the Owner's rights under this one-year warranty are cumulative, and in addition to, all other rights and remedies under the contract.

I. The Contractor shall bear the cost of correcting destroyed or damaged construction, whether completed or partially completed, of Work which is not in accordance with the requirements of the Contract Documents. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner, the Owner may correct it and charge the Contractor all costs related to correcting the Work.

J. The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual performance of the Work. The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor.

K. The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

L. Establishment of the one-year period for correction of Work relates only to the specific obligation of the Contractor to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations other than specifically to correct the Work.

1.05 MANUFACTURERS CERTIFICATIONS

A. Where required, the Contractor shall supply evidence, satisfactory to the Owner/Engineer, that the Contractor can obtain manufacturers' certifications as to the Contractor's installation of equipment.

1.06 DEFINITIONS

A. Standard Product Warranties are preprinted written warranties published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.

B. Special Warranties are written warranties required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties or to provide greater rights for the Owner.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01740
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK

A. This Section specifies administrative, verification and procedural requirements for project closeout, including but not limited to:

1. Operation & Maintenance data and Manuals, instrumentation and control adjustments in Section 01730 and in Sections in Divisions 9 through 16.

2. Project Record Documents in Section 01720.

3. Spare parts and maintenance materials (spare paint, lubricants, special tools) in Sections in Divisions 9 through 16.

4. Record Shop Drawings in Section 01300.

5. Warranties, guarantees, and bonds in Section 01735 and applicable Sections in Technical Divisions 10 through 16.

6. Reconciliation of final accounting, final change order, final payment application in Sections 01026 and 01035.

7. As-built construction schedule in Section 01310.

8. Permit close-outs including Certificate of Occupancy or Certificate of Completion.

1.02 CLOSEOUT PROCEDURES

A. Provide all deliverables as specified above, prior to submitting the final application for payment.

B. Verify that the Contractors Shop Drawing log, testing log (field tests, shop tests, and performance tests), warranties list, and material samples list is consistent with that of the Engineer.

C. Provide submittals to Owner/Engineer that are required by governing or other authorities having applicable jurisdiction including but not limited to permit close out information, certificates of occupancy, etc.

D. Submit Certificate of Occupancy or Certificate of Completion to the Owner.

E. Submit Application for Final Payment identifying total adjusted Contract Sum, previous payments and sum remaining due, following submittal and approval of Record Documents and Record Drawings.

F. Submit Contractor's Final Release and Release of Liens with final payment application.

1.03 FINAL CLEANING

A. Contractor to complete final cleaning prior to submittal of the final application for payment. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Remove from the project site all temporary construction facilities (those used for both the Contractor and Engineer) as specified in Section 01500. Remove tools, construction equipment, machinery, and surplus material from Project site.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

D. Provide final cleaning by a professional service company if project is located in a building or facility. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturers written instructions. Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces. Complete the following cleaning operations for all buildings or facilities worked on as part of the Project before requesting inspection for certification of Substantial Completion for entire Project of for a portion of the Project:

1. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

2. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches equipment vaults, manholes, attics, and similar spaces.

3. Sweep concrete floors broom clean in unoccupied spaces.

4. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.

5. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.

6. Remove labels that are not permanent.

7. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration. Remove any rust from areas. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.

8. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment.

9. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

10. Replace parts subject to unusual operating conditions.

11. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

12. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills. Clean ducts, blowers, and coils if units were operated without filters during construction.

13. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

14. Leave Project clean and ready for occupancy.

E. For pipeline projects, clean Project site, yard, streets, parking areas, easement areas, grounds, landscaped areas, and all other areas disturbed by construction activities. Remove rubbish, waste material, litter, and other foreign substances.

1. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.

2. Rake grounds that are neither planted nor paved to a smooth even textured surface.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01980
CMMS INTEGRATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Cityworks, by Azteca, is the computerized maintenance management system (CMMS) currently being used by the City of Columbia to track asset- and maintenance-management information. Assets provided as part of this Contract, both installed and designated as spare parts, will be maintained within the CMMS and as such the Contractor shall provide all required attribute and maintenance data as defined below. For the purposes of this specification, an asset is a piece of equipment or associated structure provided by the Contractor within the scope of this Contract for which the manufacturer specifies maintenance tasks.

B. The data as specified herein will be used by the City of Columbia to integrate the new assests and their corresponding preventive maintenance schedules into the Cityworks asset database in advance of the assets being put into use.

C. The Contractor shall provide an Equipment List identifying the type and quantity of assets to be provided and for which assets contracted maintenance is included in the project. The electronic template spreadsheet will be provided to the Contractor following Contract award and the Contractor shall submit the completed spreadsheet to the Owner/Engineer for approval.

D. The Contractor shall assemble all manufacturer asset data and preventive maintenance recommendations for all assets into spreadsheets as described below. Electronic template spreadsheets will be provided to the Contractor following Contract award and the Contractor shall submit the competed spreadsheets to the Owner/Engineer for approval.

1.02 SUBMITTALS

A. Equipment List. Contractor shall submit to Owner/Engineer the information detailed below in the format specified in the spreadsheet template at the Preconstruction Meeting. To facilitate Contractor's preparation of the Asset and Preventive Maintenance Data files, the Equipment List will be reviewed with Owner representatives to confirm the relevant equipment and to what equipment tab each asset maps. The date of the review will be established by the Owner at the Preconstruction Meeting.

B. Asset and Preventive Maintenance Data Files. Contractor shall submit to the Owner/Engineer the information detailed below in the format specified in the spreadsheet templates no later than 60 days prior to Owner-approved scheduled startup testing of any asset. Contractor shall include a milestone for delivery of the Asset Data and Preventive Maintenance Data file submittal in the construction schedule. If the submittal is found to be incomplete or incorrect, the Owner/Engineer may delay the scheduled startup until such time as the Contractor has corrected the deficient submittal and the Owner/Engineer has had adequate time to properly review the resubmittal, all at no additional cost to the Owner.

C. Submitted spreadsheets must be prepared using Microsoft Excel (.xlsx). The templates contain data validation and defined lists that are to remain intact.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.01 EQUIPMENT LIST

A. The Contractor shall provide the following information for each type of asset included in the project using the Excel template to be provided for this, 01980AttachmentA_EquipList. The filename of the related submission is to follow the convention SSxxxx_EquipList_mmddyyyy, where xxxx is the project number and mmddyyyy is the date of submission.

- Type of equipment
- Quantity of that type of equipment to be provided
- Indication of whether or not contracted maintenance is included in the project for that equipment type
- Description of any contracted maintenance included in the project, as included in the specification for that equipment type
- Specification Section number for the equipment type

B. Prior to Contractor starting to identify the Asset and Preventive Maintenance data as described in 3.02 and 3.03, the Contractor shall initiate review of the Equipment List with Owner representatives to accomplish the following:

- Confirm which assets are to be included in the Asset and Preventive Maintenance Data files.
- Identify which equipment type tab in the Asset Data Template is to be used for each equipment type; this will be noted in the Equipment List file as part of the review.

3.02 ASSET INFORMATION

A. The Contractor shall be responsible for providing asset data and preventive maintenance recommendations for all equipment within this project specified for the following systems:

1. Division 2 - Sitework
2. Division 11 - Process Equipment
3. Division 15 - Mechanical

B. For each of the assets provided in the Contract, the Contractor shall provide all required attribute data for each and every asset included as part of the individual Asset Type. The asset attributes required vary by asset type. The Excel template to be provided to the Contractor, 01980AttachmentB_AssetDataTemplate, will include a tab for each asset type, the current set of which are shown below, specifying all associated attribute data and will contain instructions. The filename of the related submission is to follow the convention SSxxxx_AssetData_mmddyyyy, where xxxx is the project number and mmddyyyy is the date of submission.

Equipment Asset Types
Fabricated Slide Gates

3.03 MAINTENANCE INFORMATION

A. The Contractor shall be responsible for providing all preventive maintenance tasks recommended by the equipment manufacturers to the Owner/Engineer for all assets described above.

B. All required CMMS integration spreadsheets with asset attribute data and preventive maintenance tasks shall be submitted to the Owner/Engineer as required in Section 01730. All spreadsheets shall be approved by the Owner/Engineer prior to startup of any asset.

C. The Contractor shall provide this information in the Preventive Maintenance Data file, 01980AttachmentC_PrevMaintDataTemplate Excel file provided to the Contractor. The Contractor shall provide a separate tab for each unique Asset/Asset Subtype/Manufacturer/Model/Part # combination. The filename of the related submission is to follow the convention SSxxxx_MaintenanceData_mmddyyyy, where xxxx is the project number and mmddyyyy is the date of submission.

D. Required maintenance information is as follows:

- Asset Type
- Asset Subtype – selected from list specific to each asset type, where applicable
- Manufacturer
- Model
- Part number
- Source Document Title – Operation & Mainteance (O&M) Manual or other document referencing the required maintenance tasks
- Source Document Page Number - O&M Manual or other document page number referencing the required maintenance tasks
- Section number – specification section number
- Section title – specification section title
- Task number – a unique sequential number for assigned to eash maintenance task
- Task Description – a unique description of the maintenance activity
- Company Contracted to Maintain – name of company that will be providing maintenance services as part of the project as applicable
- Estimated Standard Hours – suggested number of hours required to perform the task
- Whether or not the task is required to maintain manufacturer’s warranty on the asset
- Frequency – manufacturer’s recommended frequency of the maintenance task as indicated by a checkmark in the appropriate column or indication runtime duration if runtime dependent.

E. The spreadsheet template to be provided to the Contractor and submitted preventive maintenance tasks will be in the format as shown below. The template includes a summary tab to reference the individual task tab names.

Asset Type:
Asset Subtype:
Manufacturer:
Model:
Part #:

Source:
Source page #:
Section #:
Section Title:

Task #	Task Description	Company Contracted to Maintain	Estimated standard hours	Req for Wty?	Frequency (times/year)									Frequency (runtime dependent)
					365	52	12	6	4	2	1	0.33	0.2	
				Y/N	D	W	M	BIM	Q	SA	A	3 YRS	5 YRS	
1	[xxx]													
2	[xxx]													
3	[xxx]													
4	[xxx]													
5	[xxx]													
6	[xxx]													
7	[xxx]													
8	[xxx]													
9	[xxx]													
10	[xxx]													
11	[xxx]													
12	[xxx]													
13	[xxx]													
14	[xxx]													
15	[xxx]													
[nn]	[xxx]													

END OF SECTION

SECTION 01990
GIS DATABASE UPDATE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Gather and provide data to the Owner/Engineer to update and modify the Owner's geographic information system (GIS) dataset (geodatabase).

B. The data to be updated shall encompass the sewer system features contained within the Owner's existing GIS (e.g. manholes, sewer pipes, etc.).

C. The data updates shall include the physical asset attribute information and locations collected by the Contractor as part of the utilizing the related specifications listed herein. Data shall be collected and submitted to the Owner/Engineer in the format described herein.

D. The data collected and submitted as a part of this specification only relates to new assets that are found in the field by the Contractor during work and/or investigation, or major discrepancies found during work and/or investigation from the information provided to the Contractor of asset location or information. This includes manholes that could not be previously located, could not be accessed, or new manholes or assets found in the field. The information provided by the Contractor to the Owner/Engineer for these items will be utilized by the Owner/Engineer to update the Owner's existing GIS.

E. All data submittals are independent of project record drawings.

1.02 RELATED WORK

A. Measurement and Payment is specified in Section 01025.

B. Cured-in-place Pipe Lining is specified in Section 02765.

C. Manhole Rehabilitation is specified in Section 02763.

D. Sanitary Sewer Flow Control is specified in Section 02767.

E. Pre-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02732.

F. Pipe Bursting Sewer Replacement with HDPE is specified in Section 02777

G. Post-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02733.

H. Database Template Description PACP is specified in Section 02734.

I. PVC and DI Point Repairs on Gravity Pipe is specified in Section 02766.

J. Sewer Line Cleaning Prior to CCTV and Rehabilitation Work is specified in Section 02650.

1.03 SUBMITTALS

A. Contractor must submit to the Owner/Engineer data for new assets that were found in the field during work and/or investigation, or discrepancies found during work and/or investigation. These should be submitted in the format described below, on a monthly basis on the same schedule as the other work being performed that result in data deliveries from the Contractor.

1.04 DATA FORMAT AND DESCRIPTION

A. All coordinates obtained will be provided in South Carolina State Plane Coordinates (NAD 1983 HARN, International Feet) and all elevations will be provided to the Owner in NAVD '88 datum.

B. All coordinate data collected will be accurate to within 0.15' (fifteen-hundredths of a foot) to meet the latest Standards of Practice Manual for Land Surveying in South Carolina as published by SCLLR.

C. At the completion of the field surveying activities, surveyor will prepare a surveyor's report containing quantity counts of the items surveyed and a narrative describing the survey procedures used. The final report will be signed and sealed by a licensed land surveyor in the state of South Carolina. This report shall be submitted to the Owner/Engineer in PDF format along with the data in the format below.

D. Information to be submitted to the Owner/Engineer shall be in an Excel or GIS format. If submitted with GIS, coordinate with Owner/Engineer for acceptable format. If submitted in Excel, version must be an Excel version 97-2003 Workbook (.xls) and each asset type collected should be separated in workbook as different sheets. Each new asset found shall be surveyed and the following information shall be captured at a minimum (all measurements must be in feet unless specified otherwise and depths should be collected to the nearest tenth of a foot).

1. Asset type (coordinate with Owner/Engineer for allowed types)
2. X coordinate of asset (Easting)
3. Y coordinate of asset (Northing)
4. Date of GPS survey (mm/dd/yyyy)
5. Asset ID (use Owner approved naming convention)
6. Elevation of Manhole (manhole rim, cleanout cap, etc.)
7. Ground Elevation at Manhole
8. Depth of Manhole (measured from rim to invert)
9. Invert Elevation of Manhole (Manhole Rim Elevation – Manhole Invert Depth)
10. Clock position of pipes coming in/out (out pipe should always be 6'oclock position with every other pipe clocked in the clock-wise direction)

11. Invert Elevations of pipes coming in/out

12. Depths of pipes coming in/out (calculated, Manhole Rim Elevation – Pipe Invert Elevation)

13. Sizes of pipes coming in/out (inches)

14. Material of pipes coming in/out

15. Asset ID of Pipes coming in/out (use Owner approved naming convention)

16. Flow Condition of Asset (Dry, Light, Heavy or Full)

17. Evidence of surcharge (Yes/No)

1.05 PHOTOGRAPHS

A. A minimum of 1 photo of the overall asset shall be taken and any additional photos as directed by the Owner/Engineer, and shall be named as follows depending on the type of photo(s) taken:

1. Close-Up Photo: Structure ID, "C", Date, Photo Number, JPG
Example: 01673MH_C_YYYYMMDD_0001.JPG
(01673MH = structure ID; A=close-up indicator; YYYYMMDD=8-digit date; 0001= image index)

2. Area Photo (1): Structure ID, "A", Date, Photo Number, JPG
Example: 01673MH_A_YYYYMMDD_0001.JPG

(01673MH = structure ID; A=area indicator; YYYYMMDD=8-digit date; 0001= image index)

3. Upstream Photos (2): Structure ID, "US", _1(_2,_3 etc),Date, Photo Number, JPG
Example: 01673MH_US_1_YYYYMMDD_0001.JPG

(01673MH = structure ID; US=direction indicator; _1 (_2,_3, etc)=upstream pipe number; YYYYMMDD=8-digit date; 0001= image index)

In the case where there is more than one upstream pipe, each set of upstream pipe photos shall be labeled with its corresponding pipe number, with pipe number 1 being the first pipe from the downstream pipe in a clockwise direction. Additional upstream pipes shall be numbered in sequential order from the downstream pipe in a clockwise position as _1,_2, etc.

4. Downstream Photo (3): Structure ID, "DS", Date, Photo Number, JPG
Example: 01673MH_DS_YYYYMMDD_0001.JPG

(01673MH = structure ID; DS=direction indicator; YYYYMMDD=8-digit date; 0001= image index)

In the rare circumstance where there is more than one downstream pipe, only each additional downstream pipe shall be labeled with its corresponding pipe number, with

pipe number 1 being the first pipe from the main downstream pipe in a clockwise direction. Additional upstream pipes shall be numbered in sequential order from the downstream pipe in a clockwise position as _1,_2, etc. The number shall be added after the DS designation as _1, etc.

5. Internal Photo: Structure ID, "I", Date, Photo Number, JPG
   Example: 01673MH_I_YYYYMMDD_0001.JPG

   (01673MH = structure ID; I=internal indicator; YYYYMMDD=8-digit date; 0001= image index)

6. Structure Defect Photo: Structure ID, "M", Date, Photo Number, JPG
   Example: 01673MH_M_YYYYMMDD_0015.JPG

   (01673MH = structure ID; M=defect indicator; YYYYMMDD=8-digit date; 0015= image index)

7. Pipe Photo: Direction, Structure ID, "P", Date, Photo Number, JPG
   Example: IN_01673MH_01674MH_P_YYYYMMDD_0002.JPG

   (IN (or OUT) = direction of pipe relative to access structure; 01673MH_01674MH = structure ID for pipe comprised of upstream structure ID_downstream structure ID; P=pipe photo indicator; YYYYMMDD=8-digit date; 0002= image index) See Section 3.07 G for naming of parallel pipes between identical upstream and downstream structures.

B. In all filenames, the image index allows multiple images to be taken sequentially from 0001, 0002, 0003, etc. If site is revisited for the same intended purpose (ie, pre-rehab manhole inspection), the indexing shall continue where previous visit's image indexing ended plus an index value of 1.

C. Image indexes are cumulative for each same photo type within the same inspection, but not for different photo types belonging to the same inspection. For example, for a particular inspection, the area photo index would begin at "0001", the defect photo would also begin at "0001", and so on. A second area photo would be 0002 within this same inspection. Multiple upstream pipes shall be treated as separate photo types, with each pipe shall have photos starting with 0001. Numbers should be sequential starting with 0001 for all photo types for each inspection.

D. During the inspection work, if a previously unknown asset is found, it shall be named following the Owner's unique asset numbering system as directed by the Owner and as described in this and the related work specifications.

PART 2 NO USED

PART 3 EXECUTION

A. Contractor shall insert a measuring rod into the interior of the manhole to verify rim to invert distance measurements of the manhole, as well as the invert and size of each adjoining pipe.

B. Contractor shall capture and provide X, Y, and Z coordinates and elevations with survey-grade accuracy, as well as other asset information required as described in the specifications.

C. Contractor is solely responsible for all damages resulting from operations.

D. As part of this process the Contractor will identify and correct flow and connectivity issues within the dataset as well as any data gaps or missing/inconsistent data values as directed by the Owner/Engineer.

END OF SECTION

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DIVISION 02

SITEWORK

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SECTION 02011
TEST PITS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work specified in this Section includes the excavation of exploratory test pits to determine or verify underground utility or structure locations or other purposes.

B. Test pit excavation under this Section shall be made where indicated on the Contract Drawings or as ordered by the Owner/Engineer. The Work shall include all necessary excavating, disposing of excavated material, backfilling and compaction, paving, and all incidental Work required. Any test pit performed by Contractor at locations not shown, or not as directed by the Owner/Engineer shall be at no additional cost to Owner.

C. This Item of Work is not intended for the general use of the Contractor to verify the location of underground utilities, structures or service connections for the Work shown on the Contract Drawings. The cost of any such Work shall be included in the appropriate Bid Item for permanent Work.

1.02 RELATED WORK

A. Section 01046, Control of Work

B. Section 01320, Construction Photographs

C. Section 02200, Earthwork

D. Section 02510, Asphalt Paving, Markings and Appurtenances

PART 2 PRODUCTS

2.01 TRENCH REFILL MATERIALS

A. Refer to Section 02200.

2.02 PAVEMENT

A. Refer to Section 02510, Asphalt Paving, Markings and Appurtenances.

PART 3 EXECUTION

3.01 GENERAL

A. Test pits for the purpose of identifying any conflicts with underground pipelines or structures shall be excavated within thirty (30) days of the Notice to Proceed, and in advance of the actual construction at locations shown on the Contract Drawings and as ordered by the Engineer and as specified below.

B. If the test pit is located in the trench limits, temporary pavement is required. If the test pit is located outside the trench limits, permanent restoration is required, including permanent pavement.

C. The existing pavement and/or sidewalks to be removed and existing pavement and/or sidewalks to remain shall be carefully saw cut to leave a smooth, straight and vertical edge. Test pits are to be as small as possible while maintaining worker safety. Test pits are to be backfilled and compacted immediately after their purpose has been satisfied and the surface restored and maintained in a manner satisfactory to the Owner/Engineer.

D. Material shall be carefully excavated so that the underground utility or structure being searched for, or any other utility or structure, will not be damaged or destroyed. Excavation shall be with a hand shovel if conditions so warrant and hand excavation will be required within two (2) feet of any utility. Any utility or structure damaged or destroyed shall be replaced or repaired at no additional cost to the Owner.

E. Support of the excavation and dewatering shall be sufficient to accomplish the purpose of the test pit and be in conformance, where required, with other applicable Sections of these Specifications.

F. The Contractor shall be responsible for having all utilities marked in the area prior to digging a test pit.

G. The test pit shall be backfilled in accordance with the requirements of Section 02200.

H. If the test pit is within paved areas, it shall be repaved in accordance with Section 02510, unless located within the trench and excavation work is proposed within seven (7) days.

I. The Contractor shall submit field sketches and digital photographs (close up and some distance away to show relative location) of each Test Pit completed. Field Sketches shall contain elevations of pipe and duct bank inverts and/or crowns, elevations (top and bottom), sizes, locations (horizontal and vertical) from a known point (curb, etc.) and materials of all observed utilities or other obstructions within the trench limit. Test Pits shall be numbered and kept on file with as-built drawings.

3.02 SERVICE CONNECTION OR UTILITY VERIFICATION

A. Test pits may be carried out to verify the location and type of service connections or utilities or for other purposes as requested by the Owner/Engineer.

B. Test pits at gas main crossings shall be utilized to determine if the crossing can be made at the location indicated on the plans.

END OF SECTION

SECTION 02050
DEMOLITION, ABANDONMENT AND SALVAGE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Work specified in this Section includes furnishing all labor, materials, equipment and incidentals required to demolish, abandon, modify, remove, salvage, and dispose of Work shown on the Contract Drawings and as specified herein.

B. Included, but not limited to, are demolition, modifications, abandonment, and removal of existing materials, equipment or Work necessary to install the new Work as shown on the Contract Drawings and as specified herein and to connect with existing Work in approved manner.

C. Demolition, modifications and removals which may be specified under other Sections shall conform to requirements of this Section.

D. All items designated on the Contract Documents to be removed and salvaged shall be turned over the Owner and delivered to a site within the City of Columbia as directed by the Owner. All items indicated for demolition but not indicated for salvage shall be disposed of by the Contractor.

E. Blasting and the use of explosives will not be permitted for any demolition Work.

1.02 RELATED WORK

A. Section 01010, Summary of Work

B. Section 01300, Submittals

C. Section 02100, Site Preparation

D. Section 02200, Earthwork

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Section 01300, proposed methods and operations of demolition of the structures and modifications prior to the start of Work. Include in the schedule the coordination of shutoff, capping and continuation of utility service as required.

B. Furnish a detailed sequence of demolition and removal Work to ensure the uninterrupted progress of the Owner's operations. Sequence shall be compatible with sequence of construction and shutdown coordination requirements as specified in Section 01014, Sequence of Work and Plant Operations During Construction.

C. Before commencing demolition Work, all modifications necessary to bypass the affected structure shall be completed. Actual Work shall not begin until the Owner/Engineer has inspected and approved the modifications and authorized commencement of the demolition Work in writing.

1.04 JOB CONDITIONS

A. Protection

1. Execute the demolition and removal Work to prevent damage or injury to structures, occupants thereof and adjacent features which might result from falling debris or other causes, and so as not to interfere with the use, and free and safe passage to and from adjacent structures.

2. Closing or obstructing of roadways, sidewalks and passageways adjacent to the Work by the placement or storage of materials will not be permitted and all operations shall be conducted with a minimum interference to traffic on these ways.

3. Erect and maintain barriers, lights, sidewalk sheds and other required protective devices.

B. Scheduling

1. Carry out operations so as to avoid interference with operations and Work in existing facilities.

C. Notifications

1. At least two weeks prior to commencement of any demolition or removal, confirm with the Owner/Engineer in writing of proposed schedule therefor. Owner/Engineer shall inspect the existing equipment and to identify and mark those Items which are to remain the property of the Owner. No removals shall be started without the permission of the Owner/Engineer.

D. Conditions of Structures

1. The Owner and the Engineer assume no responsibility for the actual condition of the structures to be demolished or modified.

2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur prior to the start of demolition Work.

E. Repairs to Damage

1. Promptly repair damage caused to adjacent facilities by demolition operation when directed by Owner/Engineer and at no cost to the Owner. Repairs shall be made to a condition at least equal to that which existed prior to construction.

F. Traffic Access

1. Conduct demolition and modification operations and the removal of equipment and debris to ensure minimum interference with roads, streets, walks both onsite and offsite and to ensure minimum interference with occupied or used facilities.

2. Special attention is directed towards maintaining safe and convenient access to the existing facilities by City Operations staff and associated vehicles.

3. Do not close or obstruct streets, walks or other occupied or used facilities without permission from the Owner/Engineer. Furnish alternate routes around closed or obstructed traffic in access ways.

1.05 RULES AND REGULATIONS

A. The Building Code of the State of South Carolina shall control the demolition, modification or alteration of the existing buildings or structures.

1.06 DISPOSAL OF MATERIAL

A. Salvageable material and equipment noted on the Contract Drawings shall become the property of the Owner at their option, otherwise it becomes property of the Contractor and Contractor will be responsible for proper disposal. Dismantle all such items to a size that can be readily handled and deliver them to a designated storage area as directed by the Owner/Engineer. Any such material damaged due to improper handling will not be accepted and the replacement value of the material deducted from the payment to the Contractor.

B. All other material and Items of equipment shall become the Contractor's property and must be removed from the site and be disposed of properly.

C. The storage or sale of removed Items on the site will not be allowed.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL

A. All materials and equipment removed from existing Work, shall become the property of the Contractor, except for those which the Owner has identified and marked for his/her use. All materials and equipment marked by the Owner to remain shall be carefully removed, so as not to be damaged, cleaned, protected and delivered to a place specified by the Owner/Engineer.

B. Dispose of all demolition materials, equipment, debris and all other Items not marked by the Owner to remain, off the site and in conformance with all existing applicable laws and regulations. The Owner/Engineer must approve any plans to reuse the material at another location.

C. Pollution Controls

1. Use water sprinkling, temporary enclosures and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.

   a. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding and pollution.

   b. Clean adjacent structures, facilities, and general Work area of dust, dirt and debris caused by demolition operations. Return adjacent areas to conditions existing prior to the start of the Work.

3.02 STRUCTURAL REMOVALS

A. Structures designated for demolition or removal shall be removed to a point 3 feet below existing grade, or greater if required to provide clearance for new pipelines or other utilities, including allowance for pipe/utility bedding. The portion of the structure that will remain below grade shall be cleaned of rubble and debris including exposed reinforcing steel, backfilled with crusher run material in accordance with specification Section 02200 (Earthwork) and graded to match the existing grade around the structure. All mechanical and electrical equipment and piping shall be removed from those structures prior to backfilling and grading.

B. Structural steel members shall be cut into sections of such weight and size as will permit convenient handling, hauling, and storage. Concrete to be demolished and removed shall be broken into pieces not greater than 24 inches in any dimension by methods reviewed by the Engineer.

C. Partial removal of structure walls and slabs shall be to the lines shown unless otherwise directed by the Owner/Engineer. Where no limits are shown, the limits shall be 4-in outside the Item to be installed. The removal of masonry beyond these limits shall be at the Contractor's expense and these excess removals shall be reconstructed to the satisfaction of the Owner/Engineer with no additional compensation to the Contractor.

D. All concrete, brick, tile, concrete block, roofing materials, reinforcement, structural or miscellaneous metals, plaster, wire mesh and other Items contained in or upon the structure shall be removed and taken from the site, unless otherwise approved by the Owner/Engineer. Demolished Items shall not be used in backfill.

E. After removal of parts or all of masonry walls, slabs and like Work which tie into new Work or existing Work, the point of junction shall be neatly repaired so as to leave only finished edges and surface exposed.

3.03 ABANDONMENT OF EXISTING PIPING AND MANHOLES

A. Existing piping and manholes designated for abandonment shall be removed from service, dewatered, and, if indicated on the Drawings, filled with flowable fill concrete. Where existing

piping and manholes are in active service by the Owner, the Contractor shall coordinate with Owner/Engineer to ensure all services have been relocated and/or abandoned prior to decommissioning of pipe and/or manhole. Provide the Owner ten (10) days notification prior to abandonment of existing piping and manholes.

3.04 ELECTRICAL REMOVALS (NOT USED)

3.05 CLEAN-UP

A. Remove from the site all debris resulting from the demolition operations as it accumulates. Upon completion of the Work, all materials, equipment, waste and debris of every sort shall be removed and premises shall be left, clean, neat and orderly.

END OF SECTION

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SECTION 02100
SITE PREPARATION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Work specified in this Section includes furnishing all labor, materials and equipment required and performing all site preparation, complete as shown on the Contract Drawings and as specified herein.

B. Obtain all permits required for site preparation Work prior to proceeding with the Work, including clearing and tree removal.

C. The areas to be cleared, grubbed and stripped within public rights-of-way and utility easements shall be minimized to the extent possible for the scope of Work and in consideration of the actual means and methods of construction used. No unnecessary site preparation within these areas shall be performed. No tree shall be removed unless specified, shown on the Contract Drawings or with prior permission of the Owner.

D. Contractor shall contact the appropriate regulatory authority and the Owner to review and approve any trees to be cut prior to starting any cutting.

1.02 RELATED WORK

A. Section 02050, Demolition and Modifications

B. Section 02200, Earthwork

C. Section 02930, Loaming, Seeding and Sodding

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Section 01300, copies of all permits required prior to clearing, grubbing, and stripping Work.

B. The proposed site for the disposal of material and debris from the site preparation shall be submitted for approval to the Owner/Engineer.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 CLEARING

A. Cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish and any other objectionable material resting on or protruding through the surface of the ground.

B. Preserve and protect trees and other vegetation designated on the Contract Drawings or directed by the Owner/Engineer to remain as specified below.

3.02 GRUBBING

A. Grub and remove all stumps, roots in excess of 1-1/2-in in diameter, matted roots, brush, timber, logs, concrete rubble and other debris encountered to a depth of 18-in below original grade or 18-in beneath the bottom of foundations, whichever is deeper.

B. Refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to a density conforming to the surrounding ground surface in accordance with Section 02200.

3.03 STRIPPING

A. Strip topsoil from all areas to be occupied by buildings, structures, and roadways and all areas to be excavated or filled.

B. Topsoil shall be free from brush, trash, large stones and other extraneous material. Avoid mixing topsoil with subsoil.

C. Stockpile and protect topsoil until it is used in landscaping, loaming and seeding operations. Dispose of surplus topsoil after all Work is completed.

3.04 DISPOSAL

A. Cut tree trunks and limbs exceeding 4-in in diameter shall be cut into 4-ft lengths and stockpiled on site in the area designated on the Contract Drawings or approved by the Owner/Engineer.

B. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved offsite disposal area. No rubbish or debris of any kind shall be buried on the site.

C. Burning of cleared and grubbed materials or other fires for any reason will not be permitted.

3.05 PROTECTION

A. Trees and other vegetation designated on the Contract Drawings or directed by the Owner/Engineer to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards and enclosures, or by other approved means. Conduct clearing operations in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the Work being constructed and so as to provide for the safety of employees and others.

B. Maintain protection until all Work in the vicinity of the Work being protected has been completed.

C. Immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the Work shall immediately be cut off cleanly inside the exposed or damaged area. Treat cut surfaces with an acceptable tree wound paint and topsoil spread over the exposed root area.

D. When Work is completed, remove all dead and downed trees. Live trees shall be trimmed of all dead and diseased limbs and branches. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches. Cuts over 1-inch in diameter shall be treated with an acceptable tree wound paint.

E. Restrict construction activities to those areas within the limits of construction designated on the Contract Drawings, within public rights-of-way, and within easements provided by the Owner. Adjacent properties and improvements thereon, public or private, which become damaged by construction operations, shall be promptly restored to their original condition, to the full satisfaction of the property Owner.

F. Construct as necessary based on the type of equipment to be used during the pipelines installations, an access road within the right of way to facilitate the construction activity.

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SECTION 02140
DEWATERING AND DRAINAGE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work specified in this Section includes Designing, furnishing, installing, operating, monitoring, maintaining and removing temporary dewatering and drainage systems as required to lower and control water levels to at least 2 feet below the lowest level of the excavation to permit construction in the dry. Contractor shall obtain and pay for all permits required for temporary dewatering and drainage systems

B. Furnish, maintain and remove temporary surface water control measures adequate to drain and remove surface water entering excavations.

C. Retain the services of a professional engineer registered in the State of South Carolina to prepare dewatering and drainage system designs and submittals described herein.

D. Work shall include the design, furnishing equipment and materials, installation, protection, and monitoring of geotechnical instrumentation required to monitor the performance of the dewatering and drainage system as required herein.

E. Collect and properly dispose of all discharge water from the dewatering and drainage systems in accordance with the provisions of this Section and Section 01046. Under no circumstances shall water from dewatering systems be discharged into the existing or new sanitary sewer systems.

F. Obtain and pay for all permits required for dewatering and drainage systems.

G. Repair damage caused by dewatering and drainage system operations.

1.02 RELATED WORK

A. Submittals are included in Section 01300

B. Control of Work is included in Section 01046.

C. Site Preparation is included in Section 02100.

D. Trenching, Backfilling and Compaction is included in Section 02200.

E. Fill and Backfill Materials are included in Section 02200.

F. Sedimentation and Erosion Control are included in Section 02270.

1.03 SUBMITTALS

A. Dewatering and drainage system designs shall be prepared by a licensed professional engineer retained by the Contractor. The Contractor shall submit an original and three copies of the licensed professional engineer's certification on the PE form specified in Section 01300. The Contractor shall also submit qualifications as required herein.

B. The Contractor shall submit a dewatering and drainage system design plan. The plan shall include a description of the proposed dewatering system and include the proposed installation methods to be used for dewatering and drainage system elements and for observation wells. The plan shall include equipment, drilling methods, holes sizes, filter sand placement techniques, sealing materials, development techniques, the number and location of dewatering points and observations wells, etc. Include the dewatering system design calculations in the plan.

C. The plan shall identify the anticipated area influenced by the dewatering system and address any impacts to adjacent existing and proposed structures. The submittal shall also include detailed plans for pre-construction surveys of existing structures in the vicinity of the dewatering system, settlement monitoring of existing structures during construction, and provisions to address settlement of existing structures resulting from dewatering activities.

D. Coordinate dewatering and drainage submittals with the excavation and support submittals. The submittal shall show the areas and depths of excavation to be dewatered.

E. Do not proceed with any excavation or dewatering activities until the dewatering submittals has been reviewed and approved by the Owner/Engineer.

F. If visible contaminants, odorous waste or any other potentially hazardous material is encountered during the dewatering process, the Contractor shall stop work and store the contaminated water in approved containers. Contractor shall develop disposal plan, to be approved by the Owner/Engineer before work can proceed. The Contractor shall make every effort to limit the environmental impact of the contaminants.

G. Preconstruction surveys as specified below.

1.04 QUALITY ASSURANCE

A. Regulations: Perform all work in accordance with current applicable regulations and codes of all Federal, State and local agencies.

B. The Contractor shall have at least 5 years of experience with work compatible to the Work shown and specified, employing labor and supervisory personnel who are similarly experienced in this type of Work.

C. The Contractor's design engineer shall be registered in the State of South Carolina and have a minimum of 5 years of professional experience in the design and construction of dewatering and drainage systems and shall have completed not less than 5 successful dewatering and drainage projects of equal type, size, and complexity to that require for the work.

1.05 DESIGN REQUIREMENTS

A. The Contractor is responsible for the proper design and implementation of methods for controlling surface water and groundwater.

B. The primary purpose of the groundwater control system is to preserve the natural undisturbed condition of the subgrade soils in the areas of the proposed excavations. Prior to excavation, the Contractor shall lower the groundwater to at least 2-ft below the lowest excavation subgrade elevation. Additional groundwater lowering may be necessary beyond the 2-ft requirement, depending on construction methods and equipment used and the prevailing groundwater and

soil conditions. The Contractor is responsible for lowering the groundwater as necessary to complete construction in accordance with the plans and specifications at no additional cost to the Owner.

C. Design deep wells, well points and sumps, and all other groundwater control system components to prevent loss of fines from surrounding soils. Sand filters shall be used with all dewatering installations unless screens are properly sized by the Contractor's design engineer to prevent passage of fines from surrounding soils.

D. The Contractor shall be responsible for damage to properties, buildings or structures, sewers and other utility installations, pavements and work that may result from dewatering or surface water control operations.

E. Design review and field monitoring activities by the Owner/Engineer shall not relieve the Contractor of his/her responsibilities for the work.

F. The Contractor shall perform pre-conditions surveys of facilities located within 50ft of the work. Pre-condition survey shall be performed to include detailed documentation of facilities to include, but not limited to, buildings, roadways, utilities, asphalt parking lots and driveways. Surveys shall document interior and exterior cracking, settlement and distresses which exist prior to any construction activities. Pre-condition shall be submitted to Owner/Engineer prior to beginning any construction activity.

1.06 DEFINITIONS

A. Where the phrase "in-the-dry" is used in this Section, it shall be defined as an excavation subgrade where the groundwater level has been lowered to at least 2-ft below the lowest level of the excavation, is stable with no ponded water, mud, or muck, is able to support construction equipment without rutting or disturbance and is suitable for the placement and compaction of fill material, pipe or concrete foundations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pipe for observation wells shall consist of minimum 1-in I.D, Schedule 40 PVC pipe and machine slotted PVC well points, maximum slot size 0.020-in.

B. Piping, pumping equipment and all other materials required to provide control of surface water and groundwater in excavations shall be suitable for the intended purpose.

C. Standby pumping systems and a source of standby power shall be maintained at all sites.

PART 3 EXECUTION

3.01 GENERAL

A. Control surface water and groundwater such that excavation to final grade is made in-the-dry, the natural undisturbed condition of the subgrade soils are maintained, and softening and/or instability or disturbance due to the presence or seepage of water does not occur. All

construction and backfilling shall proceed in-the-dry and flotation of completed portions of work shall be prohibited.

B. Methods of groundwater control may include but are not limited to perimeter trenches and sump pumping, perimeter groundwater cutoff, well points, ejectors, deep wells and combinations thereof.

C. Where groundwater levels are above the proposed bottom of excavation level, a pumped dewatering system will be required for predrainage of the soils prior to excavation, and for maintaining the lowered groundwater level until construction has been completed to such an extent that the structure, pipeline or fill will not be floated or otherwise damaged.

D. It is expected that the type of system, spacing of dewatering units and other details of the work will have to be varied depending on soil/water conditions at a particular location.

E. All work included in this Section shall be done in a manner which will protect adjacent structures and utilities and shall not cause loss of ground or disturbance to the pipe bearing soils or to soils which support overlying or adjacent structures.

F. Install, monitor and report data from observation wells. Evaluate the collected data relative to groundwater control system performance and modify systems as necessary to dewater the site in accordance with the Contract requirements.

G. Locate groundwater control system components where they will not interfere with construction activities adjacent to the work area or interfere with the installation and monitoring of geotechnical instrumentation including observation wells. Excavations for sumps or drainage ditches shall not be made within or below 1H:1V slopes extending downward and out from the edges of existing or proposed foundation elements or from the downward vertical footprint of the pipe.

3.02 SURFACE WATER CONTROL

A. Construct surface water control measures, including dikes, ditches, sumps and other methods to prevent, as necessary, flow of surface water into excavations and to allow construction to proceed without delay.

3.03 EXCAVATION DEWATERING

A. At all times during construction, provide and maintain proper equipment and facilities to promptly remove and properly dispose of all water entering excavations. Excavations shall be maintained in-the-dry. Groundwater levels shall be kept at least 2-ft below the lowest excavation level.

B. Excavation dewatering shall maintain the subgrade in a natural undisturbed condition and until the fill, structure or pipes to be built thereon have been completed to such extent that they will not be floated or otherwise damaged by allowing water levels to return to natural elevations.

C. Pipe, masonry, and concrete shall not be placed in water or be submerged within 24 hours after being installed. Water shall not flow over new masonry or concrete within four days after placement.

D. In no event shall water rise to cause unbalanced pressure on structures until the concrete or mortar has set at least 24 hours. Prevent flotation of the pipe by promptly placing backfill.

E. Dewatering shall at all times be conducted in such a manner as to preserve the natural undisturbed condition of the subgrade soils at the proposed bottom of excavation.

F. If the subgrade of the trench or excavation bottom becomes disturbed due to inadequate dewatering or drainage, excavate below normal grade as directed by the Owner/Engineer and refill with structural fill, screened gravel or other material as approved by the Owner/Engineer at the Contractor's expense.

G. It is expected that the initial dewatering plan may have to be modified to suit the variable soil/water conditions to be encountered during construction. Dewater and excavate, at all times, in a manner which does not cause loss of ground or disturbance to the pipe bearing soil or soil which supports overlying or adjacent structures.

H. If the method of dewatering does not properly dewater the excavation as specified, install additional groundwater observation wells as directed by the Owner/Engineer and do not place any pipe or structure until the readings obtained from the observation wells indicate that the groundwater has been lowered a minimum of 2-ft below the bottom of the final excavation within the excavation limits.

I. Dewatering units used in the work shall be surrounded by suitable filter sand and no fines shall be removed by pumping. Pumping from the dewatering system shall be continuous until pipe or structure is adequately backfilled. Stand-by pumps shall be provided.

J. Water entering the excavation from precipitation or surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to a sump and pumped from the excavation to maintain a bottom free from standing water.

K. Drainage shall be disposed of in an approved area as specified in Section 01046. Existing or new sanitary sewers shall not be used to dispose of drainage.

3.04 WELL POINT SYSTEMS

A. Where necessary, install a vacuum well point system around the excavation to dewater the excavation. Each well point and riser pipe shall be surrounded by a sand or gravel filter. Sand or gravel shall be of such a gradation that, after initial development of the well points, the quantity and size of soil particles discharged shall be negligible. Well point systems shall be capable of operating continuously under the highest possible vacuum.

B. Installation of well point systems shall be in accordance with the approved submittal and in the presence of the Owner/Engineer.

3.05 DEEP WELLS

A. Where necessary, install a deep well system around the excavation to dewater or depressurize the excavation. Each well shall be surrounded by a sand or gravel filter with adequate gradation such that after development, the quantity and size of soil particles discharged are negligible. Sufficient number of wells shall be installed to lower or depressurize the groundwater level to allow excavation to proceed in-the-dry.

B. Installation of deep well shall be in accordance with the approved submittal and in the presence of the Owner/Engineer.

3.06 OBSERVATION WELLS

A. Install observation wells to monitor groundwater levels beneath and around the excavated area until adjacent structures and pipelines are completed and backfilled.

B. Observation Well Locations and Depths:

1. A minimum of 3 wells (one upstream and two downstream of the groundwater gradient) shall be installed around the excavation area. They shall be located in critical areas with respect to groundwater control to monitor performance of dewatering systems designed by the Contractor's Engineer.

2. Observation wells required shall be installed to a depth of at least 10-ft below the deepest level of excavation, unless otherwise approved by the Owner/Engineer, and to whatever depth is necessary to indicate that the groundwater control system designed by the Contractor's Engineer is performing as intended. Additional observation wells may be required by the Owner/Engineer if deemed necessary to monitor the performance of the Contractor's groundwater control system.

3. Locations and depths of observation wells are subject to approval by the Owner/Engineer.

C. Protect the observation wells at ground surface by providing a lockable box or outer protective casing with lockable top and padlock. Design the surface protection to prevent damage by vandalism or construction operations and to prevent surface water from infiltrating.

1. Provide two copies of keys for each padlock to the Owner/Engineer for access to each well.

2. Observation wells shall be developed so as to provide a reliable indication of groundwater levels. Wells shall be re-developed if well clogging is observed, in the event of apparent erroneous readings, or as directed by the Owner/Engineer.

3. Submit observation well installation logs, top of casing elevation, and well locations to the Owner/Engineer within 24 hours of completion of well installation.

D. Observation Well Maintenance

1. The Contractor shall maintain each observation well until adjacent structures and pipelines are completed and backfilled. Clean out or replace any observation well which ceases to be operable before adjacent work is completed.

2. It is the Contractor's obligation to maintain observation wells and repair or replace them at no additional cost to the Owner, whether or not the observation wells are damaged by the Contractor's operations or by third parties.

E. Monitoring and Reporting of Observation Well Data

1. The Contractor shall begin daily monitoring of groundwater levels in work areas prior to initial operation of drainage and dewatering system. Daily monitoring in areas where

groundwater control is in operation shall continue until the time that adjacent structures and pipelines are completed and backfilled and until the time that groundwater control systems are turned off.

2. The Contractor is responsible for processing and reporting observation well data to the Engineer on a weekly basis. Data is to be provided to the Owner/Engineer on a form, which shall include the following information: observation well number, depth to groundwater, total depth of well, top of casing elevation, groundwater level elevation and date and time of reading.

F. The groundwater level shall be kept at a minimum of 2-ft below the lowest subgrade level for a given excavation.

3.07 REMOVAL OF SYSTEMS

A. At the completion of the excavation and backfilling work, and when approved by the Owner/Engineer, all pipe, deep wells, well points, pumps, generators, observation wells, other equipment and accessories used for the groundwater and surface water control systems shall be removed from the site. All materials and equipment shall become the property of the Contractor. All areas disturbed by the installation and removal of groundwater control systems and observation wells shall be restored to their original condition.

B. Leave in place any casings for deep wells, well points or observation wells located within the plan limits of structures or pipelines or within the zone below 1H:1V planes extending downward and out from the edges of foundation elements or from the downward vertical footprint of the pipe, or where removal would otherwise result in ground movements causing adverse settlement to adjacent ground surface, utilities or existing structures.

C. Where casings are pulled, holes shall be filled with sand. Where left in place, casings should be filled with cement grout and cut off a minimum of 3-ft below finished ground level or 1-ft below foundation level so as not to interfere with finished structures or pipelines.

END OF SECTION

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SECTION 02200
EARTHWORK

PART 1 – GENERAL

1.01 DESCRIPTION

A. REQUIREMENTS:

Furnish all labor, materials, equipment and incidentals necessary to perform all excavation, backfill, fill and grading required to complete the work shown on the Drawings and specified herein. The work shall include, but not necessarily be limited to: excavation for structures, culverts, footings, manholes, pipes, vaults, ducts and paving; backfilling, fill and required borrow; embankment and grading; disposal of surplus and unsuitable materials; and all related work such as sheeting, bracing, dewatering and water handling.

B. CONTENTS AND RELATED WORK:

This section includes the following:

1. Preparation of subgrade for structure foundations, general fill placement, embankment construction, sidewalks and pavement.

2. Placement and compaction of structural fill in soil embankments, and beneath structures, sidewalks and pavements/

3. Excavation and backfill of trenches within construction lines.

4. Excavating and backfilling for underground utilities.

5. Related work:

   a. Demolition and Salvage: Section 01046

   b. Site Preparation: Section 02100

   c. Dewatering: Section 02140

   d. Erosion, Sedimentation and Dust Control: Section 02270

   e. Top Soiling and Seeding: Section 02933

   f. Pavement Removal and Replacement: Section 02500

   g. Gravity Sewers, Force Mains and Accessories: Section 02530

h. Rock Excavation: Section 02210

i. Microtunneling: Section 02320

j. Jacking and Boring: Section 02450

C. DEFINITIONS:

1. COMPACTION: The construction activities required to obtain a specified percentage of the maximum dry density (MDD) at the measured moisture content determined in accordance with applicable ASTM D1556, ASTM D2937, ASTM D6938 and ASTM D698. The minimum required percent compaction beneath structures, piping, and pavement is provided in Table A in this section.

2. EARTH EXCAVATION: Excavation consists of removal of materials encountered to subgrade elevations indicated, which in the opinion of the Engineer, using guidelines listed below is not classified as rock excavation.

3. EARTH EXCAVATION BELOW SUBGRADE: Same as Earth Excavation except excavation is performed below elevations given as subgrade on the Drawings.

4. ROCK EXCAVATION: To be completed in compliance with Section 02211 of the Specifications.

5. STRUCTURAL FILL MATERIAL: Material placed and compacted beneath structures, footings, foundations, slabs and roadways. Structural fill material shall be Type A, B, C or D as determined by the Engineer or as shown on the Drawings.

6. UNSUITABLE MATERIAL: Materials which do not meet the requirements of structural fill or common fill and cannot meet the compaction requirements shall be classified as unsuitable material.

7. ADDITIONAL EXCAVATION: When excavation has reached the required subgrade elevations, notify the Engineer, who will make an inspection of conditions. If the Engineer determines that bearing materials at the required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered, and replace excavated material as directed by the Engineer with suitable material.

8. SUBGRADE: The undisturbed earth or the compacted soil layer immediately below granular sub-base, drainage fill, or topsoil materials which are shown on the Project Drawings as the planned bottoms for footings, foundations, slabs and/or trench excavations.

9. STRUCTURE: Buildings, foundations, slabs, junction chambers, curbs, or other man-made stationary features occurring above or below ground surface.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In case of conflict between the requirements of this section and the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ASTM C136	Standard Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D422	Test Method for Particle-Size Analysis of Soils
ASTM D1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D6938	Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D2937	Test Method for Density of Soil in Place by Drive Cylinder Method
ASTM D2216	Test Method for Moisture Content of Soils
ASTM D698	Moisture Density Relationship of Soils Using 5.5-lb Rammer and 12-in. Drop (Standard Proctor Method of Density Measurement)
ASTM D422	Grain Size Analysis for Soils
ASTM 4318	Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3017	Test Method for Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

Reference	Title
SCDOT	Standard Specifications for Highway Construction

B. QUALITY ASSURANCE TESTING:

1. An independent quality assurance testing laboratory, under the direction of the Engineer and the Owner, will take soil/aggregate samples and perform moisture content, gradation, compaction, and density tests during placement of backfill materials to check compliance with these specifications. The Contractor shall provide access and remove surface material at locations designated by the Engineer and provide such assistance as necessary for sampling and testing. The Engineer may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these specifications.

Tests will be made by an independent testing laboratory in accordance with the following test methods:

Test	Standard Procedure
Moisture content	ASTM D3017 or ASTM D2216
Gradation	ASTM C136 or D422
Density in-place	ASTM D1556, D6938 or D2937
Moisture-density relationships	ASTM D698

2. Prior to the general placement of fill, and during such placement, the Engineer may select areas within the limits of the fill for testing the degree of compaction obtained.

3. In-place density testing of trenches shall be a minimum of 75 and a maximum of 125 linear feet of trench and at vertical intervals of 2 feet or less as the fill is being placed, or as determined by the Engineer.

4. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

1.03 SUBMITTALS

Submittals shall be made in accordance with Section 01300. In addition, the following specific information shall be provided:

1. Samples of fill materials proposed for use shall be submitted, per Section 01300, to the Engineer 2 weeks in advance of use. Samples shall consist of 0.5 cubic foot or a 20-lb sample of each type of material, whichever is greater.

2. FIELD AND LABORATORY TEST REPORTS: Independent testing laboratory shall furnish the Engineer and Contractor two copies of the field and laboratory test reports. Passing field test report of in-place density and compaction will be required as evidence of acceptance of materials represented.

3. AGGREGATE MATERIAL CONFORMANCE TEST RESULTS: Prior to acceptance of aggregate materials for use as fill material conduct aggregate quality tests in accordance with the requirements of this Section and appropriate reference standards. The Engineer and Owner reserve the right to accept or reject materials based on certification from the supplier that the aggregate meets the requirements of this specification.

4. BORROW SOURCE MATERIAL TEST RESULTS: Prior to acceptance borrow source for soil fill materials conduct quality tests in accordance with the requirements of this Section and appropriate reference standards. The Engineer and Owner reserves the right to accept or reject soil fill materials based on conformance with the materials properties outlined in Section 2.01 of this specification.

1.04 FIELD MEASUREMENTS

A. Verify that survey bench mark and intended elevations for the Work are as indicated.

1.05 GENERAL

A. The elevations shown on the Drawings as existing are taken from the best existing data and are intended to give reasonably accurate information about the existing elevations. They are not precise. Become satisfied as to the exact quantities of excavation and fill required.

B. Perform earthwork operations in a safe and proper manner with appropriate precautions being taken against all hazards.

C. Maintain all excavated and filled areas for structures, trenches, fills, topsoil areas, embankments and channels in good condition at all times until final acceptance by the Owner. Repair all damage caused by erosion or other construction operations using material of the same type as the damaged material.

D. Perform earthwork within the rights-of-way of the SCDOT in accordance with requirements and provisions of the permits issued by this agency for the construction within its rights-of-way. Such requirements and provisions, where applicable, will take precedence and supersede the provisions of these Specifications.

E. Control grading in a manner to prevent surface water from running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains or temporary drains. Free access must be provided to all parts of project.

F. No classification of excavated materials will be made. Excavation work will include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the work, regardless of the type, character, composition or condition thereof.

G. Ensure that all earthwork operations comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations. Conduct operations in a manner acceptable to the Engineer.

H. Make a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and floodplains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. Provide all services, labor, equipment and materials necessary or convenient for completing the work within the time specified in these Contract Documents.

1.06 COORDINATION

A. Coordinate work with the Owner and other Contractors as required.

B. Verify work associated with lower elevation utilities is complete before placing higher elevation utilities.

PART 2 – MATERIALS

The fill materials listed shall not impacted by environmental contaminants and comply with all applicable federal, state, and local regulations.

2.01 FILL MATERIALS

A. TYPE A – SELECT SAND/GRAVEL MATERIAL:

Type A material shall be a clean gravel/sand mixture free from organic matter and shall conform to the following gradation:

U.S. Standard Sieve Size	Percent by Weight Passing
¾-inch	100
3/8-inch	70-100
No. 4	55-100
No. 10	35-95
No. 20	20-80
No. 40	0-55
No. 100	0-2

B. TYPE B – SELECT COARSE GRAINED FILL MATERIAL:

Type B material shall be a select granular material free from organic matter and of such size and gradation that the specified compaction can be readily attained. Material shall have a sand equivalent value determined in accordance with ASTM D2419 of not less than 20 and shall conform to the following gradation:

U.S. Standard Sieve Size	Percent by Weight Passing
3-inch	100
No. 4	35-100
No. 30	20-100

The coefficient of uniformity shall be 3 or greater.

The material may be an imported quarry screening, clean natural sand or gravel, select trench excavation or a mixture thereof.

C. TYPE C – GENERAL BACKFILL MATERIAL:

Type C material shall be unclassified material which is free from topsoil, peat, wood, roots, bark, debris, lumber, garbage, rubbish or other extraneous material. The maximum size of rock and/or stone shall not exceed 6 inches. Type C material will have a plasticity index less than 25 percent and the rock to soil ratio shall not exceed one part rock to three parts soil. If the material excavated from the site meets these requirements, it may be classified as Type C.

D. TYPE D – AGGREGATE BACKFILL:

Type D material shall be free-draining granular material or commonly known as pea gravel and shall conform to the following gradation:

U.S. Standard Sieve Size	Percent by Weight Passing
1/4-inch	100
No. 8	0-5

E. TYPE E – SURGE STONE BACKFILL:

Type E material shall be crushed rock commonly known as drain rock and shall conform to the following gradation:

U.S. Standard Sieve Size	Percent by Weight Passing
1-1/2-inches	100
3/4-inch	30-75
1/2-inch	15-55

U.S. Standard Sieve Size	Percent by Weight Passing
1/4-inch	0-5

Type E material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65.

F. TYPE F – AGGREGATE BASE COARSE (ABC) STONE:

Type F material shall be crushed rock and shall conform to the following gradation:

U.S. Standard Sieve Size	Percent by Weight Passing
1-1/2-inch	87-100
3/4-inch	45-90
No. 4	20-50
No. 30	6-29
No. 200	0-12

Type F material shall be composed of hard, durable, sound pieces having a specific gravity of not less than 2.65.

G. TYPE G – COARSE AGGREGATE BACKFILL:

Type G material shall be pervious backfill material conforming to the following gradation:

U.S. Standard Sieve Size	Percent by Weight Passing
2-inch	100
No. 50	0-100
No. 100	0-8
No. 200	0-4

H. TYPE H – CLASS A RIPRAP MATERIAL:

Type H material shall be SCDOT Class A or riprap shall be graded rock having a range of individual rock weights as follows:

Rock Size	Weight of Stone	Percent Smaller by Weight
0.75 feet	37 pounds	100
0.50 feet	11 pounds	50
0.20 feet	0.7 pounds	15

Based on a specific gravity of 2.65.

I. TYPE I – CLASS B RIPRAP MATERIAL:

Type I material shall be SCDOT Class B or riprap shall be graded rock having a range of individual rock weights as follows:

Rock Size	Weight of Stone	Percent Smaller by Weight
1.30 feet	200 pounds	100
0.95 feet	75 pounds	50
0.40 feet	5 pounds	10

Based on a specific gravity of 2.65.

J. TYPE J – UNCLASSIFIED MATERIAL:

Type J material shall be unclassified material and may be obtained from excavation on site. The material may contain extraneous material such as demolition waste, unsuitable material excavated from beneath structures, and clearing and grubbing debris up to 50 percent by volume excess fill in non-structural areas. Extraneous material shall be thoroughly mixed and the maximum size of organic particles shall be 6 inches.

K. CONCRETE:

Concrete for bedding, initial backfill or encasement shall have a compressive strength of not less than 3,000 psi. Ready-mixed concrete shall be mixed and transported in accordance with ASTM C 94. Reinforcing steel shall conform to the requirements of ASTM A 615, Grade 60.

PART 3 – EXECUTION

3.01 GENERAL

A. EXCAVATION ACTIVITIES:

Perform excavation and compaction using machinery, except in areas where hand work is necessary to protect structures, buried utilities, and private/public properties. No additional compensation will be paid for hand excavation/compaction unless identified on the Drawings and the Specifications.

Perform excavation and compaction of every description and with all encountered materials to the lines, grades, or depth indicated on the Drawings, and as specified herein.

Extend excavation and compaction a sufficient distance from the footings, and foundations to permit placement and removal of concrete formwork, installation of other utilities and to allow access for inspection and testing.

B. EXCAVATION BELOW SUBGRADE:

Do not excavate below depths indicated on the Drawings or below such depths as required by the Engineer.

Excavation below depths indicated on the Drawings that occur through the fault of the Contractor, shall be restored to the indicated or required depths with suitably compacted structural fill material at the expense of the Contractor. The type of the material used for structural fill for excavation below subgrade will be as selected by the Engineer. The expense for restoration of the materials that were removed with prior approval of the Engineer and Owner will be paid by the Contractor.

If the removal of unsuitable materials below the subgrade is required by Engineer, the voids caused by the approved over excavation shall be backfilled and compacted up to the planned subgrade elevation with Structural Backfill Material.

C. CONTROL OF WATER:

The Contractor shall keep excavations reasonably free from water during construction. The static water level shall be drawn down a minimum of 1 foot below the bottom of excavations to maintain the undisturbed state of natural soils and allow the placement of any fill to the specified density. Disposal of water shall not damage property or create a public nuisance. The Contractor shall have on hand pumping equipment and machinery in good working condition for emergencies and shall have workmen available for its operation. Dewatering systems shall operate continuously until backfill has been completed to 1 foot above the normal static groundwater level. Dewatering shall be performed in accordance with Section 02140.

Groundwater shall be controlled to prevent softening of the bottom of excavations, or formation of "quick" conditions. Dewatering systems shall not remove natural soils. The Contractor shall control surface runoff to prevent entry or collection of water in excavations.

Release of groundwater to its static level shall be controlled to prevent disturbance of the natural foundation soils or compacted fill and to prevent flotation or movement of structures or pipelines.

Site grades and surfaces around excavations shall be slopes to promote surface drainage away from excavations and prevent runoff into open excavations, trenches, pits, or shafts.

D. SURPLUS MATERIAL:

Unless otherwise specified, surplus excavated material shall be disposed of off site in accordance with applicable ordinances and environmental requirements.

If the quantity of surplus material is specified, the quantity specified is approximate. The Contractor shall satisfy himself that there is sufficient material available for the completion of the

embankments before disposing of any material inside or outside the site. Shortage of material, caused by premature disposal of any material by the Contractor, shall be replaced by the Contractor, at no additional cost to the Owner.

Material shall not be stockpiled to a depth greater than 5 feet above finished grade within 25 feet of any excavation or structure except for those areas designated to be preconsolidated. For these areas, the depth of stockpiled material shall be as specified. The Contractor shall maintain stability of the soil adjacent to any excavation. The Contractor shall install silt fences around stock piles to prevent release fine and silt particles.

E. HAULING:

When hauling is done over highways or city streets, the loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading. The loads shall be watered after trimming to eliminate dust.

F. FINISH GRADING:

Finished surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.

Finished grade shall be as specified by the contours ±0.10 foot except where a local change in elevation is required to match sidewalks, curbs, manholes and catch basins, or to ensure proper drainage. Allowance for topsoil and grass cover, and sub-base and pavement thickness shall be made so that the specified thickness of topsoil can be applied to attain the finished grade.

When the work is at an intermediate stage of completion, the lines and grades shall be as specified ±0.5 foot to provide adequate drainage.

If the soil is to be cultivated or straw is to be incorporated into the surface, rocks larger than 2 ½ inches in maximum dimension, roots and other debris on the surface of the slope shall be removed and disposed of prior to cultivation or placement of straw.

G. ENVIRONMENTAL REQUIREMENTS:

Do not perform excavation, backfilling or compaction when weather conditions are such, in the opinion of the Engineer, that work cannot be performed satisfactorily. Do not use frozen and/or saturated materials containing moisture that will not allow satisfactory compaction.

Prior to start of clearing, grubbing, excavation, stockpiling, or compaction activities, install and verify operation of all erosion control devices shown on the Drawings and as required to meet applicable local laws for Erosion and Sediment Control (E&S).

Maintain storm inlets/sewers, E&S, storm drains, surface drainage, perimeter ditches, and silt fence free of debris and excess sediment build-up. No damming or ponding of water in gutters or other waterways will be permitted.

The Contractor shall maintain earthwork surfaces true and smooth and protected from erosion. Where erosion occurs, the Contractor shall provide fill or shall excavate as necessary to return earthwork surfaces to the grade and finish specified.

Prevent spread of dust during performance of work described in this Section. Moisten excavation areas and clean roadways as necessary to maintain dust control as directed by the Engineer, the Owner, and/or to meet the requirement of State and local environmental laws.

H. STONE STABILIZATION:

When the bottom of the trench is not sufficiently stable to prevent vertical or lateral displacement of the pipe after installation with bedding, stone stabilization will be required to develop a non-yielding foundation for the bedding and pipe. When such conditions are encountered, the trench will be excavated to a depth determined by the Engineer, and AASHTO No. 57 stone will be placed to an elevation 6 inches below the bottom of the pipe. The pipe will then be laid with bedding as directed by the Engineer.

3.02 PROTECTION AND STABILITY OF EXCAVATIONS

The Contractor at its own expense shall protect and provide stability for excavation areas in accordance with Federal, State and local laws, ordinances, and other requirements of agencies having jurisdiction.

At all times maintain compliance with applicable OSHA trench and excavation safety regulations. Slope sides of excavations shall comply with local codes, ordinances, and requirements of agencies having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated as specified in Section 02350. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

At its own expense the Contractor shall protect adjacent structures, buildings and pipelines in the vicinity of the work. The Contractor will maintain sufficient barricades, planks, chains, flagging and rope to barricade open excavation areas after the completion of work each day.

3.03 PLACEMENT AND COMPACTION OF BEDDING AND FILL MATERIAL FOR PIPELINES AND OTHER APPLICATIONS

Fill material shall be placed in horizontal layers and compacted with power operated tampers, rollers, idlers, or vibratory equipment. Material type, maximum layer depth, relative compaction, and general application are specified in Table A. Unless otherwise specified, fill classes shall be used where specified in Table A under Application.

Table A. Fill Placement and Compaction Requirements

Fill Class	Material Type	Maximum Uncompressed Layer Depths (in.)	Minimum Relative Compaction, (%)	General Application	
				Pipelines	Other
A1	A	8	95	Bedding and initial backfill	Slabs on grade (other than specified for Class E1)
A2	A	48	95	Initial and subsequent when ponded or jetted	
B1	B	8	95	Subsequent backfill	Structure backfill
B2	B	8	90		Site fill, upper 1 ft. of areas requiring less than ¼ inch of settlement
C1	C	8	90-95	Subsequent backfill compaction as specified	
C2	C	8	90		Site fill, embankments and dikes
D1	D	8	95	Bedding, initial and subsequent backfill	Bedding for tanks, initial and subsequent tank backfill
E1[a]	E	8			Fill under slabs for structures and tank slabs with pressure relief valves
F1[b]	F	12	95	Initial and subsequent backfill	Structural backfill
G1	G	8	95	Bedding for plastic pipe, initial and subsequent backfill	
H1	H				Embankment slope face, channel slope face
I1	I				Embankment slope face, channel slope face
J1	J	8	90		Excess fill in non-structural areas

[a]Compaction of layers shall be accomplished in a minimum of 2 passes of equipment with complete coverage across the width of the field.
[b]Material shall not be used for bedding or initial backfill for plastic pipe.

3.04 EARTHWORK FOR STRUCTURES

A. STRUCTURAL EXCAVATION:

The bottom shall not be more than 0.15 foot above or below the lines and grades specified. If the elevation of structure excavation is not specified, the excavation shall be not more than 0.1 foot above or below the elevation specified for fill material below the structure. Slopes shall vary no more than 0.5 foot from specified grade unless the excavation is in rock where the maximum variation shall be 2 feet.

Should the excavation be carried below the lines and grades specified on the drawings or should the bottom of the excavation be disturbed because of the Contractor's operations and require over-excavation and backfill, the Contractor shall refill such excavated space to the proper elevation in accordance with the procedure specified for backfill. The cost of such work shall be borne by the Contractor.

Unless otherwise specified, excavations shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is specified to be placed directly against excavated surfaces.

B. FOUNDATION PREPARATION:

Rock foundations for concrete or masonry footings shall be excavated to sound material. The rock shall be roughly leveled or cut to steps and shall be roughened. Seams in the rock shall be grouted under pressure as directed by the Engineer.

When footings are to be supported on piles, excavations shall be completed to the bottom of the footings before any piles are drilled or driven therein. When swell or subsidence results from driving piles, the Contractor shall excavate, or backfill the footing area to the grade of the bottom of the footing with suitable material as specified. If material under footings is such that it would mix into the concrete during footing placement or would not support the weight of the fluid concrete, the Contractor shall replace the material with suitable material, install soffit forms or otherwise provide a suitable platform on which to cast the footing as directed by the Engineer.

Whenever excavation beneath a structure is substantially completed to grade, the Contractor shall notify the Engineer who will make an inspection of the foundation. No concrete or masonry shall be placed until the foundation has been inspected by the Engineer. The Contractor shall, if directed by the Engineer, dig test pits and make test borings and foundation bearing tests.

C. STRUCTURAL FILL CLASSIFICATION:

Unless otherwise specified, structural fill shall be Class B1, C1, E1 and F1. The structural fill should be placed in 8-inch loose lifts at ±2 percent of the optimum moisture content and compacted to 95 percent of the maximum dry density as determined by ASTM D698. The upper 1 foot of structural fill placed and compacted beneath structures shall be compacted to 98 percent of the maximum dry density in accordance with ASTM D698.

After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.

Structural fill shall not be placed until the pre-fill subgrade has been inspected by the Engineer. No backfill material shall be deposited against concrete structures until the concrete has developed a strength of not less than 2,500 pounds per square inch in compression, or until the concrete has been in place for 28 days, whichever occurs first.

3.05 EARTHWORK FOR PIPELINES AND CONDUITS

A. GENERAL:

Earthwork for other pipelines and conduits is specified in paragraph 02200-3.03, Table A; in the standard details and in the following paragraphs.

B. PIPELINE EXCAVATION:

The bottom of the trench shall be carried to the specified lines and grades with proper allowance for pipe thickness and for bedding as specified.

C. PIPELINE BACKFILL:

1. BEDDING: The Contractor shall not proceed with backfill placement in excavated areas until the subgrade has been inspected by the Engineer. All pipe shall have a minimum thickness of bedding material below the barrel of the pipe as specified. Bedding material shall be placed in the bottom of the trench, leveled and compacted. Bell holes shall be excavated at each pipe joint to permit proper inspection and uniform bearing of pipe on bedding material.

After the pipe has been laid to alignment and grade, unless otherwise specified, additional bedding material shall be placed in layers the full width of the trench and compacted up to the specified level. Bedding shall be placed simultaneously on both sides of the pipe, keeping the level of backfill the same on each side. The material shall be carefully placed and compacted around the pipe to ensure that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe. Contractor shall use particular care in placing material on the underside of the pipe to prevent lateral movement during backfilling.

2. INITIAL BACKFILL: After pipe has been properly bedded, Contractor shall place and compact initial backfill as specified in Table A.

3. SUBSEQUENT BACKFILL:

a. General: Backfill material, placement and compaction above the pipe zone shall be as specified. Backfill above the pipe zone shall not commence until pipe zone backfill has been inspected and accepted by the Engineer.

b. Improved Areas: Unless otherwise specified, select granular backfill (Class A1) shall be used under all paved and unpaved roadways and paved and unpaved roadway shoulders, roadway embankments, and in all public right-of-ways and easements. The trench shall be backfilled to an elevation which will permit the placement of the specified surface or paving. Paving shall be as specified in Section 02500. Other surfaces shall be restored, including compaction, to the condition existing prior to construction including restoration of yard areas.

c. Unimproved Areas: Class C1 backfill shall be used for all trenches in pastureland, cultivated land, undeveloped land, and for other unimproved areas where specified. Class C1 backfill shall not be used in any public right-of-way. Trench excavation which meets the requirements of Type C material may be used. The Contractor shall maximize the use of fine-grained materials (e.g., sand, silty sand, sandy silt) as Class C1 backfill.

For Class C1 backfill, the trench above the pipe zone shall be backfilled to within 12 inches of original ground surface. The top 12 inches of soil shall be removed and stored in such a manner that it will not become mixed with unsatisfactory soils. After the trench has been backfilled, the stored topsoil shall be replaced at a uniform depth in its original area compacted to its original condition. The Contractor shall leave the backfilled trench neatly mounded not more than 6 inches above existing grade for the full width of the Class C1 backfill area.

3.06 EARTHWORK FOR EMBANKMENTS

A. FOUNDATION PREPARATION:

The surface of the embankment foundation shall not contain standing water and shall be free of loose material, foreign objects and rocks greater than 6 inches in maximum dimension. Immediately prior to placement of embankment fill material, the embankment foundation shall be proof-rolled with a loaded dump truck or 20-ton rubber-tired roller. The proof-roll will identify suitable soft subgrade soils and areas with adequate embankment foundation soils. Near surface embankment foundation soils that have suitable in-place moisture content should be scarified to a depth of 6 inches, moisture conditioned as necessary and compacted to 95 percent of the maximum dry density in accordance with ASTM D698. Areas identified during the proof-roll as having soft, yielding, or unsuitable soils shall be removed, and replaced with suitability compacted structural fill material. After the embankment foundation preparation has been completed, the Contractor shall promptly place and compact the first lift of embankment fill to prevent damage to the surface. The surface of the embankment shall be maintained to permit travel of construction equipment. Ruts in the surface of any layer shall be filled and leveled before compacting subsequent lifts.

B. EMBANKMENT FILL:

Rocks, broken concrete or other solid materials, which are larger than 4 inches in greatest dimension, shall not be placed in embankment areas where piles are to be placed or driven.

Fill material having a sand equivalent value less than 10 shall be placed in the lower portions of embankments and shall not be placed within 2.5 feet of finished grade.

When the embankment material consists of large, rocky material or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, such material shall be well distributed throughout the embankment. Sufficient earth or other fine material shall be placed around the larger material as it is deposited so as to fill the interstices and produce a dense, compact embankment.

Embankment fill should be placed in 10-inch loose lifts at ± 3 percent of the optimum moisture content and compacted to 95 percent of the maximum dry density as determined by ASTM D698.

C. EMBANKMENT TOLERANCES:

1. GENERAL: Embankment slopes within 4 feet of shoulder grade shall vary less than 0.5 foot from the designated slope. Slopes beyond 4 feet from shoulder grade shall vary less than 1 foot from the designated slope. Measurements for variance shall be made perpendicular to the slope. Slopes which are 6 to 1 or flatter shall vary less than 0.2 foot from the designated slope.

If embankments are constructed of rock greater than 12 inches in diameter, the slopes more than 4 feet below shoulder grade may vary up to 2 feet from the designated slope.

2. ROADWAY EMBANKMENT TOLERANCES: The excavated surface shall be less than 0.08 foot above or below the grades specified after deducting for the roadway pavement thickness.

Vertical alignment tolerances permitted on the roadway surface shall not exceed ±0.30 foot from the vertical alignment specified, with the provision that within the tolerance range local surface irregularities shall not exceed 0.15 foot as measured by the gap between the roadway surface and a 10 foot straightedge placed on any flat graded surface. On vertical curves, the same standards will apply except that an additional gap allowance will be made for the road surface curvature over the 10 foot length of the straightedge.

Horizontal alignment tolerances permitted shall not exceed ±1 foot, providing the departure is relatively uniform over any specific length of the roadway.

Roadway median strips shall be graded to drain and shall not vary more than 0.1 foot from the specified grade.

3.07 SUBGRADE FOR PAVEMENT

The soil subgrade beneath the aggregate base course of pavements shall be scarified to a depth of 9 inches and recompacted to at least 98 percent of the maximum density as determined by ASTM D698.

3.08 NON-STRUCTURAL SITE FILL

Unless otherwise specified, site fill shall be Class C2 fill. If the existing slope in an area to be filled is greater than 5(H):1(V), the Contractor shall bench the area prior to filling.

END OF SECTION

SECTION 02210
ROCK AND BOULDER EXCAVATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work specified in this Section includes furnishing all labor, materials, equipment and incidentals required to excavate and dispose of rock and boulders as shown on the Contract Drawings and as specified herein such that damage is prevented to adjacent utilities, pipes, structures, property and the Work and such that resulting ground vibrations are maintained below the maximum levels specified in this Section. The Contractor shall furnish acceptable material for backfill in place of the excavated rock to bring the limits of the trench and/or excavation to those required on this project.

B. If allowed by local authorities and identified on Contract Drawings, blasting may be used to loosen rock and boulders for excavation. If blasting is performed, provide the services of a licensed Professional Engineer or geologist, registered in the State of South Carolina, to prepare blasting plans and supervise blasting operations.

C. Protect existing structures, utilities, roadways, adjacent property, workers, Engineer, Owner, all abutters and the public from damage or injury from excessive ground vibrations and rock block movements. Should any damage occur to the existing utility or structures caused by rock removal methods (blasting, drilling etc.) shall be repaired at the Contractor's own expense with no additional cost to the Owner.

D. Furnish, install and put into operation an audible warning system to indicate impending blasting. Familiarize workers, Engineer, Owner, all abutters and the public with the system implemented.

E. Conduct blast monitoring of every blast round during the conduct of construction using the blast monitoring procedures and equipment specified in this Section.

F. Conduct pre-blast survey for this Work as specified herein.

G. Obtain and pay for all permits and licenses required to complete the Work of this Section. Original permits shall be prominently displayed on the Work site prior to initiating blasting operations.

1.02 RELATED WORK

A. Trenching, Backfill and Compaction is included in Section 02200.

B. Granular Fill Materials are included in Section 02200.

C. Sedimentation and Erosion Control is included in Section 02270.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, at least two weeks prior to commencing rock and boulder excavation the following:

1. A description of the means and methods of rock and boulder excavation techniques including size and energy of any impact equipment and chemical properties of any chemical agents to be used for chemical splitting.

2. Name and qualifications of the person(s) responsible for monitoring and reporting rock excavation vibrations.

3. Submit letters to property owners for pre-blast survey appointments.

4. Submit three copies of the pre-blast survey, including three sets of photographs and/or video recordings, as specified herein.

5. Submit blasting plans. Blasting plans shall be prepared by a licensed Professional Engineer or licensed geologist, registered in the State of South Carolina, having a minimum of 5 years of professional experience in blasting operations. The blasting plan shall include precondition surveys and sketches to show blast locations; proximity to, and methods for protection of, existing structures and utilities; drill hole patterns, amount of charges, firing sequence and times; vibration monitoring plan; powder factor; time delays, weight of explosive in each delay, total pounds of explosives, method of transportation, storage and handling, manufacturers data sheet for all explosives, primers and initiators to be employed, calculations of ground velocities at the nearest structures and nearest utilities, proposed seismograph locations, energy ratio, acceleration and displacement, methods for protection of the existing structures and utilities including special perimeter control blasting procedures; and any other pertinent information required. The plan shall also include methods of matting or covering of the blast area to prevent flyrock and excessive airblast overpressure; details of the audible advance signal system to be employed at the job site as a means of informing workers, Engineer, Owner, all abutters and the general public that a blast is about to occur. Field monitoring methods and techniques including seismographs shall also be addressed.

6. Submit an original and three copies of the licensed Professional Engineer or licensed geologist's certification, on the form specified in Section 01300, stating that blasting plans have been prepared by the professional engineer or geologist,

B. Review by the Owner/Engineer of material submitted by the Contractor shall not relieve the Contractor of responsibility for the accuracy, adequacy and safety of the rock and boulder excavation, exercising proper supervision and field judgment and producing the results within the limits required by this Section.

1.04 DEFINITIONS

A. Rock: Any large mass of stone, bedrock, or ledgerock.

B. Boulder: Rock fragments exceeding 1 cubic yard in volume.

C. Rock Excavation: The removal of rock, which, in the opinion of the Owner/Engineer, cannot be removed by conventional mechanical excavation equipment and requires continuous, systematic drilling, blasting, wedging, sledging, cutting, barring, jack hammering, hoe ramming or expansive chemical splitting.

D. Boulder Excavation: The removal of boulders exceeding 1 cubic yard in volume which can be removed by conventional mechanical excavation equipment.

E. Rock fragments less than 1 cubic yard which can be removed without resorting to rock excavation shall be considered as "Soil Excavation".

F. Soil Excavation: The removal of earth, including boulder less than 1 cubic yard in volume, weathered rock and rock fragment that can be removed by conventional mechanical excavation. Soil Excavation shall include all excavation of earth materials that are not considered as rock excavation or boulder excavation.

G. Loose or disintegrated rock, loose or rotted shale, nested stones, hardpan and the like shall not be considered as rock or boulder.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. When rock is encountered, it shall be uncovered, but not excavated, until measurements are made by the Owner/Engineer.

B. Rock in pipe trenches shall be excavated so as to be not less than 6 inches below the pipe after it has been laid. The width shall be as shown on the Contract Drawings. Before the pipe is laid, the pipe bedding shall be installed to the correct subgrade with thoroughly compacted suitable material that is the same material as that required for bedding the pipe, furnished and placed at the expense of the Contractor.

C. Rock at structures shall be excavated so as to be no less than 12 inches below the bottom of the structure slab. The width shall be 2 feet beyond the outside wall of the structure. Before the structure is laid, the structure bedding shall be installed to the correct subgrade with thoroughly compacted suitable material that is the same material that is required for bedding the structure, furnished and placed at the expense of the Contractor.

3.02 ROCK EXCAVATION

A. Rock excavation may be performed by drilling, wedging, sledging, cutting, barring, jack hammering, hoe ramming, expansive chemical splitting, or other similar process in a manner, which does not cause damage to the existing structures, new construction or affect the ongoing operations at the plant.

B. All rock excavation operations shall comply with the project, state and local noise and dust regulations.

C. If rock below grade is shattered by rock excavation methods, and if, in the opinion of the Owner/Engineer, the shattered rock is unfit for subgrade, the rock shall be removed and the excavation refilled with thoroughly compacted screened gravel or structural fill at no additional cost.

D. Whenever so directed during the progress of the work, the Contractor shall remove all dirt and loose rock from designated areas and shall clean the surface of the rock thoroughly, using steam to melt snow and ice, if necessary. Water in depressions shall then be removed as required so that the whole surface of the designated area can be inspected to determine whether seams or other defects exist.

E. The surfaces of rock foundations shall be left sufficiently rough to bond well with the concrete to be built thereon, and if required, shall be cut to rough benches or steps.

F. Before any masonry or embankment is built on or against the rock, the rock shall be scrupulously freed from all vegetation, dirt, sand, clay, boulders, scale, excessively cracked rock, loose fragments, ice, snow, and other objectionable substances. Picking, barring, wedging, streams of water under sufficient pressure, stiff brushes, hammers, steam jets, and other effective means shall be used to accomplish this cleaning. All free water left on the surface of the rock shall be removed.

3.03 BOULDER EXCAVATION

A. Boulders and rock fragments up to 1 cubic yard in volume may be reduced in size by rock excavation methods to simplify its removal.

3.04 EXCESS ROCK EXCAVATION

A. If rock is excavated beyond the limits of payment indicated on the Contract Drawings and Specifications, the excess excavation, whether resulting from over breakage or other causes, shall be backfilled, by and at the expense of the Contractor, as specified below in this Section.

B. In pipe trenches, excess excavation below the elevation of the bottom of the bedding, cradle, or envelope shall be filled with material of the same type, placed and compacted in the same manner, as specified for the bedding, cradle, or envelope.

3.05 PREPARATION OF ROCK SURFACES

A. Whenever so directed during the progress of the Work, the Contractor shall remove all dirt and loose rock from designated areas and shall clean the surface of the rock thoroughly, using steam to melt snow and ice, if necessary. Water in depressions shall then be removed as required so that the whole surface of the designated area can be inspected to determine whether seams or other defects exist

B. The surfaces of rock foundations shall be left sufficiently rough to bond well with the concrete to be built thereon, and if required, shall be cut to rough benches or steps.

C. Before any masonry or embankment is built on or against the rock, the rock shall be scrupulously freed from all vegetation, dirt, sand, clay, boulders, scale, excessively cracked rock, loose fragments, ice, snow, and other objectionable substances. Picking, barring, wedging, streams of water under sufficient pressure, stiff brushes, hammers, steam jets, and other effective means shall be used to accomplish this cleaning. All free water left on the surface of the rock shall be removed.

3.06 PREPARATION FOR BLASTING

A. Perform a pre-blast survey for all structures within the influence range of blasting operations, or within 250 ft of the blast area, whichever is greater. The pre-blast survey shall consist of a close visual inspection, fully supported by photographs or video recordings, performed by, or under the supervision of, a licensed Professional Engineer or geologist experienced in such surveys. Insurance underwriter shall be present during such surveys. Contractor is responsible for mailing documentation to schedule an appointment with homeowner. Once appointment is scheduled with property owner, the Contractor is responsible to give notice in writing, to the property owner and any representative of local authorities required to be present at such survey. Notify in writing the dates on which surveys are planned so that representatives are present during the examination. Provide copies of notices to the Owner/Engineer.

B. Observations shall be recorded of the existing conditions for residences, buildings and other structures, which might be affected.

C. The survey shall consist of a description of interior and exterior conditions. Descriptions shall locate cracks, damage or other defects existing and shall include information to make it possible to determine the effect, if any, of the construction operations on the defect. Where significant cracks or damage exists, or for defects too complicated to describe in words, photographs shall be taken and made part of the record.

D. The records of each property examined shall be signed by the representatives present and, if practicable, by the property owner, whether or not they are present at the examinations.

E. Upon completion of all earth/rock excavation and blasting work, the Contractor shall make a similar examination of properties and structures where complaints of damage have been received or damage claims have been filed. Give notice to interested parties so that they may be present during the final examinations. Records of the final examination shall be signed and distributed as the original pre-blast survey.

F. Any damage noted after completion of blasting operations which cannot be determined from the pre-blast survey to be a preexisting condition shall be presumed to have been caused by blasting operations. Such damage shall be repaired promptly and completely to the property owner's satisfaction to restore the condition of the property to that existing prior to blasting.

G. Maintain pre-blast survey records for a period of not less than 3 years following final completion and acceptance of the Work. In the event of damage claims, a report shall be prepared by the Contractor on the particular structures from those notes and photographs and submitted to the Owner/Engineer.

3.07 VIBRATION MONITORING

A. Vibration Limit Criteria - The Contractor shall limit rock excavation operations to prevent damage to any adjacent building, structure, utilities, pipes or other features near the site. The Contractor is solely responsible to determine the maximum vibration and air blast tolerable at each facility. However, in no case shall the following be exceeded.

B. Peak Particle Velocity (PPV) limits at the ground surface at existing residences, structures, utilities, and existing pipelines:

Frequency (Hz)	Maximum Peak Particle Velocity (in. per. sec.)
Over 40	2.0
30 to 40	1.5
20 to 30	1.0
Less than 20	0.5

C. Scaled Distance (SD), distance/square root of maximum lbs/delay, shall be established based on the initial blasting and the distance to the closest structure and the charge weight that does not damage any adjacent structure or utility. The established SD shall be used for all blasting associated with this particular portion of the project.

D. Air blast Overpressure Limit: The Contractor shall conduct all blasting activity in such a manner that the peak air blast overpressure measured at the location of the nearest above ground, occupied structure to air blast does not exceed 0.013 psi.

E. The Contractor shall monitor peak particle velocities and air blast overpressures using a minimum of two seismographs operated by personnel trained in their use during all rock excavation activities. Seismograph locations shall be mutually agreed upon by the Owner/Engineer and Contractor.

F. Initial vibration monitoring for blasting operations to establish the SD shall be at the closest existing utility or structure to the blast areas.

G. Vibration monitoring requires that time of firing be precisely known so that the seismographs can be started before firing. The Contractor shall establish a signal system, which will allow records of vibrations caused by blasting or other rock excavation activities to be made.

H. Vibration monitoring for non-explosive methods shall be on a continuous basis throughout the operation.

I. The Owner/Engineer may direct that additional vibration monitoring be performed if conditions warrant such action at no additional cost to the Owner.

J. Vibration Monitoring Instrumentation – Provide two (minimum) seismographs for full time use on the project during blasting which have been calibrated within the previous six months to a standard, which is traceable to the National Bureau of Standards. Required characteristics of seismographs are listed below:

1. Measure the three mutually perpendicular components of particle velocity in directions vertical, radial and perpendicular to the vibration source.

2. Measure and display the maximum peak particle velocity component and air blast overpressure immediately after each blast.

3. Furnish a permanent record of a velocity/time waveform, on a strip chart or from magnetic tape.

3.08 DISPOSAL OF ROCK AND BOULDERS.

A. Fragmented rock with dimensions not exceeding 6 inches in any direction may be mixed with common fill and used as common fill in accordance with Section 02200).

B. Rock and boulders may be crushed and screened for reuse in the work, provided that the resultant materials meet the requirements for gravel, crushed stone, or structural fill as specified in Section 02200).

C. Excavated material shall be stacked without excessive surcharge on the excavation or obstructing free access to hydrants and gate valves. Inconvenience to traffic and abutters shall be avoided as much as possible.

D. Should conditions make it impracticable or unsafe to stack material adjacent to the excavation, the material shall be hauled and stored at a location provided. When required, it shall be re-handled and used in backfilling the trench at no additional cost to the Owner.

E. Rock and boulder material disposed of by wasting shall be replaced by available surplus suitable soils. Common fill to supply any deficiency of backfill shall be provided at no additional cost.

F. Unused rock and boulders shall be removed and disposed of off-site.

END OF SECTION

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SECTION 02270
SEDIMENTATION AND EROSION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and perform all installation, maintenance, removal and area cleanup related to erosion and sedimentation control work as shown on the Drawings and as specified herein. The work shall include, but not necessarily be limited to; installation of temporary access ways and staging areas, silt fences, stone filter boxes, stone filter berms, sediment removal and disposal, device maintenance, removal of temporary devices, temporary mulching, excelsior matting installation and final cleanup.

B. Temporary erosion and pollution control shall include construction work off-site where such work is necessary as a result of borrow pit operations, haul roads or equipment storage sites.

C. In addition to permits obtained by the Owner, the Contractor shall acquire any additional necessary land disturbance permits from the local regulatory agency prior to commencing work. The Contractor shall be responsible for submitting sufficient documents such that approval can be acquired.

D. Install temporary erosion and sediment controls that will ensure the stormwater, other water, and drainage from job site areas which will be stripped or modified of its naturally existing or artificially established stabilization or protection against erosion shall pass through some type of filter system before being discharged and that these areas shall be kept sufficiently moist to control dust.

E. The Contractor shall implement the practices set in the Stormwater Pollution Prevention Plan (SWPPP) submitted as a part of the Notice of Intent (NOI) for Stormwater Discharges from Large and Small Construction Activities, NPDES General Permit SCR100000 and the South Carolina Department of Health and Environmental Control's (SCDHEC) "Storm Water Management BMP Handbook."

1.02 RELATED WORK

A. Dust control is included in Section 01046.

B. Trenching, Backfill and Compaction is included in Section 02200.

C. Granular fill materials are included in Section 02200.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, within 20 days after award of Contract, technical product literature for all commercial products to be used for erosion and sedimentation control.

1.04 QUALITY ASSURANCE

A. Be responsible for the timely installation and maintenance of all sedimentation control devices necessary to prevent the movement of sediment from the construction site to offsite areas or into

the stream system via surface runoff or underground drainage systems. Measures in addition to those shown on the Drawings necessary to prevent the movement of sediment off site shall be installed, maintained, removed, and cleaned up at the expense of the Contractor. No additional charges to the Owner will be considered.

B. Sedimentation and erosion control measures shall conform to the requirements outlined in the South Carolina Department of Health and Environmental Control, City of Columbia, and the County guidelines and regulations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Crushed stone for sediment filtration devices, access ways and staging areas shall be as specified in Section 02200.

B. Berm structural stone shall be rip-rap as follows:

1. Rip-rap shall be sound, durable rock which is roughly rectangular shape and of suitable quality to insure permanence in the condition in which it is to be used. Rounded stones, boulders, sandstone or similar soft stone will not be acceptable. Material shall be free from overburden, spoil, shale and organic material, meet the Engineer's approval and be well graded within the following limits:

Weight of Stone	Percent Finer by Weight
40 lb	100
12 lb	50
3 lb	0

C. Silt Fence

1. Silt fence shall be nylon reinforced polyester netting with fabric weight in excess of 4.0 ounces per yard and having a built-in cord running throughout the top edge of the fabric. Silt fence fabric shall be equal to Mirafi 100X, inert to chemicals commonly found in soil, and resistant to mildew, rot, insects, and rodent attack.

2. Reinforcing mesh shall be ½ inch galvanized steel

3. Posts shall be steel 48-inch long (min), 50,000 psi min yield. Standard “T” section with a nominal face width of 1.38” and nominal “T” length of 1.48”. Weigh 1.25 pounds/foot. Have a soil stabilization plate with a minimum cross section area of 17 square inches attached to steel posts. Painted with a water based, baked enamel paint.

4. Siltation fences shall be installed in the locations as indicated on the Drawings. Siltation fences shall be installed prior to clearing operations. Siltation fences shall be kept in good repair and maintained throughout construction. Sediment shall be removed when the ponding capacity is reduced by one-half.

5. Siltation fences shall be constructed around all inlets to the stormwater system. They shall be repaired and maintained throughout construction. Sediment shall be removed before the ponding capacity is reduced by one-half.

D. 1/4-in woven wire mesh for filter boxes shall be galvanized steel or hardware cloth.

E. Straw mulch shall be utilized on all newly graded areas to protect areas against washouts and erosion. Straw mulch shall be comprised of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold or other objectionable material. The straw mulch shall contain at least 50 percent by weight of material to be 10-in or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

F. Sediment Tubes

1. Sediment tubes shall consist of compacted geotextiles, curled excelsior wood, natural coconut fiber or hardwood mulch. Straw, pine needle and leaf mulch-filled sediment tubes are not permitted. The outer netting shall consist of seamless, high-density polyethylene photodegradable materials treated with ultraviolet stabilizers or with seamless high-density polyethylene non-degradable materials.

2. The sediment tube diameter shall range between 18and 24 inches.

3. Where installed within the SCDOT highway right-of-way, the selected sediment tube shall be listed on the SCDOT approved products list.

G. Erosion control blanket shall be installed in all seeded drainage swales and ditches as shown on the Drawings or as directed by the Owner/Engineer. Erosion control blanket shall be 100 percent agricultural straw matrix stitch bonded with degradable thread between two photodegradable polypropylene nettings, such as Model S150 Double Net Short-Term Blanket (10 months) by North American Green, Evansville, IN or equal.

H. Silt check dam material shall be coarse, angular, clean-washed crushed stone, gravel, or rock ranging in size from 12” D50 Riprap (DHEC) meeting the requirements of SCDOT Class A or Class B erosion control stone.

I. Turf Reinforcement Mats

1. Turf reinforcement mats shall be a three-dimensional stable net structure with sufficient thickness, void space and strength to capture and retain soil I to allow for the development of root growth and vegetation within the matrix. All components of the turf reinforcement mat shall be 100-percent synthetic and resistant to biological, chemical and ultraviolet degradation. The materials shall be designed to reduce soil erosion and assist in the growth, establishment, and protection of vegetation for a period exceeding 5 years.

2. The product shall be selected to meet the slope characteristics and design flow velocity of the application.

PART 3 EXECUTION

3.01 SILT FENCE

A. Silt fencing shall be installed as shown on the Drawings, and as required to prevent migration of sediment.

B. The silt fence shall be installed in order to leave 10 feet between the silt fence and the creek or wetland.

C. A trench shall be excavated approximately 8 inches wide and 8 inches deep when placing fabric by hand. Twelve inches of geotextile fabric shall be placed into the 6-inch deep trench, extending the remaining 8 inches towards the upslope side of the trench. The trench shall be backfilled with soil or gravel and compacted.

D. Twelve inches of fabric shall be buried into the ground when pneumatically installing silt fence with a slicing method.

E. Posts shall be installed to a minimum depth of 24 inches, with a minimum of 1 to 2 inches above the fabric, and no more than 3 feet of the post above the ground.

F. The fabric shall be attached to the steel posts using heavy-duty plastic ties that are evenly spaced and placed in a manner to prevent sagging or tearing of the fabric. In call cases, ties should be affixed in no less than four places.

G. The fabric shall be installed a minimum of 24 inches above the ground. When necessary, the height of the fence above ground may be greater than 24 inches.

H. In tidal areas, extra silt fence height may be required. The post height will be twice the exposed post height. Post spacing will remain the same and extra height fabric will be 4, 5, or 6 feet tall.

I. Locate silt fence checks every 100 feet maximum and at low points.

J. The fence shall be installed perpendicular to the direction of flow and place the fence the proper distance from the toe of steep slopes to provide sediment storage and access for maintenance and cleanout.

K. The Contractor shall inspect the silt fencing every 7 calendar days and within 24 hours after each rainfall event that produces ½ inch or more of precipitation. Check for sediment buildup and fence integrity. Check where runoff has eroded a channel beneath the fence, or where the fence has sagged or collapsed by fence overtopping.

1. If the fence fabric tears, begins to decompose, or in any way becomes ineffective, replace the section of fence immediately.

2. Remove sediment accumulated along the fence when it reaches one-third the height of the fence, especially if heavy rains are expected.

3. Remove trapped sediment from the site or stabilize it on site.

4. Remove silt fence within 30 days after final stabilization is achieved or after temporary best management practices (BMPs) are no longer needed.

5. Permanently stabilize disturbed areas resulting from fence removal.

L. Accumulated silt and debris shall be removed by the Contractor from behind the face of the silt fence as needed to provide proper silt fence operation. Clogged or damaged fabric shall be immediately replaced at no additional cost.

3.02 SEDIMENT TUBES

A. Sediment Tubes shall be installed along contours, in drainage conveyance swales, and around inlets to help reduce the effects of soil erosion by energy dissipation and retaining sediment.

B. Sediment tubes shall be located in the area specified on the drawings, and installed in accordance with the details and manufacturer's recommendations. The tube shall be installed so that 20 percent of the tube diameter is buried and there are no gaps between the bottom of the tube and top of the ground. When the length of the area to be crossed requires multiple tubes, they shall be installed to allow a minimum of 6-inch overlap.

C. Tubes shall be securely anchored in place by wood stakes or steel posts, a minimum of 48 inches in length placed on 2-foot centers. Stakes shall be connected to the mesh on the downstream side and driven to extend 12 inches above the tube.

3.03 TURF REINFORCEMENT MATS

A. The Contractor shall grade and compact the areas to be protected with turf reinforcement mats (TRM) as indicated on the plans. Large rocks, soil clods, vegetation and other sharp objects that could keep the TRM from close contact with the subgrade shall be removed. The top 2 inches of soil, which shall be the seedbed, shall be loosened. Apply seeding in accordance with the seeding schedule. Do not apply mulch in areas that are to be covered with TRMs.

The Contractor shall install the TRM in accordance with the manufacturer's recommendations and the following:

1. The TRM shall extend two to three feet over the crest of the slope and be anchored in a terminal anchor trench a minimum of 12 inches deep by 6 inches wide. Anchor the trench at 1-foot spacings and backfill with compact soils. The TRM shall be unrolled along the placement area and loosely laid (not stretched) in such a manner that it will conform to the surface irregularities when material is placed on or against it. The TRM may be folded and overlapped to permit proper placement in the designated area. Secure TRM to ground surface using U-shaped minimum eight gauge wire staples driven flush into the soil. All anchors should be between 8 and 18 inches long and have sufficient anchoring strength to restrain the TRM in its installed location.

2. The TRM shall be joined by overlapping a minimum of 18 inches (unless otherwise specified), and secured against the underlying foundation material. Securing pins, approved and provided by the TRM manufacturer, shall be placed along the edge of the panel or roll material to adequately hold it in place during installation. The upstream or up-slope TRM shall overlap the abutting down-slope TRM. At vertical laps, securing pins shall be inserted through both layers along a line through approximately the midpoint of the overlap. At horizontal laps and across slope laps, securing pins shall be inserted through the bottom layer only. Securing pins shall be placed along a line approximately 2 inches in from edge of the placed TRM at intervals not to exceed 12 inches unless otherwise specified. Additional pins shall be installed as necessary and where appropriate to prevent any undue slippage or movement of the TRM. The use of securing pins will be held to the minimum necessary. Pins are to be left in place unless otherwise specified.

C. Should the TRM be torn or punctured, or the overlaps or sewn joint disturbed, as evidenced by visible fabric damage, subgrade pumping, intrusion, or grade distortion, the backfill around the damaged or displaced area shall be removed and restored to the original approved condition. The repair shall consist of a patch of the same type of TRM being used, overlaying the existing TRM. When the TRM seams are required to be sewed, the overlay patch shall extend a minimum of 1 foot beyond the edge of any damaged area and joined by sewing as required for the original TRM except that the sewing shall be a minimum of 6 inches from the edge of the damaged fabric. TRM panels joined by overlap shall have the patch extend a minimum of two foot from the edge of any damaged area.

3.04 STABILIZED CONSTRUCTION ENTRANCES:

1. Construction Specifications

   a. Clear the entrance/exit area of all vegetation, roots, and other objectionable material.

   b. Grade the road foundation so that the entrance/exit will have a cross slope.

   c. Place stone to the dimensions, grade, and elevation shown on plans.

   d. Temporary construction entrance/exit shall be constructed using washed stone 2 to 3 inches in size.

   e. Construction of temporary construction entrance/exit shall utilize filter fabrics.

2. Maintenance Guidelines

   Maintain the gravel pad in a condition to prevent mud or sediment from leaving the construction site. This may require periodic topdressing with 2-

inch stone. Contractor shall immediately remove mud and all objectionable materials spilled, washed, or tracked onto any road.

3.05 GRASS LINED CHANNEL:

1. Construction Specifications

   a. Excavate the channel and shape it to an even cross-section as shown. When staking, indicate a 0.2-foot overcut around the channel perimeter for silting and bulking.

   b. Grade soil away from channel so that surface water may enter freely.

   c. Apply lime, fertilizer, and seed to the channel and adjoining areas in accordance with the vegetation plan.

   d. Spread straw mulch at the rate of 100 lb/ 1000 ft^2.

   e. Start laying the jute fiber netting from the top of the upstream end of the channel and unroll it down grade. Do not stretch netting.

   f. Bury the upslope end and staple the net every 12 inches across the top end, every 3 feet around the edges and across the net so that the straw is held closely against the soil. Do not stretch the netting when stapling.

   g. Netting strips should be joined together along the sides with a 3-inch overlap and stapled together.

   h. To join ends of strips, insert the new roll of net in a trench as with upslope end and overlap it 18 inches with the previously laid upper roll. Turn under 6 inches of the 18-inch overlap and staple every 12 inches across the end.

2. Maintenance Guidelines

   During the establishment period, check grass-lined channels weekly and after every rainfall. After grass is established, check the channel weekly and after every heavy rainfall event. Immediately make repairs. It is particularly important to check the channel outlet and all road crossings for bank stability and evidence of piping or scour holes. Remove all significant sediment accumulations to maintain the designed carrying capacity. Keep the grass in a healthy, vigorous condition at all times, since it is the primary erosion protection for the channel.

3.06 ROCK CHECK DAMS:

1. Construction Specifications

   a. Check dams shall be placed at the locations shown on the Drawings. The check dams shall be field fit into the existing ditch and placed such that the top is below the ditch to prevent flooding of adjacent areas.

   b. Place stone to the lines and dimensions shown in the plan on a filter fabric foundation.

   c. Keep the center stone section at least 9 inches below natural ground level where the dam abuts the channel banks.

   d. Extend stone at least 1.5 feet beyond the ditch banks to keep overflow water from undercutting the dam as it re-enters the channel.

   e. Protect the channel downstream from the lowest check dam, considering that water will flow over and around the dam.

   f. Make sure that the channel reach above the most upstream dam is stable.

   g. Ensure that channel appurtenances, such as culvert entrances below check dams, are not subject to damage or blockage from displaced stones.

2. Maintenance

   a. Inspect check dams and channels for erosion damage weekly and after each runoff event.

   b. Anticipate submergence and deposition above the check dam and erosion from high flows around the edges of the dam. Correct all damage immediately. If significant erosion occurs between dams, install a protective riprap liner in that portion of the channel.

   c. Remove sediment accumulated behind the dams as needed to prevent damage to channel vegetation, allow the channel to drain through the stone check dam, and prevent large flows from carrying sediment over the dam. Add stones to dams as needed to maintain design height and cross section.

   d. Upon stabilization of the disturbed areas, the check dams shall be removed and the remaining sediment cleaned out of the ditch. The Contractor shall reshape the ditch to its existing shape or blend into

the adjacent ditch section. The Contractor shall properly seed the ditch and protect with matting.

3.07 TEMPORARY MULCHING

A. Apply temporary mulch to areas where rough grading has been completed but final grading is not anticipated to begin within 30 days of the completion of rough grading.

B. Straw mulch shall be applied at rate of 100 lbs/1000 sq ft and tackified with latex acrylic copolymer at a rate and diluted in a ratio per manufacturer's instructions.

3.08 EROSION CONTROL BLANKETS

A. Erosion control blankets shall be installed in all seeded drainage swales and ditches as shown on the Drawings and as directed by the Owner/Engineer in accordance with manufacturer's instructions. The area to be covered shall be properly prepared, fertilized and seeded with permanent vegetation before the blanket is applied. When the blanket is unrolled, the netting shall be on top and the fibers in contact with the soil over the entire area. The blankets shall be applied in the direction of water flow and stapled. Blankets shall be placed a minimum of three rows (of 4-ft) wide (total approx. 12-ft width) within the drainage swale/ditch and stapled together in accordance with manufacturer's instructions. Side overlaps shall be 4-in minimum. The staples shall be made of wire, .091-in in diameter or greater, "U" shaped with legs 10-in in length and a 1-1/2-in crown. Commercial biodegradable stakes may also be used with prior approval by the Engineer. The staples shall be driven vertically into the ground, spaced approximately two linear feet apart, on each side, and one row in the center alternately spaced between each size. Upper and lower ends of the matting shall be buried to a depth of 4-in in a trench. Erosion stops shall be created every 25-ft by making a fold in the fabric and carrying the fold into a silt trench across the full width of the blanket. The bottom of the fold shall be 4-in below the ground surface. Staple on both sides of fold. Where the matting must be cut or more than one roll length is required in the swale, turn down upper end of downstream roll into a slit trench to a depth of 4-in. Overlap lower end of upstream roll 4-in past edge of downstream roll and staple.

1. To ensure full contact with soil surface, roll matting with a roller weighing 100 lbs/ft of width perpendicular to flow direction after seeding, placing matting and stapling. Thoroughly inspect channel after completion. Correct any areas where matting does not present a smooth surface in full contact with the soil below.

3.09 REMOVAL AND FINAL CLEANUP

A. Once the site has been fully stabilized against erosion, remove sediment control devices and all accumulated silt. Dispose of silt and waste materials in proper manner. Regrade all areas disturbed during this process and stabilize against erosion with surfacing materials as indicated on the Drawings.

END OF SECTION

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SECTION 02317
UNDERGROUND UTILITY WARNING TAPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Underground warning tape shall be furnished and installed as shown on the Drawings. Tape shall be provided for all main line sewer pipes, regardless of pipe material.

B. Underground warning tape shall be furnished and installed in other areas as ordered by the Owner/Engineer.

1.02 SUBMITTALS

A. Submit in accordance with Section 01300.

B. Submit manufactures literature identifying all materials of construction, conformance with applicable reference standards, dimensions, specified material properties, colors and wording.

PART 2 PRODUCTS

2.01 MATERIALS

A. The detectable warning tape shall be polyethylene tape manufactured in accordance with the following technical data:

TECHNICAL DATA

PROPERTIES	**TEST METHOD**	**VALUE**
Thickness	ASTM 02103	0.004” (4 mils)
Elongation	ASTM D882-75B	800%
Tensile Strength	ASTM 0882	75 lbs/foot

B. Tape shall be 6 inches wide.

C. The warning tape shall be heavy gauge 0.004 inch polyethylene and shall be resistant to acids, alkalis and other soil components. It shall be highly visible in the following colors with the associated phrases stamped in black letters and repeated at a maximum interval of 40 inches.

Type of Utility	**Color**	**Warning Message**
Sanitary Sewer	Green	Caution – Sanitary Sewer Buried Below
Storm Drain	Green	Caution – Storm Drain Buried Below
Water	Blue	Caution – Water Line Buried Below

D. The tape shall be of the type specifically manufactured for marking and locating utilities.

E. Tape shall be Terra Tape as manufactured by Reef Industries Houston, Texas or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. All buried pipe and fittings shall be installed with detectible underground warning tape located approximately 24” above top of pipe.

B. Printed side of the tape shall be installed facing up.

END OF SECTION

SECTION 02450
JACKING AND BORING

PART 1—GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, supplies and incidentals required to install casing pipe by jacking and auger boring, jacking and hand mining or microtunneling methods at the locations shown on the Drawings and thereafter installing wastewater carrier pipe by sliplining methods.

B. The work shall include, but not be limited to, the following: jacking and receiving pits, steel casing pipe, potable water carrier pipe, centering skids, casing seals, vents, coatings, location markers, settlement monitors, temporary construction access and miscellaneous appurtenances as required to complete the installation.

C. Work shall be done in accordance with the details shown on the Drawings and as specified herein and in accordance with all State and local laws, regulations and requirements.

D. Furnish the services of a licensed professional engineer, registered in the State of South Carolina to prepare jacking designs and submittals.

E. Furnish special insurance, traffic control, flaggers and any other requirements imposed by the SCDOT, the Norfolk Southern Railroad, and City of Columbia Standard Specifications.

F. Furnish special insurance, traffic control, flaggers and any other requirements imposed by the City of Columbia, SCDOT, the Norfolk Southern Railroad and the CSX Railroad.

G. Convene a pre-installation meeting with the Owner, Engineer, Contractor, SCDOT district engineer and railroad district engineer a minimum of two weeks prior to commencing work of this section.

1.02 QUALITY ASSURANCE

This section contains references to the following Codes and Standards. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the Codes and Standards, the requirements of this section shall prevail.

AASHTO – American Association of State Highway and Transportation Officials
AREMA – American Railway Engineering and Maintenance-of-Way Association
ASTM – American Society for Testing and Materials
AWPA – American Wood Preservers Association
AWS – American Welding Society
NUCA – National Utilities Contractors Association
NSCE-8 –Specification for Pipeline Occupancy of NS Corporation Property
SCDOT – South Carolina Department of Transportation

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, complete shop drawings and product data for pipe, fittings and related appurtenances. Submit a laying schedule showing stationing, elevations, pipe classes and class coding.

B. Jacking system designs shall be prepared by a licensed professional engineer, registered in the State of South Carolina having a minimum of five years of professional experience in the design and construction of jacking systems. Submit P.E. Certification Form included in Section 01300. Submit drawings indicating the layout of jacking pits and sequence of construction for coordination with other aspects of the project. The submittal shall include but not be limited to the casing design calculations, dewatering, soil stabilization, jacking pits, jacks, reaction blocks and method for spoil removal, manufacturer's data on casing pipe, end seals, casing spacers, and whether using hand mining, auger boring or microtunneling technologies.

C. Method for fitting up and inserting carrier pipe into the casing pipe shall be submitted including, but not limited to, method for joining pipe prior to insertion and pipe skids or centering devices.

D. Submit history of previous work completed of equivalent nature and scope. Include qualification and experience of key personnel. The installer shall be a company specializing in performing work of this section with a minimum of 5 years of documented experience of projects of similar magnitude and conditions. The Contractor's field supervisor and equipment operator shall have a minimum of 1-year experience in the operation of the equipment being used. The field supervisor shall be on-site at all times during the preparation and execution of the boring and jacking operation.

E. Record Documents - Record actual locations of casing, carrier pipe, and invert elevations. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.04 REFERENCES

A. Stein, Dietrich, *Trenchless Technology for Installation of Cables and Pipeline*, Stein and Partner, Bochum, Germany, 2005.

B. Thomson, James, *Pipejacking and Microtunneling*, Blackie Academic and Professional, London, U.K., 1995.

C. Najafi, Mohammad, *Trenchless Technology – Pipeline and Utility Design, Construction and Renewal*, McGraw Hill, New York , NY, 2005

D. Pipe Jacking Association, *Guide to Best Practice for the Installation of Pipe Jacks and Microtunneling*, Marshall Robinson Roe, Oxford, United Kingdom, 1995

E. ASCE, *Geotechnical Baseline Reports for Underground Construction,* American Society of Civil Engineers, Reston, Virginia, 2007

F. ASCE, *Horizontal Auger Boring Projects,* American Society of Civil Engineers, Reston, Virginia, 2004

G. Iseley, D.T. et al, *Trenchless Construction Methods and Soil Compatibility Manual,* National Utility Contractors Association (NUCA), 1999

H. TRB, *Trenchless Installation of Conduits Beneath Roadways, Synthesis of Highway Practice 242*, Transportation Research Board (TRB), 1997

1.05 DESIGN REQUIREMENTS

The completed installation shall be suitable in all respects for transporting water/wastewater without affecting the stability and integrity of the overlying roadways or railway. Design casing pipe for leak-proof construction. The casing length shall be as shown on the Drawings. The Contractor may extend the casing length if approved by the Engineer at no additional cost to the Owner.

A. HIGHWAY CROSSINGS:

Design casing for earth and other pressure loads present, plus AASHTO H20 live loading.

B. RAILROAD CROSSINGS:

Design casing for earth and other pressure loads present, plus railroad E80 live loading with 50 percent added for impact.

Design bracing, backstops, and use jacks of sufficient rating for continuous jacking without stoppage, except for adding pipe sections and as conditions permit, to minimize tendency of ground material to "freeze" around casing pipe.

Perform work in accordance with State of South Carolina Department of Transportation Standards, NUCA Trenchless Excavation Construction Equipment & Methods Manual, NUCA Pipe Jacking & Microtunneling Design Guide, AREMA, and Norfolk Southern guidelines, as applicable.

Verify invert elevations of existing work prior to excavation and installation of casing.

1.06 DELIVERY, STORAGE AND HANDLING

A. All pipe shall be subjected to a careful inspection prior to being installed. If any pipe fails to meet the specified requirements, it shall be removed and replaced with satisfactory pipe.

1.07 PROJECT/SITE REQUIREMENTS

A. Waters levels are to be below the invert elevation of the jacking and receiving pits prior to the start of work. The floor of the jacking and receiving pits shall be kept free from ground and surface waters during the operation and the Contractor shall be prepared to implement additional groundwater control on short notice as directed by the Engineer. The Contractor shall submit his proposed method for controlling groundwater along the casing pipe and at the face of the jacking shield during the jacking operation.

B. Discharge from dewatering operations shall be treated and discharged as specified in Section 02140.

C. Inspect the locations where jacking operations will be conducted and the pipe is to be installed, verify the conditions under which the work will be performed, and provide all items required for the orderly prosecution of the work.

D. Be prepared to work at night and on weekends, if required, to complete the work. Request and obtain written authorization from the Engineer prior to working nights and weekends.

E. Jacking operations under highways shall not result in vertical movement exceeding 0.5-inches or any lesser amount required by SCDOT. If any movement or settlement occurs which causes or might cause damage to streets or structures over, along, or adjacent to the work, jacking operations shall stop immediately except for those activities which will assist in making the work secure and prevent further movement, settlement, or damage. Jacking operations may resume only after all necessary precautions have been taken to prevent further movement, settlement, or damage.

F. Streets and structures damaged by jacking operations shall be repaired or replaced as necessary to restore them to their condition prior to beginning jacking operations by the Contractor at no additional cost to the Owner.

G. Jacking operations under railways shall not result in vertical movement exceeding 0.5 inches or any lesser amount required by the railroad. If any movement occurs, jacking operations shall stop immediately except for those activities which will assist in making the work secure and prevent further movement, settlement, or damage. Jacking operations may resume

only after all necessary precautions have been taken to prevent further movement, settlement, or damage.

H. Location of jacking pits shall be such that local residents and business have access to driveways.

1.08 CASING PIPE INSTALLATION TOLERANCES

A. TOLERANCES:

1. No more than 1-inch horizontal and 1-inch vertical deviation from design location shall be permitted in the position of the jacked pipe. The downstream invert elevation of a casing pipe section shall at all times be lower than the upstream invert elevation.
2. When the jacked pipe deviates from design line or grade by amount greater than that specified, the pipe shall be returned to design line or grade plus or minus the specified tolerance at a rate of not more than 1 inch per 25 feet.
3. If the jacked pipe is off design line or grade by an amount that requires redesign of the pipeline or associated structures, the Contractor shall do so at no additional cost to the Owner.

PART 2—PRODUCTS

2.01 CASING AND JACKING PIPE MATERIALS

Furnish materials in accordance with the SCDOT and railroad company standards.

Steel casing pipe shall meet the requirements of ASTM A53/A53M, or ASTM A106, Grade B, 35,000 psi minimum yield strength with full circumference welded joints in accordance with AWS D1.1 to withstand excavation forces.

The steel casing pipe shall have a minimum wall thickness as shown in the following tables and on the Drawings. These thicknesses are the minimum, and may need to be increased depending on actual site conditions that may impact forces exerted on the pipe. The Contractor may opt to use a steel casing pipe with a larger wall thickness if approved by the Engineer and at no additional cost to the Owner.

Carrier Pipe Diameter (in)	Casing Pipe Diameter (in)	Casing Pipe Wall Thickness (in)	Location
36	48	0.6250	Pickens St
36	48	0.6250	Blossom St

2.02 CARRIER PIPE MATERIALS

Carrier system piping shall be as specified in Section 02530.

2.03 GROUT AND COVER MATERIALS

Soil backfill for trench approaches and pits to finish grade shall be as specified in Section 02200.

Fill and seal grout at pipe ends using the following method:

1. End seals constructed of 1/8" thick neoprene rubber with ½" thick T304 stainless steel bandings and 100% non-magnetic worm gear mechanisms. Casing end seals shall be Advance Products & Systems, Inc. Model AW.

2.04 ACCESSORIES

A. CASING SPACERS:

Casing spacers shall be a two-piece shell fabricated from T-304 stainless steel of a minimum 14 gauge thickness. Each shell section shall be lined with a 0.090-inch thick, ribbed PVC extrusion with a retaining section overlapping the edges of the shell. Bearing surfaces (runners) shall be attached to support sections at positions to properly support the carrier pipe with the casing. The runners shall be mechanically bolted to the riser. Risers shall be made of T-304 stainless steel of a maximum 10 gauge. All risers shall be welded to the shell. Casing spacers shall be manufactured by Cascade Waterworks Manufacturing Company.

B. GROUND-SURFACE MONITORING POINTS:

1. Ground-surface monitoring points (GMPs) will be used to monitor vertical deformation of the ground, road surfaces, railroad ties and structures at locations selected by the Engineer.

2. GMPs shall consist of a 2-inch long masonry nail with an identification tag. The nail shall be manufactured from hardened, zinc-plated steel. The nail shall have a ribbed thread along its shank and a conical point. It shall also have an indent in the center of its head to receive a surveyor's plumb bob. The identification tag shall be 1-1/2-inhes diameter by 3/32-inch thick with a punched number for identification. The masonry nail shall be placed through the central hole in the identification tag and driven into an asphalt-covered surface or a wooden railroad tie such that the identification tag lies directly between the asphalt-covered surface or railroad tie and the head of the masonry nail.

C. MIXES

1. Sand fill shall be of such sizes that when dry, one hundred percent by weight shall pass a No. 20 sieve and not over 5 percent by weight shall pass a No. 100 sieve.
2. Mortar shall consist of one-part cement, 1/4 part lime and two parts sand. Sand shall comply with ASTM C144. Lime shall comply with ASTM C207, Type S. Cement shall comply with ASTM C150, Type II.
3. Cement grout shall consist of a mixture of about one-part cement to six parts sand. The amount of cement may be increased or decreased as necessary and as permitted to provide good flowing characteristics.
4. Bentonite or polymer slurry shall be applied as required to the external surface of the pipe to reduce skin friction during jacking.

PART 3—EXECUTION

3.01 EXAMINATION

A. The Contractor shall verify existing conditions before starting work. Verify connection to existing piping system, size, location, and invert elevations are in accordance with the Drawings.

B. The Contractor shall be responsible for interpreting subsurface investigation reports, determining the site soil conditions and investigating the site prior to Bid. The Contractor shall be responsible for obtaining permits and permissions for conducting site investigations. The Contractor shall not be entitled to additional compensation if rock and/or water is encountered.

3.02 PREPARATION

A. Jacking and receiving pit sub-grades shall be kept free from ground and surface waters during jacking operations. Dewatering plan shall be in accordance with Section 02140. Additional groundwater controls may be ordered by the Engineer on short notice and shall be implemented as directed. Groundwater shall be maintained below the bottom of the jacking pit. Groundwater control along and at the face of the jacking pipe shall include chemical grout stabilization or other methods as proposed by the Contractor, as required.

3.03 PROTECTION OF EXISTING FACILITIES

A. The Contractor shall comply with all permits obtained to conduct the work. This shall include prior coordination with highway or railroad personnel.

B. Access shall be maintained to existing buildings, roadways, railways and other facilities requiring access. Modify installation as necessary to maintain access.

C. Excavated materials and equipment shall not be stored inside rights-of-way without prior permission from the necessary agency.

D. Casing installation shall not interfere or create hazardous conditions within roadways or railways. Ground stabilization shall be performed to minimize loss of ground at the pits or around the face of the casing. The Contractor shall be responsible for any settlement resulting from the casing installation activities, at no additional cost to the Owner.

E. Blasting shall only be conducted upon full authorization from the Owner, Engineer and highway agency. No blasting will be conducted with railroad rights-of-way.

F. Excavation, trenching and shoring operations shall be conducted in accordance with current Occupational Safety and Health Act (OSHA) regulations, and ANSI A10.16.

G. Unless otherwise directed by the Engineer, settlement markers shall be placed at 25 foot intervals along the centerline of the casing when outside of paved areas and at 15 foot intervals when inside paved areas. Each centerline marker shall have markers offset 15 feet on each side. When set, the settlement markers shall be tied to construction benchmarks and shall not be disturbed during construction activities.

H. Measurements to the settlement markers, to the nearest one-thousandth foot, shall be made at regular intervals during construction. If the measurement indicates settlement or heaving in excess of 1-inch, the Contractor shall cease work, and consult the Engineer, highway district engineer, and/or railroad authority to determine the best method for corrective action. Corrective action shall be conducted immediately, prior to resuming casing installation, and at no additional cost to the Owner.

3.04 CASING PIPE INSTALLATION BY JACKING

A. The jacking pits shall be made of adequate length to provide room for the jacking frame, the jacking head, the reaction (thrust) blocks, the jacks, auger rig (if used), and the jacking pipe, and shall be made sufficiently wide to allow ample working space on each side of the jacking frame. The depth of the pit shall be such that the invert of the casing pipe, when placed on the guide frame, will be at the elevation desired for the completed line. The jacking pits should also be of sufficient length to provide room for the installation of the wastewater carrier pipe by slip lining methods.

B. The receiving pits shall be made of sufficient length and width to provide ample working room for the removal of the jacking shield or jacking shoe, as applicable, and for the construction of any piping appurtenances or structures for the wastewater carrier pipe.

C. Excavate jacking pit and receiving pit and provide excavation supports as required for support of the pits. Excavation support shall be pre-augured soldier piles and lagging or steel sheeting as specified in Section 02200. Extend the lateral earth support system to a sufficient depth below the bottom of the pits to resist any pressure developed by the soil and groundwater outside the pit. Submit complete design calculations for the excavation support system as prepared by a Professional Engineer registered in the State of South Carolina.

D. Furnish a level concrete slab at the bottom of the jacking pit. Steel rails or beams shall be embedded in the concrete slab for placement and alignment of each piece of pipe during installation operations. The guide rails shall be installed at the line and grade of the proposed casing pipe.

E. Provide a safety railing all around the top of the jacking and receiving pits at all times.

F. Furnish, install and remove reaction (thrust) blocks or such other provisions as may be required in driving the pipe forward. Install reaction blocks of sufficient bearing area to transmit the thrust of the jacks to the soil without excessive soil deflection and without disturbance of adjacent structures or utilities.

G. The contractor is directed to the geotechnical baseline report and must be aware that the soils in the area of the jacking operations are soft soils. The reaction block design must be able to accommodate these soft soils with minimal movement.

H. Use a jacking frame which applies a uniform pressure evenly over the entire end of the jacking pipe with no point loads.

I. Maintain proper alignment and elevation of the pipe consistently throughout the jacking operation.

J. Push casing pipe into ground with boring auger rotating or hand mining within pipe to remove spoil. Do not advance cutting head ahead of casing pipe except for distance necessary to permit cutting teeth to cut clearance for the pipe. No unsupported excavation shall be permitted ahead of the casing pipe.

H. When within the railroad right-of-way, the boring operation shall be progressed continuously on a 24-hour basis without stoppage (except for adding segments of pipe) until the leading edge has reached the receiving pit.

3.05 PITS OR APPROACH TRENCHES

A. Excavate approach trenches or pits in accordance with installation plan, shop drawings and as site conditions require. The pits shall be generally rectangular in shape, with adequate space for the equipment and operating personnel. Sides shall be shored with sheeting or trench boxes as needed. Ensure casing entrance face is as near perpendicular to alignment as conditions permit. Establish a vertical entrance face at least 1 foot above top of casing.

B. Dewatering measures and excavation supports shall be installed as required. Keep floor of pit dry during the execution of work. The floor of the pit shall be firm and stabilized, establishing a solid foundation for which to work. If necessary, over-excavate the floor and place a base of gravel or concrete as stabilization material.

3.06 SPOIL REMOVAL

A. The Contractor may choose to remove the spoil at the face of the jacking shield using auger boring equipment or hand mining methods. The Contractor may propose other methods such as microtunneling for approval.

The contractor is directed to the geotechnical baseline report and must be aware that the invert levels of the casing pipes will be at or near the interface between soft soil and either partially weathered rock (PWR) or crystalline rock which will make it difficult to maintain line and grade using mechanized spoil removal methods.

B. MANUAL SPOIL REMOVAL (HAND MINING):

The Contractor may choose to remove the spoil at the face of the jacking pipe by hand mining. The Contractor must meet the following minimum requirements for hand mining:

1. The face of the jacking pipe must be fitted with a jacking shield which effectively extends the crown of the pipe beyond the end of the jacking pipe and over the pipe invert where spoil removal is to be performed by hand mining. At no time may the excavation extend beyond the end of the jacking shield crown.
2. The Contractor must provide a positive means for supplying fresh air constantly to the face of the casing pipe and shield area.
3. The Contractor must provide constant two-way communication between the personnel at the shield face and the jacking pit.
4. The Contractor must provide adequate lighting at the shield face. Lighting fixtures should be explosion proof and protected from moisture.
5. No gasoline or diesel powered equipment shall be allowed inside the casing pipe. Excavation tools must be pneumatic or hydraulic powered.
6. The Contractor must conduct all operations in strict accordance with the requirements of the U.S. Department of Labor Safety and Health Regulations for Construction promulgated under the Occupational Safety and Health Act of 1970 (Public Law-91-596).

C. AUGER SPOIL REMOVAL

The Contractor may choose to use auger equipment to excavate the casing pipe face. The auger equipment shall be compatible with the jacking equipment used and shall be capable of removing the material at the face of the casing pipe and transporting the spoil back to the jacking pit while maintaining required line and grade. A cutting shoe shall be fitted to the end of the casing pipe, and the cutting face at the front of the auger string shall never be allowed to advance closer than within one foot of the end of the casing pipe and the fitted cutting shoe.

D. PAYMENT FOR SPOIL REMOVAL:

Regardless of the spoil material encountered and the method of spoil removal, no separate or additional payment shall be made to the Contractor for spoil removal.

3.07 GROUND SURFACE MONITORING POINTS (GMPs)

A. GMPs shall be installed at location as directed by the Engineer.

B. All GMPs shall have the horizontal as-installed location determined to an accuracy of plus or minus 0.5-ft and the elevation to an accuracy of plus or minus 0.001-ft.

C. There will be no separate payment for GMPs.

3.08 OBSTRUCTIONS DURING JACKING

A. Man-Made Obstructions shall be defined as man made objects such as concrete, wood, railroad ties, wood sheeting and various steel obstructions that are 2 cubic feet in volume or larger and as such, completely stop the normal forward progression of the jacked pipe when jacking by the full effort and power available from the Contractors on site jacking equipment.

B. Naturally occurring obstructions include boulders, cobbles and bedrock. Partially weathered rock (PWR) and crystalline rock have been identified as existing along the pipeline alignment. The Contractor shall anticipate the presence of rock and provide methods capable of removing the naturally occurring bedrock while maintaining line and grade tolerances. Boulders, cobbles and bedrock anticipated as part of this work shall not be claimed as an obstruction for the purposes of additional payment.

C. The Contractor shall notify the Engineer immediately upon encountering an obstruction which stops forward progress of the Work. The Engineer shall verify that an obstruction has stopped the forward progress of the Work for more than 30 minutes and authorize the Contractor to commence activities to remove the obstruction.

D. No compensation will be considered or allowed for over-breakage of obstruction beyond a circumferential arc 6 inches outside of the outside diameter of the jacked pipe. Where such circumferential removal leaves or creates a “void” over or around the pipe, the Contractor shall be required to inject or place concrete or other suitable substance to “structurally” fill the void to the satisfaction of the Engineer.

E. There shall be no separate payment for obstruction removal.

3.09 SOIL STABILIZATION

A. The Contractor shall furnish all labor, materials and equipment as required to stabilize the soils in the area of the jacking operations. Such stabilization shall include the use of chemical grouting.

B. The design of the chemical grout mix shall provide the following minimum values when injected into medium dense Ottawa 20-30 sand:

1. Unconfined compressive strength ≥100 psi
2. Unconfined initial tangent modules >100 psi
3. Permeability $\leq 10^6$ cm/sec

C. All chemical grouting equipment shall be of a type, capacity and mechanical capability suitable for doing the Work. The equipment shall be maintained in good operating condition at all times.

D. The chemical grout pumping unit shall be equipped with piping and/or hoses of adequate capacity to carry the base grout and reactant solutions separately to the point of mixing. The hoses shall come together in a "Y" fitting containing check valves to prevent backflow. The "Y" fitting shall be followed by a suitable baffling chamber, and shall be easily accessible for sampling mixed grout. A water flushing connection or valve shall be placed behind the "Y" to facilitate flushing the grout from the mixing hose and baffle between grouting sessions. Distribution of proportioned grout, under pressure, to the grouting locations shall be monitored by separate, automatic recording, flow rate indicators and gauges.

E. Chemicals shall be stored in metal tanks, suitably protected from accidental discharge by valving and other necessary means. Tank capacity shall be sufficient to supply at least one day's worth of grouting materials so as not to interrupt the Work in the event of chemical delivery delays.

F. The Contractor shall provide at the site all necessary chemical quality control testing apparatus, including but not limited to: hydrometers, balance scales, graduates, viscometer and all other devices that are required to conduct chemical material acceptance tests, chemical proportioning tests, and grout quality tests for proper quality control of the Work.

3.10 INSTALLATION OF CARRIER PIPE BY SLIP LINING

A. The Contractor shall provide all labor, materials and equipment as required to prepare the casing pipe to receive the carrier pipe and to install the carrier pipe within the casing pipe using slip lining methods.

B. The casing pipe shall be cleaned and inspected prior to beginning insertion of the carrier pipe. The Contractor shall confirm that the casing pipe is ready to receive the carrier pipe and that there are no obstacles, debris, or jagged edges which may prevent complete insertion of the carrier pipe, or any sags or crowns that do not meet the tolerance limits specified in 1.08.

C. The Contractor shall utilize the jacking and receiving pits constructed for the jacking of the casing pipe, and the dewatering system installed for the jacking operation, as much as is practicable, for the installation of the carrier pipe by slip lining.

D. As and where shown on the Drawings, the Contractor shall install either DIP carrier pipe within the casing pipe. Where DIP is specified for the carrier pipe, the Contractor may install the pipe using the cartridge method or using a pre-joined string of pipe.

E. The carrier pipe shall be supported within the casing pipe by pipe skids or other devices such as 'spiders' designed to maintain the pipe position as close as possible to the vertical and horizontal center of the casing pipe. Where DIP carrier pipe is used, the skid or other device must be sized to keep the DIP bell clear of the casing pipe during installation. This will necessitate a skid located near the bell end of each pipe section, at the least.

F. The Contractor shall submit details of the skids, vertical spacers or other devices proposed, materials of construction and their method of attachment to the carrier pipe.

G. The Contractor may install the carrier pipe using a winch and a follow-on to pull the pipe string, or a backhoe and a push ring or other device to push the pipe string into place. The ends of the pipe string must be protected during the installation to prevent end damage.

H. Following installation of the carrier pipe, the Contractor shall inspect the pipe for damage and for proper alignment within the casing pipe. Any damage shall be repaired or the damaged pipe removed and replaced at no extra cost to the Owner.

I. The Contractor shall pressure test the section of carrier pipe within the casing pipe immediately after installation. Acceptance testing shall be per the appropriate pipe specification section.

J. After the carrier pipe has successfully passed acceptance testing, the Contractor shall construct end seals and install vent pipes in accordance with SCDOT Policies and Procedures, Norfolk Southern Railroad Specifications, CSX Railroad Specifications and City of Columbia Standards.

K. The Contractor shall provide blocking and shoring required to resist the thrust from the pressurized force main to prevent movement of the carrier pipe within the casing and damage to pipe skids, spiders or other devices maintaining the carrier pipe position inside the casing.

3.11 SITE RESTORATION

A. At the conclusion of all jacking operations, remove all systems used to grout, lubricate and dewater the operation. Remove or abandon the excavation support system as specified in Section 02200.

B. Following pipe installation and backfill operations, restore the profile of the right-of-way to its original condition. Construct sidewalk and fencing, if applicable, to match existing. Install sodding or seeding to match existing, as required.

C. Remove all equipment, supplies, excess excavation materials and miscellaneous items associated with the jacking operation and leave the site in a clean and tidy condition.

END OF SECTION

SECTION 02515
CONCRETE SIDEWALKS, CURBS, GUTTERS AND WALKWAYS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install concrete sidewalks, walkways, curbs, gutters, pads and driveway aprons as shown on the Drawings and as specified herein.

B. Furnish all labor, materials, equipment and incidentals required to replace in-kind concrete sidewalks, walkways, curbs, gutters, pads and driveway aprons disturbed by the Contractor through normal operation of completing the Work.

1.02 RELATED WORK

A. Trenching, Excavation and Backfill is included in Section 02200.

B. Loaming and seeding is included in Section 02930.

C. Concrete is included in Section 003300.

1.03 REFERENCE STANDARDS

A. ASTM International

1. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.

B. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M213 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

A. Concrete shall be as specified in Section 03300, but in no case less than 3,500 psi at 28 days.

B. Welded wire fabric shall conform to ASTM A185 and shall be of size and gauge shown.

C. Expansion joint filler shall be bituminous type, 1/2-in thick meeting AASHTO M-213-65.

D. Materials for gravel base course shall be as specified in Section 02200.

PART 3 EXECUTION

3.01 REMOVAL OF EXISING SIDEWALKS, CURBS, GUITTERS, WALKWAYS, AND APRONS

A. All concrete indicated on the Drawings to be removed, or that necessary for normal completion of the Work shall be cut on a straight and true line, along expansion joints, using a powered concrete saw.

B. All debris shall be promptly removed from the site and disposed of properly.

3.02 INSTALLATION

A. The subgrade for walkways shall be shaped parallel to the proposed new concrete surfaces and thoroughly compacted. All depressions occurring shall be filled and again compacted until the surface is smooth and hard.

B. After the subgrade has been prepared, a gravel base course shall be placed. After being thoroughly compacted, the base course shall be at least 8-in in thickness and parallel to the proposed surfaces of the new concrete surfaces.

C. Forms

1. Side and transverse forms shall be smooth, free from warp, of sufficient strength to resist springing out of shape, of a depth to conform to the thickness of the new concrete surfaces and of a type satisfactory to the Owner/Engineer.

2. All mortar or dirt shall be completely removed from forms that have been previously used. The forms shall be well staked and thoroughly braced and set to the established lines with their upper edge conforming to the grade of the finished surface which shall have sufficient pitch to provide for surface drainage, but not to exceed 1/4-in/ft.

3. All forms shall be oiled before placing concrete.

D. Wire Fabric Reinforcement

1. All wire fabric shall be stored off the ground and shall be protected from moisture and be kept free from dirt, oil, or injurious coatings.

2. Splices in welded wire fabric shall be lapped not less than 1-1/2 courses or 12-in, whichever is greater. Wire fabric splices shall be tied together with wire ties spaced no more than 24-in on center. Support as approved in middle of slab.

3. Before being placed in position, wire fabric shall be thoroughly cleaned of loose mill and rust scale, dirt and other coatings, including ice, that reduce or destroy bond. Where there is delay in depositing concrete after reinforcement is in place, fabric shall be re-inspected and cleaned when necessary.

4. In no case shall wire fabric be covered with concrete until the amount and position of the fabric have been checked by the Owner/Engineer.

E. Placing and Finishing Concrete

1. Concrete walkways shall be placed in alternate slabs not exceeding 30-ft in length, except as otherwise indicated on the Drawings. The slabs shall be separated by transverse, preformed expansion joint filler.

2. Preformed expansion joint filler shall be placed adjacent to structures as directed.

3. Concrete shall be placed in such quantity that, after being thoroughly consolidated in place, it shall have a minimum of 4-in in depth. Finishing operations shall be delayed until all bled water and water sheen has left the surface and concrete has started to stiffen. After water sheen has disappeared, edging operations shall be completed. After edging and jointing operations, the surface shall be floated with an aluminum or magnesium float. Immediately following floating, the surface shall be steel troweled. If necessary, tooled joints and edges shall be rerun before and after troweling to maintain uniformity. Finish with broom at right angles to alignment of walk, then round all edges with 1/4-in radius after brooming.

4. When completed, the walkways shall be kept moist and protected from traffic and weather for at least 3 days.

END OF SECTION

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SECTION 02575
BITUMINOUS PAVEMENT, MARKINGS, AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install the bituminous paved roadway, parking areas, and guard, rails as shown on the Drawings and as specified herein.

B. The work includes preparation of existing paved surfaces and repaving of those surfaces as specified herein.

C. All pavement markers and markings shown on the Drawings or that existed prior to construction shall be replaced with new markers and new markings.

1.02 RELATED WORK

A. Site Preparation in included in Section 02100.

B. Earthwork is included in Section 02200.

C. Sedimentation and Erosion Control: Section 02270.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer in accordance with Section 01300, shop drawings showing dimensions, layouts, and details of construction, and accessories required.

1.04 REFERENCE STANDARDS

A. Except as otherwise specified herein, the material and construction shall be in accordance with the current *Standard Specifications for Highway Construction* and relevant supplemental specifications as issued by the South Carolina Department of Transportation (SCDOT).

B. American Society for Testing and Materials (ASTM)

1. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs 60,000 Psi Tensile Strength.

C. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M144 – Standard Specification for Calcium Chloride.

2. AASHTO M180 – Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrail.

D. American Wood Preservers Association (AWPA)

1. AWPA C1 – All Timber Products, Pressure Treatment (General Requirements).

2. AWPA C14 – Wood for Highway Construction, Pressure Treatment.

3. AWPA M4 – Standard for the Care of Preservative-Treated Wood Products.

4. AWPA P5 – Standards for Waterborne Preservatives.

E. Where reference is made to one of the above standards, the revision in effect at the time of Bid opening shall apply.

PART 2 PRODUCTS

2.01 MATERIALS

A. Bituminous concrete surface course shall meet Section 403 of SCDOT standards as referenced above.

B. Bituminous concrete binder course shall meet Section 402 of SCDOT standards.

C. Calcium chloride shall meet AASHTO M-144 and shall be spread wherever directed to allay dust conditions. The Owner/Engineer may direct the Contractor to employ sprinkling of water in lieu of calcium chloride for dust control.

D. Asphalt – Tack coat shall consist of either emulsified asphalt or cutback asphalt conforming to the above referenced SCDOT standards.

E. Pavement marking paint shall be fast-drying type conforming to the above referenced SCDOT standards and Federal Specifications TT-P 1952B.

F. Graded aggregate base course shall meet Section 305 of SCDOT standards.

PART 3 EXECUTION

3.01 BITUMINOUS CONCRETE PAVING – GENERAL

A. Bituminous concrete pavement shall be installed in accordance with the current SCDOT *Standard Specifications*.

B. The binder course shall be placed as soon as possible after the aggregate base course has been prepared, shaped, and compacted.

C. The binder course shall be placed and compacted by steel-wheeled rollers of sufficient weight to thoroughly compact the bituminous concrete. Where necessary, the new pavement shall be rolled smooth and even with the existing pavement.

D. Contractor shall maintain pavement under this Contract during the guarantee period of one year and shall promptly (within three days of notice given by Owner/Engineer) refill and repave areas which have settled or are otherwise unsatisfactory for traffic.

E. All pavement thicknesses referred to herein are compacted thicknesses. The Contractor shall place sufficient mix to ensure that the specified thickness of pavement occurs where called for.

F. When required, remove existing pavement by saw, pneumatic hammer, or wheel, cutting edges of trenches to be repaved as directed by the Owner/Engineer. After pipe laying, backfilling, and compaction operations are completed satisfactorily, and after the gravel subbase is shaped and compacted, place the type of pavement as shown on the Drawings.

G. Hose clean all road surfaces after backfilling and before any surfacing but, in no case, shall pavement be placed until the gravel base is dry and compacted to at least 98-percent maximum density at optimum moisture content in accordance with the requirements of Section 02200.

H. All new and existing manhole frames, utility boxes, and drain inlets shall be set to the grade of the wearing course. At no time shall the manhole frames be allowed to protrude above the surface of the wearing course.

I. Furnish and spread calcium chloride on or wet down disturbed surfaces to allay dust conditions as directed by the Owner/Engineer.

J. The contact surfaces of castings, previously constructed asphalt or Portland cement concrete pavements shall be painted with a tack coat in accordance with SCDOT standards. Surfaces shall be thoroughly cleaned of all loose material and debris prior to application of the tack coat.

K. After the paving mixture has been properly spread, initial compaction shall be obtained by the use of power rollers weighing not less than 240 pounds per inch width of tread.

L. Final compaction of the surface shall be accomplished by rollers weighing not less than 285 pounds per inch width of tread. Along curbs, structures, and all places not accessible with a roller, the mixture shall be thoroughly compacted with tampers. Such tampers shall not weigh less than 25 pounds and shall have a tamping face of not more than 50 square inches. The surface of the mixture after compaction shall be smooth and true to the established line and grade.

M. When the air temperature falls below 50°F, extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials, and placing and compacting the mixtures.

N. No mixtures shall be placed when the air temperature is below 40°F nor when the material on which the mixtures are to be placed contains frost or has a surface temperature the Owner/Engineer considers too low.

O. No vehicular traffic or loads shall be permitted on the newly completed pavement, until adequate stability has been attained and the material has cooled sufficiently to prevent distortion or loss of fines. If climatic or other conditions warrant it, the period of time before opening to traffic may be extended at the discretion of the Owner/Engineer.

P. Pavement replacement and other surfacing as specified herein will be a condition of progress payment applications.

Q. Pavement shall be replaced at each roadway crossing as pipeline installation is completed.

3.02 TRENCH PAVEMENT RESTORATION

A. Restore trench pavement in County and State roads as shown on the Drawings.

B. If points of settlement or holes appear in the pavement, the Contractor shall repair the same within three days of notification by the Owner/Engineer. If, after due notice, the Contractor fails to make the repairs, the work will be done by the Owner and the total cost of such repairs will be charged to the Contractor.

3.03 GUARDRAILS

A. Guardrails shall be installed at locations as shown on the Drawings and as detailed.

B. Posts shall be set plumb in augered holes and backfilled with the specified material thoroughly tamped. Install uniform 4-inch layer of crushed stone at finish grade in areas shown on the Drawings.

C. Guardrails shall be joined together as shown on the Drawings and securely bolted to all posts. Nut end of bolts shall be placed on the backside of the guardrail post and peened to prevent removal.

D. Each post shall have a minimum of two carriage bolts installed as shown on the Drawings.

E. Where guardrails meet and change direction, angle and provide two end posts—one post for each direction of rail. End posts shall not be further than three feet apart and rails shall not be further than four inches apart. Rails and post tops shall be constructed parallel with finish grade and generally appear as one continuous line without abrupt change in alignment.

F. Where temporarily removing existing guardrails to perform the work, replace the guardrails to match existing.

3.04 ROAD MARKERS

A. Road markers shall be installed in accordance with the manufacturer's instructions.

B. Road marker locations shall be spotted in the field and approved by the Owner/Engineer before installation.

3.05 ROADWAY MARKINGS

A. Markings shall be located as shown on the Drawings or as existed prior to construction.

B. All surface dirt within the areas to be painted shall be removed. Large areas of tar, grease, or foreign materials may require sand blasting, steam cleaning, or power brooming to accomplish complete removal. Application of stripes shall not proceed until final authorization is received from the Owner/Engineer.

C. No thinners shall be used for the pavement marking applications, except in accordance with the manufacturer's specifications and at the direction of theOwner/ Engineer.

D. No paint or pavement marking material shall be heated above the temperature marked on the container.

E. Bituminous concrete pavements shall have been in place for 48 hours prior to the application of pavement markings.

F. If for any reason, material is spilled or tracked on the pavement; or if any markings applied, in the Owner/Engineer's judgement, fail to conform because of a deviation from the desired pattern, the Contractor shall remove such material by a method that is not injurious to the roadway surface and is acceptable to the Owner/ Engineer. Contractor shall clean the roadway surface and prepare the surface for a reapplication of markings, and reapply the markings as directed without additional compensation.

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SECTION 02605
PRECAST CONCRETE MANHOLES

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials and equipment required to install precast concrete manholes, frames and covers, and appurtenances as shown on the Drawings and as specified herein.

1.02 RELATED WORK

A. Trenching, backfilling, and compaction are included in Section 02200.

B. Granular fill materials are included in Section 02200.

1.03 SUBMITTALS

A. Submit to the Owner/Engineer, in accordance with Section 01300, shop drawings, product data, materials and details of construction, reinforcing and joints. Submittals shall include at least the following:

1. Base sections, riser sections, eccentric and concentric conical top sections, flat slab tops, grade rings with notarized certificate indicating compliance with ASTM C478.

2. Pipe connections to manholes.

3. Manhole frame and cover with notarized certificate indicating compliance with the specified ASTM standard and Class designation.

4. Method of repair for minor damage to precast concrete sections.

5. Sewer brick with notarized certificate indicating compliance with ASTM C32, Grade SS.

6. Sectional plans and elevations showing dimensions and reinforcing steel placement.

7. Structural calculations including assumptions.

8. Concrete design mix.

9. Concrete test cylinder reports from an approved testing laboratory certifying conformance with this Section.

10. Results of leakage tests.

1.04 REFERENCE STANDARDS

A. ASTM International

1. ASTM A48 - Standard Specification for Gray Iron Castings.

2. ASTM C32 - Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale).

3. ASTM C33 - Standard Specification for Concrete Aggregates.

4. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)

5. ASTM C150 - Standard Specification for Portland Cement

6. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes

7. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

8. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections

9. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections using Preformed Flexible Joint Sealant.

10. ASTM D4101 - Standard Specification for Propylene Plastic Injection and Extrusion Materials

B. American Concrete Institute (ACI)

1. ACI 318 - Building Code Requirements for Structural Concrete

2. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures

C. American Association of State Highway and Transportation Officials (AASHTO)

1. Standard Specifications for Highway Bridges

D. Occupational Safety and Health Administration (OSHA)

E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All material shall be new and unused.

B. Materials' quality, manufacturing process and finished sections are subject to inspection and approval by Owner/Engineer or other Owner representative. Inspection may be made at place of manufacture, at work site following delivery, or both.

C. Materials will be examined for compliance with ASTM standards, this Section and approved manufacturer's drawings. Additional inspection criteria shall include: appearance, dimensions, blisters, cracks and soundness.

D. Materials shall be rejected for failure to meet any requirements specified herein. Rejection may occur at place of manufacture, at work site, or following installation. Sewer manhole precast

concrete sections will be manufactured using the "wet method" of fabrication. Mark for identification rejected materials and remove from work site immediately. Rejected materials shall be replaced at no cost to Owner.

E. Repair minor damage to precast concrete sections by approved method, if repair is authorized by Engineer. Epoxy mortar may be utilized for repairs subject to the approval of the Owner/Engineer.

1.06 GENERAL WASTEWATER FACILITY INSTALLATION REQUIREMENTS

A. Installation of wastewater facilities shall be in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) Regulation R.61-67 to include the requirements outlined herein.

B. Separation of Sewers and Water Mains:

1. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or contact with any part of a sewer manhole.

2. Horizontal and Vertical Separation from Potable Water Mains. Sewers shall be laid at least 10 feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. Any deviation shall be approved by the Engineer and SCDHEC.

3. Crossings. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of 18 inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

4. Force Mains. There shall be at least a 10-foot horizontal and 18-inch vertical separation between sanitary sewer force mains and potable water mains.

5. Special Conditions. When it is impossible to obtain the distances specified, the Contractor shall coordinate an alternative design that:
   a. maximize the distances between the sewer line and the potable water main and the joints of each;
   b. use pipe materials which meet the requirements of SCDHEC; and
   c. allow enough distance to make repairs to one of the lines without damaging the other.

6. Sewer Manholes. No potable water pipe shall pass through or contact with any part of a sewer manhole.

C. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided.

D. Drop manholes are required where the invert differential is 24 inches or more.

E. Each section of sewer pipe shall be specified to be laid to the appropriate line and grade, as designed, working in the upstream direction with the bell end laid upgrade.

PART 2 PRODUCTS

2.01 GENERAL

A. Reference to a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance, operation, maintenance, spare parts and manufacturer's service.

C. Provide no more than 2 lifting lugs or holes in each precast section for proper handling.

D. Cement shall conform to ASTM C150, Type II cement or equal.

E. Precast concrete sections shall be properly cured prior to shipping. Precast concrete sections shall not be shipped before concrete has attained 3,000 psi compressive strength.

F. Mark date of manufacture, name and trademark of manufacturer on the inside of each precast section.

2.02 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast concrete base sections, riser sections, transition top sections, flat slab tops and grade rings shall conform to ASTM C478 and meet the following requirements:

1. Design precast concrete base and flat slab top for their own weight, weight of soil at 130 pcf, and a live load equal to AASHTO H-20 truck loading applied at finished grade.

2. The wall thickness shall not be less than 5-in for 48-in diameter reinforced barrel sections, 6-in for 60-in diameter reinforced barrel sections and 7-in for 72-in diameter reinforced barrel sections.

3. Bottom slab thickness shall be no less than the riser wall thickness.

4. Construct precast concrete bases as shown on the Drawings.

5. Base, riser and transition top sections shall have tongue and groove joints.

6. Top section shall be eccentric cone where cover over pipe exceeds 4-ft. Top section shall be a flat slab where cover over top of pipe is 4-ft or less or where top elevation of manhole is to be set above grade in a flood prone area as indicated on the Drawings.

7. Provide integrally cast knock-out panels in precast concrete manhole sections at locations, and with sizes shown on Drawings. Knock-out panels shall have no steel reinforcing.

2.03 BRICK MASONRY

A. Bricks shall be sound, hard, uniformly burned, regular and uniform in shape and size. Underburned or salmon brick shall not be acceptable. Only whole brick shall be used.

1. Bricks for channels and shelves shall conform to ASTM C32, Grade SS except that the mean of five tests for absorption shall not exceed 8 percent and no individual brick exceed 11 percent.

2. Bricks for raising manhole frames to finished grade shall conform to ASTM C62.

B. Mortar shall be composed of 1 part Portland cement, 2 parts sand, and hydrated lime not to exceed 10-lbs to each bag of cement. Portland cement shall be ASTM C150, Type II; hydrated lime shall conform to ASTM C207.

C. Sand shall be washed, cleaned, screened, well graded with all particles passing a No. 4 sieve and conform to ASTM C33.

2.04 MANHOLE FRAME AND COVER

A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30.

B. Manhole covers shall have a 24-in. clear opening and a diamond pattern, blind pick holes, the words “City of Columbia” and “Sanitary Sewer” cast in 3-in letters.

C. All standard manhole frames and covers shall be Neenah Foundry model R-1642, East Jordan Iron Works, Inc. model #1045 frame and #1040A cover, US Foundry model #755-NC, or equal.

D. All water tight manhole frames and covers shall be Neenah Foundry model Lift Mate, East Jordan Iron Works, Inc. model #1033 Hingeco, US Foundry model #750-KI, or equal.

2.05 MANHOLE HATCHES

A. All flat slab tops installed above grade at elevations above the flood plain, as indicated on the drawings shall include an aluminum access hatch rather than a cast-iron manhole frame and cover.

1. Access doors shall provide a minimum of a 30-inch by 30-inch clear opening.

2. The access door shall have a 1/4" (7mm) thick, mill finish, extruded aluminum channel frame, incorporating a continuous concrete anchor. A 1-1/2 inch (38mm) drainage coupling shall be located in the front left corner of the channel frame. The entire frame must be supported by a full bed of Class A concrete.

3. The access door panels shall be 1/4" (7mm) aluminum diamond plate reinforced to withstand a H-20 uniform live load with a maximum allowable deflection of 1/150 of the span, and shall not protrude into the channel frame when in the open position.

4. The access doors shall open to 90 degrees and automatically lock with a T-316 stainless steel hold open. The doors shall incorporate enclosed stainless steel compression spring assists. Doors shall close flush with the frame. Hinges and all fastening hardware shall be T-316 stainless steel. Unit shall lock with a T-316 stainless steel slam lock with removable key and have a non-corrosive handle. Unit shall have a hinged aluminum grate fall-through protection system.

5. The access hatch shall be installed in accordance with the Drawings and the manufacturer's recommendations.

6. Hatches shall be Halliday H1W3030 (water tight), as manufactured by Halliday Products Orlando, Florida, or approved equal or size and type as shown on the Drawings.

2.06 MANHOLE RUNGS

A. There shall be no manhole rungs.

2.07 JOINTING PRECAST MANHOLE SECTIONS AND CATCH BASINS

A. Seal tongue and groove joints of precast manhole sections with either rubber O-ring gasket or preformed flexible joint sealant. O-ring gasket shall conform to ASTM C443. Preformed flexible joint sealant shall be Kent Seal No. 2 by Hamilton-Kent; Ram-Nek by K.T. Snyder Company or equal.

B. Completed joint shall withstand 15 psi internal water pressure without leakage or displacement of gasket or sealant.

2.08 PIPE CONNECTIONS TO MANHOLES

A. Connect pipe to manholes in the following ways:

1. Flexible sleeve - Integrally cast sleeve in precast manhole section or install sleeve in a formed or cored opening. Fasten pipe in sleeve with stainless steel clamp(s). Coat stainless steel clamp(s) with bituminous or asphaltic dampproofing material to protect from corrosion. Flexible sleeve shall be Lock Joint Flexible Manhole Sleeve; Kor-N-Seal connector; PRX Press-Seal Gasket or equal.

2. Compression gasket - Integrally cast compression gasket in precast manhole section. Insert pipe into compression gasket. Compression gasket shall be A-Lok or equal.

3. At the discretion of the Engineer the following procedure may be allowed: Grout in place - Precast manhole section shall have a formed, tapered circular opening larger than the pipe outside diameter. Grout shall be non-shrink and waterproof equal to Hallemite, Waterplug or Embeco. Plastic pipe shall have a waterstop gasket secured to pipe with a stainless steel clamp prior to grouting.

2.09 DAMPPROOFING

A. Two coats of bituminous waterproofing material applied to the exterior surfaces of sanitary sewer manholes by brush or spray and in accordance with the manufacturer's recommendations. Dampproofing shall be Hydrocide 648 by Sonneborn Building Products; Dehydratine 4 by A.C. Horn Inc; RIW Marine Liquid by Toch Brothers or equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Manhole Installation.

1. Manholes and catch basins shall be constructed to the dimensions shown on the Drawings and as specified herein. Protect all work against flooding and floatation.

2. Place manhole on a bed of 12-in crushed stone as shown on the Drawings. Set manhole and catch basin base grade so that a maximum grade adjustment of 12-in is required to bring the manhole frame and cover to final grade.

   a. Use precast concrete grade rings or brick and non-shrink mortar to adjust manhole frame and cover to final grade.

3. Set precast concrete barrel sections plumb with a 1/4-in maximum out of plumb tolerance allowed. Seal joints of precast barrel sections with either a rubber O-ring set in a recess or preformed flexible joint sealant in sufficient quantity to fill 75 percent of the joint cavity. Fill the outside and inside joint with non-shrink mortar and finished flush with the adjoining surfaces. Caulk the inside of any leaking barrel section joint with lead wool or non-shrink grout to the satisfaction of the Owner/Engineer.

4. Allow joints to set for 14 hours before backfilling unless the Owner/Engineer specifically approves a shorter period.

5. Plug holes in the concrete barrel sections required for handling with a non-shrinking grout or non-shrinking grout in combination with concrete plugs. Finish flush on the inside.

6. Backfill carefully and evenly around manhole sections.

B. Manhole Pipe Connections

1. Construct manhole pipe connections, including pipe stubs, as specified herein. Close or seal pipe stubs for future connections with a gasketed watertight plug.

C. Brickwork

1. Mix mortar only in such quantity as may be required for immediate use. Use mortar before initial set has taken place. Mortar shall be used within 1-1/2 hours and shall be constantly worked with hoe or shovel until used. Anti-freeze mixtures shall not be included in the mortar. Install masonry when the outside temperature is above 40 degrees F unless provisions are made to protect the mortar, bricks and finished work from frost by heating

and enclosing the work with tarpaulins or other suitable material. Owner's/Engineer's decision regarding the adequacy of protection against freezing shall be final.

2. Construct channels and shelves of brick and concrete as shown on the Drawings. Brick lined channels shall correspond in shape with the lower half of the pipe. Set shelf elevation at crown of highest pipe and slope 1-in/ft to drain toward the flow through channel. Construct brick surfaces exposed to sewage flow with nominal 2-in by 8-in face exposed (i.e., bricks on edge).

D. Setting Manhole Frame and Cover

1. Set manhole covers and frames in a full mortar bed. Utilize bricks or precast concrete grade rings, a maximum of 12-in thick, to assure frame and cover are set to the finished grade. Set manhole frame and cover to final grade prior to placement of permanent paving.

E. Setting Access Hatches

1. Install in accordance with the manufacturers recommendations.

F. Dampproofing

1. Paint outer surfaces of precast sanitary sewer manholes with two coats of bituminous dampproofing at the rate of 30 to 60 sq ft per gallon, in accordance with manufacturer's instructions.

3.02 LEAKAGE TESTS

A. Pipelines shall be tested as specified in Section 02610.

B. Test each sewer manhole for leakage. Owner/Engineer shall observe each test. Perform exfiltration test as described below:

C. Assemble manhole in place; fill and point all lifting holes and exterior joints within 6-ft of the ground surface with an approved non-shrinking mortar. Test prior to placing the shelf and invert and before filling and pointing the horizontal joints below 6-ft of depth. Lower ground water table below bottom of the manhole for the duration of the test. Plug all pipes and other openings into the manhole and brace to prevent blow out.

D. Fill manhole with water to the top of the cone section. If the excavation has not been backfilled and no water is observed moving down the surface of the manhole, the manhole is satisfactorily watertight. If the test, as described above is unsatisfactory as determined by the Owner/Engineer, or if the manhole excavation has been backfilled, continue the test. A period of time may be permitted to allow for absorption. Following this period, refill manhole to the top of the cone, if necessary and allow at least 8 hours to pass. At the end of the test period, refill the manhole to the top of the cone again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each manhole shall not exceed one gallon per vertical foot for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be made as directed by the Owner/Engineer. If leakage due to a defective section of joint exceeds three gallons per vertical foot per day, the manhole shall be rejected. Uncover

the rejected manhole as necessary and to disassemble, reconstruct or replace it as directed by the Owner/Engineer. Retest the manhole and, if satisfactory, fill and paint the interior joints.

E. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

F. An infiltration test may be substituted for an exfiltration test if the ground water table is above the highest joint in the manhole. If there is no leakage into the manhole as determined by the Owner/Engineer, the manhole will be considered watertight. If the Owner/Engineer is not satisfied, testing shall be performed as previously described.

3.03 CLEANING

A. Thoroughly clean all new manholes of all silt, debris and foreign matter of any kind, prior to final inspections.

END OF SECTION

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SECTION 02610
SEWER TESTING AND CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and test and clean all new sewer pipelines installed under this Contract as specified herein.

1.02 RELATED WORK

A. Buried pipelines are included in Division 2.

B. Above grade and exposed pipelines are included in Division 15.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Furnish all necessary equipment and labor for cleaning and testing all new sewer pipelines. The procedures and methods shall be approved by the Owner/Engineer.

B. Make any taps and furnish all necessary caps, plugs, etc, as required in conjunction with testing pipelines. Furnish a test pump, gauges and any other equipment required in conjunction with carrying out the hydrostatic tests.

3.02 CLEANING PIPELINES

A. As pipe laying progresses and at the conclusion of the work thoroughly clean all new pipelines by flushing with water or other means to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period. If, after this cleaning, obstructions remain, they shall be removed by other means by the Contractor as approved by the Owner/Engineer.

3.03 TESTING GRAVITY PIPELINES

A. All gravity pipelines shall be tested for leakage by an infiltration or exfiltration test. Buried piping shall be tested by an infiltration test if the groundwater is more than 2-ft above the crown of the pipe for the full length of the section to be tested. Air testing may be used in lieu of an exfiltration test subject to approval of the Owner/Engineer.

B. Exfiltration Test

1. Leakage tests by exfiltration shall be made by creating a head in the pipeline to be tested by filling the line and either a manhole or temporary riser on one end of the line with water. The length of pipe to be tested shall be such that the head over the crown at the upstream end is not less than 2-ft and the head over the downstream crown is not more than 6-ft. The pipe shall be plugged by pneumatic bags or mechanical plugs in such a manner

that the air can be released from the pipe while it is being filled with water. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of at least one hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period.

2. If any joint shows an appreciable amount of leakage, the jointing material shall be removed and the joint repaired. If any pipe is defective, it shall be removed and replaced. If the quantity of water required to maintain a constant head in the pipe does not exceed 1.9 gallons per inch of diameter per day per 100-ft of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory.

C. Infiltration Test

1. Pipe shall be tested for infiltration after the backfill has been placed and the ground water allowed to return to normal elevation. The length of line to be tested shall be not less than the length between adjacent manholes and not more than the total length of each size of pipe. The allowable infiltration shall be 1.9 gallons per inch of diameter per day per 100-ft of pipe in each section tested. There shall be no gushing or spurting leaks.

2. If an inspection of the completed pipeline or any part thereof shows pipes or joints which allow noticeable infiltration of water, the defective work or material shall be replaced or repaired as directed.

3. Rates of infiltration shall be determined by means of V-notch weirs, pipe spigots, or by plugs in the end of the pipe installed in an approved manner and at such times and locations as may be directed by the Engineer.

D. When the pipeline to be tested is reinforced concrete pipe, the allowable leakage in the above tests shall be 4.7 gallons per inch of diameter per 100-ft of pipe.

E. Low Pressure Air Test

1. Low-pressure air tests shall be made with equipment specifically designed and manufactured for the purpose of testing pipelines using low-pressure air. The equipment shall be provided with an air regulator valve or air safety valve so set that the internal air pressure in the pipeline cannot exceed 8 psig. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. All air used shall pass through a single control panel.

2. Install plugs at manholes. Brace plugs securely as required for safety and allow no one in the manholes while pressurizing the line or during the test.

3. Low-pressure air shall be introduced into the sealed line until the internal air pressure reaches 4 psig. The internal air pressure in the sealed line shall not be allowed to exceed 8 psig. At least 2 minutes shall be allowed for the air pressure to stabilize in the section under test. After the stabilization period, the low-pressure air supply hose shall be quickly disconnected from the control panel. The time required in minutes for the pressure in the section under test to decrease from 3.5 to 2.5 psig shall not be less than that shown in Table 1 of ASTM F1417.

4. If the pipe section does not pass the air test, sectionalize the section tested to determine the location of the leak. Once the leak has been located, repair and retest.

F. TESTING PRESSURE PIPELINES (NOT USED)

G. MANDREL TESTING FOR GRAVITY SANITARY SEWERS

1. Perform deflection testing on flexible (PVC, HDPE) and semi-rigid (CCFRP) pipe to confirm pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034.

2. Perform testing no sooner than 30 days after backfilling of line segment, but prior to final acceptance testing of the line segment.

3. Pull the approved mandrel by hand through sewer sections. Replace any section of sewer not passing the mandrel. Mandrel testing is not required for stub outs.

4. Retest repaired or replaced sewer sections.

END OF SECTION

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SECTION 02615
DUCTILE IRON PIPE FOR BURIED SEWER SERVICE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work specified in this Section includes the installation of buried ductile iron pipe for gravity and pressure sanitary sewer service as indicated on the Contract Drawings and as herein specified.

B. The Contractor shall furnish and install sewer piping and service connection piping to the lines and grades and in the locations indicated on the Contract Drawings and/or as ordered by the Owner/Engineer.

C. Piping shall be located substantially as shown on the Drawings. The Owner/Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.

D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

A. Section 02140, Dewatering and Drainage

B. Section 02200, Earthwork

C. Section 02270, Sedimentation and Erosion Control

D. Section 02610, Sewer Testing and Cleaning

E. Section 02605, Precast Concrete Manholes

F. Section 02317, Underground Warning Tape

1.03 SUBMITTALS

A. Submit shop drawings and product data, including piping layouts, design calculations, warranty information, and test reports, in accordance with Section 01300 and the referenced standards.

B. Submit the name of the pipe and fitting suppliers and a list of materials to be furnished.

C. Prior to shipment of pipe, certified copies of mill tests confirming the type of materials used in the pipe, and shop testing of pipe to show compliance with the requirements of the applicable standards, along with a sworn affidavit of compliance that the pipe complies with the referenced standards, shall be submitted.

D. Submit copies of all shop tests, including hydrostatic tests.

E. Submit anticipated production and delivery schedule.

F. Prior to shipment of pipe, submit a certified affidavit of compliance from the manufacturer stating that the pipe, fittings, gaskets, linings and exterior coatings for this project have been manufactured and tested in accordance with AWWA and ASTM standards and requirements specified herein.

G. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.

H. Submit certified statement that inspection and all specified tests have been performed.

1.04 REFERENCES

A. The following standards based on the latest edition form a part of this specification as referenced:

1. ASTM A746 Standard Specifications for Ductile Iron Gravity Sewer Pipe
2. AWWA C104 Cement-Mortar Lining for Ductile Iron Pipe and Fittings for Water
3. AWWA C105 Polyethylene Encasement for Ductile Iron Pipe Systems
4. AWWA C110 Ductile Iron Full Body Fittings, 3 in. through 64 in.
5. AWWA C111 Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings
6. AWWA C115 Flanged Ductile Iron Pipe with Threaded Flanges
7. AWWA C151 Ductile Iron Pipe, Centrifugally Cast, for Water or Other Liquids
8. AWWA C150 Thickness Design of Ductile Iron Pipe
9. AWWA C153 Ductile Iron Compact Fittings, 3 in. through 64 in. for Water Service
10. AWWA C600 Installation of Ductile Iron Water Mains and their Appurtenances

1.05 QUALITY ASSURANCE

A. It is a requirement of these Contract Documents to have all of the ductile iron pipe under this section be of a domestic manufacturer designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers. Similarly, it is a requirement of these Contract Documents to have all of the ductile iron fittings under this section designed and supplied by a single manufacturer rather than have selection and supply of these items by a number of different manufacturers.

B. All pipe and fittings shall be inspected and tested at the foundry as required by the standard specifications by which the material is manufactured.

C. All pipe and fittings shall be subject to inspection by the Owner/Engineer after delivery to the job site and may also be subject to inspection at the foundry by a representative of the Owner.

D. In addition, the Owner reserves the right to have any or all pipe, fittings, and special castings inspected and/or tested by an independent service at either the manufacturer's plant or elsewhere. Such inspection and/or tests will be at the Owner's expense.

E. All ductile iron pipe shall be domestically manufactured in the United States. Pipe shall be cast, cleaned, lined, coated, fabricated, tested, and certified at a USA manufacturing facility.

F. All pipe and fittings shall be marked in accordance with all applicable AWWA standards. Legibly and permanently mark all pipe, fittings, specials and appurtenances to be consistent with the laying schedule and marking drawings (if required) with the following information:

1. Manufacturer, date.

2. Size, type, class, or wall thickness.

3. AWWA Standard(s) produced to.

1.06 GENERAL WASTEWATER FACILITY INSTALLATION REQUIREMENTS

A. Installation of wastewater facilities shall be in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) Regulation R.61-67 to include the requirements outlined herein.

B. Separation of Sewers and Water Mains:

1. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or contact with any part of a sewer manhole.

2. Horizontal and Vertical Separation from Potable Water Mains. Sewers shall be laid at least 10 feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. Any deviation shall be approved by the Engineer and SCDHEC.

3. Crossings. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of 18 inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural

support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

4. Force Mains. There shall be at least a 10-foot horizontal and 18-inch vertical separation between sanitary sewer force mains and potable water mains.

5. Special Conditions. When it is impossible to obtain the distances specified, the Contractor shall coordinate an alternative design that:
   a. maximize the distances between the sewer line and the potable water main and the joints of each;
   b. use pipe materials which meet the requirements of SCDHEC; and
   c. allow enough distance to make repairs to one of the lines without damaging the other.

6. Sewer Manholes. No potable water pipe shall pass through or contact with any part of a sewer manhole.

C. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided.

D. Drop manholes are required where the invert differential is 24 inches or more.

E. Each section of sewer pipe shall be specified to be laid to the appropriate line and grade, as designed, working in the upstream direction with the bell end laid upgrade.

PART 2 PRODUCTS

2.01 PIPE

A. Ductile iron gravity and pressure pipe shall conform to the current ASTM A746, and AWWA C111 and C151 (ANSI A21.51) standard. All pipe shall be new, and shall have the AWWA or ASTM designation, pressure class and size of pipe stamped on the outside of each joint.

B. Thickness design shall be per AWWA C150, latest standard, with minimum Pressure Class 350 for piping 12-in and smaller, minimum Pressure Class 250 for piping from 14 to 20-in, minimum Pressure Class 200 for 24-inch piping, and minimum Pressure Class 150 for piping 30 to 64-in.

C. Pipe to be shipped per AWWA C600 and in accordance with the pipe manufacturer’s recommendations and stored in a manner that the pipe is not damaged. The Contractor will replace damaged piping at no additional cost to the Owner.

2.02 JOINTS AND GASKETS

A. Unless otherwise noted, all ductile iron pipe/fitting joints shall be push-on rubber gasket type per AWWA C111 in unrestrained areas.

B. In restrained areas as indicated on the Drawings, both pipe and fitting joints shall be push on rubber gasket, locking ring type restrained joints per the manufacturer' standard, except where flange joints are shown on the Drawings.

1. Restrained push on joints shall be by one of the following or an approved equal:
   a. Amarillo Fast-Grip gasket, Flex Ring, Field Flex Ring, and LOK Ring by American Cast Iron Pipe
   b. Red Field Lok gasket, TR Flex by US Pipe
   c. Megalug by EBBA Iron
   d. Or Equal

2. Restrained joint gaskets shall be colored, non-black. The color shall be consistent throughout the entire cross section of the gasket and not be attained by surface coating; the color shall be inherent within the rubber. Gaskets shall meet applicable requirements of AWWA/ANSI C111/A21.11 and shall be ANSI/NSF Standard 61 certified. Restrained gaskets shall be manufactured in the United States. Restrained joints shall be rated at a minimum as follows:

   a. 350 psi for 4”-18” diameter
   b. 250 psi for 20”-24” diameter
   c. 150 psi for 30”-64” diameter

C. Threaded ductile iron flanges for ductile iron pipe shall be fabricated per AWWA C115 and sealed during installation with a special high pressure, full face gasket per AWWA C111. At the pipe manufacturer's option, the use of 250 lb pattern flanges, which are faced and drilled in accordance with ANSI B16.1 may be substituted in order to match valves or other equipment and/or to meet the required working pressure requirements. All flanges shall be rated for the same pressure as the adjacent pipe in all cases. Compatibility of the flanges with 250 lb class and higher special class AWWA valves will the responsibility of the Contractor.

1. Flanges shall be pre-drilled and then faced after being screwed onto the pipe, with flanges true to 90 degrees of the pipe axis and shall be flush with the end of the pipe.

2. Gaskets shall be full face rubber, 1/8" thick SBR material. Such as American Toruseal Gasket, or approved equal. Special material ring gaskets such as those by Garlock or equal may be required for pressures exceeding 250 for ANSI rated and custom flanges.

3. Flanged joints shall be supplied with bolts and nuts on one end, bolt studs with a nut at each end, or studs with nuts on one end where the flange is tapped. The number and size of bolts shall comply with the same standard as the flange. Bolts and nuts shall, except as otherwise specified or noted in the Specifications or on the Drawings, comply with ASTM A193, grade B7.

4. Blind flanges shall mate with regular flanges.

5. Filler flanges and beveled flange fillers shall be furnished faced and drilled complete with extra length bolts.

2.03 FITTINGS

A. Fittings for ductile iron pipe shall be of ductile iron, and shall conform to AWWA C153 or AWWA C110.

B. Pipe fittings shall be ductile iron with pressure rating of 350 psi for 24-in and smaller piping and 250 psi for 30-in and larger piping. Fittings shall have the same pressure rating, as a minimum, of the connecting pipe.

2.04 COUPLINGS AND ADAPTERS

A. Sleeve type couplings shall be Dresser Style 38, 138 or equal by Ford Meter Box Co., Smith Blair or Romac industries.

2.05 EXTERIOR COATING

A. All buried pipe shall be installed with an external bituminous coating in accordance with AWWA C151 and C110 respectively.

B. Zinc Coating

1. The exterior of ductile iron pipe for buried service or where noted on the plans shall be coated with a layer of arc-sprayed zinc. The mass of the zinc applied shall be 200 g/m2 of pipe surface area. A finishing layer topcoat shall be applied to the zinc. The mean dry film thickness of the finishing layer shall not be less than 3 mils with a local minimum not less than 2 mils.

2. The zinc coating system shall conform to ISO 8179 standard.

3. All pipe shall be manufactured and zinc coated in the United States at the pipe manufacturer’s facility.

C. Polyethylene Encasement

1. If required and noted per plans, polyethylene encasement for use with ductile iron pipe shall be V-Bio and meet all the requirements for ANSI/AWWA C105/A21.5, Polyethylene Encasement for Ductile Iron Pipe Systems. Polyethylene encasement for use with ductile iron pipe systems shall consist of three layers of co-extruded linear low-density polyethylene (LLDPE), fused into a single thickness of not less than eight mils.

2. The inside surface of the polyethylene wrap to be in contact with the pipe exterior shall be infused with a blend of anti-microbial biocide to mitigate microbiologically influenced corrosion and a volatile corrosion inhibitor to control galvanic corrosion. Ductile iron pipe and the polyethylene encasement used to protect it shall be installed in accordance with AWWA C600 and ANSI/AWWA C105/A21.5 and also in accordance with all recommendations and practices of the AWWA M41, Manual of Water Supply Practices.

3. Where required, buried pipe shall be installed with polyethylene encasement. V-Bio polyethylene encasement shall have a minimum thickness of 8 mils and meet or exceed the minimum standards established by AWWA C105, current edition.

4. Polyethylene encasement shall meet minimum size requirements per TABLE 3 of section 2.15 of DIPRA's Installation Guide for Ductile Iron Pipe.

5. Test results from an independent testing agency certifying that the V-Bio polyethylene encasement meets all criteria established by AWWA C105, current edition, shall be submitted to the Owner/Engineer prior to approval of the polyethylene encasement for use. In general, samples shall be submitted and include test results in accordance with the AWWA standard associated with tensile strength, elongation, dielectric strength, impact resistance, and propagation tear resistance.

6. A 2-inch wide plastic adhesive tape, such as Calpico Vinyl, Polyken, U.P.C. Tape, or approved equal, shall be used for sealing seams, cuts, or tears in polyethylene encasement. Duct tape shall not be allowed.

2.06 INTERIOR LINING

A. For sanitary sewer, ductile iron pipe and fittings shall be lined with a ceramic-filled amine-cured epoxy, Protecto 401 by Induron, or equal on sanitary sewers. The lining thickness shall be 40 mils minimum. Application shall be performed by an applicator approved by the coating manufacturer, in accordance with manufacturer's instructions and under controlled conditions at the applicator's shop or the pipe manufacturer's plant. Applicator shall submit a certified affidavit of compliance with manufacturer's instructions and requirements specified herein.

B. Interior lining shall cover all exposed surfaces of the pipe and fittings. The lining shall extend from the spigot end through the socket to the edge of the gasket sealing the recess for pipe using push-on joints. The lining shall also cover the exterior of the spigot end from the end of the pipe to beyond the gasket sealing area.

PART 3 EXECUTION

3.01 GENERAL

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe, lining or coatings. Pipe and fittings shall not be dropped or skidded against each other. Slings, hooks or pipe tongs shall be used for pipe handling. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe, lining or coatings shall be repaired per manufacturer's recommendations. Handling and laying of pipe and fittings shall be in accordance with manufacturer's instruction and as specified herein.

B. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.

C. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.

D. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations and/or AWWA C600.

E. Gaskets for push-on joints to be stored shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

F. Piping underneath structures shall be concrete encased.

3.02 INSTALLING DUCTILE IRON PIPE AND FITTINGS

A. Ductile iron pipe and fittings shall be installed in accordance with requirements of AWWA C600, except as otherwise specified herein. A firm, even bearing throughout the length of the pipe shall be provided by digging bell holes at each joint and by tamping backfill materials at the side of the pipe to the springline per details shown on the Drawings. Unless approved at specific locations, blocking will not be permitted. If any defective pipe or fitting is discovered after it has been laid, it shall be removed and replaced with a sound pipe or fitting in a satisfactory manner by the Contractor, at his/her own expense.

1. All pipe and fittings shall be kept clean until they are used in the work and shall be sound and thoroughly cleaned before laying. When laid, the pipe and fittings shall perform to the lines and grades required. When laying is not in progress, including lunch breaks, open ends of the pipe shall be closed by a watertight plug or other approved means. Sufficient backfill shall be placed to prevent flotation. The deflection at joints shall not exceed that recommended by the manufacturer.

2. All ductile iron pipe laid underground shall have a minimum of [3] of feet of cover unless otherwise shown on the Drawings or as specified herein. Pipe shall be laid such that the invert elevations shown on the Drawings are not exceeded.

3. Fittings, in addition to those shown on the Drawings shall be provided, where required, in crossing utilities which may be encountered upon opening the trench. Solid sleeve closures shall be installed at locations approved by the Owner/Engineer.

4. The pipe interior shall be maintained dry and broom clean throughout the construction period.

5. When field cutting the pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. The end of the cut pipe shall be beveled to conform to the manufacturer's recommendations for the spigot end. Any coating removed from the cut end shall be repaired according to manufacturer's recommendation. Cutting of restrained joint pipe will not be allowed, unless approved at specific joints in conjunction with the use of restrainer glands by EBAA Iron or field adaptable restrained joints. Where field cuts are permitted, the pipe to be cut shall be supplied by the factory as "gauged full length". Should full length gauged pipe be unavailable, the pipe to be cut shall be field gauged at the location of the new spigot using a measuring tape, or other means approved by the manufacturer, to verify that the diameter is within the tolerances permitted in Table 1 of AWWA C151.

B. Jointing Ductile-Iron Pipe

1. Push-on joints shall be made in strict accordance with manufacturer's instructions, AWWA C600 and Appendix B of AWWA C111. If there is conflict, the manufacturer's instructions

shall take precedence. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe. The joint surfaces shall be cleaned and lubricated and the plain end of the pipe shall be aligned with the bell of the pipe to which it is to be joined and pushed home. After joining the pipe, a metal feeler shall be used to make certain that the rubber gasket is properly seated.

2. Bolts in restrained joints shall be tightened alternately and evenly.

3. Restrained joints shall be installed according to pipe manufacturer's instructions.

4. Flanged joints shall be assembled in strict accordance with the manufacturer's instructions and Appendix C of AWWA C111. If there is conflict, the manufacturer's instructions shall take precedence. Extreme care shall be taken to ensure that there is no restraint on opposite ends of pipe or fitting, which would prevent uniform gasket compression, cause unnecessary stress, bending or torsional strains, or distortion of flanges or flanged fittings. Adjoining push on joints shall not be assembled until flanged joints have been tightened. Flange bolts shall be tightened uniformly to compress the gasket uniformly and obtain a seal. Flange bolts shall be left with approximately 1/2-inch projection beyond the face of the nut after tightening. After installation bolts and nuts shall be encapsulated using wax sealing tape per AWWA Standard C217.

5. Sleeve couplings shall only be installed for closure or as shown on the Drawings. Couplings shall not be assembled until adjoining joints have been assembled. After installation, bolts and nuts shall be encapsulated using wax sealing tape per AWWA Standard C217, and install protective wrap recommended by the manufacturer or as required herein.

3.03 CONNECTIONS TO STRUCTURES

A. Wherever a pipe 3-in in diameter or larger passes from concrete to earth horizontally, two flexible joints spaced from 2 to 4-ft apart depending on pipe size shall be installed, within 2-ft of the exterior face of the wall, whether or not shown on the Drawings.

B. Unless otherwise specified, all pipes passing through a wall will utilize a wall sleeve designed to pass the thrust through the wall via restrained piping.

3.06 TESTING AND CLEANING

A. All gravity and pressure testing of sewer pipe is included in Section 02610.

3.07 UNDERGROUND UTILITY MARKING

A. The tape shall be provided and installed in accordance with Section 02317.

END OF SECTION

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SECTION 02622
POLYVINYL CHLORIDE GRAVITY SEWER PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. The Work specified in this Section includes furnishing all labor, materials, equipment and incidentals required to install and test polyvinyl chloride (PVC) sewer pipe and fittings, complete as shown on the Contract Drawings and as specified herein.

B. The Contractor shall furnish and install sewer piping to the lines and grades and in the locations indicated on the Contract Drawings and/or as ordered by the Owner/Engineer.

C. Piping shall be located substantially as shown on the Drawings. The Owner/Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.

D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

A. Section 02140, Dewatering and Drainage

B. Section 02200, Earthwork

C. Section 02270, Sedimentation and Erosion Control

D. Section 02610, Sewer Testing and Cleaning

E. Section 02605, Precast Concrete Manholes

F. Section 02317, Underground Warning Tape.

1.03 SUBMITTALS

A. The Contractor shall furnish, prior to use of the materials, satisfactory written certification of his compliance with the manufacturer's standards for all materials, conformance with the methods of the manufacturer, and accordance with all standards.

B. Submit to the Engineer, within 30 days of the effective date of the Contract, the name of the PVC pipe supplier and a list of materials to be furnished.

C. Prior to each shipment of PVC pipe, submit certified test reports that the PVC pipe for this Contract was manufactured and tested in accordance with all ASTM Standards specified and referenced herein.

D. Submit to the Owner/Engineer, in accordance with Section 01300, detailed shop drawings and product data for all pipe, fittings, and appurtenances specified in this Section. Product data submittals shall include the following as a minimum: details of the proposed pipe; properties and strengths of the pipe; joint details; instructions on storage, handling, transporting, and installation; standard catalog sheets; and material certifications.

E. The Contractor shall submit pipe thickness/stiffness calculations, design data and specification data sheets prepared and stamped by a registered professional engineer listing all parameters used in the CCFR pipe design and thickness calculations based on AWWA M45.

F. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.

G. Submit pipe testing plan including detailed procedures and methods and equipment that will be used for pipeline testing as specified herein.

1.04 REFERENCES

A. The following standards based on the latest edition form a part of this specification as referenced:

B. American Society for Testing and Materials (ASTM) Publications

1. D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

2. F679 - Specification for Poly (vinyl chloride) (PVC) Large - Diameter Plastic Gravity Sewer Pipe and Fittings.

3. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

4. D 3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

5. F794 - Standard Specification Poly (vinyl chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter. (Only closed profile gravity sewer pipe will be considered based on this ASTM specification.)

6. F1803 - Standard Specification Poly (vinyl) (chloride) (PVC) Closed Profile Gravity Sewer Pipe.

7. D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

8. D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

9. F949 – Standard Specification for Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

1.05 QUALITY ASSURANCE

A. All pipe delivered to the job site shall be accompanied by test reports certifying that the pipe and fittings conform to the herein-mentioned ASTM specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Engineer to apply such tests as the Engineer deems necessary.

B. All tests shall be made in accordance with the methods prescribed by the herein mentioned ASTM specifications, and the acceptance or rejection shall be based on the test results.

C. The Contractor shall furnish all labor necessary to assist the Owner/Engineer in inspecting the pipe. Pipe will be inspected upon delivery, and such as does not conform to the requirements of this Contract shall be rejected and shall immediately be removed by the Contractor.

1.06 DELIVERY, STORAGE AND HANDLING

A. All items shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced as directed by the Engineer.

B. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.

C. Any pipe or fitting showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.

D. While stored, pipe shall be adequately supported from below at not more than 3-ft intervals to prevent deformation. The pipe shall be stored in stacks no higher than that given in the following table:

Pipe Diameter (inches)	Max. No. of Rows Stacked
8 or less	5
12 to 21	4
24 to 27	3

E. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than 30 days. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup or direct or indirect sunlight will not be permitted.

F. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and the interior shall be kept clean until testing.

G. In handling the items, use special devices and methods as required to achieve the results specified herein. No uncushioned devices shall be used in handling the item.

1.07 GENERAL WASTEWATER FACILITY INSTALLATION REQUIREMENTS

A. Installation of wastewater facilities shall be in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) Regulation R.61-67 to include the requirements outlined herein.

B. Separation of Sewers and Water Mains:

1. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or contact with any part of a sewer manhole.

2. Horizontal and Vertical Separation from Potable Water Mains. Sewers shall be laid at least 10 feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. Any deviation shall be approved by the Engineer and SCDHEC.

3. Crossings. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of 18 inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

4. Force Mains. There shall be at least a 10-foot horizontal and 18-inch vertical separation between sanitary sewer force mains and potable water mains.

5. Special Conditions. When it is impossible to obtain the distances specified, the Contractor shall coordinate an alternative design that:
   a. maximize the distances between the sewer line and the potable water main and the joints of each;
   b. use pipe materials which meet the requirements of SCDHEC; and
   c. allow enough distance to make repairs to one of the lines without damaging the other.

6. Sewer Manholes. No potable water pipe shall pass through or contact with any part of a sewer manhole.

C. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided.

D. Drop manholes are required where the invert differential is 24 inches or more.

E. Each section of sewer pipe shall be specified to be laid to the appropriate line and grade, as designed, working in the upstream direction with the bell end laid upgrade.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS, AND SPECIALS

A. The polyvinyl chloride pipe and fittings, including also those required for stubs, shall conform to one of the following:

1. ASTM D3034 for diameters 4-inch through 15-inch.

2. ASTM F679 (Wall thickness T- 1) for diameters 18-inch through 27-inch.

B. The pipe shall have pipe diameter to wall thickness ratio (SDR) of a maximum of 35, as manufactured by Diamond, Ipex USA, National Pipe, North American Pipe Corporation, Royal Pipe Systems or equal.

C. Straight pipe shall be furnished in lengths of not more than 13 feet, and Y-branches shall be furnished in lengths of not more than 3 feet, unless otherwise permitted by the Owner/Engineer. Saddle Y-branches will not be allowed.

D. Fittings and special pipe pieces shall conform to the specifications for straight pipe insofar as applicable.

2.02 JOINTS

A. Joints for the polyvinyl chloride pipe shall be push-on bell and spigot joints using elastomeric ring gaskets conforming to ASTM F477. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use. The joints shall conform to ASTM D3212.

PART 3 EXECUTION

3.01 GENERAL

A. No single piece of pipe shall be laid unless it is straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

B. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner. All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required. PVC pipe and fittings shall be installed in accordance with requirements of the manufacturer and/or as otherwise provided herein.

C. As soon as the excavation is complete to normal grade of the bottom of the trench, bedding shall be placed, compacted and graded to provide firm, uniform and continuous support for the pipe. Bell holes shall be excavated so that only the barrel of the pipe bears upon the bedding. The pipe shall be laid accurately to the lines and grades indicated on the Drawings. Blocking under the pipe will not be permitted. Bedding shall be placed evenly on each side of the pipe to mid-diameter and hand tools shall be used to force the bedding under the haunches of the pipe and into the bell holes to give firm continuous support for the pipe. Bedding shall then be placed to 12-in above the top of the pipe. The initial 3-ft of backfill above the bedding shall be placed in 1-ft layers and carefully compacted. Compaction shall be done evenly on each side of the pipe and compaction equipment shall not be operated directly over the pipe until sufficient backfill has been placed to ensure that such compaction equipment will not have a damaging effect on the pipe. Equipment used in compacting the initial 3-ft of backfill shall be approved by the pipe manufacturer's representative prior to use.

D. All piping shall be sound and clean before installation. When installation is not in progress, including lunchtime, the open ends of the pipe shall be closed by watertight plug or other approved means. Good alignment shall be preserved during installation. The deflection at joints shall not exceed that recommended by manufacturer. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench.

E. When cutting pipe is required, the cutting shall be done by machine, leaving a smooth cut at right angles to the axis of the pipe. Cut ends of pipe to be used with a bell shall be beveled to conform to the manufactured spigot end.

F. The Owner/Engineer may examine each bell and spigot end to determine whether any preformed joint has been damaged prior to installation. Any pipe having defective joint surfaces shall be rejected, marked as such and immediately removed from the job site.

G. Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be "pulled" or "cramped".

H. Before any joint is made, the pipe shall be checked to assure that a close joint with the next adjoining pipe has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to grade by striking it.

I. Precautions shall be taken to prevent flotation of the pipe in the trench.

J. When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe. If trench boxes, moveable sheeting, shoring or plates have been installed below the top of the pipe, they shall be moved slowly taking care not to disturb pipe, bedding or backfill. As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.

3.02 JOINTING PVC PIPE (PUSH-ON TYPE)

A. Joints shall be made in strict accordance with the manufacturer's instructions. Pipe shall be laid with bell ends looking ahead. A rubber gasket shall be inserted in the groove of the bell end of the pipe and the joint surfaces cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be joined and pushed home with a come-along or by other means. Check that the reference mark on the spigot end is flush with the end of the bell.

B. All manhole connections shall be as shown on the Drawings and as specified in Section 02605. All concrete and mortared connections shall be equipped with an integral O-ring, or other sealant, such that a positive watertight seal is established as specified in Section 02605.

3.03 WYE BRANCHES, CHIMNEYS AND STUBS

A. All fittings shall be furnished by the same manufacturer that furnishes the pipe.

B. Wye branches shall be furnished and installed and capped as shown on the Drawings or in locations directed by the Owner/Engineer. Each wye branch shall be provided with a PVC end cap and shall be backed with a piece of wood (2-in by 4-in) that extends to a point 3-ft below the finished ground surface.

C. PVC chimneys shall be installed according to the detail on the Drawings at locations to be determined by the Owner/Engineer. Concrete shall be as specified in Division 3. No backfill shall be placed over concrete within 16 hours of placing.

D. Ample time shall be given to the Owner/Engineer to obtain the exact location of each wye branch and chimney before it is covered. Wye branches and chimneys, which are covered before the Owner/Engineer has had time to obtain their location, shall be exposed at no additional cost so that location measurements can be taken.

E. PVC manhole drops shall be installed as shown on the Drawings. Concrete for encasements shall be 3500 psi as specified. No backfill shall be placed over this concrete within 16 hours of placing.

F. Pipe stubs for manhole connections shall not exceed 3.25-ft in length unless directed otherwise by the Owner/Engineer. Install caps where required.

3.04 SERVICE CONNECTIONS

A. Service connections shall be installed at a minimum slope of 2 percent at the locations shown on the Drawings and/or to the limits determined by the Owner/Engineer in the field. In each case, the end shall be capped and backed with a 2-in by 4-in wood post extending to 3-ft below the finished ground surface.

B. Service connections shall be 6-in diameter unless otherwise shown on the Drawings.

3.05 TESTING AND CLEANING (GRAVITY PIPELINES)

A. Exfiltration and infiltration testing shall be completed on all PVC gravity pipelines and shall be as specified in Section 02610.

B. Submit a testing plan including detailed procedures and methods and equipment that will be used for pipeline testing at least 10 days before starting the testing for Owner/Engineer's review. All tests shall be conducted in the presence of the Owner/Engineer. Furnish all necessary equipment and labor for carrying out the specified tests.

C. In addition to exfiltration and infiltration testing specified in Section 02610, all PVC pipes shall be tested for deflection as follows:

1. Pipe deflection shall be measured not less than 90 days after the backfill has been completed and shall not exceed 5 percent. Deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

2. Deflection shall be measured with a rigid mandrel (Go/No Go) device cylindrical in shape and constructed with a minimum of nine evenly spaced arms or prongs. Drawings of the mandrel with complete dimensions shall be submitted to the Owner/Engineer for each diameter of pipe to be tested. The mandrel shall be hand pulled through all sewer lines.

3. Any section of sewer not passing the mandrel shall be uncovered at no additional cost to the Owner and the bedding and backfill replaced to prevent excessive deflection. Repaired pipe shall be retested at no additional cost to the Owner. Retested pipe shall not deflect more than 4 percent.

3.06 UNDERGROUND UTILITY MARKING

A. The tape shall be provided and installed in accordance with Section 02317.

END OF SECTION

SECTION 02624
CENTRIFUGALLY CAST FIBERGLASS REINFORCED SEWER PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install centrifugally cast fiberglass reinforced (CCFR) gravity sewer pipe and appurtenances as shown on the Drawings and as specified herein.

B. The Contractor shall furnish and install sewer piping to the lines and grades and in the locations indicated on the Contract Drawings and/or as ordered by the Owner/Engineer.

C. Piping shall be located substantially as shown on the Drawings. The Owner/Engineer reserves the right to make such modifications in locations as may be found desirable to avoid interference between pipes or for other reasons. Pipe fitting notation is for the Contractor's convenience and does not relieve him/her from installing and jointing different or additional items where required to achieve a complete piping system.

D. Where the word "pipe" is used it shall refer to pipe, fittings, or appurtenances unless otherwise noted.

1.02 RELATED WORK

A. Section 02140, Dewatering and Drainage

B. Section 02200, Earthwork

C. Section 02270, Sedimentation and Erosion Control

D. Section 02610, Sewer Testing and Cleaning

E. Section 02605, Precast Concrete Manholes

F. Section 02317, Underground Warning Tape.

1.03 SUBMITTALS

A. The Contractor shall furnish, prior to use of the materials, satisfactory written certification of his compliance with the manufacturer's standards for all materials, conformance with the methods of the manufacturer, and accordance with all standards.

B. Submit to the Engineer, within 30 days of the effective date of the Contract, the name of the CCFR pipe supplier and a list of materials to be furnished.

C. Prior to each shipment of CCFR pipe, submit certified test reports that the CCFR pipe for this Contract was manufactured and tested in accordance with all ASTM Standards specified and referenced herein.

D. Submit to the Owner/Engineer, in accordance with Section 01300, detailed shop drawings and product data for all pipe, fittings, and appurtenances specified in this Section. Product data submittals shall include the following as a minimum: details of the proposed pipe; properties and strengths of the pipe; joint details; instructions on storage, handling, transporting, and installation; standard catalog sheets; and material certifications.

E. The Contractor shall submit pipe thickness/stiffness calculations, design data and specification data sheets prepared and stamped by a registered professional engineer listing all parameters used in the CCFR pipe design and thickness calculations based on AWWA M45.

F. Submit handling procedures for all phases from finished fabrication through delivery including storage, transportation, loading, and unloading. This will include storage at the project site and required protection following installation prior to startup.

1.04 REFERENCE STANDARDS

A. American Water Works Association (AWWA)

1. AWWA C950 - Fiberglass Pressure Pipe

2. AWWA M45 - Fiberglass Pipe Design

B. ASTM International

1. ASTM D638 - Test Method for Tensile Properties of Plastics

2. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

3. ASTM D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

4. ASTM D3681 - Standard Test Method for Chemical Resistance of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe in a Deflected Condition.

5. ASTM D3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe

6. ASTM D4161 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals.

7. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

C. American National Standards Institute (ANSI)

D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

A. All pipe and fittings shall be from a single manufacturer. The supplier shall be responsible for the provisions of all test requirements specified in ASTM D3262 as applicable.

B. All pipe to be installed under this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory acceptable to the Owner. The Contractor shall require the manufacturer's cooperation in these inspections. The cost of plant inspection of all pipe approved for this Contract will be borne by the Owner.

C. Inspections of the pipe may also be made by the Owner/Engineer or other representatives of the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified herein, even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.

D. Candidate Manufacturer for pipe, joints and fittings is HOBAS Pipe USA, or approved equal.

1.06 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in shipping, handling and laying to avoid damaging the pipe and fittings. Follow the manufacturer's recommendations during unloading, handling, storing, stringing and installing the pipe and fittings. Any pipe or fitting damaged in shipment shall be replaced or repaired as directed by the Owner/Engineer.

B. Any pipe or fitting showing a crack or which has received a blow that may have caused an incipient fracture, even though no such fracture can be seen, shall be marked as rejected and replaced or repaired as directed by the Owner/Engineer.

1.07 GENERAL WASTEWATER FACILITY INSTALLATION REQUIREMENTS

A. Installation of wastewater facilities shall be in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) Regulation R.61-67 to include the requirements outlined herein.

B. Separation of Sewers and Water Mains:

1. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or contact with any part of a sewer manhole.

2. Horizontal and Vertical Separation from Potable Water Mains. Sewers shall be laid at least 10 feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. Any deviation shall be approved by the Engineer and SCDHEC.

3. Crossings. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of 18 inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the

sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

4. Force Mains. There shall be at least a 10-foot horizontal and 18-inch vertical separation between sanitary sewer force mains and potable water mains.

5. Special Conditions. When it is impossible to obtain the distances specified, the Contractor shall coordinate an alternative design that:
   a. maximize the distances between the sewer line and the potable water main and the joints of each;
   b. use pipe materials which meet the requirements of SCDHEC; and
   c. allow enough distance to make repairs to one of the lines without damaging the other.

6. Sewer Manholes. No potable water pipe shall pass through or contact with any part of a sewer manhole.

C. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided.

D. Drop manholes are required where the invert differential is 24 inches or more.

E. Each section of sewer pipe shall be specified to be laid to the appropriate line and grade, as designed, working in the upstream direction with the bell end laid upgrade.

PART 2 PRODUCTS

2.01 CENTRIFUGALLY CAST FIBERGLASS REINFORCED PIPE

A. The pipes shall be manufactured in accordance with ASTM D3262 and shall meet the following material designation criteria: Type 1, Liner 2, Grade 3, Stiffness D. The pipe stiffness is to be measured in accordance with ASTM D2412. The corrosion liner shall not be considered as contributing to the structural strength of the pipe. The pipe shall be as manufactured by Hobas Pipe USA or equal.

B. The pipe shall be manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion resistant, consistent composite structure to meet the operating conditions as shown on the Drawings. The pipe shall also meet the strain corrosion resistant requirements of ASTM D3681 for a minimum deflection of 6 percent. Pipe shall withstand a minimum of 0.9% strain for 50-years as determined by ASTM D3681 and ASTM D3262. The pipe shall be a composite laminate consisting of a corrosion resistant inner liner, structural layer and exterior surface. Stiffening ribs or rings shall not be used. The corrosion liner shall consist of a minimum thickness of 0.04-inches on non-reinforced polyester resin. Corrosion liner resin shall have a minimum elongation of 50% as measured in accordance with ASTM D638. All component materials shall conform to applicable ASTM standards.

C. The Contractor shall submit pipe thickness calculations to the Owner/Engineer for review. The pipe shall be designed in accordance with the applicable provisions of AWWA M45 and shall meet the following design conditions:

1. AASHTO H-20 Live Load.

2. A soil modulus of elasticity of 2,000 psi and a soil weight 130 pounds per cubic foot.

3. Safety factor of 2.5.

4. Groundwater levels shall be estimated to be at the ground surface.

5. Service temperature range shall be 40 to 90 degrees F.

6. Maximum long-term deflection shall be 5 percent.

7. The thickness to be used for the CCFR pipe shall be the largest thickness as determined by calculations for deflection, bending, buckling and minimum stiffness.

8. The pipe shall have a minimum nominal pipe stiffness of 72. Thicknesses shall be increased as necessary based on the pipe design and thickness calculations.

D. Pipe shall be furnished in standard laying lengths not exceeding 20-ft. When required by radius curves, pit size, or sewer irregularity, pipe shall be supplied in nominal lengths of 10 feet or other even divisions of 20 feet.

E. All fittings and accessories shall be furnished by the pipe supplier and shall have joint configurations compatible with the pipe.

F. Each length of pipe shall be marked with the nominal size, the pipe stiffness designation, name of manufacturer, date of manufacture and/or acceptance.

G. Complete records of inspections, examinations and tests performed by the manufacturer shall be kept and submitted to the Owner and Engineer.

2.02 JOINTING METHODS

A. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier.

B. Pipe and fittings installed using trench excavation methods shall be field connected with fiberglass sleeve couplings that utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness and shall meet the performance specifications of ASTM D4161. Joints at tie-ins, when needed, may utilize fiberglass, gasket-sealed closure couplings.

C. Pipe installed using direct jacking methods shall be field connected with flush fiberglass bell-spigot joints and shall utilize elastomeric sealing gaskets as the sole means to maintain joint water tightness and shall meet the performance specifications of ASTM D4161. Joints at tie-ins, when needed, may utilize fiberglass, gasket-sealed closure couplings.

2.03 FITTINGS

A. Fittings shall be contact molded or manufactured from mitered sections of CCFR pipe joined by glass-fiber-reinforced overlays. Pipe sections used to construct fittings shall have the same stiffness as the main pipe and shall be capable of withstanding all operating conditions.

B. Closures may be accomplished using a special closure kit, fiberglass gasket-sealed closure couplings, flush fiberglass bell-spigot joints, or other method approved by the Engineer. Location of closures shall be subject to the approval of the Engineer.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPE AND FITTINGS

A. CCFR pipe and fittings shall be installed using trench excavation methods as specified and as shown on the Drawings.

B. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe. Pipe and fittings shall not be dropped or skidded against each other. Slings, hooks or pipe tongs shall be used for pipe handling. All pipe and fittings shall be examined before laying and no piece shall be installed which is found to be defective. Any damage to the pipe or fittings shall be repaired per manufacturer's recommendations. Handling and laying of pipe and fittings shall be in accordance with manufacturer's instruction and as specified herein.

C. If any defective pipe is discovered after it has been laid, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before laying, shall be kept clean until they are used in the work and when installed or laid, shall conform to the lines and grades required.

D. Materials, if stored, shall be kept safe from damage. The interior of all pipe, fittings and other appurtenances shall be kept free from dirt, excessive corrosion or foreign matter at all times.

E. Pipe shall not be stacked higher than the limits recommended by its manufacturer. The bottom tier shall be kept off the ground on timbers, rails, or concrete. Stacking shall conform to manufacturer's recommendations.

F. Gaskets shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-in, first-out basis.

G. When cutting pipe is required, the cutting shall be performed by machine, leaving a smooth cut at right angles to the axis of the pipe.

3.02 TESTING AND CLEANING

A. Testing and cleaning of pipe is specified in Section 02610.

3.03 UNDERGROUND UTILITY MARKING

A. The tape shall be provided and installed in accordance with Section 02317.

SECTION 02625

HIGH DENSITY POLYETHYLENE PIPE

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:

1. This section specifies high density polyethylene (HDPE) pipe, fittings, and appurtenances for piping 4 inches to 63 inches in nominal diameter.

B. Characteristics:

1. The piping system shall conform with the following:

Dimension ratio (DR)	17
Pressure Class in accordance with AWWA C906	100
Maximum deflection in installed condition, percent of the average inside diameter of the pipe	4.2%

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

References	Title
ANSI/AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution
ASTM D2321	Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2657	Heat Joining Polyolefin Pipe and Fittings
ASTM D3350	Polyethylene Plastics Pipe and Fittings Material
PPI TR 31	Underground Installation of Polyolefin Piping

3. All HDPE materials, pipe and fittings shall be inspected and tested in accordance with the requirements of AWWA C906.

B. Affidavit of Compliance:

1. The manufacturer shall furnish an affidavit of compliance conforming to the requirements of AWWA C906, Section 1.5, affirming that the piping components comply with the requirements of AWWA C906 and this section. The affidavit shall be signed under penalty of perjury by an officer of the pipe manufacturer's company.

1.03 SUBMITTALS

A. The following submittals shall be provided in accordance with Section 01300:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (□) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
2. Detail drawings which show the type and location of all fittings, joints, and connections to structures and manholes.

1.04 GENERAL WASTEWATER FACILITY INSTALLATION REQUIREMENTS

A. Installation of wastewater facilities shall be in accordance with South Carolina Department of Health and Environmental Control (SCDHEC) Regulation R.61-67 to include the requirements outlined herein.

B. Separation of Sewers and Water Mains:

1. Potable Water Supply Interconnections. There shall be no physical connections between a public or private potable water supply system and a sewer, or appurtenance thereto which may permit the passage of any sewage or polluted water into the potable supply. No potable water pipe shall pass through or contact with any part of a sewer manhole.

2. Horizontal and Vertical Separation from Potable Water Mains. Sewers shall be laid at least 10 feet horizontally from any existing or proposed potable water main. The distance shall be measured edge to edge. Any deviation shall be approved by the Engineer and SCDHEC.

3. Crossings. Sewers crossing potable water mains shall be laid to provide a minimum vertical separation of 18 inches between the outside of the potable water main and the outside of the sewer. This shall be the case where the potable water main is either above or below the sewer. Whenever possible, the potable water main shall be located above the sewer main. Where a new sewer line crosses a new potable water main, a full length of pipe shall be used for both the sewer line and potable water main and the crossing shall be

arranged so that the joints of each line shall be as far as possible from the point of crossing and each other. Where a potable water main crosses under a sewer, adequate structural support shall be provided for the sewer line to prevent damage to the potable water main while maintaining line and grade.

4. Force Mains. There shall be at least a 10-foot horizontal and 18-inch vertical separation between sanitary sewer force mains and potable water mains.

5. Special Conditions. When it is impossible to obtain the distances specified, the Contractor shall coordinate an alternative design that:
   a. maximize the distances between the sewer line and the potable water main and the joints of each;
   b. use pipe materials which meet the requirements of SCDHEC; and
   c. allow enough distance to make repairs to one of the lines without damaging the other.

6. Sewer Manholes. No potable water pipe shall pass through or contact with any part of a sewer manhole.

C. Manhole top elevations shall be greater than or equal to the fifty (50) year flood elevation, unless watertight covers are provided.

D. Drop manholes are required where the invert differential is 24 inches or more.

E. Each section of sewer pipe shall be specified to be laid to the appropriate line and grade, as designed, working in the upstream direction with the bell end laid upgrade.

PART 2 PRODUCTS

2.01 GENERAL

A. HDPE materials, pipe and fittings shall be manufactured, inspected, sampled and tested in accordance with the requirements of AWWA C906 and this section. In case of conflict between the requirements of this section and AWWA C906, the requirements of this section shall prevail.

2.02 MATERIALS

A. HDPE piping components shall be manufactured from materials that meet or exceed the requirements of the Plastic Piping Institute designation PE3408 and that conform to the requirements of ASTM D3350 for a cell classification of PE 345434C.

B. Bolts and nuts for buried mechanical joining components such as flanges shall be made of noncorrosive, high-strength, low-alloy steel having the characteristics specified in ANSI/AWWA C111/A21, regardless of any protective coating.

2.03 PIPE

A. Pipe shall have the nominal dimensions shown with an DIP outside diameter basis and the dimensions and tolerances specified in AWWA C906. DR rating and pressure class shall be as specified in paragraph 1.01 Characteristics.

2.04 FITTINGS

A. Fittings shall conform to the applicable requirements of AWWA C906 for the joining methods specified in paragraph 3.02 Joining.

2.05 PIPE MARKINGS

A. Pipe marking shall conform to the requirements of AWWA C906.

2.06 PRODUCT DATA

A. The following product data shall be provided in accordance with Section 01300:
   1. Affidavit of Compliance specified in paragraph 1.02 Affidavit of Compliance.
   2. A report containing a copy of all manufacturer's test results for all tests conducted in accordance with paragraph 1.02 Inspection and Testing.

PART 3 EXECUTION

3.01 PIPE HANDLING AND STORAGE

A. The Contractor shall use care in handling and storage of the pipe. Pipe shall be stored on clean, level ground to prevent undue scratching or gouging of the pipe. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The handling of the pipe shall be done in such a manner that it is not damaged by dragging over sharp objects or cut by chokers or lifting equipment.

B. Sections of pipe with cuts, gouges, or scratches on the outside diameter (OD) surface that exceed 10-percent of the wall thickness of the pipe shall be removed completely and the ends of the pipeline rejoined. The inside diameter (ID) surface shall be free of cuts, gouges, and/or scratches.

3.02 INSTALLATION

A. Reference Section 02777, Pipe Bursting Sewer Replacement

3.03 TESTING

A. Reference Section 02610, Sewer Testing and Cleaning.

END OF SECTION

SECTION 02650

SEWER LINE CLEANING PRIOR TO CCTV AND REHABILITATION WORK

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Clean all sewer pipe to be inspected using closed circuit television (CCTV), and as specified, defined or directed by Engineer. Furnish all labor, materials, equipment and incidentals required to clean all sewer pipe as required and directed by Engineer.

B. Cleaning shall include proper high pressure water jetting, rodding, bucketing, brushing, and flushing sewers and manholes prior to inspection by CCTV, pipeline rehabilitation or replacement, point repairs, manhole rehabilitation, and testing operations. It shall also include traffic control, water used for jetting as appropriate, debris dewatering, removal and proper disposal of debris, and root cutting as necessary.

C. Cleaning may involve hydraulic light sewer cleaning (small amounts of debris or deposits settled and/or light root growth existing within the sewer line) or mechanical heavy sewer cleaning (large amounts of debris, grease, attached deposits, large size stones and bricks, and/or heavy root growth existing within the sewer line). Cleaning shall dislodge, transport and remove all sludge, mud, sand, gravel, rocks, bricks, grease, roots, sticks, and all other debris from the interior of the sewer pipe and manholes.

D. Hydraulic light sewer cleaning shall be paid for under the appropriate CIPP lining, point repair, pipe bursting, or manhole rehabilitation item in the Schedule of Prices. Mechanical heavy sewer cleaning and heavy root removal shall be paid for under the Mechanical Heavy Sewer Cleaning/Root Removal item in the Schedule of Prices.

E. The goal of the cleaning is to remove all debris, roots, deposits, and other blockages to a 95 percent minimum open area so the rehabilitation can be successfully installed without any significant installation issues or post defects. On all sewers, perform sewer cleaning work to an acceptable level as necessary to perform a thorough television inspection of the. If the pipe condition is such that cleaning may cause a potential collapse, the pipe shall be televised without attempting to clean it to the 95 percent condition, pending approval by Engineer.

F. Root cutting or sawing may be deemed necessary and should be brought to that attention of the Owner/Engineer. If deemed necessary by the Owner, root cutting shall be paid for separately under the Mechanical Heavy Sewer Cleaning/Root Removal item in the Schedule of Prices.

G. If access to private property is required to perform the work the contractor must determine access prior to starting. Clearing and other costs related to gaining access (including restoration) should be included in contractor’s pricing.

H. Any access to private property must be approved by the homeowner prior to starting work.

I. Contractor to assume responsibility for relocating sheds if such relocation is required to perform work. The final location of the shed will be determined on a case by case basis.

J. Fences to be replaced in kind and a gate should be placed along the easement to allow future access by Owner forces and equipment. Each of these will be determined on a case by case basis directly with the Property Owner and Contractor.

K. Contractor shall include site restoration including irrigation line repairs, driveway restoration, shrubbery replacement, etc. when choosing a route of access/repair.

1.02 RELATED WORK

A. Measurement and Payment is specified in Section 01025.

B. Cured-in-place Pipe Lining is specified in Section 02765.

C. Manhole Rehabilitation is specified in Section 02763.

D. Sanitary Sewer Flow Control is specified in Section 02767.

E. Pre-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02732.

F. Pipe Bursting Sewer Replacement with HDPE is specified in Section 02777.

G. Post-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02733.

H. Database Template Description PACP is specified in Section 02734.

I. GIS Database Update Specification in Section 00312.

1.03 SUBMITTALS

A. Submit a Traffic Control Plan to the Owner's Representative, which includes the following items.

   a. Traffic control plan shall be submitted to the Engineer three (3) weeks prior to commencement of work. This will allow time for the traffic control plan to be submitted to the permitting agency for any additional comments. Traffic control plan must include road/lane closures, detours, and all devices to be used to maintain traffic while performing work.

B. Confined space entry plan, certifications and hazardous atmosphere training certifications, if applicable.

C. The work described in this Scope of Work, including any internal sewer or manhole inspections, shall meet the minimum requirements as presented in the OSHA Standard, Title 29 CFR 1910.146, Permit Required Confined Spaces. Upon commencement of the Work, copies of all confined space entry permits shall be submitted to Engineer. Contractor shall notify the Owner or delegated representative each day by phone, email or fax when it is necessary for Contractor to enter a manhole(s). Contractor shall identify all manholes that Contractor plans on entering that day by street location and manhole number.

D. Contractor to complete a work summary sheet each month by Asset ID, electronically in Excel format, documenting what was cleaned that month for each asset. This shall be submitted on a monthly basis along with the pay application to the Owner. A copy of the template will be provided upon request.

1.04 NOTIFICATIONS

A. Notify the Owner and Engineer:

1. On a weekly basis of scheduled work for the upcoming week, including a map showing the area of work, and a map and list of fire hydrants that will be utilized for a water source, and a list of streets being affected. Submittal shall be provided by electronic mail in PDF format. Provide 24-hour notice for deviations from the plan that are not caused by weather or natural causes.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for the work described are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Immediately of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown, or if a new asset is found, the notification shall include a diagram clearly indicating the location of structures in relation to immediately adjacent structures in PDF format via electronic mail. Contractor shall also provide updated information per 00 31 22 (00312) GIS Database Update Specification.

7. If any obstructions are found within the easement, even if not impacting work.

B. Notify the public and coordinate with homeowners:

1. Contractor shall prepare and install yard signs to notify customers in the area of work being conducted and who to contact for information. The city-approved Columbia Water yard sign file will be provided by City. This file is the standard sign layout to be filled in with project specific information. (Sign specs: digital print full color two-sided coroplast 4mm 18”x24” & metal step stakes 30”x10”).

a. Refer to section 01500 page 8 for information regarding project signage.

b. Signs shall be placed in key intersections and at the project site, incoming/outgoing roads to the area/neighborhood, and intersections near the site at start of project.

c. Signs shall be placed in yards a minimum of 7 days prior to work but no more than 14 days ahead of scheduled work.

d. Signs shall be displayed throughout scheduled work and will be replaced if removed or damaged.

e. Signs shall be removed at the conclusion of the project.

2. A minimum of 72 hours prior to the inspection or work on any manhole, cleanout, service lateral, or line segment, distribute door-to-door an Owner approved Homeowner Notification door hanger describing the work to be performed, if work is performed or accessed through private property or easement adjacent to property, or if the property is potentially tied to the section of line being inspected or worked on. On the day of work and prior to beginning the work, knock on the doors of all properties that will require entering their private property to access the manholes, cleanouts, or pipes which will potentially be impacted by the work and notify occupants of the work to be performed.

3. Contractor shall use approved magnetic car signs affixed to vehicles at all times during the project to identify affiliation with the City of Columbia, SC.

4. Contractor responsible for determining route of access for the proposed work, unless specified otherwise, and is responsible for coordinating with the Property Owner to obtain any temporary access to perform the work. Clearing and other costs related to gaining access (including restoration) should be included in Contractor's pricing.

5. Contractor to notify Property Owner of any that all trees or other obstructions within easements that need to be moved to access or perform the work. The Property Owner shall be given a minimum of 7 days to relocate the obstruction off of the easement at their own cost to their own chosen location. After this time period, the Contractor shall be responsible for removing and disposing of the obstruction, and all costs associated with this. Contractor to coordinate with the Engineer on each obstruction found before proceeding.

PART 2 - PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT

A. Hydraulically propelled Sewer Cleaning Equipment.

1. Hydraulically propelled sewer cleaning equipment shall be the movable dam type constructed such that a portion of the dam may be collapsed during cleaning to prevent flooding of the sewer.

2. The movable dam shall be the same diameter as the pipe being cleaned and shall provide a flexible scraper around the outer periphery to ensure total removal of grease.

3. Contractor shall take precautions against flooding prior to using sewer cleaning balls or other such equipment that cannot be collapsed instantly.

B. High Velocity Hydro-Cleaning Equipment shall have the following:

1. A minimum 600-foot long high pressure hose.

2. Two or more high velocity nozzles able to produce a scouring action from 15 to 45 degrees in all size lines to be cleaned.

3. A high velocity gun for washing and scouring manhole walls and floor.

4. Capability of producing flows from a fine spray to a long distance solid stream.

5. A water tank, auxiliary engines and pumps and a hydraulically driven hose reel.

6. Equipment operating controls located above ground.

C. Mechanical heavy cleaning equipment shall be either power buckets or power rodders by the Flexible Tool Division of Rockwell Manufacturing Co. or equal. Mechanical equipment can only be utilized with approval of Engineer and after the structural condition of the pipe has been verified by the Contractor and Contractor has indicated that jetting will not be sufficient to perform the cleaning and mechanical cleaning will not further damage the pipe.

1. Bucket machines shall:

a. Be furnished with buckets in pairs and with sufficient dragging power to perform the work efficiently.

b. Use V-belts for power transmission or have an overload device. No direct drive machines will be permitted.

c. Be equipped with a take up drum and a minimum 500-foot cable.

2. Power rodding machine shall:

a. Be either sectional or continuous.

b. Hold 750 feet minimum of rod.

c. Have rods made from treated steel.

d. Be fully enclosed and have an automatic safety throw out clutch.

PART 3 - EXECUTION

3.01 PERFORMANCE

A. Cleaning Precautions: During sewer cleaning operations, satisfactory precautions shall be taken when using cleaning equipment.

1. When hydraulically propelled cleaning tools (which depend on water pressure to provide their cleaning force) or tools which retard the flow in the sewer line are used, precautions shall be taken to ensure the water pressure created does not damage or cause flooding of public or private property being served by the sewer.

2. When possible, sewage flow in the sewer shall be used to provide the necessary pressure for hydraulic cleaning devices.

B. When additional water from fire hydrants is necessary to avoid delay in normal work procedures, the Contractor shall apply for a temporary meter and backflow assembly for service from the City. There shall be no cost for the meter, but the Contractor is responsible for all water usage fees.

C. If the Owner does not own the fire hydrants in the vicinity, the Contractor shall be responsible for obtaining the water and paying for any associated costs for usage. Water shall be conserved and not used unnecessarily. No fire hydrant shall be obstructed in case of a fire in the area served by the hydrant.

D. Sewer Cleaning:

1. The designated sewer manhole sections shall be cleaned using hydraulically propelled, high velocity jet, or mechanically powered equipment.

2. Cleaning equipment selection shall be based on the conditions of lines at the time the work commences.

3. The equipment and methods selected shall be satisfactory to the Engineer.

4. The equipment shall be able to remove dirt, grease, rocks, sand, and other materials and obstructions from the sewer lines and manholes.

5. If cleaning of an entire section cannot be successfully performed from one manhole, the equipment shall be set up on the other manhole and cleaning again attempted. If successful cleaning still cannot be performed or the equipment fails to traverse the entire manhole section, it will be assumed a major blockage exists, and the cleaning effort shall be repeated with other equipment types.

6. The goal of the cleaning is to remove all debris, roots, deposits and other blockages to a minimum of 95% open area. On all sewers, Contractor shall perform sewer cleaning work to an acceptable level as necessary to perform a thorough television inspection and to allow the installation of a CIPP liner. If the pipe condition is such that cleaning my cause a potential collapse, then the pipe shall be televised without attempting to clean it to 90 percent condition, pending approval by Engineer.

E. Selection of cleaning equipment shall be based on the conditions of the manholes and sewer lines at the time the work commences. All pipe segments cleaned shall be noted as such in the CCTV inspection database submittal provided to the Owner (see specification Section 33 01 51- Pre-Rehabilitation Sanitary Sewer CCTV Inspection).

1. Light hydraulic cleaning (small amounts of debris existing within the sewer line):

    a. Use balls, scooters, high pressure water jetting equipment, brushes, and swabs.

    b. "Light hydraulic Cleaning" will be defined and managed as follows:

        1) Sewer reaches which do not require mechanical heavy cleaning, as defined below, and all cleaning up to and including 3 passes of high pressure water jetting. If, after three passes of high-pressure water jetting, the sewer is still not clean, the Contractor shall inform the Engineer of the condition and the reason(s) for the failure to fully clean the line. The Engineer may then direct the Contractor to perform heavy cleaning of the problem section of sewer.

        2) Costs related to light hydraulic cleaning such sewers shall be included in the Contractor's unit price for the appropriate CIPP Lining item in the Schedule of Prices. Costs related to light hydraulic cleaning of pipeline rehabilitation or replacement, point repairs, or manhole rehabilitation shall be included in the appropriate rehabilitation/replacement bid item in the Schedule of Prices.

2. Mechanical heavy cleaning (large deposits and/or encrustations of debris, grease or heavy root growth existing within the sewer line) will be defined and managed as follows:

    a. Use bucket machines, scrapers, hydraulic pressure jetting with special aggressive root cutting nozzles, or tools and augers. Cleaning requiring more than 3 passes with hydraulic cleaning equipment to achieve acceptable results shall be considered heavy cleaning.

    b. Mechanical heavy cleaning will be conducted only with approval and direction of the Engineer. "Mechanical Heavy Cleaning" is defined and managed as follows:

        1) Sewer reaches requiring debris removal for depths larger than 25 percent of the pipe height and requires more than 3 passes with the jetter to sufficiently remove the debris and other deposits and/or obstructions from the sewer line. Sewer reaches requiring root removal for lengths up to 25 percent of the pipe segment and requires more than 3 passes with the jetter to sufficiently remove the roots."

        2) Costs related to the cleaning of such sewers shall be included in Contractor's unit price for Mechanical Heavy Sewer Cleaning/ Root Removal in the Schedule of Prices.

        3) Compensation for heavy cleaning a particular line will only be paid if at least one of the following apply:

a) The Engineer authorized the heavy cleaning prior to Contractor performing the work. The Contractor shall obtain a written signature from the Owner or his representative agreeing to the terms, prices, and lengths of the heavy cleaning. A Daily Heavy Cleaning Log shall be kept and signed by the Owner's inspector verifying that the cleaning performed meets the requirements/definition of heavy cleaning as defined in these specifications.

b) Contractor proves that both significant time AND effort were necessary to clean the line. The time required to clean and inspect the line shall be at least twice the average time required to clean and inspect other previous sewer segments on the project of comparable length/ diameter sewers in the project area Video proof of heavy cleaning must be obtained by acquiring a "before" video of all accessible portions of the obstructed reach and submitting that to Engineer along with the completed inspection. A submerged camera does not justify a need for heavy cleaning; proof that the submergence was due to a blockage and/or heavy debris and not a sag in the line will be required.

3. Contractor shall clean these pipes to the standards listed above. Upon completion of the cleaning, each sewer line shall be televised to assess the condition of the sewer pipe and to confirm that it meets the standards of cleanliness listed above. Mechanical heavy cleaning will be paid for only if these standards are met. Mechanical heavy cleaning will be paid for on a linear foot basis only for the length required to be cleaned, not the entire length of pipe, unless otherwise agreed to be paid for before performing the work in writing.

F. Contractor shall provide appropriate screening to stop materials from passing into downstream sewers. All solid or semisolid materials dislodged during cleaning operations shall be removed from the sewer by the Contractor at the downstream manhole in the sewer section being cleaned. These materials shall become property of the Contractor, shall be removed from the site at the end of each workday, and shall be properly disposed of in a lawful manner by Contractor. Passing dislodged materials downstream from the sewer segment being cleaned shall not be permitted. In such an event, as observed or detected by the Owner, Engineer, or any third party Contractor shall be responsible for cleaning the affected downstream sewers in their entirety, at no additional cost to Owner.

G. Use properly selected equipment to remove all dirt, grease, rock, and other deleterious materials and obstructions.

H. Protect existing sewer lines from damage caused by improper using cleaning equipment. Contractor is solely responsible for the operations and for preventing sewer backups into area homes and causing sewage overflow. Contractor is solely responsible for all damages resulting from operations.

I. Take precautions to avoid damage or flooding to public or private property being served by the line being cleaned.

J. Use sewage flow in the sewer lines to provide necessary pressures for hydraulic cleaning devices whenever possible.

K. Disposal of Material:

1. Remove from the site and properly dispose of all solids or semi-solids recovered during the cleaning operation. The Contractor shall be responsible for properly disposing of all collected material at their expense. Material may not disposed of at the city's wastewater treatment plant. Any materials disposed of at the landfill shall be dewatered and the Contractor is responsible for all associated costs. Liquids resulting from dewatering operations may be disposed of within the city's sanitary sewer system with prior approval by the city; however, no solids shall be allowed to re-enter the sanitary sewer system. Specifics regarding the scheduling, monitoring, disposal fees (if any) and approved methods and procedures for disposal are the Contractor's responsibility and shall comply with all County, State and Federal regulations.

L. No sewer cleaning shall take place in a particular sewer segment until all upstream pipe segments have been cleaned. If cleaning is performed in a downstream pipe segment to facilitate overall cleaning operations, the segment shall be re-cleaned at no additional cost, after all pipes upstream of that segment have been cleaned.

3.02 FIELD QUALITY CONTROL

A. Acceptance for this work portion shall depend on the results from the Pre-rehabilitation television inspection. The goal of cleaning is to remove all necessary debris, roots, and deposits sufficiently to inspect the pipeline and provide at least 95% percent open area of the pipeline so the rehabilitation can be successfully installed without any significant installation issues or defects due to cleaning quality. Sewers that are not sufficiently clean as to permit television inspection shall be re-cleaned and re-inspected at no additional cost to the Owner.

B. Upon cleaning acceptance, restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

PART 4 - CLOSEOUT

A. Contractor shall confirm that Monthly Work Summary Sheets are 100-percent complete, accurate, and submitted to the Engineer.

END OF SECTION

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SECTION 02732

PRE-REHABILITATION SANITARY SEWER CCTV INSPECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Work covered by this section includes furnishing all labor, competent certified technicians, equipment, tools, accessories, materials and incidentals required to closed-circuit television (CCTV) inspect the designated sanitary sewer lines specified, including all pipe segments to be rehabilitated.

B. Prior to completing any CCTV work, all sewers shall be cleaned as specified in Section 02650.

C. CCTV inspection of sanitary sewers as follows:

1. CCTV all main lines proposed for rehabilitation and all laterals proposed for CIPP rehabilitation, as well as any other lines called for CCTV in the contract documents.

2. All CCTV work shall conform to current NASSCO Pipeline Assessment Certification Program (PACP®) standards.

3. Contractor shall use a NASSCO Pipeline and Assessment Certification Program (PACP®) certified operators and software form and coding. CCTV inspections (video and data collected) shall be delivered entirely in digital format. Data files shall be formatted to facilitate upload into a NASSCO certified CCTV software package.

D. If access to private property is required to perform the work the contractor must determine access prior to starting. Clearing and other costs related to gaining access (including restoration) should be included in Contractor's pricing.

E. Any access to private property must be approved by the homeowner prior to starting work.

F. Contractor to assume responsibility for relocating sheds if such relocation is required to perform work. The final location of the shed will be determined on a case by case basis.

G. Fences to be replaced in kind and a gate should be placed along the easement to allow future access by Owner forces and equipment. Each of these will be determined on a case by case basis directly with the Property Owner and Contractor.

H. Contractor shall include site restoration including irrigation line repairs, driveway restoration, shrubbery replacement, etc. when choosing a route of access/repair.

1.02 REFERENCES

A. Where materials and methods are indicated in these specifications as being in conformance with a standard specification, it shall refer to the latest edition of the specifications and shall include all interim revisions. Listing a standard specification without further reference indicates the particular material or method shall conform to such listed specification.

1. National Association of Sewer Service Companies (NASSCO):

    a. Pipeline Assessment and Certification Program (PACP®) Reference Manual.

    b. Recommended Specifications for Sewer Collection System Rehabilitation Standard (2006).

1.03 RELATED WORK

A. Measurement and Payment is specified in Section 01025.

B. Cured-in-place Pipe Lining is specified in Section 02765.

C. Manhole Rehabilitation is specified in Section 02763.

D. Sanitary Sewer Flow Control is specified in Section 02767.

E. Pipe Bursting Sewer Replacement with HDPE is specified in Section 02777.

F. Post-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02733.

G. Database Template Description PACP is specified in Section 02734.

H. GIS Database Update Specification in Section 01990.

I. Sewer Line Cleaning Prior to CCTV and Rehabilitation Work is specified in Section 02650.

1.04 SUBMITTALS

A. Submit a Traffic Control Plan to the Owner's Representative (Engineer), which includes the following items.

    a. Traffic control plan shall be submitted to the Engineer three (3) weeks prior to commencement of work. This will allow time for the traffic control plan to be submitted to the permitting agency for any additional comments. Traffic control plan must include road/lane closures, detours, and all devices to be used to maintain traffic while performing work.

B. Confined space entry plan, certifications and hazardous atmosphere training certifications for all staff engaged in activities within or near the open structures, if applicable.

C. Prior to beginning work, submit to the Engineer certification of the NASSCO PACP Program for all CCTV operators that will be working and performing this inspection work on the project. Contractor shall not commence work until such certification is provided. Submit 2 copies of the NASSCO issued identification card and PACP certification number.

D. The work described in this Scope of Work, including any internal sewer or manhole inspections, shall meet the minimum requirements as presented in the OSHA Standard, Title 29 CFR 1910.146, Permit Required Confined Spaces. Upon commencement of the Work, copies of all confined space entry permits shall be submitted to Engineer. Contractor shall notify the Owner or delegated representative each day by phone, email or fax when it is necessary for Contractor to enter a manhole(s). Contractor shall identify all manholes that Contractor plans on entering that day by street location and manhole number.

E. Final sewer inspection reports, digital videos/photographs and data shall be submitted in accordance with the requirements of this specification.

F. Contractor to complete a work summary sheet each month by Asset ID, electronically in Excel format, documenting what was cleaned that month for each asset. This shall be submitted on a monthly basis along with the pay application to the Owner. A copy of the template will be provided upon request.

1.05 QUALITY ASSURANCE

A. Qualifications:

1. Contractor: Performed work successfully for at least three other projects, within last 5 years, with at least 500,000 linear feet and the CCTV operator shall be PACP certified and have at least 250,000 linear feet of CCTV experience in NASSCO PACP format.

2. Crew Chief: Minimum 5 years of experience on projects similar to this Project. PACP certified, and experienced using proposed equipment for this Project.

1.06 NOTIFICATIONS

A. Notify the Owner and Engineer:

1. On a weekly basis of scheduled work for the upcoming week, including a map showing the area of work, and a map and list of fire hydrants that will be utilized for a water source, and a list of streets being affected. Submittal shall be provided by electronic mail in PDF format. Provide 24-hour notice for deviations from the plan that are not caused by weather or natural causes.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for the work described are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Immediately of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown or if a new asset is found, the notification shall include a diagram clearly indicating the location of structures in relation to immediately adjacent structures in PDF format via electronic mail. Contractor shall also provide updated information per 00 31 22 (00312) GIS Database Update Specification.

7. If any obstructions are found within the easement, even if not impacting work.

B. Notify the public and coordinate with homeowners:

1. Contractor shall prepare and install yard signs to notify customers in the area of work being conducted and who to contact for information. The city-approved Columbia Water yard sign file will be provided by City. This file is the standard sign layout to be filled in with project specific information. (Sign specs: digital print full color two-sided coroplast 4mm 18”x24” & metal step stakes 30”x10”).

    a) Refer to section 01500 page 8 for information regarding project signage.

    b) Signs shall be placed in key intersections and at the project site, incoming/outgoing roads to the area/neighborhood, and intersections near the site at start of project.

    c) Signs shall be placed in yards a minimum of 7 days prior to work but no more than 14 days ahead of scheduled work.

    d) Signs shall be displayed throughout scheduled work and will be replaced if removed or damaged.

    e) Signs shall be removed at the conclusion of the project.

2. A minimum of 72 hours prior to the inspection or work on any manhole, cleanout, service lateral, or line segment, distribute door-to-door an Owner approved Homeowner Notification door hanger describing the work to be performed, if work is performed or accessed through private property or easement adjacent to property, or if the property is potentially tied to the section of line being inspected or worked on. On the day of work and prior to beginning the work, knock on the doors of all properties that will require entering their private property to access the manholes, cleanouts, or pipes which will potentially be impacted by the work and notify occupants of the work to be performed.

3. Contractor shall use approved magnetic car signs affixed to vehicles at all times during the project to identify affiliation with the City of Columbia, SC.

4. Contractor responsible for determining route of access for the proposed work, unless specified otherwise, and is responsible for coordinating with the Property Owner to obtain any temporary access to perform the work. Clearing and other costs related to gaining access (including restoration) should be included in Contractor’s pricing.

5. Contractor to notify Property Owner of any that all trees or other obstructions within easements that need to be moved to access or perform the work. The Property Owner shall be given a minimum of 7 days to relocate the obstruction off of the easement at their own cost to their own chosen location. After this time period, the Contractor shall be responsible for removing and disposing of the obstruction, and all costs associated with this. Contractor to coordinate with the Engineer on each obstruction found before proceeding.

PART 2 - PRODUCTS

2.01 TELEVISION INSPECTION EQUIPMENT

A. Contractor shall furnish all labor, materials, machinery, equipment and incidentals required to perform the thorough cleaning and CCTV of the assigned sewers within the study area as specified herein and in Section 02650.

B. Provide a mobile vehicle with video monitoring equipment specifically compatible with the camera equipment being used. The vehicle shall be large enough to accommodate at least three people at any time for viewing of the monitor. Owner and Engineer shall have unrestricted access to observe the television screen and all other operations at all times.

C. Contractor shall ensure equipment utilized for CCTV of main lines and to reinstate service laterals is capable of passing through offset joints up to 1 inch minimum.

D. Equipment must be adaptable to be able to locate assets that are buried if needed.

E. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Adjustable light source to allow an even distribution of lighting for the camera shall be suitable to allow a clear color picture of the entire periphery of the pipe. The camera shall be capable panning 360° and tilting 270° to facilitate the inspection of all laterals and defects, with optimum picture quality provided by focus and iris adjustment. The camera, television monitor, and other components of the video system shall be capable of producing a minimum 460-line resolution picture. A backup camera shall be available on the Project Site or readily available to cause no delay in schedule. The camera shall be operative in 100 percent humidity conditions. Camera shall be operative in a hazardous and corrosive environment. The camera shall be capable of zooming at least 10:1 for looking further down the pipe or up into the laterals.

F. The camera, television monitor, and other components of the video system shall be capable of producing picture quality to the satisfaction of Engineer and/or Owner.

G. The television inspection equipment shall have an accurate footage counter that shall display on the monitor the exact distance of the camera from the centerline of the starting manhole. Contractor shall, in the presence of inspector, calibrate the camera footage every week with above ground tape measure and simultaneous CCTV footage counter.

H. The CCTV equipment shall include the most current version of PACP compliant software application and database referenced in these specifications, or as approved by the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to the inspection, Contractor shall use CCTV or other means to identify any significant blockages. If the upstream manhole is full of water due to a blockage, a reverse setup shall be done to locate the blockage if possible. Then the cleaning and CCTV inspection shall be performed. No additional payment will be made for reverse setups.

B. The Contractor shall thoroughly clean the pipelines of debris, grease, roots, sediment, broken pipe, or other obstructions that could retard the movement of the television camera. Precautions shall be taken to protect the sewer lines being cleaned from damage by the cleaning equipment. Contractor should perform cleaning in accordance with Specification Section 02650.

C. Immediately after cleaning, the sewer line section shall be visually inspected by means of closed-circuit television to determine the condition of the line and to locate existing service connections. The inspection shall be done one manhole section at a time and the flow in the section being inspected will be suitably controlled as specified in Section 3.04.

D. Contractor is solely responsible for the operations and for preventing sewer backups into area homes and causing sewage overflow. Contractor is solely responsible for all damages resulting from operations.

3.02 CCTV INSPECTION

A. Perform all CCTV inspection using personnel who are trained and certified (current standing) in the use of NASSCO's Pipeline and Assessment Certification Program (PACP®).

B. Move the camera through the line in either direction (direction versus flow shall however be noted) at less than or equal to 30 feet per minute rate, stopping when necessary to permit proper documentation of the construction features and pipe condition. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

C. When manually operated winches are used to pull the television camera through the line, use telephones or other suitable means of communication set up between the two manholes of the section being inspected to ensure good communications between members of the crew.

D. Obstructions that cause a stuck camera are the responsibility of the Contractor, and the retrieval of equipment or cameras is the responsibility of the Contractor and will be performed at the Contractor's expense.

E. Adjust the camera height such that the camera lens is always centered in the pipe being televised.

F. Provide lighting system adequate for good quality pictures. A reflector in front of the camera may be required to enhance lighting in black pipe.

G. Do not float the camera unless permitted by the Owner or their designated representative.

H. The camera shall be stopped at all service laterals and pan such an angle that an internal view of the service lateral is available. Digital photographs shall be made of any service lateral or deficiency observed in the sewer line and the photograph itself shall contain a brief description of the issue. The descriptions shall also be noted in the inspection condition record within the database. Where other pipe deficiencies are noted, stop the camera to observe the condition, record information and take digital photographs. All digital photos shall be cataloged in the CCTV database and linked to the specific length along the inspection via linkage to the defect record in the database.

I. If the data is available, the Owner will provide the Contractor information on the location of known active laterals and cleanouts; however, this list may not be interpreted as all-inclusive. The Contractor shall be responsible for verifying active customer service connection prior to rehabilitation. The Contractor shall compare the service connections from the CCTV video with above ground measurements at the approximate location of center of each house or building. Any discrepancies between the CCTV data and above ground measurements of laterals shall be brought to the attention of the Owner/Engineer for a determination of lateral reinstatements. If the Contractor discovers an error or addition to the list provided, the Contractor shall immediately notify the Engineer for additional investigation.

J. Note in the PACP database the status of identified laterals as active or inactive, and other PACP database information required including location of each service lateral based on television inspection logs, accurate distance measured from the centerline of the starting manhole as well as the notation of where on the circumference of the pipe the service lateral connects, etc. See Specification Section 33 01 31 (02734) for additional PACP Database Template information.

K. Provide a complete television inspection for the upstream and downstream manholes. The CCTV operator shall pan and zoom up the manhole from the invert for each manhole, and obtain the best possible image of the manhole including cone and corbel sections and for each pipe connection within each manhole. The CCTV operator shall zoom in on each pipe connection so the photos capture the each pipe connection’s size, location, and approximate elevation.

3.03 PASSAGE OF TV CAMERA

A. It is the intent of the Scope of Work to inspect the full length of sewer between each manhole, but there may be occasions during the CCTV inspection of a sewer line section when the camera will be unable to pass an obstruction even though flow is continuing. If, during the inspection operation, the television camera will not pass through the entire pipe section, set up the CCTV equipment so that the inspection can be performed from the opposite manhole. No additional payment shall be made for reverse set-ups required due to an obstruction. Reverse setups shall be noted in the CCTV database submittal in a separate database field to indicate that the inspection was performed in the reverse direction of flow as specified in Part 4.

B. CCTV videos shall be submitted in one continuous video section from manhole to manhole, and not in multiple files, unless specifically approved by Engineer and Owner. See Part 4 and Specification Section 02734 for file naming convention details and additional PACP database template information.

C. The television camera shall travel through the lines using its own power. The digital pictures taken of the entire inside periphery of the pipe shall be clear and visible. Picture quality and definition shall be to the satisfaction of Engineer, and if unsatisfactory, the equipment shall be removed and no payment made for the unsatisfactory inspection.

D. See Specification 02650 for Sewer Line Cleaning Prior to CCTV and Rehabilitation Work.

3.04 SANITARY SEWER FLOW CONTROL

A. CCTV inspection shall be done one sewer line section (i.e. manhole structure to manhole structure) at a time, and the flow in the section shall be suitably controlled.

B. Sewer flow control procedures shall be performed in accordance with specification Section 02767.

3.05 SEWER INSPECTION SOFTWARE

A. All inspections shall use software that is capable of providing complete survey reports in compliance with the most current version of NASSCO PACP software referenced in these specifications, or as specified by the Owner. Owner has no intent to specify which software the Contractor should use, but requires the submitted database to be fully compliant with PACP. No payment will be rendered for improperly formatted data.

B. All NASSCO PACP mandatory fields and any additional available fields requested by the Owner or his representative shall be populated during the inspections. All reports and/or submittals shall adhere to NASSCO PACP/MACP Standards.

C. The software shall maintain a database of underground pipe and manhole assets referencing the pipe and manhole structure asset identifier codes provided in GIS format by the Owner. The pipe segment information shall be entered prior to the actual survey based on the numbering convention provided by the Owner. Surveys for pipes found not to be included in the Owner's GIS database will be numbered per Part 4. The software shall also have the capability to import and export survey results in the current NASSCO PACP Exchange digital format and to manage the database to meet the specifications in Part 4 herein.

PART 4 - DELIVERABLES

4.01 DIGITAL DATA DELIVERY

A. Contractor shall submit in electronic format digital videos, digital photographs, evaluation reports, and databases in NASSCO PACP Exchange format version 6 to Engineer. Please consult with the Owner before proceeding if a more recent version is currently available to determine if the more recent version should be utilized.

B. If digital videos are of such poor quality that Engineer is unable to evaluate the condition of the sanitary sewer main, locate the sewer service connections, or verify the cleaning Contractor shall be required to re-televise the sanitary sewer and provide new digital videos of good quality, at no additional cost to Owner.

C. All digital videos and data shall become the property of Owner.

4.02 DATA DELIVERY REQUIREMENTS

A. All data submittals shall include a standard Owner data transmittal form filled out in its entirety both electronically included on the hard drive with the submittal, and in hard copy attached to the hard drive upon delivery to the Owner.

B. All reports and/or submittals shall adhere to NASSCO PACP Standards.

C. Contractor shall provide a rating of each pipe per the Engineer's recommendations.

D. Contractor to provide inspection data on a monthly basis to the Engineer with the database and data on an external hard drive. The Contractor to provide two hard drives on an alternating monthly basis. The submittals shall be cumulative (i.e. each successive database delivery will include previous deliveries as well). Contractor shall provide Owner with a final external hard drive capable of storing all anticipated data for the project upon completion. The final hard drive shall be submitted on the first monthly submittal with the first month of data loaded and will become property of the Owner upon project completion. Data to be submitted shall include: 1) NASSCO PACP Database files, 2) JPEG (.jpg) files (still photos), 3).mpg or .mp4 files (videos) for each pipe segment and 4) a PDF of any separate inspection reports.

E. Each database submittal shall indicate the range of dates for which the database is being submitted as well as a list of new items as of the last submittal so that the Owner may separate out and review the newly delivered records from previous submittals in an Excel format.

F. The databases shall be cumulative, with one database for PACP CCTV inspections. Each subsequent submittal shall be added into these databases. Throughout the duration of the project, should Engineer discover inaccuracies in any of the videos, Contractor shall re-inspect those pipes at no additional cost to the Engineer or Owner. Contractor to provide all data submittals to the Engineer for review and approval. Upon approval Engineer will submit to the Owner for review and approval.

G. Databases, video files, digital photographs and supporting documentation (PDF, spreadsheets), etc. shall be placed in separate folders on the hard drives. Separate subfolders shall not be used to separate video files, etc. under the main folder. All videos, digital photographs, etc. of the same file type should be placed in a single folder on the hard drive in order to provide a single location to access the data.

H. Contractor to denote in the PACP Inspections table under 'Additional_Info' that this is a CCTV inspection by writing in 'CCTV' in all capital letters in this field for all entries related to CCTV inspections.

I. The CCTV equipment/software shall be capable of producing digital still images of all sewer line defects, and sewer line service connections in JPEG (.jpg) image format. Contractor shall take digital still images of each defect, with a minimum of one independent photo file per defect, construction features and service connections to clearly depict it. More images may be necessary depending upon the condition of the pipe. The digital images shall have a minimum size/resolution of 620x480. The screen captures or digital images shall include an onscreen display with date, sewer main reach number, footage, and type of defect/PACP Code. The filename of each JPEG (.jpg) shall be in accordance with these specifications.

J. A final, compiled version of the inspection database in PACP Exchange format shall be delivered at the end of the project to the Owner through the Engineer. The final database shall include all inspection records previously delivered in the individual inspections as well as incorporate all requested changes by the Engineer and Owner. The database filename will use the following format using upper case letters:

P_ SS7207_XYZ_BR02_ YYYYMMDD.MDB

Where P = PACP database; SS7207 = Example PO_Number ; XYZ=3 Character Prime Contractor ID assigned by Owner's GIS Administrator, BR02= Example Sub_Basin_ID, and YYYYMMDD = 8 digit date.

For projects that do not encompass an entire sub-basin, Engineer to contact Owner's GIS Administrator to obtain a "Sub_Basin_ID" for file naming.

K. The PACP database submittals shall meet the requirements for naming, linkage, etc as defined in Specification Section 02734, Database Template Description PACP.

L. Note that there are six (6) different asset type codes (including MH) that are to be used in the unique pipe/file identification codes as follows: MH (manhole), FM (force main), PS (pump station), CO (cleanout), LH (lamp hole), and OT (other miscellaneous). The samples and descriptions within these specifications utilize MH for simplicity and should be replaced with the applicable asset type code as appropriate.

M. All database inspection records shall be linked to the Owner's unique pipe numbering system which is based on the upstream and downstream structure asset numbers for the pipe end structures (manhole, outfall, cleanout, etc.). The unique pipe identifier shall take the form of UPSTREAM ASSET ID and DOWNSTREAM ASSET ID separated by an underscore (_). For example: 01673MH_01674MH would be the pipe between manhole number 01673MH and 01674MH. These values will be provided within the Owner's GIS database however, if additional intermediate structures are located in the field, the naming convention described below shall be used.

N. During the inspection work, if a previously unknown manhole not shown in the GIS is found between two named manholes, the letter "A" will be added to the end of the upstream manhole ID (no spaces or special characters allowed) to form a new manhole ID in the inspection records. The data / video files shall then be re-named to include the new manhole ID, and a new CCTV inspection shall be started from the new manhole ID. If more than one unnamed manhole is found between two named manholes, subsequent new manhole IDs will be formed using the letters "B", "C" etc. A copy of the Owner's GIS database shall be updated with the changes found in the field per the GIS Database Update Specification Section 00 31 22 (00312) requirements. Individual and final deliverables must include database records that link to the Owner's GIS database using unique manhole identification numbers per the Owner's standard manhole identification number (MH_Asset_ID field in the Owner's GIS) format. The newly located manholes must be added to the manhole inspection database using the same new identification codes.

During the inspection work, if a previously unknown manhole not shown in the GIS is found on the terminate upstream end of a pipe, the characters "Z1" will be added to the end of the downstream manhole ID (no spaces or special characters allowed) to form a new manhole ID in the inspection records. The data / video files shall then be renamed to include the new manhole ID, and a new CCTV inspection shall be started from the new manhole ID. If more than one unnamed manhole is found at the terminate upstream end, subsequent new manhole IDs will be formed using the letter Z followed by a sequential numbering sequence: "Z1", "Z2", …, "Z5", etc. A copy of the Owner's GIS database shall be updated with the changes found in the field per the GIS Database Update Specification Section 00 31 22 (00312) requirements. Individual and final deliverables must include database records that link to the Owner's GIS database using unique manhole identification numbers per the Owner's standard manhole identification number (MH_Asset_ID field in the Owner's GIS) format. The newly located manholes must be added to the manhole inspection database using the same new identification codes.

Example file names for pipe segments that may be encountered while performing sanitary sewer CCTV inspections include:

1. Example file name for pipe segment between a known Upstream structure and Downstream structure:

   01673MH_01674MH_YYYYMMDD.MPG(.MP4)

   Where 01673MH = the upstream asset ID, 01674MH = the downstream asset ID, and YYYYMMDD = 8 digit date.

2. Example file name for pipe segments associated with a relief sewer or double barrel sewer, facing downstream towards the downstream asset:

   01673MH_01674MH_(1,2 or 3)_YYYYMMDD.MPG(.MP4)

   Where 01673MH = upstream asset ID, 01674MH = downstream asset ID, 1,2 or 3 represent the pipe segment from left to right (facing downstream), YYYYMMDD = 8 digit date.

3. Example file name for pipe segment between an Upstream structure and Downstream structure where the structure had previously not been known to exist between

manholes 01673MH and 01674MH:

01673MHA_01674MH_YYYYMMDD.MPG(.MP4)

Where 01673MHA = the asset ID for the newly located upstream manhole found between manholes 01673MH and 01674MH, 01674MH = the downstream asset ID, and YYYYMMDD = 8 digit date.

4. Example file name for a previously unknown pipe segment where a new structure is found to exist Upstream of the manhole 01674MH:

   01674MHZ1_01674MH_YYYYMMDD.MPG(.MP4)
   Where 01674MHZ1 = the asset ID for the newly located upstream manhole found at the terminate end of the previously unknown pipe segment with the known downstream manhole 01674MH, 01674MH = the downstream asset ID that was previously thought to be the terminate upstream manhole, and YYYYMMDD = 8 digit date.

O. There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised from the other end heading either downstream or upstream. The name of additional database files etc. produced in these circumstances shall be the unique upstream asset ID followed by the unique downstream asset ID followed by "_1", "_2" etc. for additional files that do not use a reverse camera direction.

Examples:

Initial file name: 01673MH_01674MH_YYYYMMDD.MPG (.MP4)

Additional file name(s): 01673MH_01674MH_YYYYMMDD_1.MPG(.MP4)

Reverse setup name(s): 01673MH_01674MH_YYYYMMDD_R.MPG(.MP4)

Where 01673MH = upstream asset ID, 01674MH = downstream asset ID, YYYYMMDD = 8 digit date, 1 = a subsequent video of the same sewer pipe should multiple inspections be performed on the same date.

The direction of camera pull versus the pipe flow must be noted in the inspection record in the database in the 'Direction" field based on the starting direction. For inspections that subsequently require CCTV from the opposite direction, i.e. a reverse pull, these should have file naming conventions that end with an R to indicate the reverse pull. Should additional reverse pulls be required a sequential number _1, _2, etc. should be added to the end of the file after the R designation.

P. The name of each digital still image shall be based on the video / data file name of the sewer reach in which the image was taken. The name shall be recorded as follows:

Examples:01673MH_01674MH_HSV_37 _2_YYYYMMDD.jpg

01673MH_01674MH_R_MCU_113_7_YYYMMDD.jpg

Where 01673MH_01674MH is the pipe asset ID, R is a reverse pull indication, HSV and MCU are PACP defect codes, 37 and 113 are the footage counts for the defect locations along the pipe, 2 and 7 are the sequential defect photo numbers along the pipe, and YYYYMMD is the 8 digit date of the inspection.

Digital files of all field data collection forms (if used by Contractor) should be delivered in PDF format and shall have file names that include the same unique identifier as the database submittal so that they can easily be related to the database and digital photograph/video submittals, if a naming convention is not specified.

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SECTION 02733

POST-REHABILITATION SANITARY SEWER CCTV INSPECTION

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. The Work covered by this section includes furnishing all labor, competent certified technicians, equipment, tools, accessories, materials, and incidentals required to Closed-circuit television (CCTV) inspect the designated sanitary sewer lines specified.

B. Prior to completing any CCTV work, all sewers shall be cleaned as specified in Section 02650. Engineer may waive this requirement depending on timing from rehabilitation to CCTV and other factors as appropriate.

C. CCTV inspection of sanitary sewers as follows:

1. Perform all closed circuit television (CCTV) inspection work on sewer lines after the cured-in-place pipe (CIPP) rehabilitation, pipe bursting rehabilitation and any lateral replacement or relining has been performed.

2. Perform all CCTV inspection work for point repairs after constructing the mainline and any lateral reconnection/replacement has been performed.

3. All CCTV work shall conform to current NASSCO Pipeline Assessment Certification Program (PACP®) standards.

4. Contractor shall use a NASSCO PACP® certified operators and software form and coding. CCTV inspections (video and data collected) shall be delivered entirely in digital format. Data files shall be formatted to facilitate upload into a NASSCO certified CCTV software package.

D. If access to private property is required to perform the work the contractor must determine access prior to starting. Clearing and other costs related to gaining access (including restoration) should be included in contractor’s pricing.

E. Any access to private property must be approved by the homeowner prior to starting work.

F. Contractor to assume responsibility for relocating sheds if such relocation is required to perform work. The final location of the shed will be determined on a case by case basis.

G. Fences to be replaced in kind and a gate should be placed along the easement to allow future access by City forces and equipment. Each of these will be determined on a case by case basis directly with the Property Owner and Contractor.

H. Contractor shall include site restoration including irrigation line repairs, driveway restoration, shrubbery replacement, etc. when choosing a route of access/repair.

1.02 REFERENCES

A. Where materials and methods are indicated in these specifications as being in conformance with a standard specification, it shall refer to the latest edition of the specifications and shall include all interim revisions. Listing a standard specification without further reference indicates the particular material or method shall conform to such listed specification.

1. National Association of Sewer Service Companies (NASSCO):

a. Pipeline Assessment and Certification Program (PACP®) Reference Manual.

b. Recommended Specifications for Sewer Collection System Rehabilitation Standard (2006).

B. RELATED WORK

1. Measurement and Payment is specified in Section 01025.

2. Cured-in-place Pipe Lining is specified in Section 02765.

3. Manhole Rehabilitation is specified in Section 02763.

4. Sanitary Sewer Flow Control is specified in Section 02767.

5. Pre-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02732.

6. Pipe Bursting Sewer Replacement with HDPE is specified in Section 02777.

7. Database Template Description PACP is specified in Section 02734.

8. GIS Database Update Specification in Section 01990.

9. Sewer Line Cleaning Prior to CCTV and Rehabilitation Work is specified in Section 02650.

1.03 SUBMITTALS

A. Submit a Traffic Control Plan to the Owner's Representative (Engineer), which includes the following items

a. Traffic control plan shall be submitted to the Engineer three (3) weeks prior to commencement of work. This will allow time for the traffic control plan to be submitted to the permitting agency for any additional comments. Traffic control plan must include road/lane closures, detours, and all devices to be used to maintain traffic while performing work.

B. Confined space entry plan, certifications and hazardous atmosphere training certifications for all staff engaged in activities within or near the open structures, if applicable.

C. Prior to beginning work, submit to the Engineer certification of the NASSCO PACP Program for all CCTV operators that will be working and performing this inspection work on the project. Contractor shall not commence work until such certification is provided. Submit 2 copies of the NASSCO issued identification card and PACP certification number.

D. The work described in this Scope of Work, including any internal sewer or manhole inspections, shall meet the minimum requirements as presented in the OSHA Standard, Title 29 CFR 1910.146, Permit Required Confined Spaces. Upon commencement of the Work, copies of all confined space entry permits shall be submitted to Engineer. Contractor shall notify the Owner or delegated representative each day by phone, email or fax when it is necessary for Contractor to enter a manhole(s). Contractor shall identify all manholes that Contractor plans on entering that day by street location and manhole number.

E. Contractor shall submit to Engineer for Owner's review and approval, sample videos and photographs at the beginning of the project that shows no less than 20 line segments within the work area. Submitted videos will be reviewed to determine expected quality of data. All data shall be submitted referencing the pipe and manhole structure identifier codes approved by the Owner and described herein.

F. Final sewer inspection reports, digital videos/photographs and data shall be submitted in accordance with the requirements of this specification.

G. Contractor to complete a work summary sheet each month by Asset ID, electroniclly in Excel format, documenting what was cleaned that month for each asset. This shall be submitted on a monthly basis along with the pay application to the Owner. A copy of the template will be provided upon request.

1.04 QUALITY ASSURANCE

A. Qualifications:

1. Contractor: Performed work successfully for at least three other projects, within last 5 years, with at least 500,000 linear feet and the CCTV operator shall be PACP certified and have at least 250,000 linear feet of CCTV experience in NASSCO PACP format.

2. Crew Chief: Minimum 5 years of experience on projects similar to this Project, PACP certified and experienced using proposed equipment for this Project.

1.05 NOTIFICATIONS

A. Notify the Owner and Engineer:

1. On a weekly basis of scheduled work for the upcoming week, including a map showing the area of work, and a map and list of fire hydrants that will be utilized for a water source, and a list of streets being affected. Submittal shall be provided by electronic mail in PDF format. Provide 24-hour notice for deviations from the plan that are not caused by weather or natural causes.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for the work described are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Immediately of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown, or if a new asset is found, the notification shall include a diagram clearly indicating the location of structures in relation to immediately adjacent structures in PDF format via electronic mail. Contractor shall also provide updated information per 00 31 32 (00312) GIS Database Update Specification.

7. If any obstructions are found within the easement, even if not impacting work.

B. Notify the public and coordinate with homeowners:

1. Contractor shall prepare and install yard signs to notify customers in the area of work being conducted and who to contact for information. The city-approved Columbia Water yard sign file will be provided by City. This file is the standard sign layout to be filled in with project specific information. (Sign specs: digital print full color two-sided coroplast 4mm 18”x24” & metal step stakes 30”x10”).

   a. Refer to section 01500 page 8 for information regarding project signage.

   b. Signs shall be placed in key intersections and at the project site, incoming/outgoing roads to the area/neighborhood, and intersections near the site at start of project.

   c. Signs shall be placed in yards a minimum of 7 days prior to work but no more than 14 days ahead of scheduled work.

   d. Signs shall be displayed throughout scheduled work and will be replaced if removed or damaged.

   e. Signs shall be removed at the conclusion of the project.

2. A minimum of 72 hours prior to the inspection or work on any manhole, cleanout, service lateral, or line segment, distribute door-to-door an Owner approved Homeowner Notification door hanger describing the work to be performed, if work is performed or accessed through private property or easement adjacent to property, or if the property is potentially tied to the section of line being inspected or worked on. On the day of work and prior to beginning the work, knock on the doors of all properties that will require entering their

private property to access the manholes, cleanouts, or pipes which will potentially be impacted by the work and notify occupants of the work to be performed.

3. Contractor shall use approved magnetic car signs affixed to vehicles at all times during the project to identify affiliation with the City of Columbia, SC.

4. Contractor responsible for determining route of access for the proposed work, unless specified otherwise, and is responsible for coordinating with the Property Owner to obtain any temporary access to perform the work. Clearing and other costs related to gaining access (including restoration) should be included in Contractor's pricing.

5. Contractor to notify Property Owner of any that all trees or other obstructions within easements that need to be moved to access or perform the work. The Property Owner shall be given a minimum of 7 days to relocate the obstruction off of the easement at their own cost to their own chosen location. After this time period, the Contractor shall be responsible for removing and disposing of the obstruction, and all costs associated with this. Contractor to coordinate with the Engineer on each obstruction found before proceeding.

PART 2 - PRODUCTS

2.01 TELEVISION INSPECTION AND CLEANING EQUIPMENT

A. Contractor shall furnish all labor, materials, machinery, equipment and incidentals required to perform the CCTV of the assigned sewers within the study area.

B. Provide a mobile vehicle with video monitoring equipment specifically compatible with the camera equipment being used. The vehicle shall be large enough to accommodate at least three people at any time for viewing of the monitor. Owner and Engineer shall have unrestricted access to observe the television screen and all other operations at all times.

C. Contractor shall ensure equipment utilized for CCTV of main lines and to reinstate service laterals is capable of passing through offset joints up to 1 inch minimum.

D. Equipment must be adaptable to be able to locate assets that are buried if needed.

E. The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Adjustable light source to allow an even distribution of lighting for the camera shall be suitable to allow a clear color picture of the entire periphery of the pipe. The camera shall be capable panning 360° and tilting 270° to facilitate the inspection of all laterals and defects, with optimum picture quality provided by focus and iris adjustment. The camera, television monitor, and other components of the video system shall be capable of producing a minimum 460-line resolution picture. A backup camera shall be available on the Project Site or readily available to cause no delay in schedule. The camera shall be operative in 100 percent humidity conditions. Camera shall be operative in a hazardous and corrosive environment. The camera shall be capable of zooming at least 10:1 for looking further down the pipe or up into the laterals.

F. The camera, television monitor, and other components of the video system shall be

capable of producing picture quality to the satisfaction of Engineer and/or Owner.

G. The television inspection equipment shall have an accurate footage counter that shall display on the monitor the exact distance of the camera from the centerline of the starting manhole. Contractor shall, in the presence of inspector, calibrate the camera footage every week with above ground tape measure and simultaneous CCTV footage counter.

H. The CCTV equipment shall include the most current version of PACP compliant software application and database referenced in these specifications, or as approved by the Owner.

PART 3 - EXECUTION

3.01 PREPARATION

A. After rehab, replacement or repair, the sewer line section shall be visually inspected by means of closed-circuit television to determine the condition of the line and to locate existing service connections. The inspection shall be done one manhole section at a time and the flow in the section being inspected will be suitably controlled as specified in Section 3.04.

B. Contractor is solely responsible for the operations and for preventing sewer backups into area homes and causing sewage overflow. Contractor is solely responsible for all damages resulting from operations.

3.02 CCTV INSPECTION

A. Perform all CCTV inspection using personnel who are trained and certified (current standing) in the use of NASSCO’s Pipeline and Assessment Certification Program (PACP®).

B. Move the camera through the line in either direction (direction versus flow shall however be noted) at less than or equal to 30 feet per minute rate, stopping when necessary to permit proper documentation of the construction features and pipe condition. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the sewer conditions shall be used to move the camera through the sewer line.

C. When manually operated winches are used to pull the television camera through the line, use telephones or other suitable means of communication set up between the two manholes of the section being inspected to ensure good communications between members of the crew.

D. Obstructions that cause a stuck camera are the responsibility of the Contractor, and the retrieval of equipment or cameras is the responsibility of the Contractor and will be performed at the Contractor’s expense.

E. Adjust the camera height such that the camera lens is always centered in the pipe being televised.

F. Provide lighting system adequate for good quality pictures. A reflector in front of the

camera may be required to enhance lighting in black pipe.

G. Do not float the camera unless permitted by the Owner or their designated representative.

H. The camera shall be stopped at all service laterals and pan such an angle that an internal view of the service lateral is available. Digital photographs shall be made of any service lateral or deficiency observed in the sewer line and the photograph itself shall contain a brief description of the issue. The descriptions shall also be noted in the inspection condition record within the database. Where other pipe deficiencies are noted, stop the camera to observe the condition, record information and take digital photographs. All digital photos shall be cataloged in the CCTV database and linked to the specific length along the inspection via linkage to the defect record in the database.

I. Note in the PACP database the status of identified laterals and other PACP database information required including location of each service lateral based on television inspection logs, accurate distance measured from the centerline of the starting manhole as well as the notation of where on the circumference of the pipe the service lateral connects, etc. See Specification Section 02734 for additional PACP Database Template information. Contractor to include an active lateral count on post-rehab CCTV and verify that it matches the pre-rehab CCTV count to ensure all active laterals have been opened back up.

J. Provide a complete television inspection for the upstream and downstream manholes. The CCTV operator shall pan and zoom up the manhole from the invert for each manhole, and obtain the best possible image of the manhole including cone and corbel sections and for each pipe connection within each manhole. The CCTV operator shall zoom in on each pipe connection so the photos capture the each pipe connection's size, location, and approximate elevation.

3.03 PASSAGE OF TV CAMERA

A. It is the intent of the Scope of Work to inspect the full length of sewer between each manhole.

B. CCTV videos shall be submitted in one continuous video section from manhole to manhole, and not in multiple files, unless specifically approved by Engineer and Owner. See Part 4 and Specification Section 02734 for file naming convention details and additional PACP database template information.

C. The television camera shall travel through the lines using its own power. The digital pictures taken of the entire inside periphery of the pipe shall be clear and visible. Picture quality and definition shall be to the satisfaction of Engineer, and if unsatisfactory, the equipment shall be removed and no payment made for the unsatisfactory inspection.

D. See Specification 02650 for Sewer Line Cleaning Prior to CCTV and Rehabilitation Work.

E. All lateral connections shall be identified as repaired or abandoned in post rehabilitation CCTV.

3.04 SANITARY SEWER FLOW CONTROL

A. CCTV inspection shall be done one sewer line section (i.e. manhole structure to manhole structure) at a time, and the flow in the section shall be suitably controlled.

B. Sewer flow control procedures shall be performed in accordance with specification Section 02767.

3.05 SEWER INSPECTION SOFTWARE

A. All inspections shall use software that is capable of providing complete survey reports in compliance with the most current version of NASSCO PACP software referenced in these specifications, or as specified by the Owner. Owner has no intent to specify which software the Contractor should use, but requires the submitted database to be fully compliant with PACP. No payment will be rendered for improperly formatted data.

B. All NASSCO PACP mandatory fields and any additional available fields requested by the Owner or his representative shall be populated during the inspections. All reports and/or submittals shall adhere to NASSCO PACP/MACP Standards.

C. The software shall maintain a database of underground pipe and manhole assets referencing the pipe and manhole structure asset identifier codes provided in GIS format by the Owner. The pipe segment information shall be entered prior to the actual survey based on the numbering convention provided by the Owner. Surveys for pipes found not to be included in the Owner's GIS database will be numbered per Part 4. The software shall also have the capability to import and export survey results in the current NASSCO PACP Exchange digital format and to manage the database to meet the specifications in Part 4 herein.

PART 4 - DELIVERABLES

4.01 DIGITAL DATA DELIVERY

A. Contractor shall submit in electronic format digital videos, digital photographs, evaluation reports, and databases in NASSCO PACP Exchange format version 6 to Engineer. Please consult with the Owner before proceeding if a more recent version is currently available to determine if the more recent version shall be utilized.

B. If digital videos are of such poor quality that Engineer is unable to evaluate the condition of the sanitary sewer main, locate the sewer service connections, or verify the cleaning, Contractor shall be required to re-televise the sanitary sewer and provide new digital videos of good quality, at no additional cost to Owner.

C. All digital videos and data shall become the property of Owner.

4.02 DATA DELIVERY REQUIREMENTS

A. All data submittals shall include a standard CITY data transmittal form filled out in its entirety both electronically included on the hard drive with the submittal, and in hard copy attached to the hard drive upon delivery to the CITY.

B. All reports and/or submittals shall adhere to NASSCO PACP Standards.

C. Contractor shall provide a rating of each pipe per the Engineer's recommendations.

D. Contractor to provide inspection data on a monthly basis to the Engineer with the database and data on an external hard drive. The Contractor to provide two hard drives on an alternating monthly basis. The submittals shall be cumulative (i.e. each successive database delivery will include previous deliveries as well). Contractor shall provide Owner with a final external hard drive capable of storing all anticipated data for the project upon completion. The final hard drive shall be submitted on the first monthly submittal with the first month of data loaded and will become property of the Owner upon project completion. Data to be submitted shall include: 1) NASSCO PACP Database files, 2) JPEG (.jpg) files (still photos), 3).mpg or .mp4 files (videos) for each pipe segment and 4) a PDF of any separate inspection reports.

E. Each database submittal shall indicate the range of dates for which the database is being submitted as well as a list of new items as of the last submittal so that the Owner may separate out and review the newly delivered records from previous submittals in an Excel format.

F. The databases shall be cumulative, with one database for PACP CCTV inspections. Each subsequent submittal shall be added into these databases. Throughout the duration of the project, should Engineer discover inaccuracies in any of the videos, Contractor shall re-inspect those pipes at no additional cost to the Engineer or Owner. Contractor to provide all data submittals to the Engineer for review and approval. Upon approval Engineer will submit to the Owner for review and approval.

G. Databases, video files, digital photographs and supporting documentation (PDF, spreadsheets), etc. shall be placed in separate folders on the hard drives. Separate subfolders shall not be used to separate video files, etc. under the main folder. All videos, digital photographs, etc. of the same file type should be placed in a single folder on the hard drive in order to provide a single location to access the data.

H. Contractor to denote in the PACP Inspections table under 'Additional_Info' that this is a CCTV inspection by writing in 'CCTV' in all capital letters in this field for all entries related to CCTV inspections.

I. The CCTV equipment/software shall be capable of producing digital still images of all sewer line defects, and sewer line service connections in JPEG (.jpg) image format. Contractor shall take digital still images of each defect, with a minimum of one independent photo file per defect, construction features and service connections to clearly depict it. More images may be necessary depending upon the condition of the pipe. The digital images shall have a minimum size/resolution of 620x480. The screen captures or digital images shall include an onscreen display with date, sewer main reach number, footage, and type of defect/PACP Code. The filename of each JPEG (.jpg) shall be in accordance with these specifications.

J. A final, compiled version of the inspection database in PACP Exchange format shall be delivered at the end of the project to the Owner through the Engineer. The final database shall include all inspection records previously delivered in the individual inspections as well as incorporate all requested changes by the Engineer and Owner. The database filename will use the following format using upper case letters:

P_ SS7207_XYZ_BR02_ YYYYMMDD.MDB

Where P = PACP database; SS7207 = Example PO_Number ; XYZ=3 Character Prime Contractor ID assigned by Owner's GIS Administrator, BR02= Example Sub_Basin_ID, and YYYYMMDD = 8 digit date.

For projects that do not encompass an entire sub-basin, Engineer to contact Owner's GIS Administrator to obtain a "Sub_Basin_ID" for file naming.

K. The PACP database submittals shall meet the requirements for naming, linkage, etc as defined in Specification Section 02734, Database Template Description PACP.

L. Note that there are six (6) different asset type codes (including MH) that are to be used in the unique pipe/file identification codes as follows: MH (manhole), FM (force main), PS (pump station), CO (cleanout), LH (lamp hole), and OT (other miscellaneous). The samples and descriptions within these specifications utilize MH for simplicity and should be replaced with the applicable asset type code as appropriate.

M. All database inspection records shall be linked to the Owner's unique pipe numbering system which is based on the upstream and downstream structure asset numbers for the pipe end structures (manhole, outfall, cleanout, etc.). The unique pipe identifier shall take the form of UPSTREAM ASSET ID and DOWNSTREAM ASSET ID separated by an underscore (_). For example: 01673MH_01674MH would be the pipe between manhole number 01673MH and 01674MH. These values will be provided within the Owner's GIS database however, if additional intermediate structures are located in the field, the naming convention described below shall be used.

N. During the inspection work, if a previously unknown manhole not shown in the GIS is found between two named manholes, the letter "A" will be added to the end of the upstream manhole ID (no spaces or special characters allowed) to form a new manhole ID in the inspection records. The data / video files shall then be re-named to include the new manhole ID, and a new CCTV inspection shall be started from the new manhole ID. If more than one unnamed manhole is found between two named manholes, subsequent new manhole IDs will be formed using the letters "B", "C" etc. A copy of the Owner's GIS database shall be updated with the changes found in the field per the GIS Database Update Specification Section 00 31 22 (00312) requirements. Individual and final deliverables must include database records that link to the Owner'S GIS database using unique manhole identification numbers per the Owner'S standard manhole identification number (MH_Asset_ID field in the Owner's GIS) format. The newly located manholes must be added to the manhole inspection database using the same new identification codes.

During the inspection work, if a previously unknown manhole not shown in the GIS is found on the terminate upstream end of a pipe, the characters "Z1" will be added to the end of the downstream manhole ID (no spaces or special characters allowed) to form a

new manhole ID in the inspection records. The data / video files shall then be renamed to include the new manhole ID, and a new CCTV inspection shall be started from the new manhole ID. If more than one unnamed manhole is found at the terminate upstream end, subsequent new manhole IDs will be formed using the letter Z followed by a sequential numbering sequence: “Z1”, “Z2”, …, “Z5”, etc. A copy of the Owner’s GIS database shall be updated with the changes found in the field per the GIS Database Update Specification Section 00 31 22 (00312) requirements. Individual and final deliverables must include database records that link to the Owner’S GIS database using unique manhole identification numbers per the Owner’S standard manhole identification number (MH_Asset_ID field in the Owner’s GIS) format. The newly located manholes must be added to the manhole inspection database using the same new identification codes.

Example file names for pipe segments that may be encountered while performing sanitary sewer CCTV inspections include:

1. Example file name for pipe segment between a known Upstream structure and Downstream structure:

   01673MH_01674MH_YYYYMMDD.MPG(.MP4)

   Where 01673MH = the upstream asset ID, 01674MH = the downstream asset ID, and YYYYMMDD = 8 digit date.

2. Example file name for pipe segments associated with a relief sewer or double barrel sewer, facing downstream towards the downstream asset:

   01673MH_01674MH_(1,2 or 3)_YYYYMMDD.MPG(.MP4)

   Where 01673MH = upstream asset ID, 01674MH = downstream asset ID, 1,2 or 3 represent the pipe segment from left to right (facing downstream), YYYYMMDD = 8 digit date.

3. Example file name for pipe segment between an Upstream structure and Downstream structure where the structure had previously not been known to exist between manholes 01673MH and 01674MH:

   01673MHA_01674MH_YYYYMMDD.MPG(.MP4)

   Where 01673MHA = the asset ID for the newly located upstream manhole found between manholes 01673MH and 01674MH, 01674MH = the downstream asset ID, and YYYYMMDD = 8 digit date.

4. Example file name for a previously unknown pipe segment where a new structure is found to exist Upstream of the manhole 01674MH:

   01674MHZ1_01674MH_YYYYMMDD.MPG(.MP4)
   Where 01674MHZ1 = the asset ID for the newly located upstream manhole found at the terminate end of the previously unknown pipe segment with the known downstream manhole 01674MH, 01674MH = the downstream asset ID that was previously thought to be the terminate upstream manhole, and YYYYMMDD = 8 digit date.

O. There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised from the other end heading either downstream or upstream. The name of additional database files etc. produced in these circumstances shall be the unique upstream asset ID followed by the unique downstream asset ID followed by "_1", "_2" etc. for additional files that do not use a reverse camera direction.

Examples:

Initial file name: 01673MH_01674MH_YYYYMMDD.MPG (.MP4)

Additional file name(s): 01673MH_01674MH_YYYYMMDD_1.MPG(.MP4)

Reverse setup name(s): 01673MH_01674MH_YYYYMMDD_R.MPG(.MP4)

Where 01673MH = upstream asset ID, 01674MH = downstream asset ID, YYYYMMDD = 8 digit date, 1 = a subsequent video of the same sewer pipe should multiple inspections be performed on the same date.

The direction of camera pull versus the pipe flow must be noted in the inspection record in the database in the 'Direction" field based on the starting direction. For inspections that subsequently require CCTV from the opposite direction, i.e. a reverse pull, these should have file naming conventions that end with an R to indicate the reverse pull. Should additional reverse pulls be required a sequential number _1, _2, etc. should be added to the end of the file after the R designation.

P. The name of each digital still image shall be based on the video / data file name of the sewer reach in which the image was taken. The name shall be recorded as follows:

Examples:01673MH_01674MH_HSV_37 _2_YYYYMMDD.jpg

01673MH_01674MH_R_MCU_113_7_YYYMMDD.jpg

Where 01673MH_01674MH is the pipe asset ID, R is a reverse pull indication, HSV and MCU are PACP defect codes, 37 and 113 are the footage counts for the defect locations along the pipe, 2 and 7 are the sequential defect photo numbers along the pipe, and YYYYMMD is the 8 digit date of the inspection.

Q. Digital files of all field data collection forms (if used by Contractor) should be delivered in PDF format and shall have file names that include the same unique identifier as the database submittal so that they can easily be related to the database and digital photograph/video submittals, if a naming convention is not specified.

END OF SECTION

SECTION 02734

DATABASE TEMPLATE DESCRIPTION PACP

PART 1 - GENERAL

1.01 DATABASE TEMPLATE

A. The attached database template (version 6) and formatting as specified must be used to document and deliver the results of all work related to pipe and related inspections. This specification contains a description for each field, formatting notes, and examples to provide additional guidance. Examples are provided for fields that are open that required additional clarity. The lack of an example does not imply that the field can be left blank.

B. All codes and descriptions must be used pursuant to the applicable specifications and the valid value tables within the attached database template.

C. The databases should be filled out to be compliant with NASSCO MACP/PACP standards. All database fields that NASSCO requires must be populated. If required fields are not populated because they are unknown, a reason must be provided and supported (requiring review and approval by Engineer and Owner) and the term "99" shall be used in these fields. If a valid date value is required but unknown, the value “10000101” shall be used (e.g. Date Cleaned). Fields intentionally left blank following NASSCO standards to designate a known condition (such as an item that does not apply) should be left blank. The intent of this is to distinguish between fields that do not apply and fields that are truly unknown.

PART 2 - TABLE FORMAT AND DESCRIPTION

2.01 FORMAT AND DESCRIPTION

A. The following tables show available Field Names, the data type allowed, field size, a description of the Field, additional formatting notes if needed, and an example if provided.

B. There are 6 asset type codes that are to be used as follows: MH (manhole), FM (force main), PS (pump station), CO (cleanout), LH (lamp hole), and OT (other miscellaneous). The samples and descriptions within these specifications utilize MH for simplicity and should be replaced with the applicable asset type code as appropriate.

2.02 INSPECTIONS TABLE

A. This table shall be used to store the primary information regarding the inspection.

Field Name	Data Type	Field Size	Description	Additional Formatting Notes	Example
InspectionID	Long Integer	4	This field is automatically populated when any		

			inspection information is entered. The number generated must be entered in the InspectionID field of the Conditions table for all conditions recorded during the inspection		
Surveyed_By	Text	25	Company ID and initials of individual conducting survey	3-Character Contractor ID assigned by Owner's GIS Administrator, underscore, then initials of the individual	HYS_AAA
Certificate_Number	Text	15	NASSCO PACP # of Surveyor		04-6134
Owner	Text	30	Owner of collection system surveyed		City of Columbia
Customer	Text	30	Entity commissioning the survey		City of Columbia
Drainage_Area	Text	15	Common name of drainage area	Sub Basin Name	SR05
PO_Number	Text	15	Customer's Purchase Order Number	CIP number	SS7207
Pipe_Segment_ Reference	Text	25	Client provided segment number	Upstream_asset_ID_downstream _asset_ID. add asset ID formatting details.	01674MH_016 75MH
Date	Date/ Time	8	Inspection Date		20101214
Time	Date/ Time	8	Time of inspection		13:25
Street	Text	64	Street Number and Name	Indicate street name when applicable i.e., if asset is in street or crosses the street or can be associated with an address. Use NUMBER PREDIRECTIONAL STREET SUFFIX POSTDIRECTIONAL with no punctuation and all uppercase letters. Alleys or right-of-ways between two streets should remain unassigned. Fields, parks, other open areas should receive a positive entry of "OTHER".	321 MAIN ST
City	Text	64	City name where sewer located	Enter Columbia, Irmo, or Lexington	Irmo
Location_Details	Text	255	Descriptive explanation of sewer location		
Upstream_MH	Text	25	Client provided designation for upstream manhole	Each manhole has been given unique manhole identifications (MH_Asset_ID) per Owner	03123MHA

				guidelines, and the name of each database ID shall be that unique MH_Asset_ID. If an unnamed manhole is found, the letter "A" will be added to the end of the MH_Asset_ID to form a new MH_Asset_ID. If more than one unnamed manhole is found between two named manholes, subsequent new MH_Asset_ID's will be formed using the letters "B", "C" etc. Spaces and special characters are not allowed in the unique ID codes. For example, 03123MH or 03123MHA. If an unnamed manhole is found on the terminate upstream end of a pipe, the characters "Z1" will be added to the end of the downstream manhole ID. If more than one unnamed manhole is found at the terminate upstream end, subsequent new MH_Asset_ID's will be formed using the letter Z followed by a sequential numbering sequence ("Z1", "Z2",…, "Z5"). For example, 03123MH or 03123MHZ1.	
Up_Rim_to_Invert	Single	4	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to invert of upstream manhole	Record value as feet to nearest tenth of a foot.	8.4
Up_Grade_to_Invert	Single	4	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from average grade to invert of upstream manhole	Record value as feet to nearest tenth of a foot.	10.2
Up_Rim_to_Grade	Single	4	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to average grade of upstream manhole	Record value as feet to nearest tenth of a foot.	1.2
Downstream_MH	Text	25	Client provided designation for downstream manhole	Each manhole has been given unique manhole identifications (MH_Asset_ID) per Owner guidelines, and the name of each database ID shall be that unique MH_Asset_ID. If an unnamed manhole is found, the letter "A"	03123MHA

				will be added to the end of the MH_Asset_ID to form a new MH_Asset_ID. If more than one unnamed manhole is found between two named manholes, subsequent new MH_Asset_ID's will be formed using the letters "B", "C" etc. Spaces and special characters are not allowed in the unique ID codes. For example, 03123MH or 03123MHA. If an unnamed manhole is found on the upstream end of a pipe, the characters "Z1" will be added to the end of the downstream manhole ID. If more than one unnamed manhole is found at the terminate upstream end, subsequent new MH_Asset_ID's will be formed using the letter Z followed by a sequential numbering sequence ("Z1", "Z2",…, "Z5"). For example, 03123MH or 03123MHZ1.	
Down_Rim_to_Invert	Single	4	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to invert of downstream manhole	Record value as feet to nearest tenth of a foot.	8.4
Down_Grade_to_Invert	Single	4	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from average grade to invert of downstream manhole	Record value as feet to nearest tenth of a foot.	10.2
Down_Rim_to_Grade	Single	4	Distance (ft and tenths of ft) or (meters to 2 decimal places max) from rim to average grade of downstream manhole	Record value as feet to nearest tenth of a foot.	1.2
Sewer_Use	Text	15	Purpose of sewer	Validated entry list e.g., Combined, Force Main, Processes	Combined
Direction	Text	10	Direction of survey, Upstream or Downstream	Validated entry list e.g., Downstream, Upstream	Downstream
Flow_Control	Text	25	Type restriction of flow used	Validated entry list e.g., Bypassed, De-watered using jetter, Lift Station	Bypassed

Height	Long Integer	4	Diameter of sewer (or height if non-circular) to nearest inch(999) or nearest mm(99999)		
Width	Long Integer	4	Width of non-circular sewer to nearest inch(999) or nearest mm(99999)		
Shape	Text	15	Sewer shape	Validated entry list e.g., Arched, Barrel, Circular	Arched
Material	Text	64	Type of pipe material	Validated entry list e.g., Asbestos Cement, Brick, Cast Iron	Asbestos Cement
Lining_Method	Text	30	Type of process used to line the host pipe	Validated entry list e.g., Cured in Place, Fold and Form or Deform/Reform, Other	Cured in Place
Pipe_Joint_Length	Single	4	Length of pipe joint sections measured to one decimal place whether in feet or meters		
Total_Length	Single	4	Distance between the exit of the start manhole and the entrance of the finish measured to one decimal place whether it is feet or meters		
Length_Surveyed	Single	4	If the survey is abandoned, enter the actual length surveyed to one decimal place whether it is feet or meters		
Year_Laid	Long Integer	4	Year sewer surveyed was constructed	Record as four digit Year	1989
Year_Renewed	Long Integer	4	Year sewer surveyed was renewed	Record as four digit Year	1989
Media_Label	Text	64	Unique identifier for tape/media		
Purpose	Text	64	Reason for conducting survey	Validated entry list e.g., Capital Improvement Program Assessment, Infiltration/Inflow Investigation, Maintenance Related	Capital Improvement Program Assessment
Sewer_Category	Text	2	Importance of sewer, to be provided by client	Validated entry list e.g., A, B, C	A
Pre-Cleaning	Text	15	Type of preparatory cleaning conducted prior to survey	Validated entry list e.g., Heavy Cleaning, Jetting, No Pre-Cleaning	Heavy Cleaning
Date_Cleaned	Date/ Time	8	Date when sewer was cleaned prior to survey	Record value as yyyymmdd.	20130620

Weather	Text	12	Weather conditions when survey conducted		
Location_Code	Text	30	General description of ground cover of surveyed segment	Validated entry list e.g., Airport, Alley, Building	Airport
Additional_Info	Text	255	Supplemental info regarding survey or segment	Enter CCTV or ZOOM	CCTV
Reverse_Setup	Long Integer	4	Specifies that a second survey has been done on the pipe segment--use inspection ID from matching survey		
Sheet_Number	Long Integer	4	Number used to identify individual surveys done within a group		
IsImperial	Yes/ No	1	Used to identify whether units are metric or imperial. Defaults to imperial.		Yes
PressureValue	Single	4	Grouting pressure value		
WorkOrder	Text	20	Work order or Project reference for Asset Management		
Project	Text	64	Project Title or reference for Asset Management		

2.03 MEDIA_INSPECTIONS TABLE

A. This table shall be used to store information regarding the digital photographs and videos taken during inspections.

B. This table should be completed along with the inspections table.

Field Name	**Data Type**	**Field Size**	**Description**	**Additional Formatting Notes**	**Example**
Northing	Text	50	Y Coordinate - Latitude at the center point of the Starting Access Point - If value exists, Easting and Coordinate System are also required	All coordinate data collected will be accurate to within 0.15' (fifteen-hundredths of a foot) to meet the now current Standards of Practice Manual for Land Surveying in South Carolina as published by SCLLR. **For dye testing related work, accuracy is relaxed to sub-meter where coordinates are to be obtained.**	806354.16

Easting	Text	50	X Coordinate - Longitude at the center point of the Starting Access Point- If value exists, Northing and Coordinate System are also required	All coordinate data collected will be accurate to within 0.15' (fifteen-hundredths of a foot) to meet the now current Standards of Practice Manual for Land Surveying in South Carolina as published by SCLLR. **For dye testing related work, accuracy is relaxed to sub-meter where coordinates are to be obtained.**	1946419.03
Elevation	Text	50	Z Coordinate - Height at the center point of the Starting Access Point		
Coordinate_System	Text	50	Datum or reference system used for the GPS coordinates - If value exists, Northing and Easting are also required.	All coordinates will be provided using the SC State Plane Coordinate System, NAD83 HARN, Int'l Feet. All elevations will be provided using the NAVD 88 datum.	
GPS_Accuracy	Text	50	Describes degree of accuracy obtained from coordinates	Validated entry list e.g., Survey Level, Sub-Meter, Nearest Meter	Survey Level
MediaID	Long Integer	4	This field is automatically populated when any media (picture or movie file) is saved.		
InspectionID	Long Integer	4	Software provided designation for this inspection (THIS FIELD USED TO JOIN TABLES)		
Video_Name	Text	255	The name of the video file corresponding to data file	**DYE TEST:** Video obtained for dye testing shall have a "D_" as prefix. There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised from the other end heading either downstream or upstream. The name of additional database files etc. produced in these circumstances shall be the unique upstream asset ID followed by the unique downstream asset ID followed by 8-digit date and "_1", "_2" etc. for additional files that do not use a reverse camera direction. For	DYE TEST: D_ 01673MH_ 01674MH_YY YYMMDD.MP G (.MP4) INSPECTION: 01673MH_ 01674MH_YY YYMMDD.MP G (.MP4)

				example: Initial file name: D_ 01673MH_ 01674MH_YYYYMMDD.MPG (.MP4) Additional file name(s): D_ 01673MH_ 01674MH_YYYYMMDD_1.MPG (.MP4) Reverse setup name(s): D_01673MH_01674MH_YYYYMMDD_R.MPG (.MP4) (where D=dye testing01673MH is upstream asset ID; 01674MH=downstream asset ID, YYYYMMDD=8-digit date; 1=additional attempt at CCTV of sewer reach, R=reverse pull). Should additional reverse pulls be required a sequential number _1, _2, etc. should be added to the end of the file after the R designation. Example file name for pipe segments associated with a relief sewer or multi-barreled sewer, facing downstream, between two identical asset IDs: D_01673MH_01674MH_(1,2 or 3)_YYYYMMDD.MPG (.MP4) (where 01673MH = upstream asset ID; 01674MH = downstream asset ID; 1,2 or 3 represent the pipe segment from left to right (facing downstream), YYYYMMDD = 8 digit date. **INSPECTION:** There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised from the other end heading either downstream or upstream. The name of additional database files etc. produced in these circumstances shall be the unique upstream asset ID followed by the unique downstream asset ID followed by 8-digit date and "_1", "_2" etc. for additional files that do not use a reverse camera direction. For example:	

				Initial file name: 01673MH_ 01674MH_YYYYMMDD.MPG (.MP4) Additional file name(s): 01673MH_ 01674MH_YYYYMMDD_1.MPG (.MP4) Reverse setup name(s): 01673MH_01674MH_YYYYMMDD_R.MPG (.MP4) (where 01673MH is upstream asset ID; 01674MH=downstream asset ID, YYYYMMDD=8-digit date; 1=additional attempt at CCTV of sewer reach, R=reverse pull). Should additional reverse pulls be required a sequential number _1, _2, etc. should be added to the end of the file after the R designation. Example file name for pipe segments associated with a relief sewer or multi-barreled sewer, facing downstream, between two identical asset IDs: 01673MH_01674MH_(1,2 or 3)_YYYYMMDD.MPG (.MP4) (where 01673MH = upstream asset ID; 01674MH = downstream asset ID; 1,2 or 3 represent the pipe segment from left to right (facing downstream), YYYYMMDD = 8 digit date. The direction of camera pull versus the pipe flow must be noted in the inspection record in the database in the 'Direction' field.	
Video_Location	Text	255	For digital recordings, path of video file relative to corresponding data file	Path neutral	

2.04 CONDITIONS TABLE

A. This table shall be used to store information regarding the condition of inspected pipes.

B. This table should be completed along with the inspections table.

Conditions			
Field Name	**Data Type**	**Field Size**	**Description**

Conditions			
Field Name	**Data Type**	**Field Size**	**Description**
ConditionID	Long Integer	4	This field is automatically populated when any condition information is entered.
InspectionID	Long Integer	4	Software provided designation for this inspection (THIS FIELD USED TO JOIN TABLES)
Distance	Single	4	Distance is measured to one decimal place to feature location whether it is in feet or meters
Counter	Single	4	Time into the video of the identified condition, in seconds
PACP_Code	Text	5	Combination of Group/Descriptor and Modifier/Severity in a single data field
Continuous	Text	3	Continuous defect number with start (S) and finish (F) matching to denote beginning and ending of defect
Value_1st_Dimension	Single	4	Dimensions of defects to nearest Inch or mm
Value_2nd_Dimension	Single	4	Used for intrusion of tap or width of non-circular connecting pipe to nearest inch or mm
Value_Percent	Long Integer	4	Used to express percentage value of defects
Joint	Yes/No	1	Indicates a defect located near a joint
Clock_At_From	Integer	2	Clock At/From Position of defect/observation
Clock_To	Integer	2	Clock To Position of defect/observation
Remarks	Text	255	Additional info to describe defect/coding
VCR_Time	Text	6	Time into the video of the identified condition in HHMMSS format with 0 used as space holder.

2.05 MEDIA_CONDITIONS TABLE

A. This table shall be used to store information regarding the digital photographs and videos taken for inspections relating to pipe conditions.

B. This table should be completed along with the inspections table.

Media_Conditions					
Field Name	**Data Type**	**Field Size**	**Description**	**Additional Formatting Notes**	**Example**
MediaCondID	Long Integer	4	This field is automatically populated when any media (picture or movie file) is saved.		

ConditionID	Long Integer	4	Software provided designation for this inspection (THIS FIELD USED TO JOIN TABLES)		
Image_Reference	Text	255	If digital snapshots are taken, the name or number of the image file.	DYE TEST: Each photo shall be given a filename that consists of dye test designation, the unique dye test number followed by a number indicating the photograph sequence and using an underscore to separate the test number, photo sequence number (e.g., D_XYZ_20121211_3_1.JPG where D=dye test designation, XYZ=Contractor name; 20121211=example of 8-digit date; 3=test number; and 1=photo sequence number). No spaces or special characters will be allowed in the file names except dashes or underscores and the photograph test numbers must correlate exactly back to those entered in the digital database submission. INSPECTION: The name of each digital still image shall be based on the video / data file name of the sewer reach in which the image was taken. The name shall be recorded as follows: Examples: 01673MH_ 01674MH_HSV_37_YYYYMMDD_2.JPG 01673MH_01674MH_1_MCU_113_YYYYMMDD_7.JPG Where 01673MH_01674MH is the pipe asset ID, 1 is a reverse pull, HSV and MCU are PACP defect codes, 37 and 113 are the footage counts for the defect locations along the pipe, YYYYMMDD= 8-digit date, and 2 and 7 are the sequential defect photo numbers along the pipe.	DYE TEST: D_XYZ_20121211_3_1.JPG INSPECTION 01673MH_01674MH_1_MCU_113_YYYYMMDD_7.JPG
Image_Path	Text	255	Path to digital image reference file	Path neutral	

Video_File	Text	255	For digital recordings, name of the video file associated with this condition relative to the data file	**DYE TEST:** Video obtained for dye testing shall have a "D_" as prefix. There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised from the other end heading either downstream or upstream. The name of additional database files etc. produced in these circumstances shall be the unique upstream asset ID followed by the unique downstream asset ID followed by 8-digit date and "_1", "_2" etc. for additional files that do not use a reverse camera direction. For example: Initial file name: D_ 01673MH_ 01674MH_YYYYMMDD.MPG (.MP4) Additional file name(s): D_ 01673MH_ 01674MH_YYYYMMDD_1.MPG (.MP4) Reverse setup name(s): D_01673MH_01674MH_YYYYMMDD_R.MPG (.MP4) (where D=dye testing01673MH is upstream asset ID; 01674MH=downstream asset ID, YYYYMMDD=8-digit date; 1=additional attempt at CCTV of sewer reach, R=reverse pull). Should additional reverse pulls be required a sequential number _1, _2, etc. should be added to the end of the file after the R designation. Example file name for pipe segments associated with a relief sewer or multi-barreled sewer, facing downstream, between two identical asset IDs: D_01673MH_01674MH_(1,2 or 3)_YYYYMMDD.MPG (.MP4) (where 01673MH = upstream asset ID; 01674MH = downstream asset ID; 1,2 or 3	DYE TEST: D_ 01673MH_ 01674MH_YYYYMMDD.MPG (.MP4) INSPECTION 01673MH_ 01674MH_YYYYMMDD.MPG (.MP4)

				represent the pipe segment from left to right (facing downstream), YYYYMMDD = 8 digit date. **INSPECTION:** There may be situations that require Contractor to televise an individual pipe segment from more than one direction, i.e. the camera is only able to televise 75% of the segment heading downstream, and the remaining 25% is televised from the other end heading either downstream or upstream. The name of additional database files etc. produced in these circumstances shall be the unique upstream asset ID followed by the unique downstream asset ID followed by 8-digit date and "_1", "_2" etc. for additional files that do not use a reverse camera direction. For example: Initial file name: 01673MH_ 01674MH_YYYYMMDD.MPG (.MP4) Additional file name(s): 01673MH_ 01674MH_YYYYMMDD_1.MPG (.MP4) Reverse setup name(s): 01673MH_01674MH_YYYYMMDD_R.MPG (.MP4) (where 01673MH is upstream asset ID; 01674MH=downstream asset ID, YYYYMMDD=8-digit date; 1=additional attempt at CCTV of sewer reach, R=reverse pull). Should additional reverse pulls be required a sequential number _1, _2, etc. should be added to the end of the file after the R designation. Example file name for pipe segments associated with a relief sewer or multi-barreled sewer, facing downstream, between two identical asset IDs: 01673MH_01674MH_(1,2 or 3)_YYYYMMDD.MPG (.MP4) (where 01673MH =	

				upstream asset ID; 01674MH = downstream asset ID; 1,2 or 3 represent the pipe segment from left to right (facing downstream), YYYYMMDD = 8 digit date. The direction of camera pull versus the pipe flow must be noted in the inspection record in the database in the 'Direction' field.	
Video_File_Path	Text	255	For digital recordings, path of the video file associated with this condition relative to the data file	Path neutral	

2.06 VALIDATED ENTRY TABLES

A. These tables shall be used to determine the valid entries allowed in certain fields as specified in the tables above. These tables are related to the above-mentioned tables within the database and provide predefined validated fields. The following tables are included in the database and should not be edited or modified:

1. Valid_AccuracyOfGPS
2. Valid_Codes
3. Valid_Flow_Controls
4. Valid_Lining_Methods
5. Valid_Locations
6. Valid_Materials
7. Valid_Pre-Cleaning
8. Valid_Purposes
9. Valid_Sewer_Uses
10. Valid_Shapes
11. Valid_Start_Manhole
12. Valid_Survey_Directions
13. Valid_Weather

END OF SECTION

SECTION 02763

MANHOLE REHABILITATION

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to rehabilitate manholes as noted on the Drawings and as specified herein.

B. Where indicated in the drawings or as directed by the Owner/Engineer, work may require patching and filling cracks and spalls in manhole walls, benches, chimneys and inverts; stopping infiltration with chemical or cementitious grout; rebuilding brickwork in inverts, walls, and benching; resetting or replacing manhole frame and cover assemblies; installing chimney seals; installing new drop assemblies; coating manhole inverts; installing a cementitious or epoxy monolithic coating to the entire manhole; and adjusting elevation of manhole frames and covers.

C. Work to rehabilitate manholes covered in this section shall be paid in separate bid items depending on the type of rehabilitation. Separate bid items are included in the Schedule of Prices for the following:

1. Repairing and rebuilding brickwork for inverts, walls, chimneys and benches with new brick and mortar.

2. Patching, filling and repairing cracks and spalls.

3. Removing and resetting existing manhole frames and covers.

4. Removing and disposing of existing manhole frames and covers and installing new ones.

5. Sealing existing manhole chimneys.

6. Installing new drop assemblies.

7. Installing Monolithic Manhole Lining System.

8. Coating manhole inverts.

D. New pipe connections to existing manholes shall be paid for under the PVC or DI Point Repair Bid Item in the Schedule of Prices.

E. Remove manhole steps unless otherwise directed by the Owner or Engineer. Removal shall be paid for in one of the above Bid Items, no separate payment shall be made for removal of manhole steps.

F. Eliminate active infiltration observed in the frame seal, chimney (corbel for brick manholes), cone, wall, bench, invert, holes, or pipe connections prior to completing manhole rehabilitation. Elimination of active infiltration shall be paid for in one of the above Bid Items, no separate payment shall be made.

G. Maintain sewer flows as specified in Section 02767.

H. If access to private property is required to perform the work the contractor must determine access prior to starting.

I. Any access to private property must be approved by the homeowner prior to starting work.

J. Contractor to assume responsibility for relocating sheds if such relocation is required to perform work. The final location of the shed will be determined on a case by case basis.

K. If applicable, fences shall be replaced in kind and a gate should be placed along the easement to allow future access by Owner forces and equipment. Each of these will be determined on a case by case basis directly with the Property Owner and Contractor.

L. Contractor shall include site restoration including irrigation line repairs, driveway restoration, shrubbery replacement, etc. when choosing a route of access/repair.

M. Contractor is allowed up to two weeks from the time of installation of a temporary asphalt patch to the completion of a permanent repair unless approved otherwise by the Owner.

1.02 REFERENCES

A. Where materials and methods are indicated in these specifications as being in conformance with a standard specification, it shall refer to the latest edition of the specifications and shall include all interim revisions. Listing a standard specification without further reference indicates the particular material or method shall conform to such listed specification. The following standards shall be followed while executing the work:

1. ASTM C109 – Standard Testing Methods for Compressive Strength of Hydraulic Cement Mortars (Using 2-in Cube Specimens)

2. ASTM C150 – Standard Specification for Portland Cement

3. ASTM C267 – Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes

4. ASTM C293 – Test Method for Flexural Strength of Concrete

5. ASTM C309 – Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete

6. ASTM C496 – Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens

7. ASTM C579B – Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts and Monolithic Surfacing

8. ASTM C596 – Test Method for Drying Shrinkage of Mortar Containing Portland Cement

9. ASTM C666 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing

10. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill

11. The chemical grout repair work shall be in accordance with ASTM Designation F-2414-04, Sealing Sewer Manholes Using Chemical Grouting and manufacturers recommended installation methods.

12. Occupational Safety and Health Administration (OSHA).

1.03 RELATED WORK

A. Measurement and Payment is specified in Section 01025.

B. Cured-in-place Pipe Lining is specified in Section 02765.

C. Sanitary Sewer Flow Control is specified in Section 02767.

D. Pre-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02732.

E. Pipe Bursting Sewer Replacement with HDPE is specified in Section 02777.

F. Post-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02733.

G. Database Template Description PACP is specified in Section 02734.

H. GIS Database Update Specification in Section 00312.

I. Sewer Line Cleaning Prior to CCTV and Rehabilitation Work is specified in Section 02650.

1.04 SUBMITTALS

A. Identify the staging area for deployment of manhole repair equipment for each work area.

B. Submit to the Owner/Engineer, in accordance with the contract documents, shop drawings and product data for all manhole rehabilitation materials specified in this Section for each manhole to be rehabilitated.

1. Shop drawings and product data on the chemical grout and additives, cementitious compound, waterproofing, and corrosion control materials that will be used, the installation method, testing and equipment. For the materials that will be used, identify and furnish references for successful use of the materials in similar applications.

2. Submit a traffic control plan which includes the following items:

   a. Traffic control plan shall be submitted to the Engineer three (3) weeks prior to commencement of work. This will allow time for the traffic control plan to be submitted to the permitting agency for any additional comments. Traffic control plan must include road/lane closures, detours, and all devices to be used to maintain traffic while performing work.

3. Contractor to complete an Owner monthly work-summary sheet by Asset ID electronically in Excel format documenting what was completed that month for each asset. This shall be submitted on a monthly basis along with the pay application. A copy of the template will be provided upon request.

4. Quality control procedures for all work and installations.

5. All testing results shall be submitted to Engineer and Owner.

6. Written statement indicating compliance with the 2-year guarantee for all manhole work as required in Paragraph 1.07, below.

1.05 QUALIFICATIONS

A. The Contractor to perform the manhole rehabilitation shall be fully qualified, experienced and equipped to complete the work in a timely and satisfactory manner. Submit the following information to the Owner/Engineer for review and approval before any work is performed.

1. The number of years of experience Contractor and applicator have in performing this type of specialized work, with a minimum of 5 years of experience.

2. For monolithic lining systems, Contractor shall have successfully installed the proposed lining system in a minimum of 500 manholes.

3. For monolithic lining systems, name of the manufacturer and supplier for this work. The Contractor shall be certified by the manufacturer to install the monolithic lining system.

4. A list of all municipal installations performed by the manufacturer and Contractor over the past 5 years along with the contact name, telephone number, and brief description of work performed.

5. The Contractor shall also be capable of providing crews as needed to complete this work without undue delay.

6. The Owner reserves the right to disapprove the use of the Contractor based on the submitted qualifications.

1.06 NOTIFICATIONS

A. Notify the Owner and Engineer:

1. On a weekly basis, schedule the work for the upcoming week, including submitting a map showing the area of work, and a list of streets being affected. Submittal shall be provided by electronic mail in PDF format. Provide 24-hour notice for deviations from the plan that are not caused by weather or natural causes.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for the work described are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Immediately of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown or if a new asset is found, the notification shall include a diagram clearly indicating the location of structures in relation to immediately adjacent structures in PDF format via electronic mail. Contractor shall

also provide updated information per 00 31 22 (00312) GIS Database Update Specification.

7. If any obstructions are found within the easement, even if not impacting work.

B. Notify the public and coordinate with homeowners:

1. Contractor shall prepare and install yard signs to notify customers in the area of work being conducted and who to contact for information. The city-approved Columbia Water yard sign file will be provided by City. This file is the standard sign layout to be filled in with project specific information. (Sign specs: digital print full color two-sided coroplast 4mm 18”x24” & metal step stakes 30”x10”).

    a. Refer to section 01500 page 8 for information regarding project signage.

    b. Signs shall be placed in key intersections and at the project site, incoming/outgoing roads to the area/neighborhood, and intersections near the site at start of project.

    c. Signs shall be placed in yards a minimum of 7 days prior to work but no more than 14 days ahead of scheduled work.

    d. Signs shall be displayed throughout scheduled work and will be replaced if removed or damaged.

    e. Signs shall be removed at the conclusion of the project.

2. A minimum of 72 hours prior to the inspection or work on any manhole, cleanout, service lateral, or line segment, distribute door-to-door an Owner approved Homeowner Notification door hanger describing the work to be performed, if work is performed or accessed through private property or easement adjacent to property, or if the property is potentially tied to the section of line being inspected or worked on. On the day of work and prior to beginning the work, knock on the doors of all properties that will require entering their private property to access the manholes, cleanouts, or pipes which will potentially be impacted by the work and notify occupants of the work to be performed.

3. Contractor shall use approved magnetic car signs affixed to vehicles at all times during the project to identify affiliation with the City of Columbia, SC.

4. Contractor responsible for determining route of access for the proposed work, unless specified otherwise, and is responsible for coordinating with the Property Owner to obtain any temporary access to perform the work.

5. Contractor to notify Property Owner of any trees or other obstructions within easements that need to be moved to access or perform the work. The Property Owner shall be given a minimum of 7 days to relocate the obstruction off of the easement at their own cost to their own chosen location. After this time period, the Contractor shall be responsible for removing and disposing of the obstruction, and all costs associated with this. Contractor to coordinate with the Owner/Engineer on each obstruction found before proceeding.

1.07 GUARANTEE

A. All manhole rehabilitation work shall be guaranteed by the Contractor for a period of two years from the date of acceptance. During this period, any defects found in the rehabilitation work shall be repaired in a manner satisfactory to the Owner/Engineer at no additional cost.

1.08 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in shipping, handling and placing materials to avoid damaging the chemical grouts, cementitious materials, and other manhole rehabilitation products. Extra care may be necessary during cold weather construction. Any lining product or material damaged in shipment shall be replaced as directed by the Owner/Engineer.

B. Any materials showing deterioration, or which has been exposed to any other adverse storage condition that may have caused damage, even though no such damage can be seen, shall be marked as rejected and removed at once from the work.

C. While stored, the materials shall be adequately packaged and protected. The materials shall be stored in a manner as recommended by the manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS TO STOP ACTIVE LEAKS

A. All active leaks in manholes to be rehabilitated shall be stopped prior to performing the rehabilitation. Elimination of active leaks shall be paid for in related other bid items, no separate payment shall be made.

B. To stop active leaks in the manhole, the Contractor must use one or more of the following materials and procedures to stop the active leaks prior to completing the rehabilitation.

1. Premixed Fast-Setting, Volume-Stable Waterproof Cement Plug - This material shall consist of hydraulic cement, graded silica aggregates, special plasticizing and accelerating agents. It shall not contain chlorides, gypsums, plasters, iron particles, aluminum powder or gas-forming agents, or promote the corrosion of steel it may come in contact with. The cement plug should have the following minimum requirements:

Minimum Requirements		
Compressive Strength	ASTM C109	>1000 psi, 1hr. >2500 psi, 24 hrs.
Sulfate Resistance	ASTM C267	No weight loss after 15 cycles @ 2000 ppm
Freeze/Thaw	ASTM C666 "Method A"	100 cycles
Pull Out Strength	ASTM C234	14,000 lbs.
Set Time		<5.0 minutes

2. Chemical Grout - Repair work shall be in accordance with ASTM F 2414-04, and manufacturers recommended installation methods. Use in accordance with the manufacturer’s recommendations for the specific application. The grout shall be of a formula that is suitable for application in a manhole that is susceptible to frost, if applicable for the regional climate.

a. Drilling and injection method shall use a hydrophilic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the Owner/Engineer.

b. Exterior chemical curtain grouting method shall use a hydrophobic polyurethane chemical grout manufactured by Avanti or equal unless otherwise approved by the Owner/Engineer.

c. Expanded Gasket Procedure shall use Oil Free Oakum with hydrophilic polyurethane chemical grout manufactured by Avanti or equal used for sealing larger cracks and manhole joints, unless otherwise approved by the Owner/Engineer.

3. Obtain approval from Owner/Engineer for materials to stop active leaks before starting the Field Work.

4. Obtain approval from Owner/Engineer for application equipment prior to starting the Field Work.

2.02 PATCHING, FILLING AND REPAIRING CRACKS AND SPALLS IN CONCRETE AND MASONRY MANHOLES

A. A quick-setting cementitious material shall be used as a patching material and is to be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Physical Properties		
Compressive Strength	ASTM C109	>1800 psi, 1 hr. >2600 psi, 24hr. >3000 psi, 28 days
Bond	ASTM C882	>1600 psi, 28 days
Applied Density		105 lbs. pcf ± 5 lbs.
Shrinkage	ASTM C596	0% at 90% R.H.
Placement Time		5 to 10 minutes
Set Time		15 to 30 minutes

The material used to mix product shall be clean and potable. No material (other than water) shall be used with or added to the patching product without prior approval or recommendation from manufacturer.

2.03 COATINGS FOR INVERTS

A. A quick-setting material shall be used to coat the inverts of manholes as indicated on the Drawings. The coating shall be mixed and applied according to manufacturer's recommendations and shall have the following minimum requirements:

Physical Properties		
Compressive Strength	ASTM C109	>1800 psi, 1 hr. >2600 psi, 24hr. >3000 psi, 28 days
Bond	ASTM C882	>1600 psi, 28 days

Physical Properties		
Applied Density		105 lbs. pcf ± 5 lbs.
Shrinkage	ASTM C596	0% at 90% R.H.
Placement Time		5 to 10 minutes
Set Time		15 to 30 minutes

Water used to mix product shall be clean and potable. Potable water need not be tested. No material (other than water) shall be used with or added to the patching product without prior approval or recommendation from manufacturer.

2.04 INTERIOR FLEXIBLE CHIMNEY SEALS

A. Interior flexible chimney seals shall prevent leakage of water into the manhole though the frame joint area and the area above the manhole cone including all extensions to the chimney area. The seal shall remain flexible allowing for repeated vertical or horizontal movements of the frame due to frost lift, ground movement, or the thermal movement of pavement. The final liner material shall be made no less than 170 mils of corrosion resistant flexible urethane resin coating to be applied to the inside wall of the entire chimney area as described above. Thickness may vary depending on the local climate. The product shall have a minimum elongation of 800% and a Durometer hardness of 75. Final liner shall have a minimum tensile and adhesion strengths of 1150 psi and 175 lb. l/in. respectively. The manhole sealant shall conform to the physical requirements of ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension. Sealant shall equal or exceed Sherwin Williams Envirolastic AR 530 or "Flex-Seal" as manufactured by Sealing Systems, Inc., Loretto, MN.

2.05 BRICKWORK AND MASONRY FOR REPAIRING AND REBUILDING INVERTS, BENCHES, WALLS AND CHIMNEYS IN EXISTING MANHOLES

A. Bricks shall be sound, hard, uniformly burned, regular and uniform in shape and size. Underburned or salmon brick shall not be acceptable. Only whole brick shall be used.

B. Bricks for channels and shelves shall conform to ASTM C32, Grade SS except that the mean of five tests for absorption shall not exceed 8 percent and no individual brick exceed 11 percent.

C. Bricks for raising manhole frames to finished grade shall conform to ASTM C62.

D. Mortar shall be composed of 1 part Portland cement, 2 parts sand, and hydrated lime not to exceed 10-lbs to each bag of cement. Portland cement shall be ASTM C150, Type II; hydrated lime shall conform to ASTM C207.

Sand shall be washed, cleaned, screened, well graded with all particles passing a No. 4 sieve and conform to ASTM C33.

2.06 MANHOLE FRAME AND COVERS

A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron smooth, free from scale, lumps, blisters, sand holes and defects of any kind that render them unfit for the service for which they are intended. Manhole frame and cover seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer

inspection. Manhole frames and covers shall be the City of Columbia approved standard as published in the current City Regulations.

2.07 MANHOLE MONOLITHIC LINING SYSTEMS

A. General

1. The monolithic manhole lining system shall be designed and installed to protect concrete, brick, mortar, and other manhole surfaces from corrosion. The products shall be designed to stop infiltration, root intrusion, and further deterioration in the manhole. The interior surfaces to be protected shall include the walls, benches, inverts, pipe junctions and the chimney (corbel). The table below outlines the different monolithic manhole lining systems and the respective product specification paragraph(s) for each lining system. The pH limits listed below are typical and the type of manhole lining used shall be as shown on the drawings or as directed by the Owner/Engineer.

B. Cementitious Manhole Lining System

1. The manhole lining system shall be a monolithic, portland based, microsilica mortar, or calcium aluminate cementitious liner system suitable for use as a trowel- or spray-applied monolithic surfacing in sewer manholes.

2. The minimum thickness the cementitious lining shall be 1-inch thick.

3. The cementitious lining system shall be:

a. Calcium Aluminate Cementitious Liner

AW Cook Cemtec Silatec CAM
Strong MS-2C
Quadex Aluminaliner
Standard Cement Maximum CA
Permacast CR-9,000
Mainstay ML-CA
SewperCoat
PLS 508 PerpetuCrete CA
or approved EQUAL

1) The calcium aluminate cementitious liner product shall be used to form a structural monolithic liner covering all interior substrate surfaces and shall have the following minimum requirements:

Minimum Requirements			
Compressive Strength	ASTM C109	28 days	>9000 psi
Tensile Strength	ASTM C496	28 days	>800 psi
Flexural Strength	ASTM C293	28 days	>1500 psi
Shrinkage @90% R.H.	ASTM C596	28 days	0%
Bond	ASTM C882	28 days	>2000 psi
Density, When Applied	-		134 ± 5lbs/ft3
Freeze/Thaw	ASTM C666	N/A	300 cycles no visible damage

2) The calcium aluminate cementitious liner shall be made with calcium aluminate cement and shall be used according to manufacturer's recommendations in applications where there is mild sulfide conditions (substrate surface of pH 2.0 or higher). The liner product shall be reinforced with alkaline resistant fiberglass rods or other similar fibers not less than 1/2 inch in length. The material should meet or exceed industry standards and shall not have any basic ingredient that exceeds EPA maximum allowable limits for any heavy metals. Water used to mix product shall be clean and free from contaminants. Questionable water shall be tested by a laboratory per ASTM C-94 procedure. Potable water need not be tested.

4. When cured, the monolithic cementitious lining shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

5. The monolithic cementitious lining shall cover the complete interior of the existing sewer manhole including the benches (shelves). The lining shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration.

6. The lining shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20 degrees F to 100 degrees F. Provide test data on shrinkage of the cementitious lining based on ASTM C596.

7. If an internal flexible chimney seal is called for in the Drawings, then the lining shall be installed 1-inch below the bottom of the manhole frame. If no internal flexible chimney seal is called for in the drawings, then the lining shall be installed to 2 to 3 inches above the bottom of the manhole frame. The termination of and surface of the lining shall be suitable for proper installation of the manhole frame-chimney.

8. The cured system shall be continuously bonded to all brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole.

9. Chemical sealants, grouts or patching materials used to seal active manhole leaks, to patch cracks, to fill voids and to otherwise prepare the manhole surface prior to application of the system shall be fully compatible with the system.

10. The system shall provide a minimum service life of 25 years.

C. Epoxy Monolothic Manhole Lining System (EMMLS)

1. The EMMLS shall be a resin-filled system suitable for use as a trowel-, spray- or spin-applied monolithic lining in sewer manholes. The resin shall be 100% epoxy resin. The EMMLS shall conform to ASTM C722. The EMMLS materials shall be suitable for all the specified design conditions.

   a. The EMMLS shall provide a minimum service life of 25 years.

   b. The cured EMMLS shall be continuously bonded to all the brick, mortar, concrete, chemical sealant, grout, pipe and other surfaces inside the sewer manhole. Provide bond strength data on cured EMMLS based on ASTM C882 test method.

c. The cured EMMLS shall provide a minimum total thickness of 0.125 inches (125 mils). The cured lining thickness shall be continuous with proper sealing connections to all unsurfaced areas.

d. Chemical sealants or grouts used to seal active manhole leaks, to patch cracks, to fill voids and to otherwise prepare the manhole surfaces shall be compatible with the EMMLS.

2. When cured, the EMMLS shall form a continuous, tight-fitting, hard, impermeable lining, which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

3. The EMMLS shall bond to the sewer manhole being rehabilitated after being placed and cured. The EMMLS shall cover the complete interior of the existing sewer manhole including the benches (shelves), inverts (channels or troughs) and pipe connections. The EMMLS shall provide a continuous watertight seal or barrier.

4. The EMMLS shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration.

5. Provide water resistance data on EMMLS based on ASTM Standards D870 and D2247 test methods.

6. The EMMLS shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 30 degrees F to 80 degrees F. Provide test data on EMMLS thermal compatibility based on ASTM C884.

7. The EMMLS shall be separated from the manhole frame by a suitable joint. The joint shall be sealed with joint sealing tape.

8. For rehabilitation work, the EMMLS shall be applied over a manufacturer approved Portland based cement or microsilica mortar appied at a minimum of 1-inch thick. For new work, the EMMLS can be appied directly to concrete per the manufacturer's recommendations.

9. The EMMLS shall be as manufactured by Sherwin Williams (Duraplate 5900 or Duraplate 6100 Epoxy), Raven Lining Systems, Warren Environmental, Sauereisen, AP/M PermaForm, WBE Dorcas Inc., Tnemec Company Permashield FR system, PLS 614 PerpetuCoat Epoxy Mastic, or approved EQUAL.

PART 3 EXECUTION

3.01 GENERAL

A. Each manhole to be rehabilitated shall be thoroughly cleaned and then inspected for loose or missing bricks, loose mortar, holes, etc. Also, remove any protrusions or obstructions into the manhole including all manhole steps/rungs. All leaks shall be eliminated prior to preformaing any rehabilitation method.

B. Damage incurred to the manhole or pipe segments due to methods and equipment employed by the Contractor is the responsibility of the Contractor. Damage to public and private property from sewer surcharging that results from material or equipment left in the manhole

or sewer or from any flow blockage is the responsibility of the Contractor. The cost to repair the manhole or pipe segments and expenses incurred by the Owner as a result of the damage shall be the responsibility of the Contractor.

3.02 SURFACE PREPARATION

A. Pre-Rehabilitation Surface Preparation – Any area to be repaired which requires bonding of new cementitious, epoxy, chemical or waterproofing material to existing cement or masonry shall be prepared as follows.

1. Clean the area with high-velocity water cleaning equipment to remove all foreign matter, oil, grease, wax and dirt. This includes removal of bitumastic coatings. Pressure shall not exceed that which may cause any permanent damage to the existing manhole walls or other parts of the structure.

2. If foreign material remains after high-velocity water blasting, clean the manhole surface using an acid wash. The acid wash shall be muriatic acid (hydrochloric acid) at a ratio of 1 part acid (HCl) to 10 parts of water. The mixing, application and removal of the acid solution shall be in strict accordance with the manufacturers' recommendations and safety procedures. The acid solution shall remain on the manhole surface until all signs of foreign material have been removed. Afterward, the acid solution shall be completely washed off with water.

3. Chip or chisel away all loose or defective material from the areas to be repaired. Furnish a firm mechanical key by undercutting whenever possible.

4. Allow interior surfaces of the manhole to dry before proceding with rehabilitation.

5. Any large voids including holes left by the manhole rung removal shall be filled with quick setting patching mix.

6. Remove protruding rubber gaskets between wall joints.

B. Existing manhole rungs/steps shall be removed, ground smooth and patched and not replaced. Step removal shall be included in the individual rehabilitation bid items. No separate payment shall be made.

C. Sewer Line Protection – The Contractor shall place covers over the invert to prevent extraneous material from entering the sewer lines.

D. Drop Connections - The Contractor shall remove any interior drop connections anchored to manhole walls prior to installing the lining system. After installation and proper curing of the liner, the Contractor shall re-install interior drop connections to their original condition prior to removal. If the existing drop connection is already damaged and cannot be reused, Contractor shall replace the interior drop connection with a new one at the direction of the Owner/Engineer. All drop connections, whether new or reinstallation of existing ones shall be paid for under the Internal Drop Connection Bid Item in the Bid Form.

E. Contractor shall conduct a visual inspection of each manhole after it is cleaned. All active, hydrostatic infiltration leaks shall be plugged or sealed with an appropriate cementitious or chemical grout. Remove all loose mortar and rubble of existing chimney (corbel), cone,

walls, benches and inverts. All cracks and other voids must be repaired and filled with suitable non-shrinking cements, sealants or grouts, including all voids between the existing sewer pipes and manhole walls. All patches shall be smooth and even with the manhole wall.

3.03 STOPPING ACTIVE LEAKS IN INVERTS, BENCHES, WALLS, AND CONE

A. Premixed Fast-Setting, Volume-Stable Waterproof Cement Plug – Seal unsealed lifting holes, unsealed step holes, and voids larger than ½ inch in thickness with a waterproof, quick setting mortar. Place waterproof mortar according to manufacturer's instructions.

B. Manhole Sealing by Chemical Grout Application –Chemical grouting shall include the following:

1. Transporting, delivering, and storing the chemical grout shall be according to the manufacturers published directions and requirements.

2. Manhole Preparation – Repair the manhole frame and rings, and complete structural repairs before grouting the manhole. Cut roots and trim roots before grouting the manhole. Remove cracked or deteriorated material from the areas to be grouted.

3. Chemical Grout Formulation – Mix each batch of chemical grout according to the manufacturer's published directions and requirements.

4. Sealing Active Leaks – Use the Expanded Gasket Procedure, drilling and injection procedure and/or chemical curtain grouting to stop active leaks.

a. Expanded Gasket Procedure – The Expanded Gasket Procedure (EGP) shall be performed per ASTM F-2414-04, Sealing Sewer Manholes Using Chemical Grouting and the chemical grout manufacturers recommended installation methods. This is performed by soaking dry Oil Free Oakum with hydrophilic polyurethane chemical grout. The resulting oakum/resin plug shall be forced into the opening until it sets. Perform the EGP to:

1) Control flowing water in larger cracks, joints, or pipe to manhole boots.

2) Seal drop or lateral connections, slip line terminal seals and open joints in RCP manholes.

3) Seal between the corbel and manhole rings.

4) Seal between the manhole rings and manhole frame.

5. Drilling and Injection Procedure – The drilling and injection procedure shall be performed per ASTM F-2414-04 (latest version), Sealing Sewer Manholes Using Chemical Grouting and the chemical grout manufacturers recommended installation methods to seal the manhole with chemical grout. Drill injection holes through the manhole at locations recommended by the manufacturer. Inject the chemical grout through the holes under pressure. Injection pressure shall not cause damage to the manhole structure or surrounding surface features. Inject chemical grout through the lowest holes first. Repeat the procedure until the manhole is externally sealed. Grout travel shall be verified by observation of grout to defects or adjacent injection holes.

Drill additional injection holes as necessary to ensure grout travel. Do not inject grout from the ground surface. After chemical grout injection is complete, clean injection holes with a drill and patch with a waterproof, quick setting mortar for brick and concrete manholes. Perform the drilling and injection procedure to control flowing water in cracks.

6. Curtain Grouting– Shall be performed per ASTM F-2414-04 (latest version), Sealing Sewer Manholes Using Chemical Grouting and the chemical grout manufacturers recommended installation methods. Perform the curtain grouting procedure when there are multiple active leaks and the drilling and injection procedure does not eliminate the active leaks.

3.04 INVERT CHANNEL COATING

A. Where indicated on the Drawings, invert channels shall be coated with a material to prevent infiltration; to build up the invert channel to the invert elevations of the new sewer main or cured-in-placed lined sewer; to fill all voids, cracks, holes, etc.; and to form a smooth flow channel. The entire channel shall be coated. The coating shall be troweled uniformly onto the invert as recommended by the manufacturer. The coating shall extend out onto the bench of the manhole sufficiently to tie into the monolithic liner, if required. The Contractor shall be responsible for creating a smooth transition from all upstream pipes to the downstream pipe with the invert coating.

B. The material used for the invert channel shall be suitable for the intended purpose and shall compatible with the materials used for the manhole lining system or particular type of rehabilitation required. The material for the invert channel shall be installed in accordance with the manufacturers recommended installation instructions and procedures.

C. Coating the invert may be waived when the invert is in excellent condition or has a cured in place pipe liner in the manhole channel (i.e. an intermediate manhole has the CIPP up to the bench) and upon approval by the Owner or Engineer.

3.05 LOCATING, RAISING, RESETTING, AND/OR REPLACING MANHOLE FRAME AND COVER ASSEMBLIES

A. Where noted on the Drawings, the Contractor shall locate and uncover buried manhole frame and covers; remove existing manhole frame and covers; dispose of existing manhole frame and covers, if they are not being reused; and install new or reused manhole frame and covers as directed by the Owner and/or Engineer. The Contractor shall repair any damage to the manhole chimney or corbelling caused by the removal of the existing manhole frame at no additional cost to the Owner.

B. Existing frames and covers to be reused shall be thoroughly cleaned before re-installation.

C. If existing frames and covers are not to be reused, the Contractor shall properly dispose of these materials in accordance with local laws and Owner/Engineer approval.

D. When re-setting existing frames and covers, Contractor shall apply preformed flexible joint sealant Kent Seal No. 2 by Hamilton-Kent or Ram-Nek by K.T. Snyder Company or equal.

E. The Contractor shall install new or reused frames so that the tops of the covers are at the required grade. The Contractor shall utilize bricks or precast concrete grade rings to set the manhole frame and cover to the finished grade. Precast concrete grade rings shall be set in a bed of butyl mastic sealant. Bricks shall be set in a full mortar bed.

3.06 REBUILDING INVERTS, WALLS, BENCHES, AND CONES

A. Mix mortar only in such quantity as may be required for immediate use. Use mortar before initial set has taken place. Mortar shall be used within 1-1/2 hours and shall be constantly worked with hoe or shovel until used. Anti-freeze mixtures shall not be included in the mortar. Install masonry when the outside temperature is above 40 degrees F unless provisions are made to protect the mortar, bricks and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. Owner's/Engineer's decision regarding the adequacy of protection against freezing shall be final.

B. Construct channels, benches, walls, and cones of brick and concrete as shown on the Drawings. Brick lined channels shall correspond in shape with the lower half of the pipe. Set shelf elevation at crown of highest pipe and slope 1-in/ft to drain toward the flow through channel. Construct brick surfaces exposed to sewage flow with nominal 2-in by 8-in face exposed (i.e., bricks on edge).

C. Manage sewerage flow, including bypass pumping as needed, until such time as the new mortar has set up.

3.07 INSTALLATION OF MANHOLE DROP ASSEMBLIES

A. Where the difference in invert elevations for an entering sewer and a discharging sewer intercepting in the same manhole is 2-feet or more, a drop manhole assembly shall be constructed on the entering sewer.

B. Prior to beginning any rehabilitation, all existing drop assemblies and appurtenances shall be removed.

C. Upon completion and curing of rehabilitation, existing drop assemblies shall be reinstalled in the original location. All materials in disrepair shall be replaced. All materials reused shall be approved by the Owner/Engineer prior to installation.

3.08 CEMENTITIOUS MANHOLE MONOLITHIC LINING INSTALLATION

A. When cured, the monolithic lining shall form a continuous, tight-fitting, hard, impermeable surfacing which is suitable for sewer system service and chemically resistant to any chemicals or vapors normally found in domestic sewage.

B. The monolithic lining shall cover the complete interior of the existing sewer manhole including the benches (shelves) and inverts. The lining shall effectively seal the interior surfaces of the sewer manhole and prevent any penetration or leakage of groundwater infiltration.

C. The lining shall be compatible with the thermal condition of the existing sewer manhole surfaces. Surface temperatures will range from 20 degrees F to 100 degrees F. Provide test data on shrinkage of the lining based on ASTM C596.

D. The Contractor shall provide any necessary bypass pumping of sewage flows where and

when the rehabilitation work is being performed.

E. The Contractor shall place covers over invert to prevent extraneous material from entering the sewer lines.

F. The liner mix shall be mixed as specified by the manufacturer for 30 seconds to 1 minute after all materials have been placed in the mixing hopper. Mixing shall be accomplished such that the mix can be sprayed in a continuous manner without interruption until each application is complete.

G. The surface shall be clean and free of all foreign material and shall be damp without noticeable free water droplets or running water, but totally saturated, just prior to application. Materials shall be applied to a minimum uniform thickness, to insure that all cracks, crevices and voids are filled and a relatively smooth surface remains after light troweling. The light troweling is performed to compact the material into voids and to set the bond.

H. If a flexible chimney seal is called for in the Drawings, then the lining shall be installed 1-inch below the bottom of the manhole frame. If no flexible chimney seal is called for in the drawings, then the lining shall be installed to 2 to 3 inches above the bottom of the manhole frame. The termination of and surface of the lining shall be suitable for proper installation of the manhole frame-chimney seal, if specified.

I. The covers placed over the invert shall be removed and the bench sprayed such that a gradual slope is produced from the walls to the invert with the thickness at the edge of the invert being no less than 1/2 inch. The wall/bench intersection shall be rounded to a uniform radius the full circumference of the intersection.

J. Caution shall be taken to minimize exposure of applied product to sunlight and air movement. At no time shall the finished product be exposed to sunlight or air movement for longer than 15 minutes before replacing the manhole cover. In extremely hot and arid climates the manhole shall be shaded while reconstruction is in process. The final application shall have a minimum of four (4) hours cure time before being subjected to active flow. Traffic shall not be allowed over manholes for 24 hours after reconstruction is complete.

K. No application shall be made to frozen surfaces or if freezing is expected to occur inside the manhole within 24 hours after application. If ambient temperatures are in excess of 95 degrees F, precautions shall be taken to keep the mix temperature at time of application below 90 degrees F. Mix water temperature shall not exceed 85 degrees F. Chill with ice if necessary.

L. After all preparation has been completed the Contractor shall remove all loose material and wash walls again. Any bench, invert or service line repairs shall be made at this time using the quick setting patching mix and shall be used per the manufacturer's recommendations.

M. Test all rehabilitated manholes using the vacuum test method, following the manufacturer's recommendations for proper and safe procedures. Vacuum testing of manholes and structures shall be performed after curing of linings. Vacuum testing is required for manholes with pipes of 15 inches in diameter or less. Vacuum test shall be performed in accordance with ASTM C-1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum). Any visible leakage in the manhole or structure, before, during, or after the test shall be repaired regardless of the test results.

3.09 EPOXY MONOLITHIC LINING INSTALLATION

A. The Contractor shall provide any necessary bypass pumping of sewage flows where and when the rehabilitation work is being performed, as specified in Specification 02767, Sanitary Sewer Flow Control.

B. The Contractor shall furnish and place the EMMLS in the manhole. The installation of the EMMLS shall be in complete accordance with the applicable provisions of ASTM C722 and the manufacturers' specifications, and a representative of the manufacturer shall be present during the actual installation.

1. Prior to placing the EMMLS the manufacturer's representatives must approve the surface preparation work and installation conditions including temperatures.

2. All surfaces shall be sufficiently dry and even.

3. All bottom and horizontal surfaces including the benches and channels shall have the EMMLS applied to the required thickness by hand trowelling or spray-on methods.

4. All side vertical surfaces shall have the EMMLS applied to the required thickness by manufacturer’s recommended methodology.

5. Temperature limitations must be handled as appropriate and as approved by the manufacturer.

C. All cutting and/or sealing of EMMLS at manhole pipe, cured-in-place liner, rungs and top connections shall provide watertight seals.

D. Contractor shall submit proposed method for testing for these defects. One of the following tests shall be performed by the Contractor as directed by the Owner or the Owner’s Agent.

1. Vacuum Test: Vacuum testing is required for manholes with pipes of 15 inches in diameter or less. Vacuum test shall be performed in accordance with ASTM C-1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum). Any visible leakage in the manhole or structure, before, during, or after the test shall be repaired regardless of the test results.

2. Holiday Detection Test: A high voltage holiday detection system may be used to determine if any holidays (pinholes, voids, etc.) exist in the lining. Normally the sensitivity control of the holiday tester is set to accommodate the thickness of the applied lining (100-125 volts for each 1 mil thickness). Follow the guidelines of the holiday manufacturer for correct control settings. One such service is the Tinker & Rasor Holiday Tester Model APW.

   Should a holiday be detected, it shall be marked and the lining installation contractor will repair the void according to the correct procedure determined by the system manufacturer.

3. Ultrasonic Testing: Per ASTM D 6132.

3.10 CIPM MONOLITHIC LINING INSTALLATION (NOT USED)

3.11 FIELD TESTING AND ACCEPTANCE

D. The Engineer or Owner may enter the manholes to inspect the benching, invert channels, manhole wall/pipe connections, surface preparation, and other parts of the work. The Contractor shall provide forced air ventilation, gas monitors and detectors, harnesses, lights, etc. for the Engineer or Owner to enter the manhole and perform the inspection in complete accordance with OSHA requirements at no additional cost to the Owner.

E. The manhole wall surfaces shall be sufficiently prepared for the lining system as recommended by the lining manufacturer. The manhole wall surfaces shall be free from significant defects. Any defects, which will affect, in the foreseeable future, or warranty period, the integrity or strength of the manhole, shall be repaired at the Contractor's expense, in a manner mutually agreed upon by the Owner/Engineer and the Contractor.

F. No active infiltration in the manhole shall be observed in the manhole as confirmed by visual inspection of the Owner or Engineer. Any infiltration found shall be repaired by the Contractor immediately at no additional cost.

G. The Contractor is responsible for coordinating inspection times with the Owner/Engineer.

3.12 CLEAN-UP

A. After the installation work and testing have been accepted, restore the project area affected by the operations to a condition at least equal to what existed prior to initiating construction activities.

PART 4 CLOSEOUT

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02765

CURED-IN-PLACE PIPE LINING OF GRAVITY SEWERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Rehabilitation of gravity sanitary and storm sewer pipes using Cured-in-Place Pipe (CIPP).
      a. Installed by inversion or pull-in method
      b. Cured by steam, hot water or ultra-violet (UV) light

1.02 RELATED SECTIONS

A. Measurement and Payment is specified in Section 01025.

B. Manhole Rehabilitation is specified in Section 02763.

C. Sanitary Sewer Flow Control is specified in Section 02767.

D. Pre-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02732.

E. Pipe Bursting Sewer Replacement with HDPE is specified in Section 02777.

F. Post-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02733.

G. Database Template Description PACP is specified in Section 02734.

H. Active Service Lateral Replacement by Pipe Bursting and Open Cut is specified in Section 02761.

I. Sewer Service Lateral CIPP Lining is specified in Section 02762.

J. PVC and DI Point Repairs on Gravity Pipe is specified in Section 02766.

K. GIS Database Update Specification in Section 00312.

L. Sewer Line Cleaning Prior to CCTV and Rehabilitation Work is specified in Section 02650.

1.03 REFERENCES:

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
APS Standard	Water tightness standard for cured-in-place thermo-setting resin pipe, Porosity Test Protocol
ASTM C581	Standard Practice for Determining Chemical Resistance to Thermosetting resin used in glass fiber reinforced structures, intended for liquid service
ASTM D543	Test Method for Resistance of Plastics to Chemical Reagents

Reference	Title
ASTM D578	Standard Specification Glass Fiber Strands
ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D790	Standard Test Method of Tensile Properties of Polymer Matrix Composite Materials
ASTM D792	Standard Test Methods for Density and Specific Gravity of Plastics by Displacement
ASTM D2122	Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
ASTM D2990	Test Method for Tensile, Compressive and Flexural Creep and Creep-Rupture of Plastics
ASTM D3039	Standard Test Method of Tensile Properties of Polymer Matrix Composite Materials
ASTM D3567	Standard Practice for Determining Dimensions of "Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe and Fittings
ASTM D3681	Standard Test Method for Chemical Resistance of "Fiberglass (Glass Fiber Reinforced Thermosetting Resin) Pipe in a Deflected Condition
ASTM D5813	Standard Specification for Cured-in-Place Thermosetting Resin Sewer Pipe
ASTM F1216	Rehabilitation of Existing Pipelines and Conduits by Inversion and Curing of a Resin Impregnated Tube
ASTM F1743	Rehabilitation of Existing Pipelines and Conduits by Pulled in Place Installation of Cured-in-Place Thermosetting Resin Pipe
ASTM F2019	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Resin Pipe (CIPP)
ASTM F2561	Rehabilitation of a Sewer Service Lateral and its Connection to the Main Using a One-Piece Main and Lateral Cured-in-Place Liner

1.04 SUBMITTALS

A. Submittal Procedures: Section 01300.

B. Action Submittals:

1. CIPP Product Data:
    a. CIPP materials, including liner material and construction, resins.
    b. Short and long-term properties for liner design
    c. Safety data sheets (SDS)
    d. Third-party testing laboratory documentation,
    e. Certified testing results, including:
        1) Initial structural properties
        2) Time-corrected (long term) properties for 50-year Flexural Creep Modulus in accordance with ASTM D-2990and specified retention factor.
        3) Chemical resistance testing
2. Design calculations:
    a. Liner thickness by reach.
    b. Signed and sealed by a Registered Engineer in the State of South Carolina.

1) Supported by field data
2) Certified test reports per ASTM F1216.

3. Test report of CIPP sample(s) and tests
4. Installation Plan and Schedule:
    a. Methods, materials, equipment, and procedures to line the host pipe at manholes, terminations, overlaps and lateral connections.
    b. List of insertion locations, shot lengths, and locations where liner terminations and liner overlaps are to be provided.
    c. Locations and construction details for insertion access pits.
    d. Staging plans for wet-out, liner insertion and curing coordinated with Traffic Control plans
    e. Locations and methods for field sampling of cured liners and sample chain of custody documents.
    f. End seal and manhole connection details,
    g. Lateral locating and reinstatement details,
    h. Site specific recommendations for monitoring and controlling environmental conditions.
5. Inversion checklist
    a. Filled out for each inversion
    b. Completed checklist submitted to the ENGINEER at the time of the inversion.
    c. logs from hot water-generating equipment for minimum and maximum pressures during the curing process
    d. temperature verification logs.

C. Information Submittals
1. Manufacturer's Certificates:
    a. Current ISO 9000
    b. Signed Certification that the
        a) CIPP System has been manufactured in accordance with ASTM F1216, ASTM F1743, or ASTM F-2019 as applicable.
        b) Resin/catalyst system is suitable for CIPP applications and the proposed curing methods.
        c) Certified copies of Test Reports for physical and chemical properties of the CIPP System to be provided.
    2) Contractor is licensed to perform CIPP installation.

D. Construction Submittals
1. For each reach:
    a. Record copies of cleaning reports
    b. Record copies of Pre-installation inspection recordings and reports.
2. For each liner installed:
    a. Liner Certification Documentation per ASTM F2019, Paragraph 6.3.1 with delivered liners,

b. Certified Test Reports for initial structural properties, liner thickness and water tightness, and
c. Chain of custody documents for each sample

E. Closeout Submittals:
1. Record copies of Post inspections recordings and reports
2. Warranty information.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications
1. Latest ISO 9000 standards
2. Five years' experience fabricating similar diameter, resin, liner construction
3. Third party testing per applicable ASTM standards for provided resin and liner combination.
4. 250,000 LF of the CIPP System produced by the facility fabricating the liner.

B. Contractor Qualifications
1. The Contractor's personnel shall have successfully installed a minimum of 250,000 feet (total) of the proposed CIPP liner for a continuous period of at least three (3) years installing CIPP liners in pipe of a similar size, length and configuration as contained in this contract as documented by verifiable references.

2. The name and experience of each lead individual performing work on this contract shall be submitted. Personnel replaced by the contractor, on this contract, shall have similar, verifiable experience as the personnel originally submitted for the project.

3. The full-time, on-site superintendent/foreman that will supervise the CIPP lining installation under this Contract shall have successfully installed a minimum of 100,000 feet (total) of the proposed size range of CIPP liner for a period of at least two (2) years as documented by verifiable references.

4. The lead personnel including the superintendent, the foreman and the lead crew personnel for the CCTV inspection, resin wet-out, the CIPP liner installation, liner curing and the robotic service reconnections each shall have a minimum of three (3) years of total experience with the CIPP technology proposed for this contract and shall have demonstrated competency and experience to perform the scope of work contained in this contract as documented by verifiable references.

5. The Owner reserves the right to disapprove the use of the Contractor, Superintendent, and/or manufacturer based on the submitted qualifications

1.06 DELIVERY, STORAGE, AND HANDLING

A. Ship, store, and handle materials in accordance with Manufacturer's recommendations.
1. Account for local environmental conditions when storing materials
2. Implement and document site specific procedures

B. Impregnated liners shall be stored, transported and handled in a manner to maintain an acceptable range of environmental conditions and temperatures per the manufacturer's recommendations.
   1. Where impregnated fabric tubes are transported or stored, tamper resistant, sealed data loggers shall continuously record environmental conditions, exposure temperatures and times.

C. OWNER reserves the right to reject liners:
   1. Without Certification Documentation or liners
   2. That exceed Manufacturer's shelf life.
   3. Discovered to be damaged or improperly stored or transported prior to installation.

D. Where accepted by the OWNER, repair or replace damaged liners in accordance with the Manufacturer's recommendations.
   1. Replace damaged liners that hinder or prevent proper installation or curing, or release detrimental compounds

E. Remove rejected materials from site.
   1. Dispose of in accordance with local, state, or federal regulations

1.07 WARRANTY:

A. The Contractor shall warrant the completed work against defect in workmanship and material for a period of two years. The Engineer, while not acting as quality control agent for the Contractor, shall be allowed to view and document any portion of this contract, including but not limited to verifying type and quantities of resin used at any point during this work.

B. Defects shall be as defined in ASTM F1216, F1743, and F2019.

PART 2 PRODUCTS GENERAL

A. Complete liners shall include compatible materials, composite construction and curing methods to provide a finished CIPP System equal to or exceeding the requirements of ASTM F1216, ASTM F1743, or ASTM F2019 and ASTM D5813.

B. Minimum initial structural properties of the CIPP system provided shall be equal to or greater than the properties submitted by the Contractor, used in design calculations and accepted by the OWNER. Finished liners failing to meet the submitted minimum properties as demonstrated by field testing of the provided liner shall be deemed defective.

2.02 COMPONENT PROPERTIES

A. Fabric Tube:
   1. One or more layers of absorbent, non-woven material capable of carrying resin, withstanding installation pressures and curing temperatures, compatible with the resin system used, and having markings to determine elongated length during liner installation.
   2. Free from tears, holes, cuts, foreign materials, and other surface defects.
   3. Strength to bridge missing pipe segments and stretch to fit irregular pipe sections

4. Designed for use in gravity sewers and in strict conformance with all applicable sections of ASTM F1216, ASTM F1743, or ASTM F2019 and ASTM D5813.
5. Fabricated to a size, when installed, will tightly fit the internal circumference and length of the original pipe. Allowance to be made for circumferential stretching during the installation and shrinkage of resin.
6. Label tube with the location of the manufacturer, name of the project, liner thickness, liner diameter, liner length, and the location to be installed
7. Interior wall surface color after installation shall be a light, reflective color to distinguish fully saturated areas from dry or resin lean areas.
8. Submit certified information from manufacturer on nominal void volume in fabric tube that will be filled with resin

B. Resins:
1. Chemically resistant polyester or vinyl ester resin and catalyst system or epoxy and hardener system
2. Compatible with CIPP system:
    a. Tinted for visibility and indication of adequate liner wet-out.
    b. Appropriate for conditions encountered.
3. Furnish resin to tube ratio, by volume recommended by manufacturer.

C. Liners
1. Continuous from manhole to manhole
2. Pre-liners:
    a. Reinforced plastic tube
    1) Sized to fit existing pipe
3. Slip Sheets
    a. Installed on the bottom half of host pipe for liner insertion

2.03 CURED CIPP LINER PROPERTIES

1. Meet or exceed the initial (short term) structural properties per Table 1, ASTM F1216 or F2019 as applicable, listed below:

Structural Property (Test Method)	ASTM F1216 & F1743	ASTM F2019
Flexural strength (ASTM D790)	4,500 psi	6500 psi
Flexural modulus (ASTM D790)	250,000 psi	725,000 psi
Tensile Strength (ASTM D3039/D638)	3,000 psi	9,000 psi

2. No material properties shall be used in design calculations unless substantiated by test data certified by the manufacturer.

B. Time-Corrected Structural Properties

1. Chemical Resistance Material properties used in design calculations shall be long-term (time-corrected) values per ASTM D790 and shall employ a [50%] Creep Retention Factor.

C. Chemical Resistance
   1. Chemical corrosion resistance shall be demonstrated in accordance with ASTM F1216, D543 or C581 as applicable by certified third-party testing results

2.04 DIMENSIONS

A. Field verify pipe diameters, lengths and ovality prior to ordering liner tubes.
   1. Make allowances in determining the felt tube length and circumference for stretch during installation and shrinkage during curing.
   2. Measure the actual inside diameter at different locations to determine the appropriate size and ovality of CIPP liner.
   3. The minimum length shall be that which continuously spans half the distance from the center of the inlet manhole to the next manhole, plus the liner overlap.
   4. Individual installation runs may include one or more manhole-to-manhole sections as approved by the Engineer.

B. Nominal wall thickness shall be the greater of the calculated design thickness or the minimum specified.

2.05 DESIGN CRITERIA

A. Design thickness in accordance with ASTM F 1216 Appendices and these specifications.
   1. Material properties used in design calculations shall be long-term (time-corrected) values per Article 2.03.
   2. Calculate minimum thickness for each pipe reach based on the following parameters as shown and field verified:
      a. Nominal inside diameter.
      b. Fully deteriorated host pipe, unless otherwise shown or specified.
      c. Safety factor of 2.0.
      d. Groundwater above top of pipe at existing ground surface.
      e. Modulus of Soil Reaction, E'= 1000 psi.
      f. Dead Loads (i.e. soil depths)
      g. Unit weight of soil= 120 pcf.
      h. Minimum Ovality= 2%
      i. Live Loading: Highway, railroad or airport as applicable
      j. Minimum 50-year service life under continuous service
   3. The minimum allowable wall thicknesses shall be as follows
      a. 6.0 mm for Felt CIPP per ASTM F1216, provided to the next standard increment of 1.5 mm or next standard increment recommended by the liner manufacturer.

2.06 INSTALLATION

A. Wet-out

B. Installation Method
   1. Install liner per ASTM F1216, ASTM F1743 or F2019 as applicable.

C. Curing Method
   1. In accordance with manufacturer's recommendations for the CIPP System.

D. Curing and Cool Down Control
   1. A full protocol for time, temperatures and pressures shall be:
      a. Provided In accordance with manufacturer's recommendations for the CIPP System and the installation specific site conditions.
      b. Maintained as documentation for the correct curing of the fabric tube by liner installation.

E. Cure and Cool Down Water Control
   1. In accordance with manufacturer's recommendations for the CIPP system and Local, State and Federal requirements.

PART 3 EXECUTION

3.01 PREPARATORY PROCEDURES

A. Bypassing, Dewatering and Odor Control for Sanitary Sewers:
   1. Meet requirements of Section 02767.

B. TV Inspection and Line Obstructions:
   1. Meet requirements of Section 02732.
   2. Submit inspection report to Engineer.

C. Sewer Cleaning:
   1. In accordance with Section 02650.
   2. Clear obstructions (solids, collapsed pipe) that prevent or hinder CIPP liner installation.

D. Spot Repair:
   1. Repair areas preventing proper installation of the CIPP liner.
   2. Mitigate active infiltration impacting installation and finished properties of the CIPP liner.

3.02 INSTALLATION PROCEDURES

A. General:
   1. Wet-out location:
      a. On-site
         1) Ssubject to review and acceptance by Engineer and applicable local agencies.

2) Allow Engineer to inspect materials and "wet-out" procedure.

b. Off-site

1) Notify Engineer in advance of each wet-out

2) Allow Engineer to inspect materials and wet-out procedure

3) Transport impregnated CIPP to site under controlled environmental conditions per Article 1.06.

2. Coordinate with bypass pumping, traffic control and other activities required to complete the work.
3. Inspect existing pipes prior to lining operations:
   a. Clear debris and obstructions preventing CIPP installation.
   b. Repair severely deteriorated sections with grouted, or bridge to provide smooth continuous surface.
   c. Notify Engineer of shifted, dropped, displaced or collapsed pipe sections.
   d. Control groundwater infiltration to prevent physical property reduction and prevent inadequate curing of the liner
      1) Install reinforced plastic pre-liner tube
      2) Perform chemical grouting
4. Install temperature monitors for heat-cured liners
   a. Place sensors in bottom (invert) of host pipe, between host pipe and liner
      1) At manholes or access points
   b. Continuous monitoring and data collection for critical and large diameter pipes
      1) Discrete temperature readings shall be taken at a maximum of 18-inch intervals and 30 second sampling rate using optical fiber cable or equivalent, along the entire length of any CIPP segment.
      2) Place sensors at points where significant heat sink is anticipated.
      3) Connect fiber optic system to computer and collect temperature readings and log data during cure.
      4) Confirm functionality by demonstrating that sensors are reporting ambient temperatures.
         (a) Provide new array if three or more sensors in sequence are discovered faulty.

B. Installation Process:
1. No installations shall be undertaken in weather conditions that jeopardize the installation or are detrimental to the long-term performance of the CIPP.
2. Install by either inversion or pull-in method:
   a. Inversion Method: Fill resin-impregnated tube with water where the weight of the water will push the tube through the pipe inside out, while pressing the resin impregnated side firmly against the inside walls of the host pipe. The smooth coated side of the liner shall become the new interior surface of the pipe.
   b. Pull-In Method: Pull resin-impregnated tube into place through an existing manhole or other approved access to fully extend to the next designated manhole or termination point. Care should be exercised not to damage the tube as a result of friction during pull-in, especially where curvilinear alignments, multiple offsets, protruding services, and other friction producing host pipe

conditions are present. Once the fabric tube is in place, it should be attached to a vertical standpipe of sufficient height of water head to hold the fabric tight to the existing wall, producing dimples at side connections. A device such as a dynamometer or load cell should be provided on the winch or cable to monitor the pulling force. Measure the overall elongation of the fabric tube after pull-in completion. The acceptable longitudinal elongation shall not be more than [3%] of the overall length or exceed the recommended pulling force.

3. Use of Pre-liner
    a. When significant groundwater is encountered that prevents adequate curing
    b. Presence of lining on existing pipe that may contaminate resin or negatively affect physical properties

C. Curing:
1. In accordance with manufacturer's recommendations
2. Heat-cured liners
    a. Follow step cure or similar approach recommended
    b. Hold at top step for an adequate length of time as determined by the liner manufacturer to ensure design physical properties are attained.
    c. Rate of temperature rise and fall during heating and cooling shall not exceed 2 degrees F per minute.
    d. Process shall not be terminated until the temperature readings indicate satisfactory cure has been achieved.
    e. Extended cure times shall not adversely affect the properties of the CIPP.
    f. Evacuate water at a controlled rate to prevent negative pressure
    g. Released circulation water and/or air after cool down to at least 100 degrees F for 1 hour
    h. Remove styrene and other substances before discharging to sewer system
3. UV-cured liners
    a. Follow curing protocol
    b. Cure at constant inner pressure
    c. Follow manufacturer's recommendations for curing speed
    d. Record light train sensor readings
    e. Remove inner film, if provided

3.03 FINISHED PRODUCT

A. Shall be continuous over the entire length of an installation run.

B. Shall be impervious and free of any leakage through the CIPP wall.

C. Free of defects such as foreign inclusions, dry spots, pinholes, delamination, seam separation and wrinkling

D. Repair defects affecting integrity, strength or hydraulic capacity

E. Seal ends to existing host pipe to form water-tight seal using compatible materials

3.04 MANHOLE TERMINATIONS

A. Cut liner to extend two inches into manhole

B. Install hydrophilic seal

C. Smooth transition between existing channel invert and liner to prevent collection of debris

3.05 SERVICE CONNECTIONS:

A. Re-establish active service connections after curing and cool down.

B. Smooth jagged edges by sanding.

C. Seal leaking connections as recommended by the lining manufacturer

D. Install CIPP type repair for over-cut service connections.

3.06 CIPP SAMPLES AND TESTING

A. Sampling Frequency:
   1. For each separate CIPP liner installation. As an example – one sample from each pipeline reach where cured CIPP liner is installed.

B. Prepare sample, in accordance with the applicable ASTM procedures for the installed CIPP liner for subsequent testing of physical properties.

C. The ENGINEER reserves the right to take five (5) random core samples of the installed CIPP liner at no additional cost, in accordance with the procedures in ASTM D5813.
   1. Repair as recommended by the manufacturer.

D. Identify samples by: Date, Project Name, Size, Thickness, Location, Resin and Catalyst.

E. Test samples by an independent testing laboratory and approved by the ENGINEER.
   1. double bagged and sealed.

F. Submit liner test results in accordance with ASTM D2990.

G. Provide a delivery manifest for each liner with the following information:
   1. Inversion location.
   2. Manhole numbers for either end of the inversion.
   3. Inversion number, if assigned.
   4. Liner diameter, length and thickness.

H. Prepare Chain of Custody form for the CIPP sample(s).
   1. Submit to ENGINEER for approval,
   2. Include the inversion location
   3. Date and time sample was removed and bagged.
   4. Submit signed and verified Chain of Custody form to ENGINEER for verification

5. ENGINEER will sign the Chain of Custody form so attesting.
6. Provide copy of the delivery manifest and Chain of Custody form to ENGINEER after all signatures are affixed and the sample is ready for shipment.

I. Failure to meet the specified physical properties or minimum thickness will result in the CIPP being considered defective work.

3.07 INSPECTION AND ACCEPTANCE:

A. Inspection
1. Inspect CIPP after installation using closed circuit television in accordance with Section 02733.

B. Repair of Defects
1. Repair defects inaccordance with manufacturer's recommendations as accepted by the Owner.

C. Remove or repair wrinkles exceeding five percent (5%) of pipe diameter
1. Repair or replace voids between wrinkle and pipe
a. Submit repair methods to ENGINEER.
2. Remove or repair separated liner seams
a. Submit methods of repair to Engineer.

D. Acceptance
1. All Test Reports provided, demonstrating compliance.
2. All CCTV inspections, pre-, post, repair provided.

3.08 CLEANUP

A. Dispose of all excess material and debris not incorporated into the permanent installation.

B. Restore improvements, landscaping, surfaces damaged or impacted by performance of the Work.

3.09 WARRANTY INSPECTION

A. Provide warranty CCTV inspection 18 months after completion of the work.

B. Correct all defects discovered during the warranty period

END OF SECTION

SECTION 02767
SANITARY SEWER FLOW CONTROL

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. This Section includes all materials, labor, and equipment required to provide bypass flow control for new sanitary sewer line construction, upgrades or rehabilitation. This section also includes all materials, labor, and equipment required to provide bypass flow control for conducting proper PACP CCTV inspection of sewers.

B. The Contractor shall be responsible for maintaining wastewater flow in all public and private pipes during construction. All bypass pumping systems shall be manned by the Contractor during non-working hours, seven (7) days per week as necessary. During the installation and/or rehabilitation of sections of the sewer system, it is required that the Contractor maintain sewage flows in the system and from all abutting properties at all times. No sanitary service shall be interrupted by the Contractor except as absolutely necessary and then for only very short periods of time of no more than thirty (30) minutes and then only when coordinated with the affected property Owner. During main line cured-in-place pipe lining operations, interruption at the street tie-in will be allowed for up to twenty-four (24) hours, when coordinated, by the Contractor, with the affected property Owner.

C. The Contractor is required to furnish all power, maintenance, etc. to implement the bypass flow control system necessary to divert the existing flow around the work area for the work's duration. The design, installation, and operation for the temporary bypass pumping system shall be solely the Contractor's responsibility. Bypass pumping is required to adequately control the flow as listed in Paragraph 3.01.

D. The Contractor shall exhasust all attempts with other methods of flow control (i.e. work in low flow times, plugs, dams, blocking, etc.) prior to recommending bypass pumping. If bypass pumping is determined to be needed, concurrence from the Owner is required before proceeding.

D. If access to private property is required to perform the work, the contractor must obtain access prior to starting any work. Clearing and other costs related to gaining access (including restoration) should be included in contractor's pricing. Contractor to assume responsibility for relocating sheds if such relocation is required to perform work. The final location of the shed will be determined on a case by case basis.

E. If fence removal is required, fences shall be replaced in kind and a gate should be placed along any easements to allow future access by Owner forces and equipment. Each of these will be determined on a case by case basis directly with the Property Owner and Owner.

F. Contractor shall include site restoration including irrigation line repairs, driveway restoration, shrubbery replacement, etc. when choosing a route for bypass equipment.

G. Contractor is solely responsible for any damages resulting from his/her opertations.

ENGINEER TO EDIT THE FOLLOWING AS NECESSARY

1.02 RELATED WORK

A. Measurement and Payment is specified in Section 01025.

B. Cured-in-place Pipe Lining is specified in Section 02765.

C. Manhole Rehabilitation is specified in Section 02763.

D. Pre-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02732.

E. Pipe Bursting Sewer Replacement with HDPE is specified in Section 02777.

F. Post-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02733.

G. Active Service Lateral Replacement is specified in Section 02761.

H. Sewer Service Lateral CIPP Lining is specified in Section 02762.

I. PVC and DI Point Repairs on Gravity Pipe is specified in Section 02766.

J. GIS Database Update Specification in Section 00312.

K. Sewer Line Cleaning Prior to CCTV and Rehabilitation Work is specified in Section 02650.

1.03 SUBMITTALS:

A. Submit the following to Engineer prior to commencing work for review and approval.

1. Bypass Sewage Pumping Plan. Plan shall contain, at minimum, the following:

a. Staging areas for pumps.

b. Sewer plugging method and types of plugs.

c. Number, size, material, location and method of installation of suction piping.

d. Number, size, material, method of installation and location of installation of discharge piping.

e. Calculations of bypass pump sizes, capacity, number of each size to be on site and power requirements. Pump sizing shall clearly indicate compliance with requirements of this Specification.

f. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted).

g. Standby power generator size and location and spill prevention and control measures.

h. Downstream discharge plan along with method of protecting discharge manholes or structures from erosion and damage.

i. Thrust and restraint block sizes and locations.

j. Sections and plans showing suction and discharge pipe location, depth, embedment, select fill and special backfill.

k. Method of noise control for each pump and/or generator.

l. Any temporary pipe supports and anchoring required.

m. Schedule for installation of and maintenance of bypass pumping lines.

n. Plan indicating monitoring locations.

o. All items related to testing, inspection, maintenance, and monitoring as described in these section.

p. All other incidental items necessary and/or required to ensure facilities are properly protected including protecting the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in the Contract Documents.

q. For sewer rehabilitation by lining methods, generic plans may be developed for typical situations and various sizes to be implemented.

PART 2 - PRODUCTS

2.01 BYPASS EQUIPMENT

A. All equipment utilized for bypass pumping shall be specifically designed for intended purpose. All piping, pumps, etc. in contact with sanitary sewage shall be manufactured with materials designed for use in a sewage environment.

B. All pumps used shall be fully automatic self-priming units which do not require foot valves or vacuum pumps in the priming system.

C. The pumps shall be electric, hydraulic, or diesel powered.

D. All pumps used shall be constructed to allow dry running for long time periods to accommodate cyclical flows.

E. Above ground pumps and/or power units shall be located inside a temporary portable berm to contain any fuel or sewage that may spill during the normal course of operation.

F. Hard discharge piping shall be butt-welded HDPE with a minimum pressure rating of 2.5 times the total dynamic pump head.

G. Under no circumstances will irrigation type piping or glued PVC pipe be allowed.

H. Discharge hose may be allowed on rehabilitation projects for short-term setups (less than or equal to 48 hours) on short sections with approval from the Engineer. Hoses shall have no leaks, and all couplings shall be quick connecting with gaskets.

I. The multiple pump header system shall have check valves to facilitate pump removal, service, and/or replacement while the system remains operational.

J. All above ground pumps and/or power units shall be equipped with sound attenuation measures to reduce noise levels to 75-decibels maximum at a 50-foot distance from the equipment during all operation periods or meet other noise requirements governing the location of construction. The most stringent noise requirements must be met at all time. If equipment is operated between 8:00 PM and 6:00 AM, this equipment shall also be provided with a sound attenuation 3-sided enclosure including a roof constructed of 2 x 4 lumber frame with 1/2-inch plywood sheathing and 2-inch extruded polystyrene foam panels attached to the inside of the entire enclosure. The enclosure shall be portable to allow the enclosure to be moved when bypass pumping equipment is moved.

K. Include 100% mechanical redundancy installed online with a float or ultrasonic type system to switch to the standby system automatically if the primary system fails.

L. The discharge location (the point where the bypass main reenters the gravity sewer system) shall be to existing manholes and constructed with adequate sealant materials to minimize sewer gas and odor release to the maximum extent possible.

PART 3 - EXECUTION

3.01 FLOW REQUIREMENTS

A. **Provide bypass sewage pumping, as required, around the area of work is being performed. Bypass pumping shall be the full responsibility of the Contractor**.

B. For television inspection, bypass pumping should be utilized if the depth of wastewater flow within the sewer mains to be inspected exceed the following:

6” – 10” pipe:	20% of pipe’s diameter
12” – 24” pipe:	25% of pipe’s diameter
24” pipe:	30% of pipe’s diameter

If Contractor has exhausted all other means for flow control (plugs, nighttime work, etc.), the depth of wastewater flow within the sewer mains to be inspected may be allowed up to 50% of pipe diameter with approval from the Engineer.

C. For complete bypass required for new construction and pipe rehabilitation, the bypass system shall be a sufficient capacity to handle full pipe capacity for the pipeline section being bypassed times 1.25 and shall provide and maintain sufficient flow at all times to prevent any backwater flooding due to obstructions caused by the construction. Prior to starting work, the Contractor shall submit required information as described in this specification to the Engineer for review and approval. No work shall commence until the Engineer provides approval.

3.02 GENERAL REQUIREMENTS

A. If at any time the Contractor is unable to properly bypass pump the sewage, construction will be stopped until the Contractor is able to continue work in an acceptable manner. The Contractor will not receive additional contract time for delays caused by improper equipment, labor, or breakdowns.

B. Discharge of sewage to the ground, creeks, and/or storm sewers shall be prohibited. Any violation shall be corrected immediately. If the Owner is required to alleviate any prohibited discharges, the Contractor shall be charged two times the Owner's cost of labor, equipment and materials. All costs shall be deducted from the Contract Amount.

C. Service shall be maintained at all times. Surcharges due to plugging the sewer line for bypass pumping shall be maintained to prevent backups in services and overflows at any point in the system. Contractor is fully responsible for any backups or overflows caused by bypass pumping operations or any associated work.

D. The Contractor shall be capable of pumping all the sewage in the existing line under all weather and seasonal conditions. All pumping equipment to be used shall be submitted to the Owner for review and approval.

E. Bypass pumping systems are required to be operated and continuously 24-hours per day.

F. All suction and discharge piping shall be free of leaks and designed to carry the required pumped sewage. Any leaks shall be repaired immediately. If the piping used is inadequate in size, amount of hose on site, or condition, the Contractor shall be required to replace the hose as directed by the Owner's Representative.

G. The use of a partial plug may be considered if approved by the Engineer.

3.03 PERFORMANCE REQUIREMENTS

A. It is essential that the system operate uniterupted throughout the project’s duration. Provide, maintain, and operate all bypass facilities such as dams, plugs, pumping equipment (primary and backup units as required), conduits, all necessary power equipment, and all other labor and equipment necessary to intercept the incoming flow before it reaches the point where it would interfere with the work, carry it past the work area, and return it to the existing system downstream of the work.

B. The temporary pumping system’s design, installation, and operation shall be the Contractor’s responsibility. The bypass system shall meet all codes and requirements for regulatory agencies having jurisdiction.

C. Provide all necessary means to safely convey the sewage past the work area. The Contractor will not be permitted to stop or impede the sewer main flows under any circumstances.

D. No flow diversion around the work area shall be performed in a manner that will cause damage to or surcharging of Owner system. The diversion shall protect public and private property from damage and flooding.

3.04 FIELD QUALITY CONTROL AND MAINTENANCE

A. Testing: Prior to actual operation, test the complete bypass pumping system for leaks and pressure using clean water. Bypass piping shall be hydrostatically tested following each setup and prior to flow diversion to a minimum pressure 2.5 times the pump(s) total dynamic head. The Engineer shall be given a 24-hour notice prior to testing.

B. Inspection: Inspect the bypass pumping system on a continuous basis to ensure the system is working properly. A daily checklist for the entire system shall be required. The checklist shall contain all bypass pumping system components, and shall be specifically developed to address all aspects for the individual project. The daily checklist shall be submitted to the Engineer. The completed daily checklists shall be maintained, available for review, and on-site for the project's duration.

C. Maintenance Service: Ensure the temporary bypass pumping system is properly maintained, and a responsible operator shall be readily available at all times when pumps are operating.

D. Monitoring:

1. During bypass pumping, continuously monitor all bypass pumping system components.

2. A telemetry system or designated personnel to maintain 24-hour onsite monitoring shall be required to alert the Contractor to system malfunctions or high liquid levels in manholes.

E. Additional Materials:

1. Spare parts for pumps and piping shall be kept on site as required.

2. Adequate hoisting equipment for each pump and accessories shall be maintained on site.

3. Keep an HDPE fusion machine on site for the duration of bypass pumping to facilitate immediate repairs to hard piping.

F. Preparations and Precautions:

1. Locate any existing utilities in the area selected for the bypass pipelines. Locate the bypass pipelines to minimize any disturbance to existing utilities, and obtain approval for the pipeline locations. Pay all costs associated with relocating utilities and obtaining all approvals.

2. During all bypass pumping operations, protect the Owner system (pumping station, conveyance system, etc.) as applicable from damage inflicted by any equipment. The Contractor is responsible for all physical damage to the system caused by human or mechanical failure.

G. Installation and Removal:

1. When plugging or blocking is no longer needed for work performance, it is to be removed in a manner that permits the sewage flow to slowly return to normal without surge flows to prevent surcharging or causing other major disturbances downstream.

3. When working inside manholes, sewers, or force mains, exercise caution and comply with all applicable OSHA requirements.

4. Bypass pipeline installation is prohibited in all wetland areas. The pipeline shall be located, if possible, off streets and sidewalks and on road shoulders. If in easements, the bypass pipeline shall be within the easement area acquired for the project.

5. When the bypass pipeline crosses local streets and private driveways, place the bypass pipelines in trenches and cover with temporary pavement. Obtain any property owner approvals before placing the temporary pipeline.

3.05 CLEAN-UP

A. Upon acceptance of the work, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

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SECTION 02777

PIPE BURSTING SEWER REPLACEMENT WITH HDPE

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment, and incidentals required to install and test new high density polyethylene (HDPE) sewer pipe and appurtenances using pipe bursting as shown on the Drawings and as specified herein, but not limited to services necessary for traffic control, bypass pumping and/or diversion of sewage flows, cleaning and television inspection of lines to be pipe burst, connecting the new pipe to existing manholes, modifying existing manhole bases as needed, reinstatement of service connections, quality control, final television inspection, testing of the pipe burst lines, and warranty work, all as specified herein.

B. Main line pipe bursting, manholes modified to accept pipe bursting, and manholes repaired due to damage incurred from the pipe bursting operations shall be paid for under the respective pipe bursting bid item in the Schedule of Values. Reconnecting service laterals shall be paid for under the "Reconnect Active Sewer Laterals on Lines Rehabilitated by Pipe Bursting" Bid Item in the Schedule of Values.

C. Sewer cleaning, pre-rehabilitation and post-rehabilitation CCTV inspection of all pipes to be rehabilitated by pipe bursting methods are required and shall be in accordance per Specifications 02650, 02732 and 02733, respectively. Hydraulic light cleaning and pre- and post CCTV inspection shall be paid for under the appropriate pipe bursting bid item in the Schedule of Values.

D. Equipment used on this Contract, where covered by patents or license agreements, is furnished in accordance with such agreements, and the prices included herein cover all applicable royalties and fees in accordance with such license agreements. Defend, indemnify, and hold Owner and the Engineer harmless from and against any and all costs, loss, damage, or expense arising from or in any way connected with any claim of infringement of patent, trademark, or violation of license agreement.

E. If access to private property is required to perform the work the contractor must determine access prior to starting. Clearing and other costs related to gaining access (including restoration) should be included in contractor's pricing.

F. Any access to private property must be approved by the homeowner prior to starting work.

G. Contractor to assume responsibility for relocating sheds if such relocation is required to perform work. The final location of the shed will be determined on a case by case basis.

H. Fences to be replaced in kind and a gate should be placed along the easement to allow future access by Owner forces and equipment. Each of these will be determined on a case by case basis directly with the Property Owner and Contractor.

I. Contractor shall include site restoration including irrigation line repairs, driveway restoration, shrubbery replacement, etc. when choosing a route of access/repair.

J. Contractor is allowed up to 2 weeks from the time of the installation of a temporary asphalt patch to the completion of a permanent repair unless approved otherwise by the Owner.

1.02 DEFINITIONS

A. Pipe Bursting is a method for replacing existing buried piping by installing a replacement pipe material into an existing host conduit. The actual pipe bursting shall be accomplished by inserting a tool/head with a greater outside diameter than the maximum inside diameter of the existing host conduit, and which, when advanced pneumatically or mechanically, fragments the existing host conduit and pushes the fragments into the surrounding soil.

B. Host Conduit is defined as the existing sewer pipeline to be replaced by bursting.

C. Replacement Pipe is defined as the new inserted diameter SDR 17 ASTM F 714-05, IPS system, HDPE pipe to be installed behind the pipe bursting tool/head to replace the host conduit.

1.03 REFERENCES

A. Where materials and methods are indicated in these specifications as being in conformance with a standard specification, it shall refer to the latest edition of the specifications and shall include all interim revisions. Listing a standard specification without further reference indicates the particular material or method shall conform to such listed specification.

B. ASTM D 1238-99 Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

C. ASTM D 1505-98- Standard Test Method for Density of Plastics by the Density-Gradient Technique

D. ASTM D 790-00 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

E. ASTM D 638-99 - Standard Test Method for Tensile Properties of Plastics

F. ASTM D 1693-00 - Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

G. ASTM D 618-99 - Standard Practice for Conditioning Plastics for Testing

H. ASTM D 575 - Standard Test Methods for Rubber Properties in Compression

1.04 RELATED WORK

A. Measurement and Payment is specified in Section 01025.

B. High Density Polyethylene Pipe is specified in Section 02625.

C. Cured-in-place Pipe Lining is specified in Section 02765.

D. Manhole Rehabilitation is specified in Section 02763.

E. Sanitary Sewer Flow Control is specified in Section 02767.

F. Pre-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02732.

G. Post-Rehabilitation Sanitary Sewer CCTV Inspection is specified in Section 02733.

H. Database Template Description PACP is specified in Section 02734.

I. Active Service Lateral Replacement by Pipe Bursting and Open Cut is specified in Section 02761.

J. Sewer Service Lateral CIPP Lining is specified in Section 02762.

K. PVC and DI Point Repairs on Gravity Pipe is specified in Section 02766.

L. GIS Database Update Specification in Section 00312.

M. Sewer Line Cleaning Prior to CCTV and Rehabilitation Work is specified in Section 02650.

1.05 SUBMITTALS

A. Submit to the Owner/Engineer shop drawings in accordance with the contract documents shop drawings, product data, materials of construction, design calculations, and details of installation. The Contractor shall provide this information without delay or claim to any confidentiality. Submittals shall include but are not limited to the following:

1. Submit a Traffic Control Plan to the Owner's Representative (Engineer), which includes the following items.

2. Pre-rehabilitation and post-rehabilitation closed-circuit television (CCTV) inspection data as further defined herein.

3. Provide results from all testing requirements specified herein to Engineer and Owner.

4. Contractor to complete an Owner monthly work-summary sheet by Asset ID, electronically in Excel format, documenting what was completed that month for each asset. This shall be submitted on a monthly basis along with the pay application. A copy of the template will be provided upon request.

1.06 QUALIFICATIONS

A. The Contractor to perform the pipe bursting work shall be fully qualified, experienced and equipped to complete this work in a timely and satisfactory manner. The Contractor shall submit documentation for the following information to the Engineer for review and approval before any work is performed.

1. The pipe bursting contractor shall provide proof of training by the Pipe Bursting System Manufacturer.

2. The pipe bursting contractor shall have at least 2 years continuous experience in pipe bursting, and shall have completed at least 3 projects in the last 5 years involving pipe bursting installations for a combined 10,000 feet or more total for 8- to 24-inch diameter (outside diameter of replaced pipe) pipes.

3. Pipe bursting operations shall be performed under the constant full-time direction of a single pipe bursting supervisor, who shall have pipe burst or supervised pipe bursting for a minimum of 5,000 linear feet of 8-inch through 24-inch diameter gravity flow pipe.

4. The pipe bursting manufacturer shall to be on site during the commencement and 25 percent duration for the pipe bursting operations and during commencement for reconnecting 10 percent of the laterals.

5. Be able to provide equipment and crews as needed to complete the work without delay. The pipe bursting contractor crews shall perform all work associated with the pipe bursting operations.

6. HDPE pipe jointing shall be performed by personnel trained in using butt-fusion equipment and the required joint procedures for butt-fusion joining the product pipe being used. Qualification for the product pipe size(s) and type(s) shall be submitted and shall be current at the time of the project and when performing pipe joining. Personnel directly involved with installing the new pipe shall receive training in the proper methods for handling and installing the product pipe. Such training shall be conducted by a qualified fusion equipment manufacturer or pipe supplier representative.

7. The pipe bursting system manufacturer shall have previously demonstrated its ability to successfully install 1 million feet of pipe minimum via pipe bursting. Pipe bursting system manufacturers shall be TT Technologies, Inc., Aurora, Illinois; TRS Trenchless Replacement Service, LTD, Calgary, Alberta, Canada; Miller Pipeline Corp., Indianapolis, Indiana or approved equal.

8. The name and experience of each lead individual performing work on this contract shall be submitted. Personnel replaced by the contractor, on this contract, shall have similar, verifiable experience as the personnel originally submitted for the project.

9. The Owner reserves the right to disapprove the use of the Contractor, Superintendent, and/or manufacturer based on the submitted qualifications.

10. Equipment manufacturer and supplier name for this work and previous work listed below. The pipe bursting contractor shall be experienced with the manufacturer's equipment and systems, and shall be trained by the pipe bursting manufacturer. Training verification shall be submitted.

11. The name for the pipe bursting supervisor who will provide constant full-time direction over all pipe bursting operations. Include years of pipe bursting experience, total footage of pipe bursting experience on 8-inch diameter or larger pipe, and full information for reference projects.

12. A list with all municipal clients for whom the pipe bursting contractor has performed this type of work in the last 2 years. The list shall contain:

    a. Names, email addresses, and telephone numbers for reference project oversight persons.

    b. A full description of actual work performed including the project location, construction year, diameter for the pipe replaced and the pipe installed by pipe bursting, the total linear footage and diameters of pipe installed by pipe bursting, and the pipe's type/use (i.e., gravity sewer, force main, etc.).

c. The pipe bursting system (equipment) manufacturer's name for the work performed.

d. The name of the pipe bursting supervisor who provided direction over the work.

1.07 NOTIFICATIONS

A. Notify the Owner and Engineer:

1. On a weekly basis of scheduled work for the upcoming week, including a map showing the area of work, and a list of streets being affected. Submittal shall be provided by electronic mail in PDF format. Provide 24-hour notice for deviations from the plan that are not caused by weather or natural causes.

2. Immediately, when a collapsed pipe or other pipe failure is identified.

3. Immediately, if the conditions for the work described are found to be unsafe or impractical.

4. Immediately, if a manhole is buried, cannot be found or cannot be accessed. Along with the manhole identification number, provide a map (in PDF format) showing the location of the manhole and what procedures were used to attempt to locate the manhole.

5. Immediately of any defects posing imminent danger to the public (missing lids, covers broken during inspection, sink holes, etc.) and any observed pipe blockages, surcharging, or potential overflow conditions.

6. If the pipe configuration in the field is different than shown, or if a new asset found, the notification shall include a diagram clearly indicating the location of structures in relation to immediately adjacent structures in PDF format via electronic mail. Contractor shall also provide updated information per Section 00312 GIS Database Update Specification.

7. If any obstructions are found within the easement, even if not impacting work.

B. Notify the public and coordinate with homeowners:

1. Contractor shall prepare and install yard signs to notify customers in the area of work being conducted and who to contact for information. The city-approved Columbia Water yard sign file will be provided by City. This file is the standard sign layout to be filled in with project specific information. (Sign specs: digital print full color two-sided coroplast 4mm 18"x24" & metal step stakes 30"x10").

a. Traffic Refer to section 01500 page 8 for information regarding project signage.

b. Signs shall be placed in key intersections and at the project site, incoming/outgoing roads to the area/neighborhood, and intersections near the site at start of project.

c. Signs shall be placed in yards a minimum of 7 days prior to work but no more than 14 days ahead of scheduled work.

d. Signs shall be displayed throughout scheduled work and will be replaced if removed or damaged.

e. Signs shall be removed at the conclusion of the project.

2. A minimum of 72 hours prior to the inspection or work on any manhole, cleanout, service lateral, or line segment, distribute door-to-door an Owner approved Homeowner Notification door hanger describing the work to be performed, if work is performed or accessed through private property or easement adjacent to property, or if the property is potentially tied to the section of line being inspected or worked on. On the day of work and prior to beginning the work, knock on the doors of all properties that will require entering their private property to access the manholes, cleanouts, or pipes which will potentially be impacted by the work and notify occupants of the work to be performed.

3. Contractor shall use approved magnetic car signs affixed to vehicles at all times during the project to identify affiliation with the City of Columbia, SC.

4. Contractor responsible for determining route of access for the proposed work, unless specified otherwise, and is responsible for coordinating with the Property Owner to obtain any temporary access to perform the work. Clearing and other costs related to gaining access (including restoration) should be included in Contractor's pricing.

5. Contractor to notify Property Owner of any that all trees or other obstructions within easements that need to be moved to access or perform the work. The Property Owner shall be given a minimum of 7 days to relocate the obstruction off of the easement at their own cost to their own chosen location. After this time period, the Contractor shall be responsible for removing and disposing of the obstruction, and all costs associated with this. Contractor to coordinate with the Engineer on each obstruction found before proceeding.

1.08 GUARANTEE

A. All pipe bursting work shall be guaranteed by the Contractor and manufacturer for a 1-year period from the acceptance date. During this period, any and all serious defects discovered in the pipe bursting work, as determined by the Owner and which may materially affect the integrity, strength, function and/or operation of the pipe, shall be removed and replaced as recommended by the manufacturer in a satisfactory manner by the Contractor at no cost to the Owner. During this period, all serious defects discovered by the Owner are unacceptable. Contractor will be responsible to remove and repair, at Contractor's expense, all such defects in a manner that is satisfactory to the Owner/Engineer shall be removed and replaced in a satisfactory manner at no cost to Owner.

1.09 QUALITY ASSURANCE

A. Quality assurance is the workers' sole responsibility during the project's duration. Be responsible for any costs associated with corrective measures required to replace or repair items not meeting the quality standards.

B. No pipe bursting restoration shall be accepted that has created a sag in the restored line (not previously inherent to the existing line). Correct any sags in the line created by this operation at no additional cost to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reference Section 02625 for High Density Polyethylene Pipe.

B. Use round pipe with a smooth, even outer surface, which has joints that allow for easy connections between pipes. Pipe ends shall be designed so the bursting loads are evenly distributed around the entire pipe joint, and so point loads will not occur when the pipe is installed. Pipe used for pipe bursting shall be able to withstand all forces that will be imposed by the installation process and the final in-place loading conditions.

C. The pipe bursting equipment may include a bentonite or polymer slurry lubrication system in accordance with the pipe bursting equipment manufacturer's recommendations to reduce friction developed on the replacement pipe surface during insertion.

D. Electrofusion couplings shall be manufactured by Central, Friale by Friatec or approved equal.

2.02 EQUIPMENT

A. The pipe bursting contractor shall confirm proper pipe bursting equipment selection which, based on past experience, has proven to be satisfactory for pipe bursting the existing diameter(s) and material(s) of existing pipe(s) with a new HDPE pipe, while maintaining accurate line and grade control. Equipment shall generally include a full-bodied tool with rear expander, and constant tension winch or other method to monitor correct cable tension.

B. Sound emissions from the pipe bursting replacement process shall be limited to 80 decibels (dB) at 100 feet from the exhaust point of the pipe to be installed during the installation process. The Contractor shall measure noise and shall provide silencers or other devices to reduce equipment and work noise to meet these requirements or those that govern the location of construction, whichever is most stringent.

PART 3 - EXECUTION

3.01 MAINTAINING FLOW

A. Provide for sewage flow diversion and/or bypass pumping during pipe bursting operations as specified in Section 02767.

B. Be solely responsible for cleanup, repair, property damage costs, and claims resulting from a diversion and/or bypass pumping system failure.

3.02 PREPARATION FOR PIPE BURSTING OPERATIONS

A. Notifying Residents

1. The Contractor shall notify all property owners or businesses that discharge sewage directly to the sewer being pipe burst and whose service lateral will be affected by the work, that their service will be temporarily discontinued during installation. The Contractor shall notify individual property owners at least 48 hours in advance, giving the date, start time and estimated completion time for the work being conducted, and any restrictions on use of the sewage system facilities including exact days and hours when the sewer system cannot be used. This notification shall be coordinated with the distribution of door hangers and the Notifications section of the Specifications.

B. Service Connections and Other Existing Utilities

1. The Contractor shall conduct a pre-rehabilitation CCTV inspection for all sewers to be replaced by pipe bursting methods in accordance with Section 02732. The inspection shall be to identify pipe defects, to document all service lateral connection locations, and to confirm additional needed point repair locations other than those indicated on the Drawings. The Engineer will review pre-rehabilitation inspection videos to confirm point repair locations to be performed by the Contractor. The Contractor may not proceed with pipe bursting until the Engineer has reviewed and approved the Engineer has reviewed and approved the Contractor's pre-rehabilitation CCTV inspection data.

2. If the data is available, the Owner will provide the Contractor information on the location of known active laterals and cleanouts; however, this list may not be interpreted as all-inclusive. The Contractor shall be responsible for verifying active customer service connection prior to rehabilitation. The Contractor shall compare the service connections from the CCTV video with above ground measurements at the approximate location of center of each house or building. Any discrepancies between the CCTV data and above ground measurements of laterals shall be brought to the attention of the Owner/Engineer for a determination of lateral reinstatements. If the Contractor discovers an error or addition to the list provided, the Contractor shall immediately notify the Engineer for additional investigation. Upon completion of the rehabilitation work, a list of all service laterals abandoned or reconnected as part of the work shall be submitted to the Owner. The compiled list shall include the following information:

    a. Location of each service lateral based on the CCTV inspection logs. Location shall include both accurate distance measured from the centerline of the starting manhole as well as a notation (by clock-reference) of where on the circumference of the pipe, the service lateral connects.

    b. Status (Active or Inactive)

    c. The address of each customer and associated active lateral location.

3. Prior to pipe bursting, locate, excavate, expose, and completely disconnect all active service connections. Exercise due diligence when excavating to sufficiently allow the existing pipe to uniformly circumferentially expand through the service connection pit.

4. All buried utilities adjacent to the pipe bursting operation within 20 feet shall be reviewed. Where necessary, utilities shall be excavated to relieve transient loading during the pipe bursting operation. If the Contractor considers any utilities to be too close to the pipe to be burst, excavate a pit at the location to check clearance. If adequate clearance does not exist between the existing sewer line and the subject utility, employ substitute means to rehabilitate the existing sewer line. For utilities crossing near the

existing sewer line to be burst, soil shall be excavated and removed to relieve loading during the pipe bursting operation.

5. The Contractor shall be responsible for all costs resulting from damage to utilities during pipe bursting operations.

C. Point Repairs

1. Engineer to determine if point repair(s) are required to complete the pipe bursting operations. The Engineer shall be informed before each and every point repair is undertaken. Perform any excavation and repair to prepare the sewer segment for pipe bursting. This includes repairing significant segments of sunken sewer main that would not be corrected during the pipe bursting process, if specified on the Drawings or directed by the Engineer.

D. Existing Manholes

1. Connections at existing manholes shall be enlarged before the bursting operation if the new pipe is planned to traverse through the manhole during bursting.

E. Concrete Encasements

1. Any known concrete encasement around the pipe to be burst shall be excavated and removed prior to the bursting operation to allow pipe bursting head to have a steady and free passage.

2. Concrete encasements around nearby utilities that may interfere with the bursting operation shall be brought to the attention of the Owner/Engineer for evaluation who will provide direction to the Contractor.

3. All in-line valves and fittings shall be removed prior to the pipe bursting operation.

F. Access Pit Locations

1. Excavation, trenching, dewatering, sheeting, shoring, and bracing shall comply with all applicable OSHA, local, and state standards and specifications.

2. Locate and protect existing utilities as required during construction and/or as required by utility companies, Owner, and/or Engineer.

3. At a minimum, sedimentation tubes and silt fence shall be installed at each excavation to prevent damage to wetlands and buffer zones. All land disturbing activity shall comply with South Carolina Department of Health and Environmental Control (DHEC) and any other applicable regulatory requirements.

4. The size, location, and number for pits shall be determined to facilitate the pipe bursting insertion, minimize excavation and traffic disruption, and shall be submitted prior to construction. All access pits and excavation shall be within the limits defined on the Drawings. Provide the minimum number of pits necessary to satisfactorily complete the work. Pits shall be a sufficient size to allow equipment access and new pipeline installation. Pits shall be centered over the existing sewer, and are generally anticipated to occur at each existing manhole location, at manhole construction points, at service connections, or at points where spot repairs need to be performed.

5. Submit any pit relocations and reasons for pit relocation for review. Include any appropriate sketches deemed necessary by the Engineer. The Contractor shall be responsible for obtaining all necessary permits as they relate to the relocation should they be approved by the Engineer.

6. Access pits shall be excavated and constructed as required to allow adequate access width for workers, sheeting and shoring installation, and to provide clearance necessary to avoid damage to the pipe during insertion.

7. Keep all open excavations maintained and secured at all times using barricades, lights, signs, construction tape, or fencing, etc. and/or by other means necessary or as directed by the Engineer.

G. Cleaning/Television Inspection

1. Perform the cleaning in accordance with Section 02650 prior to televising. The cleaning shall be to the extent necessary to conduct pipe bursting operations and to televise and identify potential obstructions or other concerns. No additional compensation will be made if additional work is required because the conduit was not sufficiently cleaned. The television inspection work, unless otherwise herein specified, shall be done in accordance with Section 02733 and 02732.

H. Line Obstructions

1. If pre-installation video (CCTV) inspection reveals an obstruction in the existing sewer (heavy solids, dropped joints, protruding service laterals, protruding utility lines, or collapsed pipe) which cannot be removed by conventional sewer cleaning equipment and will prevent completing the pipe bursting process, the Contractor shall remove the obstruction with the Engineer's approval. Obstruction removal shall be performed by digging an obstruction elimination pit and removing by point repair. Collapsed pipe shall be replaced by pipe replacement or by other measures as approved by the Engineer.

I. Sags in Line

1. If pre-installation video (CCTV) inspection reveals a sag in the existing sewer that is greater than 1/4 the existing pipe's diameter or causes the CCTV camera lens to be underwater and is not identified on the Drawings, the Engineer should be notified to determine if the sag is acceptable or if repair is required. When a sag repair is necessary prior to pipe bursting, the Contractor shall take the necessary measures to eliminate these sags by pipe replacement, by digging a sag elimination pit and bringing the bottom of the pipe trench to a uniform grade in line with the existing pipe invert, or by other measures as approved by the Engineer.

3.03 PIPE BURSTING OPERATIONS

A. General

1. Though the installation process may be licensed or proprietary in nature, no change to any material, thickness, design, values, or procedural matters stated in the submittals shall be allowed without the Engineer's prior knowledge and approval.

2. Pipe bursting operations, including instances where pipe upsizing is required, shall not cause excessive disruption or heaving to the above ground terrain or improvements.

3. Upon commencing the bursting process, pipe insertion shall be continuous and without interruption from one entry point to another, except as approved by the Engineer.

4. If pipe spans between manholes are fused ahead of bursting operations, transport the pipe to the site by using rollers and/or other means that will not damage the pipe's exterior. Contractor shall not drag the pipe to the insertion pit locations.

5. Protect the pipe and joints driving ends against damage.

6. Install pulleys, rollers, bumpers, alignment control devices, and any other equipment required to protect existing manholes and to protect the pipe from damage during installation. Lubrication may be used as recommended by the manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.

B. Pre-Bursting Condition Survey

1. Prior to starting pipe bursting, conduct a pre-bursting condition video survey of all existing structures and existing conditions on or within 100 feet of the site. The survey shall include wetland areas, trees and vegetation, existing buildings and homes, roads, cart paths, and all other significant features. Coordinate activities, issue notices, obtain clearance, and provide whatever assistance is necessary to accomplish the preconstruction video survey.

2. Record observations while surveying each structure's existing conditions.

3. The pre-bursting condition survey record shall include written documentation and photographs for the conditions identified, with appropriate audio description for conditions and defects.

4. All pre-bursting condition survey records shall be submitted to Engineer.

5. Upon completing all pipe bursting, examine any properties, structures, and conditions where damage complaints have been received or damage claims have been filed. Notify all interested parties so they may be present during the final examination.

C. Installing Pipe Bursting Machine and Replacement Pipe

1. The specific type of replacement pipe material described above for HDPE shall be installed in the locations as shown on the Drawings and delineated in these specifications.

2. All sharp edges shall be removed from the exposed pipe opening.

3. The pipe bursting tool shall be advanced without interruption through the host conduit from access pit/manhole to access pit/manhole. The replacement pipe shall be advanced pushed, pulled, or both directly behind the tool to fill the void left by the shattered host conduit.

4. In areas where construction site access is limited, existing sewers are deep, or where restrictions on streets are limited and/or lane blockage is prohibited, the Contractor may consider sectional pipe installation (i.e., cartridge style) methods.

5. The bursting head shall be sized so the maximum diameter of the temporary void created by the bursting operation shall not exceed the replacement pipe's maximum outside

diameter by greater than 20 percent. The new sewer shall be installed straight along the existing pipeline centerline following the same line and grade.

6. Due to the presence of existing utilities adjacent to the sewer to be replaced, the pipe bursting method shall limit vibrations transmitted to the surrounding soils. The peak particle velocity for ground vibrations resulting from pipe bursting operations shall be limited to 0.5 inches per second as measured at a distance of 25 feet from the pipe bursting equipment or at any structure within 25 feet of the sewer.

7. If bentonite or polymer slurry is used, maintain an envelope around the pipe's exterior during the pipe bursting operation to reduce the exterior friction and the possibility of the pipe seizing in place.

8. If the pipe reaches the rejection point (seizes in place) and it is elected to construct a recovery access pit, obtain Engineer's approval, then coordinate property access, traffic control measures, and utility adjustments as necessary prior to commencing work. Excavations within delineated wetlands shall be avoided when possible.

9. If a pipe section is damaged during the bursting operation or joint failure occurs as evidenced by inspection, visible groundwater infiltration or other observations, submit methods for repairing or replacing the pipe to the Engineer for approval. Repairing pipe sections damaged during bursting operations shall be made at no additional cost to Owner.

10. Allow the new HDPE pipe to return to its original length and shape in the unstressed state, and then trim the excess pipe in the manholes. The liner pipe manufacturer's recommendations shall be followed regarding relieving and normalizing stress and strain due to temporary stretching and elongation after pulling operations have been completed. Time allowed for stress and strain relief shall not be less than 3 hours.

D. Work in Existing Manholes

1. After the pipe has been inserted into the entire sewer section length, anchor the pipe at existing manholes. The pipe shall protrude in manholes for enough distance to allow sealing and trimming.

2. After the pipe has been inserted into the entire sewer section length, install new precast manholes as needed or as directed by Engineer, and as shown on the Drawings.

3. If a new manhole is not shown on the Drawings, restore manhole bottom and invert, and repair damage caused by the insertion process. If the Engineer deems the damage caused by insertion process not repairable, replace the manhole at no cost to Owner.

4. When the replacement pipe passes through or terminates at an existing manhole, the channel and portion of the base shall be removed as the Contractor deems necessary for the bursting tool to be able to maintain a constant line and grade upstream and downstream of the manhole. The pipe within the existing manhole shall be neatly and completely saw-cut off and not broken or sheared off, to protrude at least 4 inches away from the manhole walls. If the new pipe passes through the manhole, the pipe's top half within the manhole shall be neatly cut off and not broken or sheared off, at least 4 inches away from the manhole walls. The channel in the manhole shall be rebuilt with new concrete and mortar, shall be a smooth continuation of the pipe(s), and shall be merged with other lines or channels, if any. Channel cross section shall be U-shaped with a

minimum height to the pipe's crown. The channel sides shall be built up with mortar/concrete to provide benches at a 1 in 12 pitch maximum towards the channel.

5. All cutting and sealing for the new pipe at manhole connections shall provide watertight pipe and manhole trough seals. Connections to manholes shall not be made any earlier than 24 hours following the bursting operations. This 24-hour "relaxation period" is intended to allow the pipe temperature to reach equilibrium with the surrounding soil and for the pipe to release stresses imparted during bursting operations. The time period shall be extended based on manufacturer's and/or supplier's recommendations, if required.

6. To seal the pipe at the manhole, provide a flexible gasket connector in the manhole wall at the pipe's end, centered in the existing manhole wall. Grout the flexible connector in the manhole wall filling all voids for the full thickness.

7. The replacement pipe in the manhole shall be locked down and sealed as specified above before proceeding to the next pipe bursting section. All manholes shall be individually inspected by the Engineer for replacement pipe cutoffs, benches, and sealing works prior to any additional manhole rehabilitation activities.

E. Service Connections

1. Not Used. The line segments on this project do not have service connections.

F. Post-Bursting Condition Survey and Television Inspection

1. Following the pipe bursting operations, including work associated with manhole and service connections, conduct post rehabilitation CCTV inspection in accordance with Section 02650 for the completed work.

3.04 FIELD TESTING AND ACCEPTANCE

A. Field acceptance for the new pipeline shall be based on the Engineer's evaluation of the installation, including CCTV videos, inspecting the manhole connection, and all pipe and manhole testing results.

B. Testing shall be required after the replacement pipe has been installed. The replacement pipe shall be tested before it has been sealed in-place at the manholes and before any service reconnections have been made. This test checks the integrity of the joints that have been made and verifies the replacement pipe has not been damaged by inserting it through the host conduit.

1. Perform air testing as follows for segments replaced through pipe bursting:

a. Upon completing construction, or earlier if the Engineer deems advisable, provide the necessary equipment and labor to perform low positive pressure air tests in accordance with the provisions in ASTM C 924, ASTM C1103, or ASTM F-1217 as appropriate for size and material type.

b. Perform this test in the Engineer's presence and on all types of gravity sewer pipe materials.

c. It is imperative the plugs be installed and braced to prevent blowouts. A 6-psi pressure relief device must be used.

d. No one shall be allowed in or near the manholes during pressurization, testing, or depressurization.

C. Groundwater infiltration into the new pipe, including at the manhole and service connections, shall be zero.

D. All service connections shall be open, clear, and watertight.

E. All test results shall be documented in written form and provided to the Engineer before final acceptance.

3.05 CLEAN-UP

A. After evaluating the CCTV videos, if the Engineer determines the new sewer mainline needs to be cleaned, Contractor shall re-clean the line at no additional cost to Owner. The cleaning shall be done in accordance with Section 02650.

B. Upon completing the pipe bursting operation, restore all areas disturbed by these operations including streets, yards, cross country easements, and wetland areas to a condition as good as or better than what existed prior to initiating construction activities.

3.06 CLOSEOUT ACTIVITIES

A. Provide in accordance with Section 01700.

END OF SECTION

SECTION 02930
LOAMING, SEEDING AND SODDING

PART 1 GENERAL

1.01 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to place loam, finish grade, apply lime and fertilizer, hydraulically apply seed and mulch, and maintain all seeded areas as shown on the Drawings and as specified herein, and to all grassed areas disturbed during the normal progression of the Work.

B. Furnish all labor, materials, equipment and incidentals required and place loam, finish grade and furnish and install sod to all established lawn areas disturbed during the normal progression of the Work. Any seeding of these areas shall be considered temporary.

C. Determination of placement of either seed or sod shall be at the sole discretion of the Owner/Engineer.

1.02 RELATED WORK

A. Site Preparation is included in Section 02100.

B. Trenching, Backfill and Compaction is included in Section 02200.

1.03 SUBMITTALS

A. Submit, in accordance with Section 01300, complete shop drawings, materials and equipment furnished under this Section including seed mixtures and product label information.

B. Samples of all materials shall be submitted for inspection and acceptance upon Owner/Engineer's request.

PART 2 PRODUCTS

2.01 MATERIALS

A. Loam shall be fertile, natural soil, typical of the locality, free from large stones, roots, sticks, clay, peat, weeds and sod and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain toxic material harmful to plant growth. Topsoil stockpiled under other Sections of this Division may be used, but the Contractor shall furnish additional loam at his/her own expense if required.

B. Fertilizer shall be a complete commercial fertilizer 10-08-06 or 10-07-04 grade for grass areas. It shall be delivered to the site in the original unopened containers each showing the manufacturer's guaranteed analysis, properly labeled, and conforming to all applicable State laws. Store fertilizer so that when used it shall be dry and free flowing.

C. Lime shall be ground limestone containing all the finer particles obtained in the grinding process and ground sufficiently fine so that not less than 80 percent will pass through a No. 8 sieve. The calcium carbonate equivalent must be at least 80 percent. One or both must be

greater than 80 so that the multiplication of the percent of calcium carbonate equivalent by the percent of material passing through the No. 8 sieve will be equal to or be more than 0.72. The moisture content at the time of shipment must not exceed 8 percent.

D. Grass seed shall be from the same or previous year's crop; each variety of seed shall have a percentage of germination not less than 90, a percentage of purity not less than 85 and shall have not more than 1 percent weed content. The classes of Seeding Mixture shall consist of one or more of the classes listed below. Seeding Mixtures form the specified class shall be designated by the Owner/Engineer, based on the season of the year when seeding operations are performed.

LOCATIONS	SEEDS	LBS./ACRE	SEASON TO USE
1 – Sunny	Bermuda, hulled	25	February through
	Bermuda, unhulled	25	April
	Rye grass, Italian	150	
2- Sunny	Bermuda, hulled	25	May through
	Bermuda, unhulled	25	September 15
	Millet, brown top	25	
3 – Sunny	Bermuda, unhulled	60	September 15
	Rye grass, Italian	150	through February
4 – Shady	Substitute carpet grass for Bermuda in 1, 2 and 3	40	All Season
5 – Steep Slopes	Lespedeza, Sericea (Clay Soils) Add to 1, 2, 3 and 4	25	All Season
OR			
6 - Steep Slopes	Love grass, weeping (Sandy Soils) Add to 1, 2, 3 and 4	30	All Season
	Use Dolomitic Limestone at one ton per acre. Use 500 lbs. of 10-10-10 Fertilizer per acre.		

E. The seed shall be furnished and delivered premixed in the proportions specified above. A manufacturer's certificate of compliance to the specified mixes shall be submitted by the manufacturer for each seed type. These certificates shall include the guaranteed percentages of purity, weed content and germination of the seed and also the net weight and date of shipment. No seed may be sown until the certificates have been submitted.

F. Mulch shall be a specially processed cellulose fiber containing no growth or germination-inhibiting factors. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a

homogeneous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the cellulose fiber shall be marked by the manufacturer to show the air-dry weight content.

G. Sod shall be as grown by an established sod grower, as approved by the Engineer and shall consist of the following grasses:

Botanical Name	Common Name	Percent
Poa pratensis	Kentucky Bluegrass	90 to 100
Festuca rubra	Jamestown Fescue	0 to 10

1. Sod shall be vigorous, well rooted, healthy turf, free from insect pests, disease, weeds, other grasses, stones, bare spots, burned spots and any other harmful or deleterious matter. Sod shall be machine stripped at a uniform soil thickness of approximately 1-in and not less than 3/4-in. The measurement for thickness shall not include top growth and thatch and shall be determined at the time of cutting in the field.

2. Individual pieces of sod shall be cut to the supplier's standard width and length. Maximum allowable deviation from standard widths and lengths shall be plus or minus 1/2-in on width and plus or minus 5 percent on length. Broken rolls or torn or uneven rolls will not be acceptable.

3. Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape when suspended vertically from a firm grasp on the upper 10 percent of the section.

4. Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect is survival.

5. Harvest, deliver and transplant sod within a period of 36 hours unless a suitable preservation method is approved by the Owner/Engineer prior to delivery. Sod not transplanted within this period shall be subject to inspection and approval by the Owner/Engineer prior to its installation.

6. Before stripping, mow sod uniformly at a height of 1-in to 2-1/2-in.

PART 3 EXECUTION

3.01 APPLICATION

A. Unless otherwise shown on the Drawings, loam shall be placed to a minimum depth of 6-in on all lawn areas and 4-in in areas indicated to be naturalized.

B. For all areas to be seeded:

1. Lime shall be applied at the rate of 1.0 tons/acre.

2. Fertilizer shall be applied at the rate of 400 lbs/acre.

3. Lawn grass seed shall be applied at the rate of 10 lbs/1,000 sq ft.

4. Fiber mulch shall be applied at the rate of 20 lbs/1,000 sq ft.

C. The application of fertilizer and lime shall be incorporated into soil to a depth of at least three (3) inches by discing, harrowing or other approved methods acceptable to the Owner/Engineer.

D. The application of fertilizer and lime may be performed hydraulically in one operation with hydroseeding and mulching. If lime is applied in this manner, clean all structures and paved areas of unwanted deposits.

3.02 SEEDING INSTALLATION

A. Schedules for seeding and fertilizing shall be submitted to the Owner/ Engineer for approval prior to the work.

B. The subgrade of all areas to be loamed and seeded shall be raked and all rubbish, sticks, roots and stones larger than 2-in shall be removed. Subgrade surfaces shall be raked or otherwise loosened immediately prior to being covered with loam. Subgrade shall be inspected and approved by the Owner/Engineer before loam is placed.

C. Loam shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling, the complete work will conform to the lines, grades and elevations indicated. No loam shall be spread in water or while frozen or muddy.

D. After loam has been spread, it shall be carefully prepared by scarifying or harrowing and hand raking. All large stiff clods, lumps, brush, roots, stumps, litter and other foreign material shall be removed from the loamed area and disposed of. The areas shall also be free of smaller stones, in excessive quantities, as determined by the Owner/Engineer. The whole surface shall then be rolled with a hand roller weighing not more than 100 lbs/ft of width. During the rolling, all depressions caused by settlement of rolling shall be filled with additional loam and the surface shall be regraded and rolled until a smooth and even finished grade is created.

E. Seeding, mulching and conditioning shall only be performed during those periods within the seasons which are normal for such work as determined by the weather and locally accepted practice, as approved by the Owner/Engineer. Hydroseed only on a calm day.

F. Seeding shall be done within 10 days following soil preparation. Seed shall be applied hydraulically at the rates and percentages indicated. The spraying equipment and mixture shall be so designed that when the mixture is sprayed over an area, the grass seed and mulch shall be equal in quantity to the specified rates. Prior to the start of work, the Owner/Engineer shall be furnished with a certified statement for approval as to the number of pounds of materials to be used per 100 gallons of water. This statement shall also specify the number of square feet of seeding that can be covered with the quantity of solution in the Hydroseeder.

G. In order to prevent unnecessary erosion of newly graded slopes and unnecessary siltation of drainage ways, carry out seeding and mulching as soon as satisfactory completion of a unit or portion of the project. A unit of the work will be defined as not more than 20,000 sq ft.

H. When protection of newly graded areas is necessary at a time that is outside of the normal seeding season, protect those areas by whatever means necessary (such as straw applied with a tar tack) or by other measures as approved by the Owner/Engineer.

3.03 SEEDING IN WOODED AND UNGRADED AREAS

A. For preparation and seeding in wooded areas under this Contract and where no grading is required, all of the specified materials and procedures shall be utilized except that no disking shall be performed within the drip line of trees to be preserved. The seed bed shall be prepared by the addition of a thin layer of top soil roughly 1-in deep.

3.04 SOD INSTALLATION

A. At locations specified, or shown on the plans, or designated by the Owner/Engineer, the Contractor shall carefully store the furnished sod. Upon compaction of the trench in a manner satisfactory to the Owner/Engineer, the sod shall be replaced in a neat, workman like manner, over a minimum of two (2) inches of loam. Any deficiency in sod necessary to restore the surface to a condition comparable to that which existed before construction operations began will be furnished by the Contractor unless other specified

3.05 MAINTENANCE AND PROVISIONAL ACCEPTANCE

A. Keep all seeded areas watered and in good condition, reseeding if and when necessary until a good, healthy, uniform growth is established over the entire area seeded. Maintain these areas in an approved condition including a minimum of two mowings of the lawn areas until provisional acceptance.

B. On slopes, provide against washouts by an approved method. Any washout that occurs shall be regraded and reseeded at the Contractor's expense until a good sod is established.

C. The Owner/Engineer will inspect all work for provisional acceptance at the end of the 8-week grass maintenance period.

D. A satisfactory stand will be defined as a section of grass of 10,000 sq ft or larger that has:

1. No bare spots larger than 3 sq ft.

2. No more than 10 percent of total area with bare spots larger than 1 sq ft.

3. Not more than 15 percent of total area with bare spots larger than 6-in square.

E. The inspection by the Owner/Engineer will determine whether maintenance shall continue in any area.

F. After all necessary corrective work and clean-up has been completed, the Owner/Engineer will certify in writing the provisional acceptance of the lawn areas. Maintenance of lawns or parts of lawns shall cease on receipt of provisional acceptance.

3.06 GUARANTEE PERIOD AND FINAL ACCEPTANCE

A. All seeded areas shall be guaranteed for not less than 1 full year from the time of provisional acceptance.

B. At the end of the guarantee period, inspection will be made by the Owner/Engineer. Lawn areas not demonstrating satisfactory stands as outlined above, shall be renovated, reseeded and maintained meeting all requirements as specified herein.

C. After all necessary corrective work has been completed, the Owner/Engineer shall certify in writing the final acceptance of the lawns.

END OF SECTION

DIVISION 03

CONCRETE

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SECTION 03100

CONCRETE FORMING

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies formwork requirements for concrete construction.

1.02 QUALITY ASSURANCE

A. REFERENCES:

This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, has been discontinued or has been replaced.

Reference	Title
ACI 116R	Cement and Concrete Terminology
ACI 347R	Guide to Formwork for Concrete

B. DESIGN:

Formwork design requirements shall conform to the following:

1. Formwork, shoring and reshoring shall be designed by a civil or structural engineer currently registered in the State of South Carolina having a minimum of 3 years experience in this type of design work.

2. Design and engineering of formwork, shoring and reshoring, as well as its construction, is the responsibility of the Contractor.

3. A procedure and schedule shall be developed for removal of shores (and installation of reshores) and for calculating the loads transferred to the structure during this process.

4. Structural calculations shall be made as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon.

5. When developing procedure, schedule and structural calculations, consideration shall be made regarding the structural system that exists, effects of all loads during construction and strength of concrete at each state of construction.

C. DESIGN CRITERIA:

Design of formwork shall conform to the following criteria:

1. Formwork shall be designed for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code. Where conflicts occur between the above two standards, the more stringent requirements shall govern.

2. Formwork shall be made to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.

1.03 SUBMITTALS

Submittals shall be provided in accordance with Section 01300 and shall include the following information:

1. A copy of this specification section, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph referenced to a detailed written explanation of the reasons for requesting the deviation. The Construction Manager shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. *Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirement, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.*

2. Manufacturer's installation instructions and acknowledgement that products submitted meet requirements of standards referenced.

3. Manufacturer and type of proposed form materials, form ties and form coating materials.

4. Formwork designer qualifications.

5. If requested, structural analysis and concrete strength data used in planning and implementing form removal and shoring.

PART 2 – PRODUCTS

2.01 FORMS

A. WOOD FORMS:

Wood forms shall be new 5/8-inch or 3/4-inch, 5-ply structural plywood of concrete form grade. Forms shall be built-in-place type or pre-fabricated panel. Built in place type forms shall be 4 by 8 foot sheets except where smaller pieces will cover entire area. When approved by the Construction Manager, plywood may be reused.

B. METAL FORMS:

Metal forms excluding aluminum may be used. Forms shall be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.

2.02 FORM TIES

Form ties shall be commercially fabricated for use in form construction and shall be constructed so that ends or end fasteners can be removed without causing spilling at surfaces of the concrete. Diameter on ends shall be 3/4 inch minimum to 1 inch maximum. Embedded portion of ties shall be not less than 1 1/2 inch from face of concrete after ends have been removed. Ties with built-in waterstops shall be provided in all walls that will be in contact with process liquid during plant operation and/or high ground water.

PART 3 – EXECUTION

3.01 PREPARATION

Preparation shall conform to the following:

1. Before placing of either reinforcing steel or concrete, surfaces of forms shall be covered with an approved coating material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future

finishes. A field applied form release agent or sealer of approved type or a factory applied non absorptive liner may be used.

2. Excess form coating material shall not be permitted to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.

3. Temporary openings shall be provided at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.

4. Temporary openings, also called form “windows”, shall be used to limit height of free fall of concrete and to limit the lateral movement of concrete during placement. Openings are required in walls placements greater than 20 feet in height and shall be spaced so that no more than 8 feet of solid form exists between openings measured horizontally and vertically.

5. Surfaces of forms, reinforcing steel and other embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.02 ERECTION

Form erection shall conform to the following:

1. Products shall be installed in accordance with manufacturer’s written instructions.

2. Surfaces of columns, piers, walls, and in risers shall vary from plumb a maximum of 1/2 inch for entire height and 1/4 inch in 10 feet of height. Exposed corner columns, control-joint grooves, and other exposed to view lines shall vary from plumb a maximum of 1/2 inch for entire length and 1/4 inch in 20 feet of length.

3. Maximum variation from level or from grade shall be 3/4 inch for entire length, 3/8 inch for any bay or 20 foot length and 1/4 inch in 10 feet of length for slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores and shall be 1/2 inch for entire length and 1/4 inch in 20 feet of length for exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines.

4. Maximum variation of linear structure lines from established position in plan and related position of columns, walls, and partitions shall be 3/4 inch for entire length and 3/8 inch for any bay or 20 foot length.

5. Maximum variation in size and location of sleeves, floor openings, and wall openings and variation in horizontal plan location of beam, column and wall centerlines shall be ± 1/2 inch

6. Maximum variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls shall be ± 1/2 inch and in concrete plan dimensions for footings and foundations shall be - 1/2 inch + 2 inches.

7. Maximum misplacement or eccentricity of footings and foundations shall be 2 percent of footing width in direction of misplacement but not more than 2 inches.

8. Specified thickness of footings and foundations may be decreased by up to 5 percent with no maximum increase except that which may interfere with other construction.

9. Maximum step variance in the flight of stairs for Rise is ± 1/8 inch and for Tread is ± 1/4 inch and in consecutive steps for Rise is ± 1/16 inch and for Tread is ± 1/8 inch.

10. Sufficient control points and benchmarks to be used for reference purposes to check tolerances shall be established and maintained in an undisturbed condition until final completion and acceptance of the work.

11. Regardless of tolerances listed, no portion of a structure shall be allowed to extend beyond the legal boundary of work site.

12. To maintain specified tolerances, formwork shall be cambered to compensate for anticipated deflections in formwork prior to hardening of concrete. Forms shall be sufficiently tight to prevent loss of mortar from concrete.

13. A 3/4-inch chamfer strip shall be placed in exposed to view corner of form to produce a 3/4-inch wide beveled edge.

14. At construction joints, contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement shall be overlapped by at least 1 inch. Forms against hardened concrete shall be held to prevent offsets or loss of mortar at construction joint and to maintain a true surface. Where possible, juncture of built-in-place wood or metal forms shall be located at architectural lines, control joints or at construction joints.

15. Where circular walls are formed and forms made up of straight sections are proposed for use, straight lengths not exceeding 2 feet wide shall be provided for curved surfaces 25 feet or larger. Formwork shall be braced and tied to maintain correct position and shape of members.

16. Wood forms for wall openings shall be constructed to facilitate loosening, if necessary, to counteract swelling. Formwork shall be anchored to shores or other supporting surfaces of members so that movement of any part of formwork system is prevented during concrete placement.

17. Runways for moving equipment shall be provided with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.

18. A positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation shall be provided. Forms shall be

securely braced against lateral deflection. Wedges used for final adjustment of forms shall be fastened prior to concrete placement in position after final check.

3.03 REMOVAL OF FORMS

Removal of forms shall conform to the following:

1. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

2. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, forms shall be removed as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.

3. Top forms on sloping surfaces of concrete shall be removed as soon as concrete has attained sufficient stiffness to prevent sagging. Any needed repairs or treatment required on such sloping surfaces shall be performed at once, followed by curing specified in Section 03300.

4. Wood forms for wall openings shall be loosened as soon as this can be accomplished without damage to concrete.

5. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

6. Where no reshoring is planned, forms and shoring used to support weight of concrete shall be left in place until concrete has attained its specified 28-day compressive strength. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

7. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.04 RESHORING

Reshoring shall conform to the following:

1. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

2. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.

3. During reshoring, concrete in structural members shall not be subjected to combined dead and construction loads in excess of loads that structural members can adequately support.

4. Reshores shall be placed as soon as practicable after stripping operations are complete but in no case later than the end of working day on which stripping occurs.

5. Reshores shall be placed to carry their required loads without overstressing.

6. Where no reshoring is planned, forms and shoring used to support weight of concrete shall be left in place until concrete has attained its specified 28 day compressive strength. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength by the formwork designer's structural calculations.

END OF SECTION

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SECTION 03200

CONCRETE REINFORCEMENT

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies reinforcing steel for use in reinforced concrete.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY CONTRACTOR:

To demonstrate conformance with the specified requirements for cast-in-place concrete, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test concrete related materials as required in Section 03300. Costs of testing laboratory services shall be borne by the Contractor.

B. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
ACI 315	Details and Detailing of Concrete Reinforcement
ASTM A82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Steel Welded Wire, Fabric, Plain for Concrete Reinforcement

Reference	Title
ASTM A615/A615M REV B	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A616/A616M	Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A617/A617M	Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A706/A706M REV B	Low-Alloy Steel Deformed Bars for Concrete Reinforcement
ASTM A775/A775M	Epoxy-Coated Reinforcing Steel Bars
ASTM E329	Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
AWS D1.4	Structural Welding Code Reinforcing Steel
CRSI-PRB	Placing Reinforcing Bars
CRSI-MSP 1	Manual of Standard Practice
FEDSPEC QQ-W-461H	Wire, Steel, Carbon (Round, Bare, and Coated)

1.03 PLACING DRAWINGS

The Contractor shall prepare reinforcement placing drawings conforming to the requirements of ACI 315. Placing drawings shall include bar lists, schedules, bending details, placing details, and placing plans and elevations as required to fully delineate this portion of the work.

PART 2 – PRODUCTS

2.01 BAR REINFORCEMENT

Reinforcing bars shall be deformed billet steel in conformance with ASTM A615, including supplementary requirements. Bars shall be Grade 60, except ties or field-bent bars where specified shall be Grade 40. Bars to be welded shall be Grade 40 or shall be deformed billet steel conforming to ASTM A706. ASTM A616 or ASTM A617 steel shall not be used. Bars provided as dowels for future construction and bars where specified shall be epoxy-coated in conformance with ASTM A775.

2.02 WIRE FABRIC

Wire fabric shall be welded steel mesh conforming to ASTM A185.

2.03 WIRE AND PLAIN BARS

Wire used as reinforcement and bars used as spiral reinforcement in structures shall be cold drawn steel conforming to ASTM A82.

2.04 TIE WIRE

The wire shall be minimum 16 gage annealed steel conforming to FEDSPEC QQ-W-461H.

2.05 BAR SUPPORTS

Bar supports coming into contact with forms shall be CRSI Class 1 plastic protected or Class 2 stainless steel protected and shall be located in accordance with CRSI MSP-1 and placed in accordance with CRSI PRB. Concrete block supports shall be provided for footing and slabs on grade. Stainless steel or plastic protected plain steel supports shall be provided for other work.

2.06 PRODUCT DATA

The following information shall be provided prior to installation in accordance with Section 01300:

1. Certified mill test reports.

2. Welder qualification certificate in accordance with AWS D1.4.

PART 3 – EXECUTION

3.01 FABRICATION

Reinforcing steel shall not be bent or straightened in a manner which will injure the material. Bars with kinks or with bends not shown shall not be used. Heating or welding bars shall be performed in accordance with AWS D1.4 and shall only be permitted where specified or approved by the Construction Manager. Bars shall not be welded at the bend.

3.02 PLACEMENT

Reinforcing steel shall be placed in accordance with CRSI PRB and CRSI MSP-1.

Reinforcing steel shall be positioned accurately and secured against displacement by using annealed iron wire at intersections and shall be supported by concrete or metal chairs, spacers or metal hangers. Tack welding of cross bars is not acceptable. Bars shown on the drawings shall not be repositioned (buried) to act as support bars. Additional bars shall be provided as required for supports. Steel rods and pegs may be used to support reinforcing steel on rock foundations. Reinforcing steel shall be placed in such a manner as to not damage waterproofing membrane or plastic lining which has been previously applied or constructed. Reinforcing steel shall be shop-

bent or slightly relocated where necessary to clear waterstop. Reinforcing steel shall not be placed on fresh concrete or forced into fresh concrete.

Supports for embedded items shall not be welded to the reinforcement. Additional reinforcement may be provided for this purpose.

3.03 SPLICING

Reinforcing steel shall be spliced as shown. Additional splices may be provided where approved by the Construction Manager.

In slabs, beams, girders and walls, reinforcing steel shall not be spliced in areas of maximum stress. Splices of adjacent bars shall be staggered at least one splice length, unless otherwise specified. Splices in welded wire fabric shall be at least 1 ½ meshes wide.

3.04 CLEANING

Reinforcing steel shall be cleaned of mill rust scale, dried concrete, or other coatings that may reduce bond. Reinforcement reduced in section is not acceptable. When concrete placement is delayed, reinforcement shall be cleaned by sandblasting if directed by the Construction Manager.

3.05 REPAIR OF EPOXY COATING

Epoxy coating damage need not be repaired in cases where the damaged area is 0.1 square inch or smaller. All damaged areas larger than 0.1 square inch shall be repaired in conformance with ASTM A775.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1--GENERAL

1.01 DESCRIPTION

This section specifies cast-in-place concrete which consists of furnishing all material, mixing and transporting equipment, and performing all labor for the proportioning, mixing, transporting, placing, consolidating, finishing, and curing of concrete in the structure.

1.02 QUALITY ASSURANCE

A. QUALITY CONTROL BY OWNER:

Special Inspection of concrete work shall be performed by the Special Inspector under contract with the Owner and in conformance with the IBC Chapter 17. Special Inspector(s) and laboratory shall be acceptable to the Owner in their sole discretion. Special Inspection of concrete is in addition to, but not replacing, other inspections and quality control requirements herein. Where sampling and testing required herein conforms to Special Inspection standards, such sampling and testing need not be duplicated.

All structural concrete work shall receive Special Inspection in accordance with IBC Chapter 17. Structural concrete includes all elements which resist code-defined loads and whose failure would impact life safety. Non-structural site work concrete does not require Special Inspection. Anchor bolts and anchors installed in hardened concrete require Special Inspection.

Owner provided testing shall be in accordance with Section 01400.

B. QUALITY CONTROL BY CONTRACTOR:

Where required to demonstrate conformance with the specified requirements for cast-in-place concrete, the Contractor shall provide the services of an independent testing laboratory which complies with the requirements of ASTM E329. The testing laboratory shall sample and test concrete materials as specified in paragraphs 03300-2.01, 2.02, and 3.15. Costs of testing laboratory services shall be borne by the Contractor.

C. BASIS FOR QUALITY:

Cast-in-place concrete shall conform to the requirements of ACI 301, except as modified herein.

D. REFERENCES:

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization, or if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
ACI 117	Tolerances for Concrete Construction and Materials
ACI 211.1	Selecting Proportions for Normal, Heavy Weight and Mass Concrete
ACI 301	Structural Concrete for Buildings
ACI 305.1	Specification for Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Code Requirements for Environmental Engineering Concrete Structures
ACI 350.1	Tightness Testing of Environmental Engineering Concrete Structures
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C40	Organic Impurities in Fine Aggregate for Concrete
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Ready-Mixed Concrete
ASTM C117	Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates

Reference	Title
ASTM C142	Clay Lumps and Friable Particles in Aggregates
ASTM C143	Slump of Hydraulic Cement Concrete
ASTM C150	Portland Cement
ASTM C157	Length Change of Hardened Cement Mortar and Concrete
ASTM C172	Sampling Freshly Mixed Concrete
ASTM C192	Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM C595	Blended Hydraulic Cements
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C989	Slag Cement for use in Concrete and Mortars
ASTM C1059	Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C1260	Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1567	Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar Bar Method)
ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
ASTM D75	Sampling Aggregates
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM E329	Agencies Engaged in Construction Inspection and/or Testing
CRD-C572	U.S. Corps of Engineer's Specifications for Polyvinylchloride Waterstop
IBC	International Building Code with local amendments

1.03 SUBMITTALS

The following information shall be provided in accordance with Section 01300:

1. Each proposed mix design showing (a) the expected strength at 28 days, (b) corresponding slump before and after the introduction of high-range water-reducing admixtures, (c) water/cement ratios, (d) weights and test results of the ingredients, (e) aggregate gradation, (f) test results of mix design prepared by an

independent testing laboratory, and (g) other physical properties necessary to review each mix design for conformance with these specifications.

2. Product literature and technical data for aggregates, cement, and pozzolan.

3. Product literature, technical data and dosage of all proposed admixtures including, but not limited to, air entraining, water reducing and/or retarding admixtures and shrinkage reducing admixtures at liquid containing concrete.

4. Anticipated average delivery time from batch plant to site. If this time exceeds the limit specified in paragraph 3.02, include proposed method to extend set time without deleterious effects on final product. Construction Manager reserves the right, in their sole discretion, to accept or reject such proposed methods.

5. Curing program description in sufficient detail to demonstrate acceptable strength, finish and crack control as specified.

6. Product literature and technical data for waterstops, curing and sealing compounds, bonding compounds, surface hardeners, epoxy and chemical grout for crack injection, retardant, bearing pads and trench drains.

7. Sample panels of formed wall surfaces as specified in paragraph 3.11C and Section 03100. Samples of concrete floor and slab finishes are specified in paragraph 3.12 E.

8. Concrete delivery truck tickets showing the information listed in ASTM C94, section 14.

9. The Contractor shall prepare concrete placement drawings. The placement drawings shall include the intended placement sequencing, location of each placement, the size of the concrete placements, joint locations, embedded items, and waterstop locations. Each placement shall also be label with a mix design and the type of finish the concrete surface is to receive.

PART 2--PRODUCTS

2.01 MATERIALS

Portland cement shall be ASTM C150, Type II or Type V, low alkali, containing less than 0.60 percent alkalis. In addition to standard requirements, cement shall satisfy optional chemical and physical requirements of ASTM C150, Tables 2 and 4, respectively.

If low alkali cement is not available, aggregates shall show an expansion of less than 0.1% when tested in accordance with ASTM C1260 or ASTM C1567 concrete mix test results shall be

submitted verifying that the aggregates are not reactive per the criteria in this standard. ASTM C1260 and ASTM C1567 results shall be no older than 1 year.

Portland-pozzolan cement shall be ASTM C595, Type IP (MS), interground, low alkali.

Use cementitious materials that are of the same brand and type and from the same plant of manufacture as the cementitious materials used in the concrete represented by the submitted field test records or used in the trial mixtures. See Section 2.01G.

B. GROUND GRANULATED BLAST-FURNACE SLAG:

Ground granulated blast-furnace slag (GGBFS), if used in conjunction with portland cement, shall be per ASTM C989.

C. AGGREGATES:

1. GENERAL: Except as modified herein, fine and coarse aggregates shall conform to ASTM C33. Fine and coarse aggregates shall be regarded as separate ingredients. Aggregates shall be non-reactive and shall be washed before use.

Aggregates shall be checked for alkali-silica reactive constituents per ASTM C1260. Aggregate shall have less than 0.1% expansion when tested in accordance with ASTM C1260. Aggregates having 0.1% or greater expansion when tested in accordance with ASTM C1260 may still be satisfactory provided ASTM C1567 concrete mix test results are submitted and show an expansion of less than 0.1% at 16 days. ASTM C1260 and ASTM C1567 test results shall be no older than 1 year.

Tests for size and grading of fine and coarse aggregates shall be in accordance with ASTM C136. Combined aggregates shall be well and uniformly graded from coarse to fine sizes to produce a concrete that has optimum workability and consolidation characteristics. The final combined aggregate gradation shall be established during the design mix.

Aggregates used in the concrete shall be obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by the submitted historical data or trial mixtures. See Section 2.01G.

2. FINE AGGREGATE: Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine. Gradation shall conform to ASTM C33. For classes of concrete which will be used in liquid retaining structures, fine aggregate shall not exceed 40 percent by weight of combined aggregate total, except for concrete with coarse aggregate of less than maximum size 1/2 inch.

Variations from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

U.S. standard sieve size	Permissible variation in individual tests, percent
30 and coarser	2
50 and finer	0.5

Other tests shall be in accordance with the following specifications:

Test	Test method	Requirements
Amount of material	ASTM C117	3 percent passing No. 200 sieve maximum by weight
Sand equivalent	ASTM D2419	Minimum 70

3. COARSE AGGREGATE: Coarse aggregate shall be hard, dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, and organic matter. Other deleterious substances shall not exceed the limits listed in ASTM C33, Table 3 for Class Designation 5S. Gradation of each coarse aggregate size specified in paragraph 03300-2.02 A shall conform to ASTM C33, Table 2.

Variations from the specified gradations will be acceptable in individual tests if the average of three consecutive tests is within the specified limits.

D. POZZOLAN:

Pozzolan shall be Class F fly ash conforming to ASTM C618. Class C fly ash is not allowed. Pozzolan supplied during the life of the project shall have been formed at the same single source. See Section 2.01G.

The pozzolan color shall not substantially alter the resulting concrete from the normal gray color and appearance.

Use pozzolan materials that are of the same brand and type and from the same plant of manufacture as the materials used in the concrete represented by the submitted field test records or used in the trial mixtures.

E. ADMIXTURES:

1. GENERAL: Admixtures shall be compatible with the concrete and with each other. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix. The water reducing retarders and admixtures shall reduce the water required by at least 11 percent for a given concrete consistency and shall comply with the water/cement ratio standards of ACI 211.1. Retarder dosage shall result in set time consistent with paragraph 3.02.

2. WATER REDUCING ADMIXTURES: Water reducing admixtures shall conform to ASTM C494, Type A. Acceptable products include: BASF "Pozzolith 322N"; SIKA Chemical Corp. "Plastocrete 161"; Euclid Chemical Co. "Eucon WR91"; or equal.

3. WATER REDUCING AND RETARDING ADMIXTURES: Water reducing and retarding admixtures shall conform to ASTM C494, Type D. Acceptable products include: BASF "Pozzolith 300R"; Sika Chemical Corp. "Plastiment"; Euclid Chemical Co. "Eucon Retarder 75"; or equal.

4. HIGH RANGE WATER REDUCING ADMIXTURES: High range water reducing (superplasticizing) admixtures shall conform to ASTM C494, Type F. Acceptable products include: BASF "Glenium 3000NS"; Sika Chemical Corp. "Sikament FF or 686"; Euclid Chemical Co. "Eucon 37"; W.R. Grace "ADVA 195"; or equal.

5. HIGH RANGE WATER REDUCING AND RETARDING ADMIXTURES: High range water reducing and retarding admixtures shall conform to ASTM C494, Type G. Acceptable products include: W.R. Grace "Daracem 100"; Euclid Chemical Co. "Eucon 537"; or equal.

6. AIR ENTRAINING AGENT: Air entraining agent shall conform to ASTM C260. Acceptable products include: BASF "MB-AE 90"; Sika Chemical Corp. "AEA-15"; Euclid Chemical Co. "AEA-92"; or equal. The air entraining agent added shall produce, in accordance with ASTM C260, an entrained air content specified in paragraph 03300-2.02 A for each class of concrete.

7. SHRINKAGE REDUCING ADMIXTURE: Select shrinkage reducing admixture for compatibility with air entrainment admixture and other ingredients of the concrete mix. Acceptable products include: BASF "Tetraguard AS20" and Grace "Eclipse 4500".

F. WATER:

Water for washing aggregate, for mixing and for curing shall be free from oil and deleterious amounts of acids, alkalis, and organic materials; and shall comply with the requirements of ASTM C1602. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the concrete.

G. CHANGE OF MATERIALS:

After each concrete mix design is approved by the Engineer, no changes of any sort or source will be allowed without prior written approval from the Engineer. When brand, type, size, or source of cementitious materials, aggregates, water, ice, or admixtures are proposed to be changed, new field data, data from new trial mixtures, or evidence that indicates that the change will not affect adversely the relevant properties of the concrete shall be submitted for approval by the Engineer before use in concrete.

2.02 CONCRETE CHARACTERISTICS

A. MIX PROPORTIONING:

Concrete shall be normal weight concrete composed of specified cement, pozzolan, admixtures, aggregates and water proportioned and mixed to produce a workable, strong, dense, and impermeable concrete. The Contractor may substitute interground Portland-pozzolan cement conforming to ASTM C595, containing the specified amount of pozzolan in lieu of Portland cement and pozzolan. Water-cementitious material (w/cm) ratio is based on the combined contents of cement and pozzolan in a given mix proportion.

Concrete shall be provided in accordance with the following:

Concrete class	ASTM coarse aggregate size	Maximum water-cementitious materials (w/cm) ratio	Minimum Cementitious Materials Content (pounds/CY)	Pozzolan, percent by weight of cementitious materials	Air content (percent)	Minimum[a] 28-day compressive strength, psi	Slump Range[f] (inches)
A	467	0.42	515	20-35	4-6	4000[b]	3-5
B	57 or 67	0.45	560	15-20[d]	4-6	3000	3-5
C-1	57 or 67	0.40	560	15-20	4-6	4500	3-5
C-2	57 or 67	0.42	560	15-20[d]	4-6	5000	3-5
D-1	8	0.42	600	15-20[d]	4-6	4000	3-5
E[c]	57	--	-	15-20[d]	Not Required	2000	4-8

[a] Compressive strength shall be determined at the end of 28 days based on test cylinders made and tested in accordance with ASTM C39.
[b] Compressive strength of Class A concrete may be determined at 56 days.
[c] Concrete encasement for electrical conduit shall contain 3 pounds of red oxide per sack of cement.
[d] Pozzolan use optional for this class of concrete.
[e] Minimum 28-day compressive strength shall be 500 psi and maximum 28-day compressive strength shall be 1,000 psi.
[f] Slump before addition of high range water reducing admixture (superplasticizer). Maximum slump after addition of high range water reducing admixture shall be 8".

B. USE:

Concrete shall be provided by class for the corresponding use listed as follows:

Type of use	Class of concrete
Concrete greater than 36 inches thick	A
Non-structural concrete (sidewalks, curbs, pavers, etc.)	B

Type of use	Class of concrete
Typical cast-in-place structural concrete	C-1
Precast concrete	C-2
Topping concrete (Precast Concrete Topping)	D-1
Pipe bedding and encasement, electrical conduit encasement (duct banks) and concrete fill	E

C. CONTROL TESTS:

1. GENERAL: Before beginning concrete work, the Contractor shall determine the proper proportions of materials for each class of concrete. The mix shall consist of specified cement, pozzolan, admixtures, aggregate and water. Methods for selecting and adjusting proportions of the ingredients shall be in accordance with ACI 211.1. Verification of mix characteristics for submittal may be achieved using either the Trial Mix Design method or Field Experience method. Concrete shall not be placed in the field prior to review and acceptance of mix proposed.

2. TRIAL MIX DESIGN: Each class of concrete and/or mix verified by this method shall be manufactured at the batch plant which will supply concrete to the project using materials proposed for the Work and material combinations listed in paragraphs 2.01 and 202. Testing, data and reporting shall conform to ACI 318 Section 5.3 and the following:

(a) Required compressive strength used as the basis for selecting concrete proportions (f'cr) shall be the specified concrete strength (f'c) + 1000 psi for specified concrete strengths less than 3,000 psi and f'c + 1200 psi for specified concrete strengths between 3000 psi and 5000 psi.

(b) Make at least three trial different mixtures for each class of concrete qualified by the Trial Mix Design. Each trial mixture shall have a different w/cm ratio or different cementitious materials content that will produce a range of compressive strengths encompassing f'cr.

(c) Trial mixtures shall be designed to produce a slump within ¾ in. of the maximum specified and for air-entrained concrete, an air content within 0.5% of the maximum allowable air content.

(d) For each w/cm ratio or cementitious materials content, at least twelve standard test cylinders shall be cast and cured in accordance with ASTM C192. Four cylinders from each batch shall be tested at age 7 days, 14 days, and 28 days or as required to comply with ACI 318 Section 5.3.

(e) From results of the cylinder tests, plot a curve showing the relationship between w/cm ratio and compressive strength.

(f) From the curve of w/cm ratio versus compressive strength, select the w/cm ratio that will produce f'cr. This is the maximum w/cm ratio that shall be used unless a lower w/cm ratio is specified in paragraph 2.02A.

3. FIELD EXPERIENCE DATA: When sufficient test data for a particular mix design is available which is identical or substantially similar to that proposed for use, Contractor may substitute use of this data in lieu of a trial mix design. Field data, reports, and analysis shall conform to ACI 318 Section 5.3, except as modified herein. Historical mix design proportions for which data are submitted may vary from the specified mix within the following limits: (a) f'c as specified or up to 500 psi above; (b) w/cm ratio as specified or lower; (c) pozzolan content within 5 percent of that specified; (d) maximum coarse aggregate size may not vary smaller, but gradation of coarse aggregate may vary; (e) fine aggregate fraction within +0/ 5 percent of that specified; and (f) slump after introduction of admixtures +0/-1 inch. Use of historical mix design data does not allow modification of the project mix specifications herein without the express review and acceptance of the Engineer.

2.03 WATERSTOPS

A. POLYVINYL CHLORIDE (PVC):

PVC waterstops shall be manufactured from virgin polyvinyl chloride conforming to the Corps of Engineers Specification No. CRD-C572. Unless otherwise specified or noted on the drawings, waterstops in construction joints shall be 6-inch flat center/ribbed sides/0.375 inch thick. Acceptable products include: Greenstreak Group, Inc. "Model 679"; Vinylex Waterstops and Accessories "Model R638"; or equal. Waterstops in expansion joints shall be 9 inch center-bulb/ribbed sides/0.375 inch thick. Acceptable products include: Greenstreak Group, Inc. "Model 696"; Vinylex Waterstops and Accessories Model "RLB938"; or equal.

Crosses, tees, and other shapes used for changes of direction, intersections, and transitions shall be molded pieces as recommended by the manufacturer.

B. EXPANDING (HYDROPHILIC) WATERSTOPS:

Expanding waterstops shall be bentonite-free and made from unvulcanized rubber. Acceptable products include: SIKA "SikaSwell P-2010"; Adeka Corporation "Ultra Seal MC-2010MN"; Greenstreak Group, Inc. "Hydrotite CJ-1020-2K"; or equal. These are allowable for use only where indicated on the drawings or accepted in writing by the Engineer. Provide adhesive approved by the waterstop manufacturer where required due to geometry, irregular surface conditions, or as recommended by the manufacturer. The waterstop MUST be placed between two mats or curtains of steel reinforcement. For limited cover applications or where only one mat or curtain of reinforcement is present, use Adeka Corporation "Ultra Seal KBA-1510FP".

C. INJECTED TUBE WATERSTOPS:

Chemical grout injection tube system, if shown on the Drawings, shall be "Injecto System" by De Neef Construction Chemicals or equal. Equivalent systems shall be submitted to the Engineer for review.

2.04 SEALANTS AND JOINT FILLERS

Sealants and preformed joint fillers shall be as specified in Sections 07900 and 07905.

2.05 BONDING COMPOUNDS

Epoxy resin bonding compounds to be used for wet areas shall conform to ASTM C881 Types IV or V, Class A, B, or C depending on temperature at use, and Grade to suit geometry and installation circumstances. Acceptable products include: BASF "Concresive Paste SPL" or "Concresive 1490", as applicable; Sika Chemical Corporation "Sikadur 35" or Sikadur 32", as applicable; or equal.

Non-epoxy bonding compounds may be used in dry areas for non-structural bonding or as specifically noted on the drawings only and shall conform to ASTM C1059 Type II. Acceptable products include: Edoco "Burke Acrylic Bondcrete"; ChemMasters "Cretelox"; or equal.

Bonding compounds shall be applied in accordance with the manufacturer's instructions.

2.06 EPOXY FOR CRACK INJECTION

Epoxy for crack injection shall be a two-component, moisture insensitive, high modulus, injection grade, 100 percent solids, blend of epoxy-resin compounds. The consistency shall be as required to achieve complete penetration in hairline cracks and larger. Material shall conform to ASTM C881 Type 1 Grade 1. Acceptable products include Sika Corporation "Sikadur 52"; Adhesives Technology Corporation "Crackbond SLV302"; or equal. Epoxy grout shall be used for all crack repairs except as noted below for non-structural cracks in liquid-containing concrete. The Engineer shall determine whether a crack is classified as structural or non-structural. Structural cracks must be repaired with epoxy.

2.07 CHEMICAL GROUT FOR CRACK INJECTION

Chemical (hydrophobic polyurethane) grout shall be used at the Engineer's discretion as an alternative to the injection of the epoxy grout for sealing non-structural cracks in structures intended to be watertight. Acceptable products include "Hydro Active Cut" by De Neef Construction Chemicals or SikaFix HH by Sika Corporation, or equal approved by the Engineer.

2.08 RETARDANT

Retardant for exposing aggregates for unformed surfaces in construction joints shall be Sika “Rugasol-S”; W.R. Grace “Top-Cast”; or equal. Retardant shall be applied in accordance with manufacturer’s instructions sufficient to assure a minimum penetration of 1/4 inch.

2.09 CURING AND SEALING COMPOUNDS

Curing and sealing compound shall be BASF Sonneborn “Kure-N-Seal 25LV”; Edoco, “Spartan-Cote VOC”; or equal, conforming to ASTM C309.

Curing compound shall be clear and shall be applied in accordance with the manufacturer’s instructions, except as otherwise specified. Curing and sealing compound shall be certified compliant with final finish systems.

PART 3--EXECUTION

3.01 GENERAL

This section covers the production of cast-in-place concrete. Included are methods and procedures for obtaining quality concrete through proper handling, placing, finishing, curing, and repair of surface defects.

3.02 CONCRETE

Concrete shall be truck-mixed, ready-mixed concrete conforming to the applicable portions of ASTM C94. Materials shall be proportioned by weighing. Pozzolan shall be introduced into the mixer with cement and other components of the concrete mix; pozzolan shall not be introduced into a wet mixer ahead of other materials or with mixing water. Water shall be introduced at the time of charging the mixer; additional water may be introduced within 45 minutes from charging the mixer, provided the specified slump is not exceeded and the maximum total water per the approved mix design is not exceeded. Contractor shall arrange with the testing laboratory for inspection as required to comply with these specifications.

Concrete shall be delivered to the site and discharge shall be completed within 90 minutes after introduction of water to the mixture. Extension of allowable time beyond this limit requires a Contractor proposed remedial action plan to be reviewed and accepted by the Construction Manager.

3.03 CONVEYING AND PLACING CONCRETE

A. CONVEYING CONCRETE:

Concrete shall be conveyed from the mixer to the forms in accordance with ACI 301. Concrete which has segregated in conveying shall be removed from the site of the work.

B. PLACING CONCRETE:

1. GENERAL: Concrete shall be placed in accordance with ACI 301. Do not permit concrete to drop freely more than 4-ft.

2. PLACING CONCRETE BY PUMPING: Concrete may be placed by pumping at Contractor's discretion. Use of pumping shall not, however, be cause to change or relax specified mix design characteristics. Concrete shall possess the specified characteristics at the point of placement.

Slump shall be measured at the hose discharge, except as follows. Initial slump testing in each pour shall occur at both the pumping unit inlet hopper and hose discharge. Slump loss in pumping, measured between the inlet hopper and the hose discharge, shall not exceed 1 inch. After these criteria have been satisfied, slump may be measured at the inlet hopper with allowable slump increased by the earlier measured difference, not to exceed 1 inch.

Air content shall be measured at the hose discharge, except as follows. Initial air content testing shall occur at both the pumping unit inlet hopper and the hose discharge. Loss of air content shall be measured between the inlet hopper and the hose discharge. The air content of the delivered concrete at the inlet hopper shall be increased to provide the specified air content at the hose discharge. After these criteria have been satisfied, air content may be measured at the inlet hopper.

Before starting each pumping operation, the pump and line shall be primed with a cement slurry to lubricate the system. Cement slurry shall be wasted outside the forms. Hose tip shall be equipped with a safety chain for recovery in case of hose blowout during pumping, and in no case shall hose or accessories remain in the freshly placed concrete.

Proper tremie placing techniques and equipment shall be used for all pump placed concrete. Pump discharge system shall remain full of concrete from pump to discharge point at all times. Concrete pumping shall not occur until Construction Manager has verified that the proper equipment is available, in particular, the tremie plug. Should the discharge line become open, with significant zones empty of concrete, then the pumping shall cease and the line re-primed with tremie plug installed before continuing the pour.

3. PLACING CONCRETE IN HOT WEATHER: In hot weather (above 80 degrees F), concrete shall be placed in accordance with ACI 305.1.

4. PLACING CONCRETE IN COLD WEATHER: In cold weather (below 45 degrees F), concrete shall be placed in accordance with ACI 306.1.

C. CONSOLIDATING CONCRETE:

Concrete shall be consolidated in accordance with ACI 301. If proper consolidation is not occurring, then concrete placing shall be suspended until proper consolidation can be achieved.

3.04 CURING AND SEALING

A. GENERAL:

Concrete curing shall be completed by water curing or by using a clear membrane curing compound or by a combination of both methods. Repairs or treatment of concrete surfaces shall be coordinated so that interruption of the curing will not be necessary.

Concrete surface temperature shall be maintained between 50 degrees F and 80 degrees F for at least 5 days. Curing concrete in hot weather (above 80 degrees F) shall be in accordance with ACI 305.1. Curing concrete in cold weather (below 45 degrees F) shall be in accordance with ACI 306.1.

B. WATER CURING:

When water curing is used, concrete shall be kept wet continuously for a minimum of 10 days after placement. Absorptive mats or fabric may be used to retain moisture during the curing period.

Unless otherwise specified, water curing shall be used in hot weather for water containment structures. Forms shall be covered and kept moist. The forms shall be loosened as soon as possible without damage to the concrete, and provisions made for curing water to run down inside them. During form removal, care shall be taken to provide wet cover to newly exposed surfaces.

C. CURING COMPOUND:

When curing compound is used, it shall be applied as soon as the concrete has set sufficiently so as not to be marred by the application or immediately following form removal for vertical and other formed surfaces. Preparation of surfaces, application procedures, and installation precautions shall be followed in strict compliance with the manufacturer's instructions. Curing compound shall be applied at twice the manufacturer's recommended dosage rate in two coats applied perpendicular to each other. Use of curing compound for other than liquid containing structures shall be in accordance with the manufacturer's recommendations.

Curing compound shall not be used on concrete surfaces to be coated, waterproofed, moisture-proofed, tiled, roofed, or where other coverings are to be bonded, unless the curing compound is compatible with the final finish covering or it is removed prior to covering.

3.05 PROTECTION

Concrete shall be protected from injurious action by sun, rain, flowing water, frost and mechanical injury.

Loading green concrete will not be permitted. Green concrete is defined as concrete with less than 100 percent of the specified strength.

Unless otherwise shown on the Drawings, no backfill shall be placed against concrete walls until the concrete has reached the specified strength and the connecting slabs and beams have been cast and have reached the specified strength.

Arrangements for covering, insulating, and protecting concrete in cold weather shall be in accordance with ACI 306.1.

3.06 CONSTRUCTION JOINTS

A. GENERAL:

Concrete in each unit of construction shall be placed continuously. Before new concrete is placed on or against concrete which has set, forms shall be retightened and the surface of the set concrete shall be cleaned of foreign matter. Watertight joints shall be provided as specified in paragraph 03300-3.09.

B. CONSTRUCTION:

Construction joints shall be formed as specified. A rough surface of exposed concrete aggregates shall be produced using a surface retardant at construction joints, including joints between the slab and topping concrete. The limit of the treated surfaces shall be 1 inch away from the joint edges. Within 24 hours after placing, retarded surface mortar shall be removed either by high pressure water jetting or stiff brushing or combination of both so as to expose coarse aggregates. A rough surface of exposed aggregate may also be produced by sandblasting followed by high pressure water jetting. Sandblasting, if used, shall remove 1/4 inch of laitance film and shall expose coarse aggregate to ensure adequate bond and watertightness at the construction joints.

C. LOCATIONS:

Construction joint locations shall be as follows:

1. Walls exceeding 50 feet in length shall be cast in panels not to exceed 30 feet in length. Where the number of panels is three or more, the panels shall be cast in an alternating pattern, unless 5 days have elapsed between casting of adjoining panels. Joints are not allowed within the lesser of 10 feet or 25 percent of the wall length from any corner unless specifically detailed thus on the drawings.

2. Joints in beams or girders shall be located at or near the midpoint between supports.

3. Joints in the members of a floor system shall be made at or near the center of the span.

4. Joints in walls and columns shall be at the underside of floors, slabs, beams or girders and at the tops of footings or floor slabs. Joints in columns shall be perpendicular to the axis.

5. Slabs panels shall be cast in checkerboard patterns not to exceed 40 feet in length and not to exceed 900 square feet in area, with maximum 1 ½ to 1 ratio of side lengths. Minimum lapsed time between placing adjacent panels shall be 72 hours. The requirements for size of slab panel may be waived if joints are specifically located on the Drawings.

Vertical construction joints shall be grooved at faces exposed to view including interior faces of basins and tanks. Grooves subjected to wetting or weather shall be caulked with joint sealer as specified.

Reinforcing steel and welded wire fabric shall be continued across construction joints. Girders and floor slabs shall not be constructed over columns or walls until at least one hour has elapsed to allow for shrinkage in the column or wall. No joint will be allowed between a slab and a beam or girder unless otherwise specified. Joints shall be perpendicular to the main reinforcement. Waterstops shall be provided in construction joints at locations as specified in paragraph 03300-3.09.

3.07 INSERTS AND EMBEDMENTS

A. INSERTS:

Where pipes, castings or conduits are to pass through structures, the Contractor shall place such pipes or castings in the forms before placing the concrete, or he may provide openings in the concrete for subsequent insertion of such pipes, castings or conduits. Such openings shall be provided with waterstops and V-shaped construction joint as shown and shall have a slight flare to facilitate grouting and permit the escape of entrained air during grouting.

Additional reinforcement shall be provided around openings as shown. Grout fill around inserts shall be non-shrink grout as specified in Section 03600.

Horizontal conduits and pipes, where shown in structural slabs and beams, shall be placed between the top and bottom layers of reinforcement. Spacing and size limitations shall conform to ACI 318 Section 6.3 unless specifically approved otherwise by the Engineer. Such conduits and pipes shall not run directly beneath a column or, if used, its steel base plate. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance

between said items and any part of the concrete reinforcement. The outside diameter of such conduits should not exceed one-fourth the slab or beam thickness. Securing such items in position by welding them to the reinforcement will not be permitted.

B. EMBEDMENTS:

Gate frames, gate thimbles, special castings, channels or other miscellaneous metal parts that are to be embedded in the concrete shall be set and secured in the forms prior to concrete placement. Unless otherwise specified, anchor bolts and inserts shall be embedded in concrete as shown. The Contractor shall provide inserts, anchors or other bolts necessary for the attachment of piping, valves, metal parts and equipment. Nailing blocks, plugs, strips, and the like necessary for the attachment of trim, finish, and similar work shall be provided. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids. Operators or sleeves for gate or valve stems shall be positioned to clear reinforcing steel, conduit and other embedments, and to align accurately with equipment.

3.08 EXPANSION JOINTS

Expansion joints shall be as shown. Reinforcement or other embedded metal items bonded to the concrete shall not extend through expansion joints. Waterstops shall be provided in expansion joints as specified in paragraph 03300-3.09.

3.09 WATERSTOPS

Waterstops shall conform to ACI 301. Waterstops shall be securely held in position during placing of concrete. If, after placing concrete, waterstops are materially out of position or shape, the surrounding concrete shall be removed, the waterstop reset, and concrete replaced in accordance with paragraph 03300-3.10.

Waterstops shall be provided at the following joints:

1. Expansion joints in structures.

2. Joints in parts of structures exposed to ground or water on one side and occupied by non-submerged equipment or by personnel on the other.

3. Wall and slab joints of tanks and channels subject to water pressure. Waterstops shall be provided for the full height of the wall, or as otherwise noted on the drawings.

Field splices shall be heat fused welded butt splices only and shall be acceptable only in straight sections. Lapping of splices or joining by any means other than heat fused welding shall not be allowed.

Hydrophilic waterstops shall be installed according to manufacturer’s recommendations. Surfaces of concrete shall be prepared to required level/plumb and smoothness as required by

manufacturer. Form and finish concrete placed first with contact surface requirements in mind, or grind surface if necessary. Provide bonding adhesive if required for the particular product, or if surface conditions warrant. Note restrictions on use described in paragraph 03300-2.03 B.

3.10 MODIFICATION OF EXISTING CONCRETE

A. GENERAL:

Structural dimensions related to or controlled by previously constructed or existing structures shall be verified in the field by the Contractor prior to concrete work.

B. CUTTING OR CORING CONCRETE:

Surfaces exposed to view shall be neatly saw cut to a depth of 1 inch prior to removing the existing concrete. Where existing reinforcement is exposed due to saw cutting or core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy shall be applied to the entire cut surface. Areas that require an oversize opening shall be as shown on the Drawings. The exposed surface of the oversized opening shall be coated with an epoxy bonding compound and re-finished with profiling mortar to the required opening size.

Existing joint edge shall be ground to create a chamfer matching those used adjacent, where occurs. Grind existing to imitate tooled edge.

Unless specifically notified otherwise, Contractor shall investigate concrete to be drilled, cored or sawcut to determine location of existing reinforcing steel. Penetrations shall be located so as to clear existing reinforcing steel if possible. Unless otherwise detailed on the drawings, or where not possible to avoid reinforcing steel, consult the Engineer as to acceptability of cutting reinforcing steel and provide new reinforcing systems as directed. Locating methods include chipping to expose reinforcing steel, ground penetrating radar, X-ray, or magnetic flux devices. Locates of existing reinforcing shall be paid for by the Contractor.

C. JOINING NEW CONCRETE TO EXISTING:

Existing concrete surfaces to be joined with new concrete shall be thoroughly cleaned and roughened by abrasive blasting, bush hammering or other method to achieve ¼-inch amplitude surface. Existing metalwork, embeds or other interfering items shall be removed. Coat existing surface with epoxy bonding compound just prior to placement of new concrete.

D. DOWELS:

Dowels to be installed in existing concrete shall utilize holes drilled with a hammer drill and carbide bit (core drilled holes not allowed), properly brushed and air-cleaned with oil-free compressed air, and an injectable two-component epoxy adhesive. Installation shall conform to manufacturer’s recommendations and to ICC Evaluation Reports.

E. DRILLING HOLES IN EXISTING CONCRETE FOR POST-INSTALLED ANCHORS

Non-destructive methods shall be used for locating reinforcement prior to drilling operations. For anchor locations that interfere with reinforcement, the Contractor shall first attempt to relocate anchors to avoid drilling through the reinforcement.

For situations that do not allow relocation of the anchor, cutting of reinforcement for anchor installation subject to the following will be acceptable:

1. Prior to drilling through reinforcement, the Contractor shall have an experienced individual evaluate the condition. For situations that appear questionable, the Engineer shall be consulted.

2. Holes drilled through reinforcement must be in compliance with adhesive anchor assumptions for roughened hole surface typical of a hammer drill and carbide bit. No smooth hole surfaces are allowed.

3. No slab rebar shall be cut within 24-inches of the supporting wall, column or an opening in the slab.

4. No cutting of rebar is allowed in the middle third of slab spans for anchors with diameters equal to or greater than 3/4".

5. Maximum of two rebar may be cut in any 10-foot width of slab.

6. Maximum of two rebar may be cut within any 10-foot width of concrete wall.

7. Maximum of one rebar may be cut within any 8-foot width of CMU wall.

8. No wall or slab rebar shall be cut within 24-inches of an opening.

For anchors that cannot be moved and that conflict with the above requirements, the Engineer shall be consulted for direction. Under no circumstances will it be acceptable to cut through reinforcement in beams, columns, precast members, and stairs.

F. WATERSTOPS:

Where a waterstop between new and existing concrete is required, Contractor shall install a hydrophilic waterstop unless otherwise noted on the Drawings.

3.11 FORMED SURFACE FINISHES

A. REPAIR OF SURFACE DEFECTS:

Surface defects, including tie holes, minor honeycombing or otherwise defective concrete shall be repaired in accordance with ACI 301. Areas to be patched shall be cleaned. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1 inch. The edges of the cut shall be perpendicular to the surface of the concrete. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set. Patches shall be cured as specified for the concrete. Finished surfaces shall be protected from stains and abrasions. Finishes shall be equal in workmanship, texture, and general appearance to that of the adjacent concrete. Concrete with honeycombing which exposes the reinforcing steel or with defects which affect structural strength shall be corrected.

B. FORMED SURFACE FINISHING:

Formed surfaces shall be finished as soon as practicable after form removal and repair of surface defects. Finishes shall be as follows.

1. FINISH A: Finish A shall be a grout-cleaned rubbed finish in accordance with ACI 301 except that ALL FORM FINS AND OTHER PROTRUSIONS SHALL BE COMPLETELY REMOVED TO THE FINAL SURFACE. Surfaces shall be lightly sandblasted prior to sacking. Sandblasting shall occur after the specified curing period. For interior areas not exposed to moisture or weather, water used in the sacking mortar shall be mixed with a PVA bonding compound as recommended by the manufacturer. Finish A shall be provided for uncoated surfaces at surfaces of stair wells; interior surfaces of equipment rooms, galleries and tunnels; operations areas; exposed channels and tanks from 1 foot below minimum water surfaces and up; and permanently exposed vertical and sloped surfaces, such as pipe chases. Finish A shall not be provided at concrete surfaces receiving a coating.

2. FINISH B: Finish B shall be a smooth surface with all form fins and other protrusions completely removed to the final surface. Finish B shall be provided for coated surfaces. See specification 09900 for concrete surface coatings and surface preparation, including filling bug holes before coating.

3. FINISH C: Finish C shall be a finish which has surface imperfections less than 3/8 inch in any dimension. Surface imperfections greater than 3/8 inch shall be repaired or removed and the affected areas shall be neatly patched. Finish C or smoother shall be provided for interior surfaces of wet wells, tanks and channels from 1 foot below minimum water surfaces and down and otherwise unfinished interior surfaces.

4. FINISH D: Finish D shall be the finish for surfaces which may be left as they come from the forms, except that tie holes shall be plugged and defects greater than 1/2 inch in any dimension shall be repaired.

C. SAMPLES OF FORMED SURFACE FINISH:

A sample concrete panel, 2 feet by 2 feet, representative of formed surface Finish A shall be provided to the Construction Manager. The panel shall be representative of the workmanship and finish required, including filling of tie holes. The sample shall be deemed acceptable by the

Construction Manager prior to the start of such work. The sample shall be on display at the job site, and finished surfaces shall match sample.

3.12 SLAB FINISHES

A. GENERAL:

The finishes specified herein include surface finishes, treatments and toppings for floors and slabs. Dry cement shall not be used on new concrete surfaces to absorb excess moisture. Edges shall be rounded to a radius of 1/2 inch. Joints shall be grooved to a radius and depth of 1/4 inch each. Finishes shall match the sample panels provided under paragraph 03300-3.12E.

Floors shall be sloped to drain uniformly within a room or space. Unless otherwise specified, slope shall be a minimum of 1/8 inch per foot toward nearest drain. Where finish is not specified, floor slabs shall receive steel troweling. Use of floor drains with only locally depressed slabs shall be coordinated with Construction Manager if detailed on the drawings, and restricted to locations specifically noted.

B. FLOAT FINISH:

Floating shall be performed with a hand or power-driven float in accordance with ACI 301. Begin floating when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit operation of the specific float apparatus. Floating of any one area shall be the minimum necessary to produce a finish that will meet tolerance requirements of ACI 117 for a conventional surface. Refloat the slab immediately to a uniform texture. Floating shall compact and smooth the surface and close any cracks and checking of surfaces. Float finish shall be applied to surfaces of channel, tank bottom slabs, tops of footings, and steps and surfaces to receive roofing and insulation.

C. STEEL TROWEL FINISH:

Float the concrete surface and then trowel in accordance with ACI 301. Immediately after final troweling, the surface shall be cured and protected as specified in paragraphs 03300-3.04 and 03300-3.05. Steel trowel finish shall be provided on floors unless specified otherwise.

D. BROOMED FINISH:

Immediately after concrete has received a floated finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface in accordance with ACI 301. Broomed finish shall be provided for walks, tops of tanks, slabs-on-grade exposed to atmosphere, and where otherwise indicated or specified.

E. SAMPLES OF CONCRETE FLOOR FINISHES:

A sample concrete panel, 2 feet by 2 feet, representative of each specified finish, shall be provided to the Construction Manager. The panels shall be representative of the workmanship and finishes required. Samples shall be approved in field prior to the start of such work.

3.13 TOPPING CONCRETE

A. SUBFLOOR FINISH:

Slabs to receive topping, tile or grout as shown shall be float finished to required elevations. Immediately following the final finishing, the slab shall be treated with a retardant.

B. TOPPING CONCRETE:

These requirements shall apply to the placement of normal concrete topping, with or without surface hardener, on a cured concrete substrate.

Slabs to receive topping concrete shall have an exposed aggregate subfloor finish as specified in paragraph 03300-3.13 A, or have a ¼ inch amplitude roughened surface using abrasive blast or raked finish after floating. Dirt, laitance and loose aggregate shall be removed. The cleaned base shall be kept wet for a period of 24 hours prior to the application of topping. Excess water shall be removed, and a neat cement grout shall be applied and brushed into the surface of the base. The cement grout shall not be allowed to dry and shall be spread within 15 minutes of the topping placement. The topping shall then be placed, compacted, and floated. The surface shall be tested with a straightedge to detect high and low spots of over 1/8 inch in 10 feet, which shall be eliminated.

Surface hardener shall be incorporated where specified. When the floor has hardened sufficiently, it shall receive a steel trowel finish. Structural, non-exposed topping may be float finished only.

3.14 RELATED SURFACES

A. STAIR TREAD:

Stair tread shall be constructed with nonskid nosing as specified in Section 05530. Tread shall have a steel trowel finish and shall have a slope of 1/8 inch per foot toward the front. Ends of treads shall have a 1/16 to 1/8 inch cut between concrete and metal tread to allow for expansion.

B. FINISHING OF UNFORMED SURFACES:

1. RELATED UNFORMED SURFACES: Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the adjacent formed surfaces. Final treatment of formed surfaces shall continue uniformly across the unformed surfaces.

2. PAVEMENTS AND SIDEWALKS: The surfaces of the concrete shall be screeded to grade and sloped to drain. After screeding, the surface shall receive a broomed finish as specified in paragraph 03300-3.12 D. Edges and expansion joints shall be rounded to a radius of ½ inch. Joints shall be grooved to a radius and depth of 1/4 inch each.

3.15 FIELD SAMPLING AND TESTS

A. GENERAL:

Field sampling and testing shall be performed by the independent testing laboratory. Samples of aggregates and concrete shall be taken at such times to represent the quality of the materials and work throughout the project. The laboratory shall provide the necessary labor, materials and facilities for sampling the aggregate and for casting, handling and initially storing the concrete samples at the site of work. Aggregates shall be sampled in accordance with paragraph 03300-3.15 B not less than 30 days prior to the use of such aggregates in the work. The minimum number of samples and tests are specified in paragraph 03300-3.15 C.

B. SAMPLING:

1. AGGREGATES:

a. GENERAL: Fine and coarse aggregates shall be sampled in accordance with ASTM D75. Samples shall be taken at the discharge gates of the bins feeding the weigh hopper. The Contractor shall provide safe and suitable facilities for obtaining samples. Samples shall be obtained at the concrete batch plant at the frequency specified in paragraph 03300-3.15 C. Sampling shall be repeated when the source of material is changed or when unacceptable deficiencies or variations from the specified requirements of materials are found in testing. Aggregate samples shall be tagged and their sources identified.

b. COARSE AGGREGATE: A sample weighing between 50 and 60 pounds shall be taken after the batch plant is brought up to full operation. The samples shall be taken so that a uniform cross section, accurately representing the materials on the belt or in the bins, is obtained.

c. FINE AGGREGATE: Samples shall be taken as specified for coarse aggregate. The samples shall be taken for sieve analysis of fine aggregate and specific gravity tests. Samples of sand shall be taken when the sand is moist.

2. CONCRETE: Samples of plastic concrete shall be obtained in accordance with ASTM C172. Samples shall be taken at the hopper of concreting equipment or transit mix truck, except as noted in 03300-3.03B.2

C. TESTING:

1. AGGREGATE: A minimum of one test of coarse aggregate per 400 cubic yards of concrete and a minimum of one test of fine aggregate per 200 cubic yards of concrete used

shall be made to confirm continuing conformance with specifications for gradation, cleanliness and sand equivalent. A maximum of one test per day of each aggregate is required. The full test program is required before source changes will be accepted.

2. CONCRETE:

a. STRENGTH TESTS: The strengths specified for the design mix shall be verified by the independent testing laboratory during placement of the concrete. Verification shall be accomplished by testing standard cylinders of concrete samples taken at the job site. Cylinders shall be 4 by 8 inch or 6 x 12 inch.

Standard cylinders shall represent the concrete placed in the forms. One set of six standard 6 x 12 inch (or nine 4 x 8 inch) cylinders shall be cast of each class of concrete for each 100 cubic yards or less or for each 5,000 square feet of surface area placed per day. Casting, handling and curing of cylinders shall be in accordance with ASTM C31. Additional cylinders shall be provided when an error in batching is suspected. For the first 24 hours after casting, the cylinders shall be kept moist in a storage box constructed and located so that its interior air temperature will be between 60 and 80 degrees F. At the end of 24 hours, the cylinders shall be transported to the testing laboratory.

Testing of specimens for compressive strength shall be in accordance with ASTM C39. Tests shall be made at 7 and 28 days from time of casting. Two 6 x 12 inch (or three 4 x 8 inch) test cylinders from each group of six (or nine) shall be tested at the end of 7 days and two 6 x 12 inch (or three 4 x 8 inch) shall be tested at the end of 28 days. The two remaining 6 x 12 inch (or three 4 x 8 inch) cylinders shall be tested at the end of 56 days if the 28-day strength reports below specification. A strength test shall consist of the average strength of two 6 x 12 inch (or three 4 x 8) cylinders cast from material taken from a single load of concrete. If one cylinder shows evidence of low strength due to improper sampling, casting, handling or curing, the result of the remaining cylinders may be used if approved by the Construction Manager.

The average of any three consecutive 28-day strength test results of the cylinders representing each class of concrete for each structure shall be equal to or greater than the specified strength and not more than 10 percent of the strength test results shall have values less than the specified 28-day strength for the total job concrete. No individual strength test result shall be less than the specified strength by more than 500 pounds per square inch.

Certified reports of the test results shall be provided directly to the Construction Manager. Test reports shall include sufficient information to identify the mix used, the stationing or location of the concrete placement, and the quantity placed. Slump, air content, temperature of concrete, and ambient temperature shall be noted. The 28-day strength test results shall be evaluated in accordance with ACI 214R. Quality control charts showing field test results shall be included with the test results for each class of concrete in each major structure. Charts shall be prepared in accordance with ACI 214R. Quality control charts shall be maintained throughout the entire job and shall be available for the Construction Manager’s inspection at any time.

If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the Contractor's expense. Changes and adjustments shall be reported in writing to the Construction Manager.

If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the Construction Manager. Costs of such tests shall be borne by the Contractor.

b. TESTS FOR CONSISTENCY OF CONCRETE. The slump shall be as specified when measured in accordance with ASTM C143. Samples for slump determination shall be taken from the concrete during placement. Tests shall be made at the beginning of concrete placement operation and at subsequent intervals to ensure that the specification requirements are met. Slump tests shall also be performed whenever standard cylinders are cast. For pumped concrete, slump shall be measured in accordance with paragraph 3.03B.2.

When high range water reducers are added at the site, slump tests shall be taken before and after addition of high range water reducing admixtures.

c. TESTS FOR TEMPERATURE AND AIR CONTENT: Temperature tests shall be made at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Whenever standard cylinders are cast, temperature tests shall be performed.

Air content shall be as specified when measured in accordance with ASTM C231. Air content shall be measured whenever standard cylinders are cast. For pumped concrete, air content shall be measured in accordance with paragraph 3.03B.2.

D. FINAL LABORATORY REPORT:

A final report, prepared by the testing laboratory, shall be provided at the completion of all concreting. This report shall summarize the findings concerning concrete used in the project and provide totals of concrete used by class and structure. Final quality control charts for compressive strength tests for classes of concrete specified in each major structure shall be included. The report shall also include the concrete batch plant's coefficient of variation and standard deviation results for each class of concrete.

3.16 REPAIR OF DAMAGED CONCRETE, CRACKING:

A. ACCEPTANCE OF CONCRETE:

Completed cast-in-place concrete work shall conform to the applicable requirements of ACI 301 and the Contract Documents. Concrete work that fails to meet the requirements of ACI 301 or the Contract Documents shall be repaired as approved by the Engineer to bring the concrete into compliance. Concrete that cannot be brought into compliance by approved repair methods will be

rejected. Rejected concrete work shall be removed and replaced. Repair methods shall be in accordance with ACI standards and are subject to the approval of the Engineer. The cost of repairs and replacement of defective concrete shall be borne by the Contractor.

B. REPAIR METHODS:

Damaged or excessively cracked concrete, as determined by the Engineer in their sole discretion, shall be repaired by one of the following methods as approved by the Engineer:

1. Repair Method 1: Fill the joint or crack by drilling holes to the affected area, install injection ports and force epoxy or chemical grout (expanding urethane) into the joint under pressure. The material type, whether epoxy or chemical grout shall be approved by the Engineer. After injection and curing, ports, sealing mix and surface generally shall be cleaned and worked to match the specified finish.

2. Repair Method 2: Fill cracks with low viscosity epoxy, applied by pouring/flooding crack zone until cracks are filled. Prepare surface, install, and cure according to manufacturer's recommendations. At a minimum, prepare surface to result in a clean, dry surface and with no visible detrimental material in cracks to be filled. Conform to temperature limitations for epoxy to be used. Finish to match adjacent areas.

3. Repair Method 3: Cut a bevel groove 3/8 to 1/2 inch in width and depth, and caulk with sealant in accordance with manufacturer's instructions. This repair method is only to be used where expressly allowed by the Engineer. Groove and caulk shall be applied on wet or hydrostatic pressure side of surface where occurs.

C. REPAIR METHOD USE:

1. Repair Method 1 shall be used for all cracks in walls, surfaces sloped 1:1 or greater, beams, columns, slabs, overhead surfaces and generally for liquid retaining surfaces. Need for repair depends upon crack width, location, and surface conditions under service conditions. Epoxy grout shall be used for repair of structural cracks and chemical grout (expanding urethane) shall be used for repair of non-structural cracks at liquid-containing structures. The Engineer shall determine whether a crack is classified as structural or non-structural.

2. Repair Method 2 may be utilized in lieu of Method 1 for slabs which receive a raked finish. Method 2 may also be used with Construction Manager's approval for exposed troweled and broomed finishes after review of conditions, degree of exposure to public, and proposed repair product and installation. Finish shall substantially match adjacent surfaces.

3. Repair Method 3 shall be limited to dry-surface slabs, walls subject to less than three feet of liquid pressure, or as specifically directed by the Engineer. Method 3 is not an equivalent repair method to Methods 1 or 2, which shall be considered the standards.

3.18 WATERTIGHTNESS TESTING AND REPAIR

A. WATER RETAINING CONCRETE TANKS AND CHANNELS:

Concrete tanks, basins, reservoirs and channels which have walls or slabs subjected to hydrostatic pressure shall be tested for watertightness. The tests shall be made after the structure is complete and the concrete has achieved its specified 28-day strength, but prior to application of waterproofing coating or backfilling. Filling of the tank for the watertightness test shall not exceed a rate of 4 feet/hour. Filling with water at this maximum rate shall continue to the maximum operating water surface. The water shall be kept at this level for at least 72 hours and then the dry sides of all walls and the base perimeter of the slab shall be visually inspected for evidence of leakage. Damp spots, leakage, or seepage revealed by the test, including those caused by shrinkage of concrete, honeycombed areas, construction joints, or other sources shall be repaired by Method 1, paragraph 03300-3.16-B.1. Damp spots are defined as spots from which water that can be picked up on dry hand.

The Contractor shall re-test tanks or channels which have been repaired to check the suitability of repairs. Water required for testing and re-testing shall be provided by the Contractor and disposed of so as not to create a nuisance.

All liquid retaining or conveying concrete structures must also meet maximum leakage criteria set forth in ACI 350.1 as follows:

Structure Type	ACI 350.1 Designation	Tightness Criterion
Cylindrical water and wastewater storage tanks and reservoirs other than digesters	HST-025	0.025% per day
Digesters	SHT-050	0.050% per day (surcharged hydrostatic test)
Rectangular basins and tanks	HST-050	0.050% per day
Concrete paved reservoirs and channels	HST-100	0.10% per day

Note: All damp spots on or leakage through walls or wall-to-slab joints shall be repaired as described above. Leakage equal to or less than the values shown in the table above is permitted only through the base slab or mat foundation.

Volume loss shall be measured by measuring the vertical distance from the water surface to a fixed point on the tank above the water surface taking into account evaporation from open surfaces. If the drop in water surface in the 24-hour period exceeds the values given in the table above, exclusive of evaporation, the leakage shall be considered excessive and shall be remedied.

3.19 CLEANUP

Upon completion of the work and prior to final inspection, the Contractor shall clean all concrete surfaces. The cleaning procedures shall be as follows: After sweeping with an ordinary broom to remove the loose dirt, the surface shall be flushed with clean water. Final scrubbing by hand or machine shall follow.

Floors that have curing and sealing compound shall be cleaned of loose dirt and debris by sweeping with ordinary brooms. They shall then be washed and mopped with clean water. Finally, one additional coat of the same clear curing and sealing compound shall be applied in the same manner as specified.

END OF SECTION

SECTION 03481
PRECAST CONCRETE VAULTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory design and manufacture of precast concrete vault sections and accessories.

B. Quality assurance and control.

C. Field installation of vaults.

D. Waterproofing and epoxy coating of vaults.

E. Installation of frames, hatches, and fall protection.

F. Ladders and safety devices.

G. Vault schedule.

H. For precast concrete manholes and accessories, see section 02605.

1.02 RELATED SECTIONS

A. Section 03110 - Concrete Forming

B. Section 03200 - Concrete Reinforcement

C. Section 03300 – Cast-In Place Concrete

1.03 REFERENCES

Reference	Title
ASTM C150	Portland Cement
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C478	Precast Reinforced Manhole Sections
ASTM C858	Underground Precast Concrete Utility Structures
ASTM C913	Precast Concrete, Water, and Wastewater Structures
ACI 301	Specifications for Structural Concrete Buildings
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 315R	Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
ACI 318	Building Code Requirements for Structural Concrete
CRSI 63	Recommended Practice for Placing Reinforcing Bars

1.04 DESIGN

A. All vaults shall be designed by a licensed professional engineer registered in the State of South Carolina, and engaged by the manufacturer. All dead loads, live loads, flotation, erection, temperature and anchorage stresses shall be considered.

B. The calculations and drawings shall be prepared in a neat and legible manner, sealed by the licensed Professional Engineer performing the calculations.

C. The sealed calculations shall include a summary page to list all design loads, material specifications, and design criterion used in the calculations.

D. For design, groundwater shall be assumed at the top of the vault and the design shall provide for a 1.5 percent factor of safety against floatation.

E. Vaults shall be designed for H-20 wheel load on top slab, hatches, and surcharge loading at grade around all sides of the vault.

1.05 SUBMITTALS

A. Submit evidence that shows current PCI, NPCA, and/or SCDOT certification.

B. Submit shop drawings of wall sections and bases proposed for this project, include joint design and related details for field assembly as applicable.

C. Submit certification of conformance with Contract Documents and ASTM C858.

D. Submit catalog cut and installation details for aluminum hatches with fall protection grates, and ladders with safety devices

E. Submit catalog cut for epoxy coating system used at interior surfaces and waterproofing system used on exterior surfaces.

F. Under a separate submittal, provide two file copies of calculations for each vault indicating all loads and load combinations. Other than the summary page, calculations will not be reviewed; calculations will not be returned to Contractor.

1.06 QUALITY ASSURANCE

A. Manufacturer shall be a PCI, NPCA, and/or SCDOT-certified plant for production of precast vaults as specified herein.

B. Aggregate used in producing concrete shall be from SCDOT approved sources.

1.07 QUALITY CONTROL INSPECTION

A. The quality of all materials, the process of manufacture and the finished sections shall be subject to inspection by Engineer. Such inspection may be made at the place of manufacture and/or at the Site after delivery.

B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface shall be dense, close-textured and free of honeycomb, cracks, roughness, exposure of reinforcement, damaged joints, or other irregularities.

C. All sections which have been damaged after delivery will be rejected, or if already installed, shall be repaired or removed and replaced entirely at Contractor's expense.

D. Rejected sections shall be tagged as such, segregated from other sections, and removed from the Site.

PART 2 PRODUCTS

2.01 CONCRETE

A. Minimum 28-Day Compressive Strength - 4500 psi.

2.02 REINFORCEMENT

A. Reference Section 03200.

2.03 PRECAST OR CAST-IN-PLACE CONCRETE BASES

A. Design and manufacture of precast concrete bases shall conform to the requirements of this section and ASTM C858. Cast-in-place concrete bases shall conform to Section 03110 and Section 03300.

B. Bases shall conform to the dimensions indicated on the Drawings or as required by design. The horizontal joint at the top of the base shall be compatible with that of the precast wall section.

C. Sumps shall be field constructed where shown on the Drawings. Walking surfaces shall be sloped to the sump, have a non-slip broom finish, and be sealed with a penetrating concrete sealer. Minimum concrete fill thickness at sumps shall be two inches.

2.04 PRECAST CONCRETE WALLS

A. Design and manufacture of precast concrete walls shall conform to the requirements of this section and ASTM C858.

B. All tongue-and-groove joints in the precast wall, including the joint at the top of the base, shall be made up using gaskets.

C. The precast sections shall be provided with a special groove to receive and hold the gasket in position during joint assembly.

D. After joint assembly, the gap between sections shall be packed on the inside and outside with "Masterflow 713" by Master Builder; "Five Star Grout" by U.S. Grout Corp.; or equal, and shall be troweled smooth so that no projections remain on the inside. There shall be concrete to concrete bearing between the various sections. The gasket shall not support the weight of the section.

2.05 PRECAST CONCRETE SLAB TOPS

A. Precast reinforced concrete slab tops shall be manufactured in accordance with ASTM C858. Openings and frames shall be provided for hatches where shown on the Drawings. Slab tops shall be set in a full bed of mortar.

B. Slab tops shall be crowned or sloped to drain, minimum 1/4 inch per foot.

C. Concrete slab tops shall receive a non-slip broom finish and a penetrating concrete sealer per Section 03300.

2.06 GRATING TOPS

A. Where grated tops are shown on the Drawings, the Contractor shall supply fabricated grating frames to the precast manufacturer and coordinate the grating installation for a complete Project.

2.07 PIPE SEALS

A. Where polyethylene, plastic or PVC pipe is utilized, connections between vault and pipes shall be made with flexible rubber sleeves with stainless steel straps and bolts. Provide an elastomeric waterstop gasket where sleeve sizes are not commercially available.

B. The annular space around the pipe wall or sleeve shall be packed with “Masterflow 713” by Master Builders, “Five Star Grout” by U.S. Grout Corp.; or equal. Before the grout has set, Contractor shall recheck invert elevations of the pipe.

C. For steel or ductile iron pipe, provide a pipe sleeve sized to accept the pipe plus a modular mechanical seal such as Link Seal or equal.

2.08 HATCHES

A. Hatches are described in Section 02605.

2.09 LADDER (NOT USED)

2.10 OPENINGS AND INSERTS

A. All openings required in the concrete shall be reinforced with additional diagonal bars tied to each layer of wall or slab reinforcement.

B. Any required pipe sleeves, inserts, and wall openings shall be coordinated with mechanical requirements prior to casting the units.

2.11 WATERPROOFING

A. Around the exterior of all wall joints, apply the “Bituthene” primer and membrane waterproofing system by W.R. Grace Company, or equal.

B. Exterior wall surfaces shall be waterproofed using manufacturer’s standard two-coat system, specifically designed to waterproof the exterior of concrete surfaces in a below-grade submerged condition.

C. For the top slab and above-grade exposed side walls, the concrete shall be sealed with two coats of a penetrating concrete slab sealer.

2.12 EPOXY COATING

A. After construction and testing, the interior surface of the wet well shall receive a factory applied epoxy coating as specified in section 02763. Apply at wall surfaces (full height) and ceiling.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subgrade elevations for vault base is correct, excavation is dewatered, and subgrade is pre-compacted.

B. Verify that rejected units have been removed from Site.

3.02 PREPARATION

A. Provide foundation mat of run-of-crusher stone to support base. Mat shall be 6 inches minimum depth and shall bear on sound undisturbed earth; excavate and remove subgrade material as necessary to reach sound subgrade.

B. Stone foundation mat shall be a minimum of 1 foot greater than the footprint of the vault base, and shall be compacted to a uniform, level surface.

3.03 INSTALLATION

A. Vault shall be accurately located and uniformly supported on the foundation mat in a level position.

B. Install wall sections in properly oriented position; follow manufacturer's instructions for joining together each section using the gaskets. Pack joints with grout.

C. Units shall be laid-up plumb and level.

D. Contractor is responsible for the integrity of all materials and protection against flotation during the installation and backfilling process.

3.04 COATINGS

A. All exterior below-grade wall joints shall be sealed using a membrane waterproofing system. Next, all below-grade wall surfaces shall be waterproofed, applied per manufacturer's instructions.

B. After installation is complete, the cover slab and interior walking surfaces shall be sealed as specified above.

C. After installation of mechanical equipment, provide touch-up painting of damaged epoxy wall finish.

3.05 BACKFILLING

A. Backfill using well compacted structural fill material, being careful to not damage exterior waterproof coating while providing full support under connecting pipes using compacted bedding material.

B. During the one year warranty period, all visible leaks shall be sealed in an approved manner.

3.06 SCHEDULE OF VAULTS

Vault Identification	Reference Drawing
MH-A-9	100-C-03
MH-A-44	100-C-13

END OF SECTION

DIVISION 11

EQUIPMENT

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SECTION 11109

FABRICATED SLIDE GATES

PART 1--GENERAL

1.01 SUMMARY

A. This section specifies the minimum requirements for corrosion-resistant fabricated slide gates (gates) for control of wastewater flow as shown on the Drawings and specified herein. Gates shall be all 316L stainless steel construction. The scope of supply shall include gate frames, slides, seals, stems, stem guides, operators, floor stands, gate enclosures where specified, and all other appurtenances, in-place and complete.

B. EQUIPMENT LIST: Equipment provided under this section is listed in paragraph 1.04, Service Requirements.

1.02 QUALITY ASSURANCE

A. REFERENCED STANDARDS: This Section incorporates by reference the latest revisions of the following documents. In case of conflict between the requirements of this Section and the listed documents, the requirements of the Contract Specifications shall prevail.

Reference	Title
ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
AWWA C561-12	Fabricated Stainless Steel Slide Gates
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

B. UNIT RESPONSIBILITY: Unit responsibility is assigned to the gate manufacturer (Manufacturer) for the gates and appurtenances specified in this Section.

C. All gates for this project shall be supplied by the same Manufacturer, who shall be fully experienced, reputable and qualified in the manufacturing of the equipment furnished and who has been fabricating gates and appurtenances for a minimum period of 10 years.

1.03 SUBMITTALS

A. PROCEDURES: Section 01300.

B. Product information, calculations, charts and graphs demonstrating compliance with the requirements of this Section and the Drawings.

C. Plans, elevations, sections, and details showing dimensions and mounting requirements for each gate specified.

D. Manufacturer's data including materials of construction, construction details of equipment, and weight of equipment.

E. Manufacturer's product literature.

F. Certificate of unit responsibility.

G. Results of factory testing including leak testing per AWWA C-561, Section 5.22.

H. Name, location and qualifications of the passivation shop.

I. Certification attesting that all gate components have been cleaned, passivated and tested in accordance with the procedures described in this section

J. Manufacturer's operation and maintenance manual defining maintenance requirements.

1.04 SERVICE REQUIREMENTS

A. PERFORMANCE REQUIREMENTS

1. Gates are intended to isolate channels and pipes or to control water surface elevations.

2. Gates shall be designed for the Design Head specified. The Design Head is defined as the maximum head that will be applied to the gate. The Design Head is measured from the maximum water surface elevation to the bottom of the gate.

3. Slides and frames shall have a safety factor of 5 with regard to ultimate tensile, compressive and shear strength; calculations shall be submitted to show conformance.

4. Gates shall comply with field leakage tests as defined in AWWA C561.

5. Gates shall not require exercise at a frequency of more than once per year to meet the extended warranty requirements described in this section.

6. Gates shall be passivated prior to shipping in accordance with the requirements of this section.

B. See the Gate Schedule for specific dimensional and design requirements.

Gate Schedule

Equipment Number	Gate Type[a]	Size WXH[b] (inches)	Frame Type[c]	Frame Mounting[d]	Design Head[e], feet		Operator Type[f]	Operator Mount[g]	Special Feature[h]
					Seating	Unseating			
SG-101	S	42 x 42	NSC	2	24	NA	MH	SP	
SG-102	S	36 x 36	NSC	2	24	NA	MH	SP	
SG-103	S	36 x 36	NSC	2	18	NA	MH	SP	
SG-104	S	30 x 30	NSC	2	18	NA	MH	SP	

a. C = channel, S = Sluice, W = weir
b. Nominal size of opening (aperture style gates) or channel width x slide height (channel and weir gates). See Drawings for additional dimensional requirements.
c. SC = self contained, NSC = non self contained
d. 1 = embedded frame/sill, 2 = wall mounted with embedded sill, 3 = upper section of frame wall mounted with sill and lower portion of frame embedded (e.g., sluice style gate mounted in channelized structure), e = flange mounted
e. Design Head is the maximum water surface elevation minus the invert elevation of the gate.
f. MH = manual hand wheel, MFN = manual 2" floor nut, E = electric motor
g. YTT = yoke-mounted torque tube, SP = structure-mounted pedestal, YA = yoke-mounted actuator, WB = wall bracket
h. RB = radius bottom, DS = dual stem, EN = stainless steel enclosure.
i. The unseating head indicated would be an unusual condition resulting from a closed gate on a pressurized forcemain. For this condition, the gate would not need to seal the pipe to AWWA standards but the gate would need to withstand the resulting force without damage to the gate or seals.

1.05 COMPONENT SIZING

A. Operating forces used for determining the strength of gate components (yokes, frames, slides, stems, slide nut pockets, and other load-bearing members) shall be based on the sum of the guide friction force (computed using an opening breakaway friction factor of 0.2) and the weight of slide and stem.

B. When the gate is in motion, the operating forces shall be based on the sum of the frictional force (using a guide friction factor of 0.25) and the weight of slide and stem.

1.07 PICKLING AND PASSIVATION OF STAINLESS STEEL

A. GENERAL:

1. Equipment specified under this section shall be cleaned, descaled and passivated in accordance with methods defined in ASTM A380 – *Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts,* and the specific requirements of this section.

2. For purposes of this section, passivation is defined as the removal of exogenous iron or iron compounds from the surface of stainless steel by means of treatment with an acid solution that will remove the surface contamination but will not significantly affect the stainless steel itself.

3. The processes specified in this section shall be performed in an environmentally controlled shop with at least 5-years experience performing nitric-hydrofluoric acid solution pickling in compliance with all state and federal laws. The equipment manufacturer shall submit the name and qualifications of the passivation shop in accordance with the submittal requirements of Section 01300 prior to shipping parts for passivation.

4. Equipment components that bolt together shall be disassembled prior to passivation treatment to allow for effective circulation and removal of cleaning solutions.

5. All fasteners and anchor bolts required for assembly and mounting of equipment shall be batch processed at the passivation shop, then dried and sealed in plastic bags and labeled.

6. The use of "fabricator's crayons" shall be prohibited during fabrication of equipment as these marks may prevent proper passivation.

B. PASSIVATION PROCESS REQUIREMENTS:

1. The processes required for proper passivation shall include precleaning, chemical descaling, neutralization, post-cleaning inspection, testing, certification, and protection as defined below.

   a. Precleaning – Precleaning required for the removal of all grease, oil, paint, soil, grit and other gross contaminants preparatory to the fabrication process shall be accomplished by vapor degreasing, immersion or spray application of alkaline or emulsion cleaners, steam, or high pressure water jetting.

   b. Chemical Descaling –Chemical descaling (pickling) shall be accomplished by immersion bath or spray application of a nitric-hydrofluoric acid solution to produce a matt white, pristine appearance. The acid solution and process used shall conform to Code B, Table A1.1, ASTM A380.

   c. Neutralization – The chemical reactions of the pickling media shall be stopped by rinsing of the part with a 10 percent soda ash solution for a minimum of 30-minutes followed by a water bath using high pressure water jetting. The pH of the wetted part surface shall be same as the water used for rinsing.

   d. Post Cleaning Inspection – Post treatment inspection of the chemically pickled and neutralized part shall exhibit a clean surface with no signs of etching, pitting, or frosting resulting from the pickling procedure.

   e. Testing – The passivated part shall be tested for the presence or absence of free iron with a solution of potassium ferricyanide as defined in Verification Test Practice E, ASTM A967. The test solution shall be mixed and used within 24-hours or less and applied with sterile cotton swabs. The test result shall indicate an absence of free iron on the surface of the part.

   f. Certification – All parts passivated shall be certified by an officer of both the manufacturer and the passivating shop as having been cleaned and passivated and tested in accordance with the procedures described in this section. Test results shall indicate an absence of free iron on all

passivated surfaces. Submit certification prior to shipping the equipment to the project site. Equipment that is not certified will not be accepted.

g. Protection – Protection shall be provided by applying shrink wrap to all parts of the equipment sufficient to prevent exposure of passivated surfaces to contaminants during handling, shipping and installation. Protected equipment shall be tagged with highly visible warning signs stating the equipment has been passivated and shall only be opened by authorized personnel. Equipment arriving at the project site without proper protection will require retesting for the presence of free iron and re-passivation if free iron is detected.

C. Assembly of equipment following passivation – If assembly of bolted parts is required following passivation, it shall be done at the manufacturing facility under clean conditions such that the parts will not be contaminated with exogenous iron or iron compounds. Following assembly, retest for the presence of free iron per ASTM A967 and treat any contaminated areas with citric acid solution. Equipment requiring assembly shall be re-shrink wrapped sufficient to prevent exposure of passivated surfaces to contaminants during handling, shipping and installation.

D. WITNESS OF PASSIVATION PROCESS:

1. The Owner retains the right to witness the stainless steel passivation process. Provide at least 30-days notice prior to start of passivation process.

PART 2--PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Gates shall be all stainless steel construction. Acceptable manufacturers include the following:

1. Stainless steel slide gate manufacturers:

a. Whipps, Inc. Athol, Massachusetts
b. Fontaine International Corporation, Orange Massachusetts
d. Waterman Industries, Exeter California

B. The manufacturer's standard models or products may require modifications to conform to specified requirements.

2.02 MATERIALS

A. Materials of construction shall be as follows:

Component	Material
Slide	ASTM A240 Type 316L stainless steel
Frame	ASTM A276 Type 316L stainless steel

Component	Material
Slide Seats	ASTM D4020 UHMW Polyethylene
Seating faces or seals	ASTM D4020 UHMW PE
Stem and supports	ASTM A276 Type 316 stainless steel
Fasteners, adjusting hardware, and anchors	ASTM A276 Type 316 stainless steel
Yoke	ASTM A276 Type 316L stainless steel
Flush bottom seal	Resilient synthetic rubber bonded to frame or ASTM D2000 neoprene
Pedestal/Torque Tube	ASTM A276 Type 316L stainless steel
Enclosure	ASTM A276 Type 316L stainless steel

2.03 FEATURES

A. GENERAL:

1. Mounting requirements as shown on the Drawings and specified in this section.

2. Unless otherwise indicated, provide gates with rising stems with clear, graduated plastic covers in accordance with AWWA C561.

3. Weir gates having a width greater than 60 inches shall have dual stems mechanically linked to a common operator.

4. Stainless Steel Passivation: All stainless steel components to be cleaned, descaled, and passivated after fabrication in accordance with ASTM A380 and the specific requirements of this section.

B. SLIDE:

1. Slides shall consist of steel plate reinforced with steel members welded to the plate. Minimum thickness of the steel plate shall be ¼".

2. Slides shall be reinforced with horizontal stiffeners welded to vertical stiffeners. Slides shall not deflect more than 1/1000 of the span of the gate under the design head.

3. Gates with an opening width x design head of 80' or greater shall incorporate a 3" minimum structural edge extended into the guide grove or design equivalent.

4. The slide manufacturer shall submit drawings and comprehensive design criteria to substantiate that the maximum deflection for each slide has not exceeded 1/1000 of the span regardless of the type used. Comprehensive safety factor calculations shall include bending moments, buckling stress, and bonding stress with thermal expansion factors. Safety factors shall be calculated for the slide

under the maximum head indicated in this section, and for shear at the slide/seal interface.

C. FRAME:

1. Guide frames extending above operating floors or slabs shall be self-contained and sufficiently strong so that no further support or reinforcement is required. Frames for self-contained gates shall be designed for maximum loads imposed by gate operators in the stalled condition plus the weight of the slide, stem, torque tube or pedestal, and operator.

2. The yoke shall be formed by two structural members welded at the top of the guides to provide a one-piece rigid frame and configured to enable slide removal without removing the yoke. The yoke shall be designed to support the maximum stall force applied by the operator in addition to the weight of the stem, torque tube or pedestal, and operator where this equipment is being supported at the yoke.

3. The frame shall be designed with a minimum factor of safety of 4 with regard to ultimate tensile, compressive, and shear strength.

4. Wall-mounted frames shall be the flanged type**.** Guides for wall mounted frames shall be formed from one plate with wrap around gussets. Bolted together guides are not accepted.

5. Embedded frame gates shall be installed in block-out recesses formed in the channel walls and floor.

6. Thimble-mounted gates shall be drilled to match the wall thimble. Wall thimbles shall conform to AWWA C561.

D. SEALS:

1. Gates shall incorporate factory-set self-adjusting seals utilizing a sealing surface of UHMW PE to achieve the leakage rates specified. Self adjusting seals shall not require adjustment and shall be replaceable without removing the guide frame.

2. All moving contact surfaces shall be incompatible to each other thereby minimizing sticking or jamming.

E. STEMS:

1. All stems shall be of the rising type unless otherwise specified.

2. Provide stem diameter to withstand at least twice the rated output of the electric operator or the manual operator at 40-pounds pull. Stems shall be minimum 1-1/2-inch diameter.

3. Stem guides shall be provided at intervals necessary to maintain a slenderness ratio (L/R) of the unsupported stem length of less than 200, where R is the radius of gyration of the stem.

4. Stems shall be designed to withstand tensile and compressive loads that occur under maximum operating conditions. Design for compressive loading shall meet AISC code where K=1 with a minimum safety Factor of 2 to 1.

5. Stem sections shall be joined together by solid couplings, threaded and keyed to the stems. All couplings of the same size shall be interchangeable.

6. The threaded portion of the stem shall have dual lead, machine rolled, full depth ACME type threading with a 16 micro-inch finish or better. Stub threads are not acceptable.

7. Stems shall be fixed to the slide by a threaded and keyed assembly into a lifting nut attached to the disc in a lifting bracket, which is bolted to the disc. The bolts securing the bracket shall be in tension and not shear.

8. Yoke-supported stems shall be provided with a torque between the top of the yoke and the operator constructed of 316L SS. The torque tube shall have appropriate flanges at the top and bottom for mounting to the operator and yoke, and be sized and constructed to provide lateral support to the stem between the yoke and the operator. Torque tubes shall be provided with UHMW stem guides at appropriate intervals to provide lateral support to the stem. Torque tubes shall be equipped with tabs for bolting lateral supports; the dimensions and location of the tabs shall be determined by the manufacturer and coordinated during the submittal review process.

F. OPERATORS:

1. See Gate Schedule for operator requirements.

2. Unless otherwise indicated, manual operators shall meet requirements of AWWA C561 as appropriate.

3. Yoke-supported operators shall be provided with 316 SS pedestals between the top of the yoke and the operator. See drawings for length requirements.

4. Unless otherwise indicated and whenever possible, operator base shall be set 42” above the walking surface.

5. Manual operators are specified in Section 15184.

G. ENCLOSURES:

1. Gates isolating pipes and channels within the headworks structure shall be equipped with all stainless steel enclosures for odor control purposes.

2. Enclosures shall be designed and fabricated by the gate manufacturer. Submit drawings prior to fabrication.

3. Enclosures shall be essentially air tight and designed to withstand negative pressure of 0.3" WC imposed by the odor control system drawing air from below the channel covers.

4. Enclosures shall be compatible with specified electric actuators and shall be removable without removing the actuator.

H. Enclosure face panels shall be removable from one side. Removable panels shall be provided in sections weighing no more than 30-pounds each. Provide handles for lifting the removable face panels.

I. APPURTENANCES:

Frame welded flushing connections shall be provided at inverts of gate frames with flushing ports for 100 psig compressed air or 1000 psi high pressure water. Flushing connections shall be provided for gates 48-inches in height or taller. Tubing shall be a minimum of 1/4-inch diameter, Type 316L Stainless Steel. Tubing shall be integral with the frame and secured via permanently frame welded guides to prevent dislodgement. Both sides of the frame invert shall be provided with flushing connection. Penetration into the gate frame shall not interfere with gate operation. Penetration shall be performed at the manufacturer's facility. Tubing on both sides of the frame shall terminate to a 1/2-inch diameter Type 316 stainless steel quick disconnect fitting, Snap-Tite/Parker series 71 or approved substitute. Fitting shall terminate just below floor invert. Manufacturer and Contractor shall coordinate location of quick disconnect valve box to avoid conflict with other valve boxes, equipment, etc.

2.04 FACTORY TESTING

A. Conduct shop performance test per AWWA C563 or AWWA C561 as applicable. Submit written report of results.

B. The Owner retains the right to witness the stainless steel preparation and passivation process. Provide at least 30-days notice prior to start of passivation process for gates and appurtenances.

PART 3--EXECUTION

3.01 INSTALLATION

A. Install gates and appurtenances in accordance with manufacturer's instruction and as shown on the Drawings.

B. For embedded gates, fill blockouts along guide frames and gate sill with grout following installation.

C. Provide all 316 SS anchors; size anchors in accordance with the design requirements specified in this section.

D. Proper handling shall incorporate all practices described in Section 8.5 – Protection of Cleaned Surfaces, ASTM A380. Passivated parts contaminated due to improper handling and installation will require retesting for the presence of free iron and re-passivation if free iron is detected.

3.02 FIELD TESTING

A. Operation and Leakage Tests: In accordance with AWWA C563 or AWWA C 561 as appropriate.
B. Leakage rates shall not exceed 0.05 gpm per linear foot of seating perimeter.

3.03 TRAINING

A. Provide one - four hours of training to provide operation and maintenance instruction to the Owner's maintenance crews.

END OF SECTION

DIVISION 15

MECHANICAL

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SECTION 15184

MANUAL GATE OPERATORS AND OPERATOR APPURTENANCES

PART 1 – GENERAL

1.01 DESCRIPTION

This section specifies manual operators for valves and gates, and operator appurtenances.

1.02 REFERENCES

This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued or replaced.

Reference	Title
AWWA C500	Gate Valves 3 through 48 inch NPS, for Water and Sewage Systems

PART 2 – PRODUCTS

2.01 GENERAL

Except as specified in valve and gate specification sections, manual operators shall be as specified herein. Operators shall be mounted on the valve or gate and provided as a unit. Each valve body or operator shall have cast thereon the word "OPEN," an arrow indicating the direction to open, and flow direction arrows.

2.02 OPERATORS

A. GENERAL:

Manual operators shall have operating torques less than 80 foot-pounds. Unless specified otherwise, each manual operator shall be provided with an operating wheel. Unless specified otherwise, the direction of rotation of the operator shall be counterclockwise for opening.

B. WRENCH NUTS:

Wrench nuts shall comply with Section 3.15 of AWWA C500. A minimum of two operating keys, but no less than one key per every ten valves, shall be provided for operation of the wrench nut operated valves.

C. CHAIN WHEELS:

Chain wheels shall be ductile iron. Operating chains shall be galvanized.

2.03 OPERATOR APPURTENANCES

A. VALVE BOXES:

Valve boxes shall be cast iron and shall have suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers. Covers shall be hot-dip galvanized.

B. FLOOR BOXES:

Floor boxes shall be hot-dip galvanized. Where the operating nut is in the concrete slab, the floor box shall be bronze bushed. Where the operating nut is below slab, the opening in the bottom of the box shall be sufficient for passage of the operating key.

C. ADJUSTABLE SHAFT VALVE BOXES:

Adjustable shaft valve boxes shall be concrete or cast iron Brooks No. 3RT, Christie G5, Empire 7-1/2 valve extension box, or equal. Box covers on water lines shall be impressed with the letter "W." Gas line covers shall be impressed with the letter "G."

D. FLOOR STANDS FOR MANUAL GATE OPERATORS

The floor stand shall have a weatherproof, cast iron housing, with a bronze operating nut, mounted on a high strength pedestal. The operation nut shall be internally threaded with 29-degree acme threads corresponding to stem threading. Tapered roller bearings shall be located above and below the bronze operating nut to support the output thrust of the floor stand. The gearing shall be accurately cut and of proper design to support the load conditions without undue stress. The stainless steel pinion shaft will be mounted on tapered roller bearings to provide low friction

operation and to resist axial and radial thrusts. Mechanical seals shall be provided around the operating nut and the pinion shaft to prevent lubrication from leaving the unit and moisture from entering the sealed housing. The reduction gear case shall be precision machined and equipped with tapered roller or needle bearings and sealed about the reduction shafts. Lubrication fittings shall be provided for all bearings.

Crank operated floor stands will be selected so that no more than a 40 lb. effort on the crank will be required to open or close the slide gate.

2.04 PRODUCT DATA

Manufacturer's catalog information and other data confirming conformance to design and material requirements shall be provided in accordance with Section 01300.

PART 3 – EXECUTION

3.01 GENERAL

Installation shall be as specified herein. Valve operators shall be located so that they are readily accessible for operation and maintenance. Valve operators shall be mounted for unobstructed access, but mounting shall not obstruct walkways. Valve operators shall not be mounted where shock or vibration will impair their operation. Support systems shall not be attached to handrails, process piping, or mechanical equipment.

3.02 OPERATORS

A. GENERAL:

Valves and gates shall be provided with manual operators, unless specified otherwise. Where possible, manual operators shall be located between 48 inches and 60 inches above the floor or a permanent work platform.

B. WRENCH NUTS:

Wrench nuts shall be provided on buried valves, on valves which are to be operated through floor boxes, and where specified. Extended wrench nuts shall be provided if necessary so that the nut will be within 6 inches of the valve box cover.

C. CHAIN WHEELS:

Unless otherwise specified, valves with centerlines more than 7 feet, 6 inches above the specified operating level shall be provided with chain wheels and operating chains. Chain wheel operated valves shall be provided with a chain guide. Operating chains shall be looped to extend within 4 feet of the specified operating level below the valve. For plug-type valves 8 inches and

larger, the operator shall be provided with a hammer blow wheel. Hooks shall be provided for chain storage where the chain may hang in a walkway.

3.03 OPERATOR APPURTENANCES

A. VALVE BOXES:

Valve boxes extending to finished surfaces shall be provided for buried valves.

B. FLOOR BOXES:

Floor boxes shall be provided for wrench operation of valves located below concrete slabs. Each floor box and cover shall be of the depth required for installation in the slab.

END OF SECTION

Appendix A: Geotechnical Report

Terracon Geotechnical Engineering Report - #73185026; August 16, 2018

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Geotechnical Engineering Report

Lower Saluda Relief Sewer and Major Pipe Rehabilitation

Irmo, SC

August 16, 2018

Terracon Project No. 73185026

Prepared for:

4D Engineering

Lexington, SC

Prepared by:

Terracon Consultants, Inc.

Columbia, South Carolina

August 16, 2018

4D Engineering
603 S. Lake Drive
Lexington, SC 29072

Attn: Mr. Justin Waring, PE
P: 803-356-0909
E: Justin@4DEngr.com

Re: Geotechnical Engineering Report
Lower Saluda Relief Sewer and Major Pipe Rehabilitation
CIP # SS7428
Irmo, SC
Terracon Project No. 73185026

Dear Mr. Waring:

Terracon Consultants, Inc. (Terracon) has completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P73185026 dated February 19, 2018.

This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and anticipated excavation conditions for the proposed sewer line 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.

Joseph Fredendall, E.I.T.
Geotechnical Staff Engineer

Phillip A. Morrison, P.E.
Geotechnical Department Manager
SC Registration No. 17275

REPORT TOPICS

Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the Terracon GeoReport logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES
SITE LOCATION AND EXPLORATION PLANS
EXPLORATION RESULTS (Boring Logs and Laboratory Data)
SUPPORTING INFORMATION (General Notes and Unified Soil Classification System)

REPORT SUMMARY

Topic [1]	Overview Statement [2]
Project Description	The project includes the construction of a relief sewer with a length of approximately 17,500 feet. The sewer will consist of approximately 7,500 feet of 30-inch line and 10,000 feet of 42-inch line. The invert has not been determined at this time but is presumed to be near that of the existing sewer which ranges from 7 to 24 feet below the existing ground surface (bgs) based on the provided existing utility profiles.
Geotechnical Characterization	Groundwater was encountered at depths ranging from 8 to 23 feet bgs but more typically between 12 to 17 feet bgs. Partially weathered rock (PWR) was encountered at depths of 3 to 22 feet bgs, with the shallowest occurring at the west end of the alignment. The typical PWR depths ranged from 8 to 17 feet bgs. Bedrock (as defined by the refusal of the drilling equipment and verified by isolated coring) was encountered was encountered at depths of 4 to 18 feet in some areas. The shallow refusal was encountered in Boring B-29 at the west end of the alignment. The typical depths to refusal where encountered was 12 to 15 feet. Refusal shallower than the estimated invert depths of the sewer line was encountered in Borings B-28 and B-29, located at the west end of the alignment near its crossing the Bush River Road.
Existing Topography	The alignment is generally flat. The surface elevations range from 200 feet to 180 feet.
General Comments	This section contains important information about the limitations of this geotechnical engineering report.

1. If the reader is reviewing this report as a pdf, the topics above can be used to access the appropriate section of the report by simply clicking on the topic itself.
2. This summary is for convenience only. It should be used in conjunction with the entire report for design purposes.

Geotechnical Engineering Report

Lower Saluda Relief Sewer and Major Pipe Rehabilitation

Irmo, SC

Terracon Project No. 73185026

August 16, 2018

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed sewer line to be located along the north side of the Saluda River between generally Bush River Road and the Bush River Pump Station off Garden Valley Road in Irmo, SC. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- excavation

The geotechnical engineering scope of services for this project included the advancement of thirty test borings to depths ranging from approximately 20 to 30 feet bgs.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included in the **Exploration Results** section of this report.

SUBSEQUENT SUBMITTALS

Site Characterization

Upon completion of the field exploration and laboratory testing, the results will be evaluated under the supervision of a geotechnical engineer, and the results will be posted to our website. This creates the opportunity for the design team to evaluate site preparation and develop appropriate engineering design criteria for other geotechnical related aspects of the project. The site characterization will include the following:

- Boring logs with field and laboratory data; soil stratification based on visual soil classification
- Groundwater levels observed during and after completion drilling
- Exploration Plan
- Subsurface exploration and laboratory testing procedures

- Description of subsurface conditions (**Geotechnical Characterization**)

Geotechnical Engineering

Following the site characterization and any subsequent collaboration, our engineers will develop geotechnical engineering recommendations. Recommendations will be uploaded to allow the design team the ability to review and make necessary adjustments before we finalize the report. We anticipate this submittal will include the following:

- Boring logs with field and laboratory data
- Stratification based on visual soil and rock classification
- Groundwater levels observed during and after completion drilling
- Site and Boring location plans
- Subsurface exploration procedures
- Description of subsurface conditions
- Subgrade preparation/earthwork recommendations including minimum relative density requirements
- Anticipated excavation conditions, including difficult excavation and groundwater conditions

Final Report

At the completion of our services, we will upload a printable version of our final report. This will include a page with the professional engineer's seal and signature which documents our services. Previous submittals, collaboration, and the final report, will be maintained in our system indefinitely for future reference and for integration into subsequent aspects of our services as the project goes through final design and construction.

GENERAL COMMENTS

As the project progresses, we address assumptions by incorporating information provided by the design team, if any. Revised project information that reflects actual conditions important to our services is reflected in the final report. The design team should collaborate with Terracon to confirm these assumptions and to prepare the final design plans and specifications. This facilitates the incorporation of our opinions related to implementation of our geotechnical recommendations. Any information conveyed prior to the final report is for informational purposes only and should not be considered or used for decision-making purposes.

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations 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. Terracon should be retained as the Geotechnical Engineer, where noted in the final report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our scope of services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, 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.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third party beneficiaries intended. Any third party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration, and our review of publicly available geologic and topographic maps, the provided topographic site plans, and provided plans of the existing construction.

Item	Description
Parcel Information	The project is located along the north side of the Saluda River generally between Bush River Road and the Bush River Pump Station off Garden Valley Road in Irmo, SC.
Existing Improvements	The sewer line extends through the greenway along the Saluda River. Along the alignment, it will cross through: ■ Saluda Shoals Park ■ Shaw Industries - 8S Plant ■ SC Pipeline right-of-way ■ SCE&G right-of-way
Current Ground Cover	Primarily tall grass and brush along the sewer easement and dense woods on both sides of the sewer easement. A concrete-paved walking track exists along the sewer easement on Saluda Shoals Park.
Existing Topography	Based on the provided topographic plans the sewer line right-of-way consists of gently rolling hills running adjacent to the Saluda River and Rawls Creek. The elevations at the boring locations range from approximately 172 to 184 feet.
Geology	The soils encountered in the exploration primarily consisted of residual silty sands and sandy silts overlying partially weathered rock and bedrock.
Existing Utilities	The proposed alignment runs adjacent to an existing sewer line. The invert depth of the existing sewer ranges from 7 feet at the west end of the alignment to 24 feet at the east end of the alignment. The existing sewer line is a 27-inch diameter pipe from its origin in the Coldstream neighborhood until it reaches Lorick Creek where it combines with other sewer lines and continues as a 30-inch diameter pipe to the pump station.

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Number of Borings	Planned Boring Depth (feet)	Planned Location
20	20 or auger refusal	General Sewer Line Alignment
10	30 or auger refusal	General Sewer Line Alignment

Boring Layout and Elevations: The borings were located in the field by using the proposed site plan and a handheld GPS unit (estimated horizontal accuracy of about ±10 feet). The boring elevations were interpolated from the provided topographic plans. The boring locations shown on the Boring Location Plan and the ground surface elevations shown on the boring logs are approximate and should be considered accurate only to the degree implied by the method of location.

Subsurface Exploration Procedures: Borings were advanced using a truck mounted CME-45C and an ATV-mounted CME-55 utilizing 2-¼-inch inside diameter hollow-stem augers. A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Representative disturbed soil samples were obtained from the borings and were placed in sealed containers and returned to our laboratory where our engineer visually reviewed and classified them. The purposes of this review were to check the drillers' field classifications and visually estimate the soils' relative constituents (sand, clay, etc.). The soil types and penetrometer values are shown on the boring logs. These records represent our interpretation of the field conditions based on the driller's field logs and our engineer's review of the soil samples. The lines designating the interfaces between various strata represent approximate boundaries only, as transitions between materials may be gradual.

Groundwater conditions were evaluated in each boring at the time of site exploration. With the exception of boring B-30 the borings were left open for a minimum period of 24 hours to allow groundwater to stabilize. After which, the borings were backfilled with the auger cuttings.

Our exploration services include storing the collected soil samples and making them available for inspection for 60 days from the report date. The samples will then be discarded unless requested otherwise.

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS). At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

■ Fines Content	ASTM D1140-06
■ Moisture Content	ASTM D2216-10
■ Compaction Characteristics of Soil using Standard Effort	ASTM D698-12

GEOTECHNICAL CHARACTERIZATION

Subsurface Profile

The subject site is located in South Carolina's Piedmont physiographic province. The in-place chemical and mechanical weathering of the parent sedimentary and metamorphic rock forms the soils present in this region. A common soil profile includes a surficial clayey or silty layer transitioning to coarser material at depth. Generally dividing the soil layer from the bedrock is a very dense layer referred to as *"partially weathered rock"*. Partially weathered rock is composed of irregular zones of very dense soil and rock. Partially weathered rock exhibits standard penetration test values of 100 blows per foot (bpf) or more.

The topography of the underlying bedrock surface and the thickness of the various soil and weathered rock strata vary greatly in short, horizontal distances because of variation in mineralogy of the material, previous and present groundwater conditions, and past tectonic activity (faulting, folding, intrusions, etc.). Further, the presence of boulders and rock pinnacles is possible within the soil matrix.

Alluvial soils are those deposited by the water erosion of nearby areas. These soils are generally loose or soft and may contain a high concentration of organics. They are considered geologically recent deposits.

The geotechnical characterization forms the basis of our geotechnical calculations and evaluation of site preparation, earthwork, and soil parameters. As noted in **General Comments**, the characterization is based upon widely spaced exploration points across the site, and variations are likely.

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
Alluvium [1]	8 to 18	Silty sand/sandy lean clay/sandy silt	very loose/very soft to medium dense/medium stiff
Residuum	2.5 to 30 [2]	Silty sand/sandy lean clay/sandy silt	loose/soft to very dense/hard
Partially Weathered Rock	3.8 to 30 [2]	Silty sand/sandy silt	Very dense/hard RR - 40 to 100% RQD - 17 to 76
Bedrock	1.5 [3] to 25.3 [3]	Bedrock - Biotite schist	N.A.

1. Where encountered
2. Maximum depth of exploration
3. Top of layer

Conditions encountered at each boring location are indicated on the individual boring logs shown in the **Exploration Results** section and are attached to this report. Stratification boundaries on the boring logs represent the approximate location of changes in native soil types; in situ, the transition between materials may be gradual.

Groundwater Conditions

The boreholes were observed while drilling and after completion for the presence and level of groundwater. In addition, delayed water levels were also obtained in each boring. Groundwater was encountered at depths of 12 to 25 feet in the test borings at the time of field exploration. When checked 1 to 4 days after drilling, groundwater was measured at depths of 7 to 23 feet. The water levels observed in the boreholes can be found on the boring logs in **Exploration Results**, and are presented in the table below.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

Summary of Field Testing

A summary of the field testing is provided in the table below. The elevations shown were interpolated from the provided topographic plans from Brown and Caldwell dated June 26, 2018. The anticipated invert depths were obtained from the provided plans of the existing sewer from B.P. Barber & Associates, Inc. dated June 1977.

Boring No.	Boring Elevation	Estimated Invert Depth/Elevation [1]	Groundwater Depth/Elevation	Partially Weathered Rock Depth/Elevation	Auger Refusal Depth/Elevation
B-1	178	23/155	23/155	N.E.	N.E.
B-2	178	24/154	19/159	12/166	N.E.
B-3	176	24/152	21/155	12/164	N.E.
B-4	176	24/152	16/160	12/164	N.E.
B-5	172	20/152	15/157	22/150	N.E.
B-6	174	20/154	16/158	17/157	N.E.
B-7	174	20/154	14/160	17/157	N.E.
B-8	176	17/159	17/159	17/159	N.E.
B-9	176	14/162	15/161	N.E.	N.E.
B-10	176	14/162	11/165	12/164	16/160
B-11	180	14/166	11/169	17/163	N.E.
B-12	184	16/168	15/169	17/167	25.3/158.7
B-13	176	13/163	16/160	12/164	20/156
B-14	174	13/161	11/163	17/157	N.E.
B-15	178	16/162	10/168	12/166	16/162

Boring No.	Boring Elevation	Estimated Invert Depth/Elevation [1]	Groundwater Depth/Elevation	Partially Weathered Rock Depth/Elevation	Auger Refusal Depth/Elevation
B-16	178	18/160	12/166	17/161	N.E.
B-17	180	18/162	13/167	17/163	N.E.
B-18	180	15/165	18/162	8/172	21/159
B-19	178	14/164	15/163	8/170	17/161
B-20	174	14/160	14/160	17/157	N.E.
B-21	174	10/164	17/157	N.E.	N.E.
B-22	180	12/168	12/168	17/163	N.E.
B-23	176	10/166	12/164	N.E.	N.E.
B-24	182	8/174	17/165	17/165	N.E.
B-25	176	8/168	8/168	N.E.	N.E.
B-26	178	10/168	N.E.	12/166	14.6/163.4
B-27	176	7/169	N.E.	8/168	18/158
B-28	174	13/161	8/166	8/166	12/162
B-28A	174	13/161	N.R.	N.R.	11/163
B-29	184	13/171	N.E.	3/181	3.8/180.25
B-29A	184	13/171	N.R.	N.R.	1.5/182.5
B-30	180	13/167	7/173	8/172	9.5/170.5

1. Estimated invert depths and elevations based on provided plans of the existing sewer. At the time of this report, no invert depths have been determined for the new utility.
2. N.E. = Not Encountered
3. N.R. = Not Recorded

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed in the project planning stage. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	■ Topographic plans from Brown and Caldwell dated June 26, 2018. ■ Plans of the existing sewer from B.P. Barber & Associates, Inc. dated June 1977.
Project Description	The project is located on the north side of the Saluda River between Bush River Road and the Bush River Pump Station off Garden Valley Road in Irmo, South Carolina. The project includes 17,500-foot-long relief sewer. Approximately 7,500 feet of 30-inch line and 10,000 feet of 42-inch line. Based on our conversation with Mr. Waring, we understand the invert of the proposed sewer line is possibly going to be similar to the existing sewer line which is about 10 to 20 feet deep below existing site grades. A number of horizontal crossings will be included in the project. For the purpose of this report is has been assumed that they will be jack and bore style crossings.
Grading/Slopes	It is our understanding that minimal grading will be done during construction.

GEOTECHNICAL OVERVIEW

Based on our understanding of the sewer line alignment, the soils that will be encountered by the excavations will generally consist of shallow to moderate depth medium dense/firm to very dense/hard residual soils overlying partially weathered rock and intact rock. Although alluvial soils were not encountered in the course of the exploration, it is expected that they will be encountered during construction due to the project proximity to the Saluda River and its tributaries.

Rock, defined as power auger refusal and verified by rock coring on an isolated basis, was encountered at several of the borings throughout the proposed alignment. Depth to rock at those borings which encountered it ranged from about 1 ½ feet to 25 feet bgs. The shallowest rock was encountered at the west end of the utility corridor. The core samples indicated the rock to be a biotite schist. The cores had moderate recovery (40 to 100%) and rock quantality designation (RQD) values of 17 to 76. At the borings locations where rock was encountered in the central and eastern portions of the alignment, the depth to rock was generally greater than the anticipated invert. However, those in the western post of the alignment were above the anticipated invert. The data indicates that the planned excavations will encounter rock, potentially on an isolated basis in the central and eastern portions of the alignment and more frequently nearer the west end.

In the majority of the borings, groundwater was encountered at depths of 8 to 23 feet bgs. This ranges from 10 feet below the anticipated invert depth to 8 feet above it. As the soils encountered were sandy silts and silty sands which will effectively transmit groundwater, controlling groundwater inflow will be an important factor in the installation of the new sewer line.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Excavation Conditions

The shallow existing soils encountered along the alignment should generally be readily excavatable, though large track-hoes will be necessary to perform these tasks due to the large volume of soil to move and the depth of the excavation to be made. However, partially weathered rock (PWR) was encountered in the majority of the borings at depths near to above the anticipated sewer inverts. Further, rock (defined by power auger refusal and confirmed by isolated coring) was encountered at several locations along the alignment and above the anticipate sewer invert in the west portion of the alignment. Given the length of the project and the noted soil conditions, these conditions will be encountered in the noted areas and there is a potential for encountering them elsewhere. Large, track-mounted excavating equipment, such as a CAT Model 320 or similarly powered equipment, can generally excavate through a substantial thickness of hard/dense residuum and partially weathered rock. Removal of rock and rock-like materials (mass rock, large boulders, and rock pinnacles) will likely require the use of pneumatic tools or explosives (if allowed).

As rock and rock-like material were identified along the sewer line alignment, we recommend including a rock definition in the project specifications similar to the one in the following paragraph. Unit rates for mass rock and trench rock should be included in the bid documents to limit disputes when rock-like materials are encountered.

> *Any material that cannot be excavated with a backhoe having a minimum bucket curling force of not less than 30,000 pounds and outfitted with rock teeth should be considered trench rock.*

All 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 grading 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.

Construction site safety is the sole responsibility of the contractor who controls the means, methods and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that Terracon is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

Trenchless Crossing Installation Conditions

Although the final plans are not available at this time, it is anticipated by the designers that trenchless sewer line installation will be planned for each of the following areas:

- Crossing 1 – Kinley Creek (Borings B-4 and B-5)
- Crossing 2 – Unnamed tributary (Boring B-8)
- Crossing 3 – Shaw Industries Roadway and SCE&G right-of-way (B-12 and B-13)
- Crossing 4 – Unnamed tributary (Boring B-16)
- Crossing 5 – Saluda Shoals Park access road (Borings B-26 and B-27)
- Crossing 6 – Bush River Road (B-29 and B-30)

Although the installation type has not been determined at this time, we understand that the use of jack and bore methods is likely. For this type of installation, it is typical to install entry and exit pits at each end of a proposed crossing. Due to the depth of the installation the contractor may consider supporting the excavation walls with temporary shoring to limit the area impacted by the excavation. The type of shoring would be dependent on the depth of the excavation and could range from an internally strutted system to a soldier pile and lagging system. For systems requiring deep embedment, the depth to partially weathered rock/rock should be considered.

We have provided design parameters representing the physical properties of the various soil layers within the range of likely excavations for each of the potential crossing areas listed above. The shoring systems can be designed based on these soil parameters. In areas where large variances in the soil profile were noted at each end of the anticipated crossing, a table has been included with separate values for each end of the area. The values presented in the tables do not include a factor of safety.

Crossing 1 – Borings B-4 and B-5

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1,2]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-12	SM/ML	No	110	29	0
12-30	ML	Yes – 15 feet	130	38	0

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ±30 percent in soil parameters given the range of consistency within each layer.
2. The total unit weight would be reduced by the unit weight of water for the effective value below the groundwater level.

Crossing 2 – Boring B-8

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1,2]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-17	SM/ML	No	115	29	0
17-30	ML	Yes – 17 feet	130	38	0

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ±30 percent in soil parameters given the range of consistency within each layer.
2. The total unit weight would be reduced by the unit weight of water for the effective value below the groundwater level.

Crossing 3 (East) – Boring B-12

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-8	SM	No	115	30	0
8-18	CL	No	100	28	300
18-25	SM	No	130	38	0
>25	Rock	No	145	n/a	n/a

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ± 30 percent in soil parameters given the range of consistency within each layer.

Crossing 3 (West) – Boring B-13

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1,2]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-5	SM	No	115	28	0
5-12	CL	No	100	26	250
12-20	SM	Yes – 16 feet	130	38	0
>20	Rock	Yes	145	n/a	n/a

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ± 30 percent in soil parameters given the range of consistency within each layer.
2. The total unit weight would be reduced by the unit weight of water for the effective value below the groundwater level.

Crossing 4 – Boring B-16

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1,2]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-12	SM	No	115	28	0
12-17	CL	Yes – 12 feet	100	26	250
17-20	ML	Yes	130	38	0

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ± 30 percent in soil parameters given the range of consistency within each layer.
2. The total unit weight would be reduced by the unit weight of water for the effective value below the groundwater level.

Crossing 5 (South) – Boring B-26

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-5	SM	No	130	28	0
5-12	ML	No	115	29	500
12-14	ML	No	130	38	0
>14	Rock	No	145	n/a	n/a

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ± 30 percent in soil parameters given the range of consistency within each layer.

Crossing 5 (North) – Boring B-27

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1,]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-8	SM	No	130	33	0
8-18	SM	No	130	38	0
>18	Rock	No	145	n/a	n/a

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ± 30 percent in soil parameters given the range of consistency within each layer.

Crossing 6 (South) – Boring B-29

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-4	SM	No	140	34	0
>4	Rock	No	145	n/a	n/a

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ± 30 percent in soil parameters given the range of consistency within each layer.

Crossing 6 (North) – Boring B-30

Depth, ft.	Soil Type	Groundwater Encountered	Total Unit Weight, pcf[1,2]	Internal Friction Angle, Φ[1]	Cohesion, psf[1]
0-8	SM	Yes – 7 feet	120	28	0
8-9-½	SM	Yes	140	38	0
>9-½	Rock	No	145	n/a	n/a

1. Soil parameters were estimated using Standard Penetration Test data, our local experience and published correlations. There could be a potential scatter of ± 30 percent in soil parameters given the range of consistency within each layer.
2. The total unit weight would be reduced by the unit weight of water for the effective value below the groundwater level.

To account for the pressures of the retained earth, we recommend that the support system design assume that the soils behind the bracing system will apply a trapezoidal stress distribution based on the excavation depth and the soil's shear strength. The lateral pressures developed by heavy equipment, stored material, stockpiles soils, existing building foundations, etc., near the top of the excavation must be added to the lateral soil stresses to determine the horizontal loads which must be resisted. Additionally, the designers should be aware of the relatively shallow rock depth at the west end of the alignment which may have an impact on shoring design.

Pipe Bedding

The boring data indicate loose/soft soil conditions at the anticipated invert level along some portions of the alignment and rock/rock-like materials at others. To provide uniform support of the pipe, bedding consisting of at least 12 inches of #57 stone below the invert and continued to the spring line of the pipe should be provided to evenly support the pipe unless more stringent bedding requirements are specified by the manufacturer or the City of Columbia. The actual depth of the stone should be determined in the field based on the conditions exposed by the excavation.

Groundwater Control

Based on the boring data and the estimated sewer line invert profile, groundwater will be encountered above the trench bottom along the majority of the new alignment. Where the groundwater surface will be penetrated by less than 2 feet, it may be possible to control the groundwater from within the excavation using temporary drainage sumps to pump out the seeping water while the pipe is being installed. Doing so may require the contractor to work in relatively short sections to quickly excavate the trench, place the bedding and install the pipe. To accomplish this, a 12-inch layer of open-graded stone (#57 stone or equal) can be placed at the bottom of the excavated trench to serve as a drainage medium. These materials would also provide bedding for the pipe. Periodically, the contractor would need to excavate a sump pit within the trench to allow an area for water to collect and pumps to be set. We recommend using open graded stone such as that used below the pipe to encase the pipe and fill the trench to a level

above the original static groundwater level. This should be placed and compacted prior to excavating the next segment of the trench. During excavation of the next segment, groundwater should continue to be pumped from the prior sump location until a new sump pit is installed and functioning. A filter fabric should be placed between the stone and the surrounding fill mass to prevent the migration of fine material into the void space of the stone.

Where the groundwater surface will be penetrated by more than 2 feet, it should be anticipated that some dewatering measures (such as well points or other similar dewatering methods) will likely be needed during the excavation and backfilling process. Infiltration of groundwater is expected to be rapid in these areas due to the sandy nature of the soils along the alignment. As such, the inflow may be greater than can be controlled from within the excavation. Dewatering should be maintained continuously until the utility is installed and the excavations have been backfilled above the prevailing groundwater levels. The dewatering system should be designed and installed by a specialty contractor experienced in this type of work.

The groundwater should be lowered at least 3 feet below the pipe invert prior to excavating the trench. We recommend that it be confirmed that the groundwater has been adequately lowered by the installation of periodic temporary piezometers prior to beginning excavation. Depending on the type of backfill utilized, discontinuing dewatering early or before sufficient overburden has been placed may result in loosening of the backfill, sloughing of the trench walls and/or shifting of the new line.

General Backfilling Recommendations

The majority of the soils encountered by the borings are silty sands and sandy silts with fines contents generally ranging from 40 to 70 percent. Based on the results of our borings and laboratory testing, most of these materials would be classified as AASHTO A-4 and A-6. These materials are generally no suited for use as trench backfill located inside the City/County/SCDOT rights-of-way. It should be expected that open trenches within these right-of-ways will require index testing of the excavated soil prior to backfill to verify their suitability prior to placement. Any structural fill should be placed and compacted in accordance with the recommendations in the following table, unless more stringent compaction requirements are required by the City of Columbia, SCDOT, or other controlling entities:

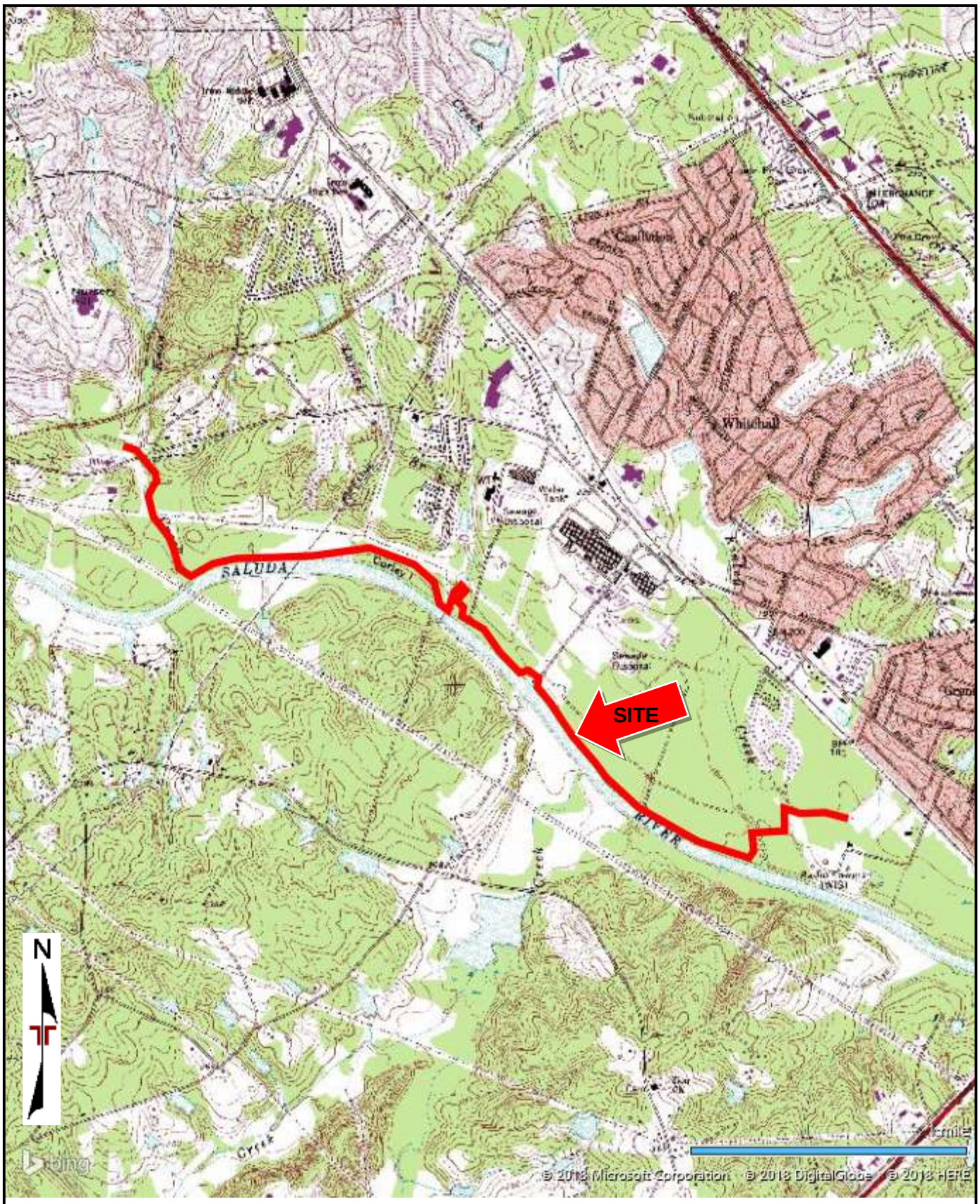
Item	Description
Fill Lift Thickness	6 inches or less in loose thickness
Compaction Requirements [1]	Areas within SCDOT, County and City rights-of-way: 95% of the material's maximum standard Proctor dry density (ASTM D 698). Areas outside SCDOT, County and City rights-of-way: 90% of the material's maximum standard Proctor dry density (ASTM D 698) in non-structural areas. However, if located in structural areas or areas that may

Item	Description
	be developed in the future, fill should be placed and compacted to 95% of maximum standard Proctor dry density.
Moisture Content	As a minimum, we recommend the moisture content to be within ±3 percent of optimum moisture based on material's maximum standard Proctor dry density (ASTM D 698).

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
3. The excavated material will become increasingly wet with depth, especially those excavated below the groundwater surface or fine grained soils (i.e. silts and clays). As such, some drying of the excavated material will likely be required to adjust the soils' moisture contents as they soils are likely well above their optimum moisture contents.

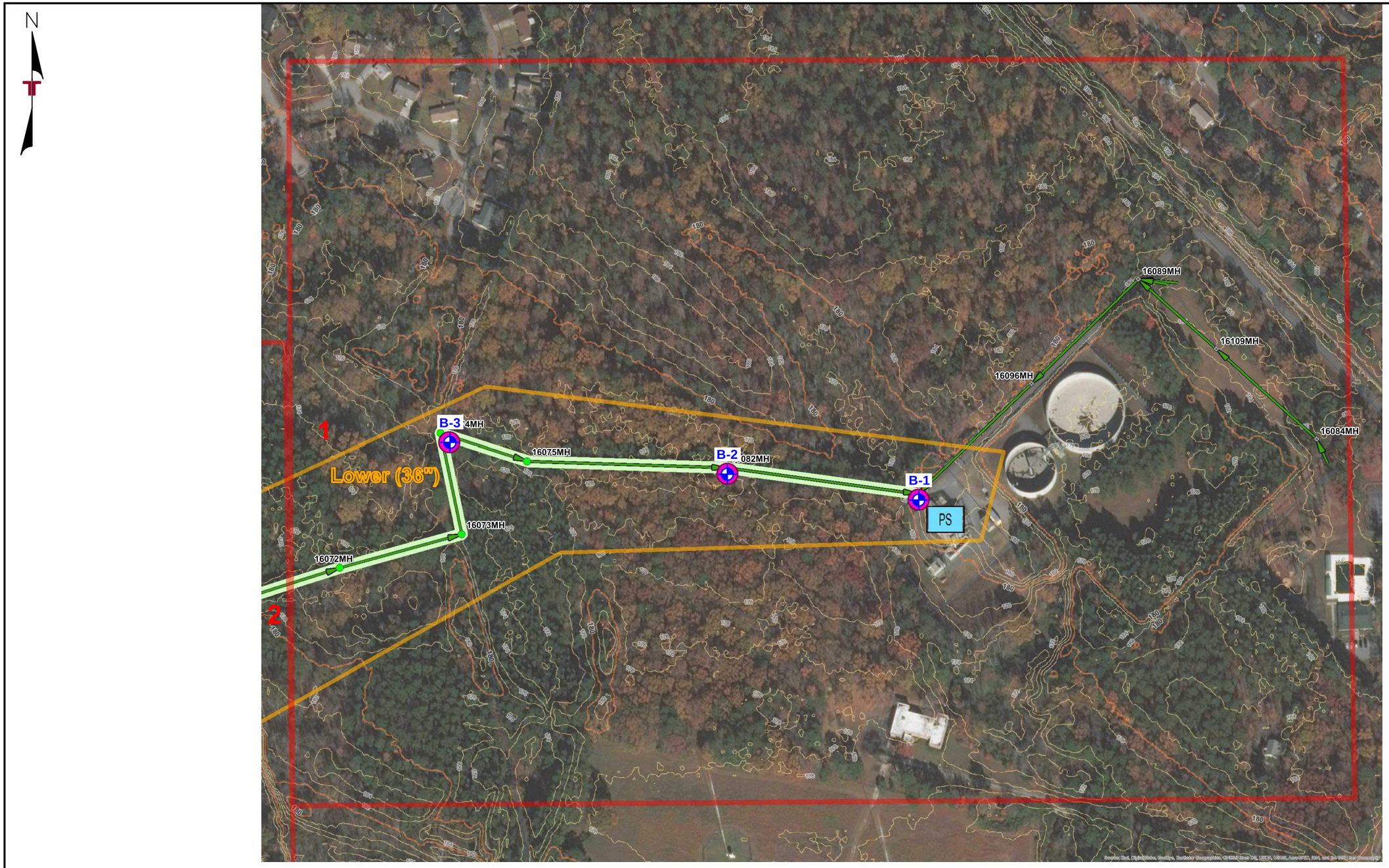
ATTACHMENTS

SITE LOCATION AND EXPLORATION PLANS



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: IRMO, SC (1/1/1990).

Project Manager: JDF	Project No. 73185026	Terracon 521 Clemson Rd Columbia, SC 29229-4307	SITE LOCATION MAP Lower Saluda Relief Sewer Irmo, South Carolina
Drawn by: PTK	Scale: AS SHOWN		
Checked by: JDF	File Name: A-1		
Approved by: PAM	Date: Aug. 2018		Exhibit A-1



NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION
BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND
IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250
SCALE IN FEET

Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM

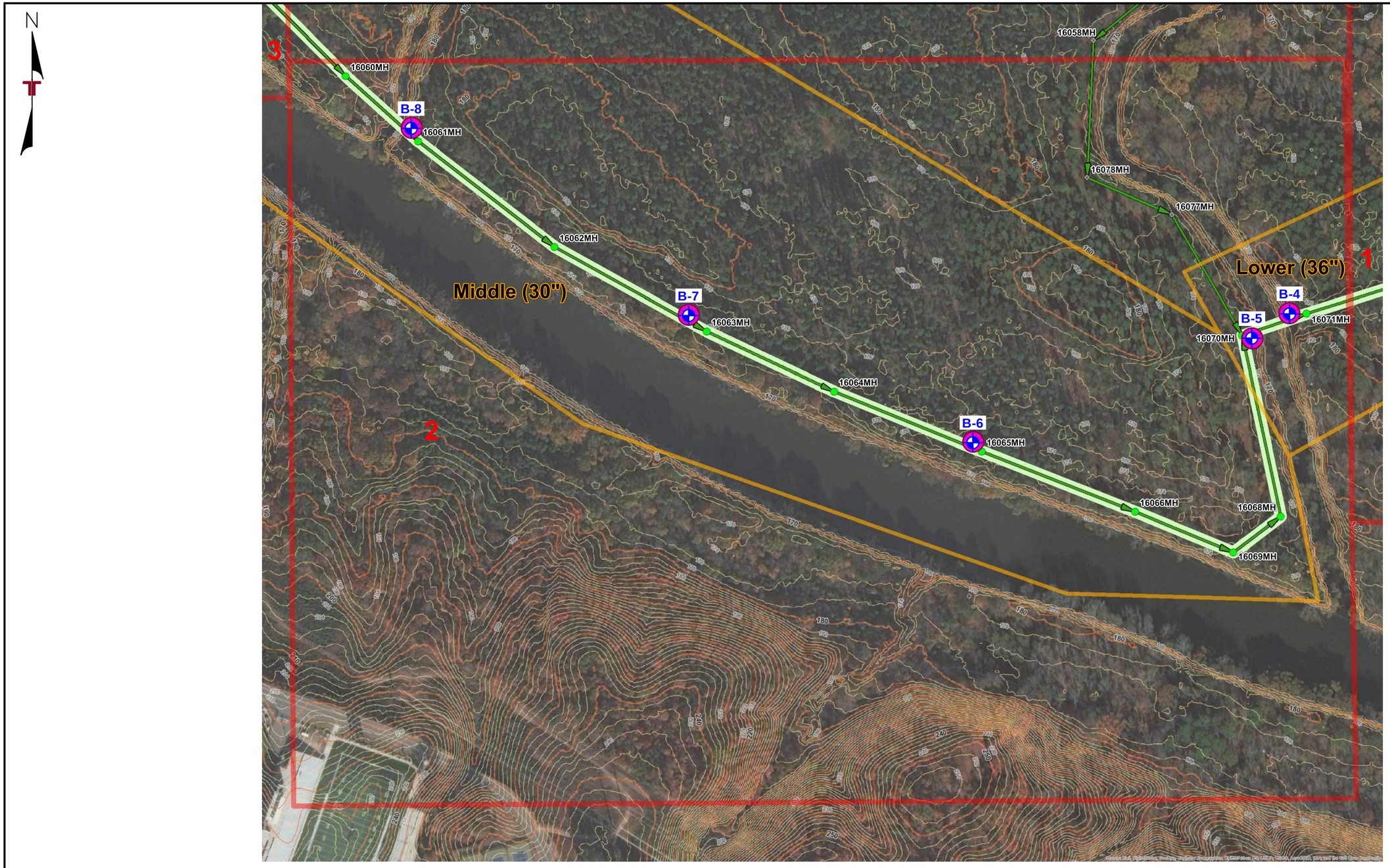
Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

Terracon
Consulting Engineers and Scientists
521 CLEMSON ROAD COLUMBIA, SC 29229
PH. (803) 741-9000 FAX. (803) 741-9900

BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit
A-2



NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND
IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250

SCALE IN FEET

Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM

Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

Terracon
Consulting Engineers and Scientists
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BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit

A-3

NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250

SCALE IN FEET

Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM

Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

Terracon
Consulting Engineers and Scientists
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PH. (803) 741-9000 FAX. (803) 741-9900

BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit
A-4

NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND
IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250

SCALE IN FEET

Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM
Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

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Consulting Engineers and Scientists
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PH. (803) 741-9000 FAX. (803) 741-9900

BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit
A-5

NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND
IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250
SCALE IN FEET

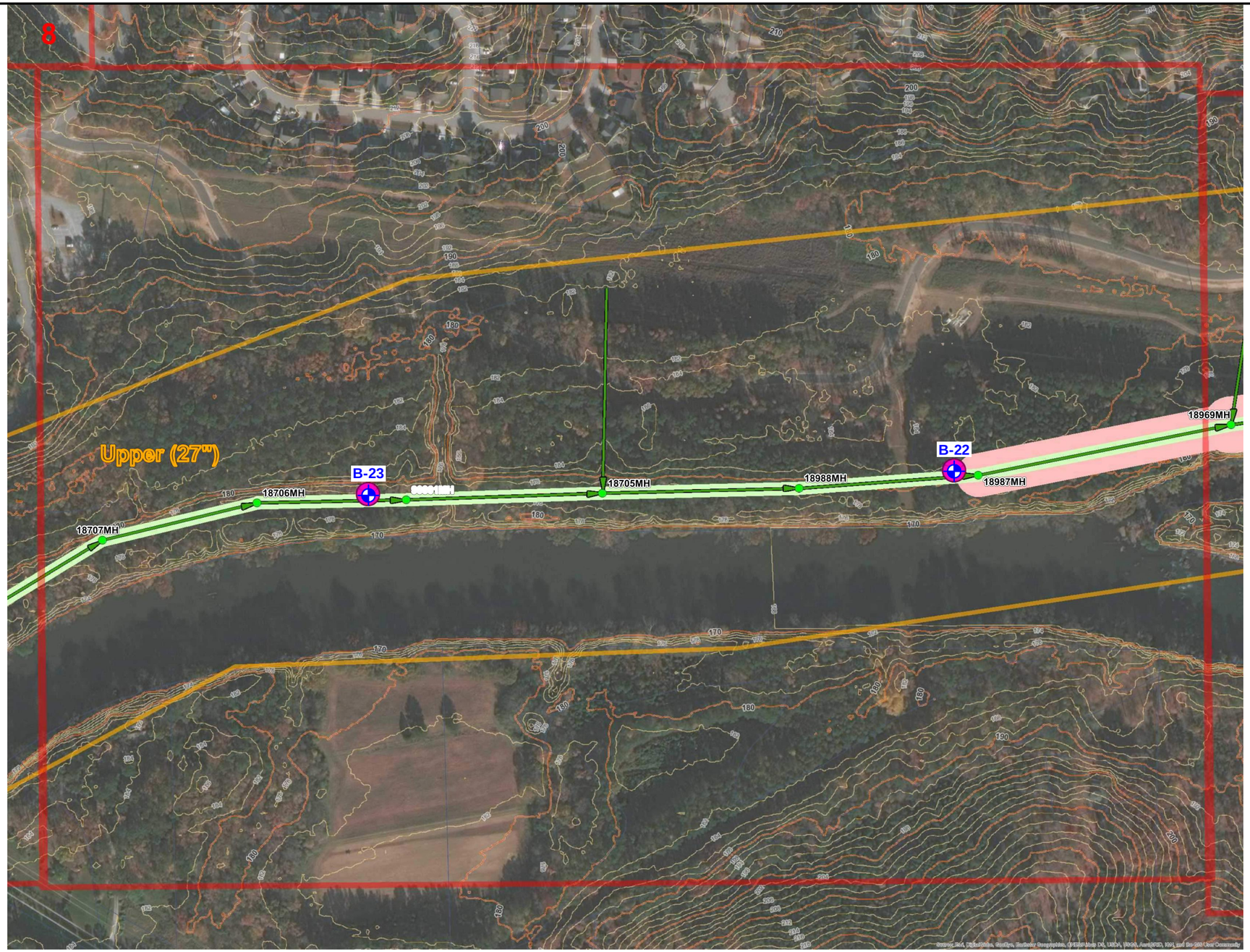
Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM
Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

Terracon
Consulting Engineers and Scientists
521 CLEMSON ROAD COLUMBIA, SC 29229
PH. (803) 741-9000 FAX. (803) 741-9900

BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit
A-6



NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION
BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250
SCALE IN FEET

Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM
Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

Terracon
Consulting Engineers and Scientists
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PH. (803) 741-9000 FAX. (803) 741-9900

BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit
A-7

NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250

SCALE IN FEET

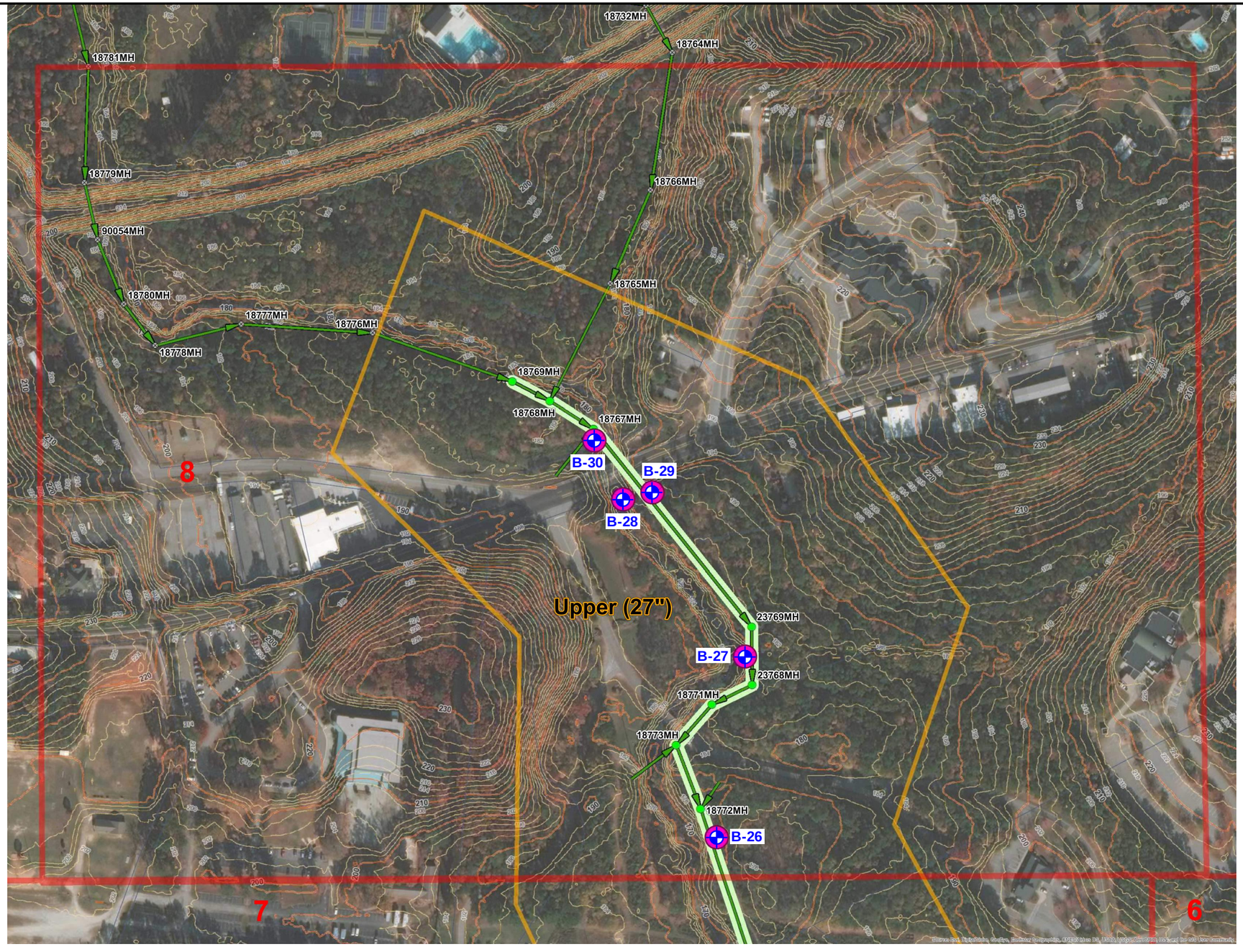
Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM
Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

Terracon
Consulting Engineers and Scientists
521 CLEMSON ROAD COLUMBIA, SC 29229
PH. (803) 741-9000 FAX. (803) 741-9900

BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit
A-8



NOTE:
BASE MAP WAS PROVIDED BY BROWN AND CALDWELL

EXPLANATION

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

250 0 50 150 250

SCALE IN FEET

Project Mngr:	JDF
Drawn By:	PTK
Checked By:	JDF
Approved By:	PAM

Project No.	73185026
Scale:	AS SHOWN
File No.	73185026
Date:	AUGUST 2018

Terracon
Consulting Engineers and Scientists
521 CLEMSON ROAD COLUMBIA, SC 29229
PH. (803) 741-9000 FAX. (803) 741-9900

BORING LOCATION PLAN

Lower Saluda Relief Sewer
Irmo, South Carolina

Exhibit

A-9

EXPLORATION RESULTS

BORING LOG NO. B-1

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0349° Longitude: -81.1417°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.2		**TOPSOIL**, (2 inches)										
		SANDY SILT (ML), brown and tan, very stiff, (residuum)			X	5-7-9 N=16						
					X	5-8-17 N=25						
5.5		**SANDY LEAN CLAY (CL)**, mottled (brown, tan, gray), very stiff	5		X	12-7-17 N=24			2.0 (HP)			
					X	10-15-14 N=29			2.0 (HP)			
			10									
					X	12-10-19 N=29			1.5 (HP)			
			15									
					X	17-13-16 N=29			1.5 (HP)			
22.0		**SANDY SILT (ML)**, brown and tan, hard	20	▽								
				▽	X	18-23-19 N=42						
			25									
30.0					X	25-16-27 N=43						
		Boring Terminated at 30 Feet	30									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *25' (End of Day)*

▽ *23' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-12-2018 | Boring Completed: 07-13-2018

Drill Rig: CME-45C | Driller: S. Blair

Project No.: 73185026

BORING LOG NO. B-2

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0351° Longitude: -81.1432°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)										
		SANDY SILT (ML), mottled (brown, tan, white), stiff, (residuum)				6-6-8 N=14						
						3-4-5 N=9				11	38-19-19	58
5.5		**SANDY LEAN CLAY (CL)**, tan and gray, medium stiff	5			3-3-3 N=6			1 (HP)			
						2-2-3 N=5			0.75 (HP)	21	39-17-22	71
12.0		**SILTY SAND (SM)**, fine to medium grained, tan and gray, very dense, (Partially Weathered Rock)	10			8-50/3"						
			15			40-50/1"						
			20			49-50/2"				6		21
			25			50/4"						
30.0		***Boring Terminated at 30 Feet***	30									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

20' (End of Day)

19' (After 24 Hours)

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-12-2018 | Boring Completed: 07-13-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-3

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0353° Longitude: -81.1455°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)										
		SANDY SILT (ML), brown and tan, very stiff to stiff, (residuum)				9-11-13 N=24						
						6-9-12 N=21						
			5			4-6-8 N=14						
						4-6-6 N=12						
12.0			10									
		SANDY SILT (ML), tan, hard, (Partially Weathered Rock)				24-47-50/2"						
17.0			15									
		SANDY SILT (ML), tan, hard, (residuum)				40-35-35 N=70						
22.0			20	▽								
		SANDY SILT (ML), tan, hard, (Partially Weathered Rock)		▽		50/2"				11		
			25									
						50/5"						
30.0			30									
		Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *22' (End of Day)*

▽ *21' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-12-2018 | Boring Completed: 07-13-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-4

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0342° Longitude: -81.1474°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SANDY SILT (ML), brown and tan, very stiff to stiff, (residuum)				7-4-16 N=20						
						8-11-13 N=24						
			5			3-6-9 N=15						
						2-5-6 N=11						
12.0			10									
		SANDY SILT (ML), tan and gray, hard, (Partially Weathered Rock)				10-50/3"						
17.0			15	▽								
		SANDY SILT (ML), gray, hard, (residuum)				4-16-31 N=47						
22.0			20	▽								
		SANDY SILT (ML), gray, hard, (Partially Weathered Rock)				21-50/2"						
			25									
						23-50/2"						
30.0			30									
		Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *23' (End of Day)*

▽ *16' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-10-2018 | Boring Completed: 07-11-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-5

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.034° Longitude: -81.1477°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SANDY SILT (ML), brown and tan, medium stiff, (residuum)				4-5-3 N=8				14		51
						3-2-3 N=5						
5.5		**SILTY SAND (SM)**, fine to medium grained, mottled (brown, tan, gray), very loose to loose	5			2-1-2 N=3			0.5 (HP)	20	22-20-2	49
						4-4-4 N=8			1 (HP)			
12.0		**SANDY SILT (ML)**, gray, very stiff to hard	10									
			15	▽		6-10-16 N=26						
				▽								
22.0		**SANDY SILT (ML)**, gray, hard, (Partially Weathered Rock)	20			21-41-33 N=74				18		60
						24-50/3"						
			25									
30.0						50/4"						
		Boring Terminated at 30 Feet	30									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *17' (End of Day)*

▽ *15' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-13-2018 | Boring Completed: 07-14-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-6

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0333° Longitude: -81.15°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS
0.5		**TOPSOIL**, (6 inches)				
		SILTY SAND (SM), fine to medium grained, brown, loose to medium dense, (residuum)				2-4-4 N=8
			5			4-5-5 N=10
						3-5-6 N=11
8.0		**SILTY SAND (SM)**, fine to medium grained, brown, loose				2-2-3 N=5
			10			
						2-4-4 N=8
			15	▽		
17.0		**SANDY SILT (ML)**, gray, hard, (Partially Weathered Rock)		▽		50/4"
20.0		***Boring Terminated at 20 Feet***	20			

DEPTH	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5						
8.0						
17.0						
20.0						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *18' (End of Day)*

▽ *16' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-13-2018 | Boring Completed: 07-14-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-7

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0342° Longitude: -81.1523°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense to loose, (residuum)				8-8-7 N=15						
						4-5-5 N=10						
			5			3-3-3 N=6						
8.0		**SANDY LEAN CLAY (CL)**, tan and gray, medium stiff				2-3-3 N=6			0.75 (HP)			
			10									
				▽		2-2-3 N=5			0.75 (HP)			
17.0		**SANDY SILT (ML)**, tan and gray, hard, (Partially Weathered Rock)	15									
						50/4"						
20.0		***Boring Terminated at 20 Feet***	20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *14' (End of Day)*

▽ *14' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-13-2018 | Boring Completed: 07-14-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-8

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0355° Longitude: -81.1546°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose, (residuum)			X	4-4-4 N=8						
					X	2-2-2 N=4						
5.5		**SANDY SILT (ML)**, tan and gray, medium stiff to soft	5		X	2-2-3 N=5						
					X	2-4-3 N=7						
			10									
					X	1-1-3 N=4						
17.0		**SANDY SILT (ML)**, tan and gray, hard	15	▽ ▽								
20.0					X	13-26-37 N=63						
		Boring Terminated at 20 Feet	20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *18' (End of Day)*

▽ *17' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-13-2018 | Boring Completed: 07-14-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-9

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0368° Longitude: -81.1563°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose to very loose, (alluvium)				2-3-3 N=6						
						2-2-3 N=5						
			5			WOH-1-2 N=3						
						2-2-2 N=4						
			10									
				▽		WOH-1-2 N=3				37	NP	40
17.0		**SANDY SILT (ML)**, tan and gray, hard, (residuum)	15									
						10-15-21 N=36						
20.0		***Boring Terminated at 20 Feet***	20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *15' (End of Day)*

▽ *15' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-13-2018 | Boring Completed: 07-14-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-10

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0394° Longitude: -81.159°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose to medium dense, (alluvium)				4-3-4 N=7				16		
						3-5-5 N=10						
5.5		**SANDY SILT (ML)**, mottled (brown, tan, gray), soft	5			2-1-1 N=2				22		
						1-1-1 N=2						
12.0		**SANDY SILT (ML)**, gray, hard, (Partially Weathered Rock)	10			50/2"				7		
16.0		***Auger Refusal at 16 ft. - Begin Coring***	15									
		BIOTITE SCHIST, light gray, extremely fractured, moderately weathered, medium strong					100	17				
20.4		***Coring Terminated at 20.4 Feet***	20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger / NQ-2 Core Bit

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Not recorded due to drilling method

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-13-2018 | Boring Completed: 07-14-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-11

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.041° Longitude: -81.1605°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose, (residuum)				5-4-5 N=9						
						6-4-4 N=8						
			5			2-3-3 N=6						
8.0		**SANDY SILT (ML)**, brown and tan, medium stiff to soft				2-2-3 N=5						
			10	▽								
				▽		2-1-3 N=4						
17.0		**SANDY SILT (ML)**, tan and gray, hard, (Partially Weathered Rock)	15									
20.0		***Boring Terminated at 20 Feet***	20			18-30-50/5"						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *12' (End of Day)*

▽ *11' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-13-2018 | Boring Completed: 07-14-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-12

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0417° Longitude: -81.1611°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), fine to medium grained, brown, loose, (alluvium)				6-6-6 N=12						
					6-4-5 N=9						
		5			5-2-2 N=4						
	8.0				2-2-1 N=3						
	SANDY LEAN CLAY (CL), mottled (brown, tan, red), soft	10									
					1-2-1 N=3						
	18.0	15									
	SILTY SAND (SM), with rock fragments, fine to medium grained, gray, very dense, (Partially Weathered Rock)				23-50/2"						
		20									
					18-25-50/4"						
	25.3	25									
	Auger Refusal at 25.3 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-27-2018 | Boring Completed: 08-02-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-13

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0427° Longitude: -81.1624°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose, (alluvium)				4-3-6 N=9						
						4-2-3 N=5						
5.5		**SANDY LEAN CLAY (CL)**, mottled (brown, tan, gray), medium stiff to soft	5			2-3-2 N=5			0.25 (HP)			
						2-2-2 N=4			0.25 (HP)			
12.0		**SANDY SILT (ML)**, gray, hard, (Partially Weathered Rock)	10			50/3"						
			15	▽								
20.0		***Auger Refusal at 20 ft. - Begin Coring*** **BIOTITE SCHIST**, light gray, slightly to moderately fractured, moderately weathered, medium strong	20			50/1"						
							85	60				
30.0			25				90	80				
		Coring Terminated at 30 Feet	30									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *16' (End of Day)*

▽ *16' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-16-2018 | Boring Completed: 07-17-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-14

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0436° Longitude: -81.1635°

DEPTH	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), fine to medium grained, brown, medium dense to loose, (residuum)					6-4-6 N=10						
					6-7-6 N=13						
		5			4-2-4 N=6						
8.0					3-5-3 N=8			1.25 (HP)			
SANDY SILT (ML), mottled (brown, tan, gray), medium stiff		10	▽								
12.0			▽								
SANDY SILT (ML), tan and gray, stiff					4-5-6 N=11						
17.0		15									
SANDY SILT (ML), gray, hard, (Partially Weathered Rock)					47-50/2"						
20.0		20									
Boring Terminated at 20 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *12' (End of Day)*

▽ *11' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-16-2018 | Boring Completed: 07-17-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-15

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0454° Longitude: -81.166°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose to medium dense, (residuum)				2-3-3 N=6				8		35
						3-5-6 N=11						
5.5		**SILTY SAND (SM)**, fine to medium grained, brown, loose to medium dense	5			2-3-3 N=6				10		34
						3-5-8 N=13						
12.0		**SILTY SAND (SM)**, fine to coarse grained, gray, very dense, (Partially Weathered Rock)	10									
						3-14-50/3"				5		35
16.0		***Auger Refusal at 16 ft. - Begin Coring*** **BIOTITE SCHIST**, light gray, slightly to moderately fractured, moderately to extremely weathered, weak to medium strong rock	15				82	64				
			20				90	80				
26.0		***Coring Terminated at 26 Feet***	25									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Not recorded due to drilling method

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-16-2018 | Boring Completed: 07-17-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-16

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0468° Longitude: -81.1657°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (3 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose, (residuum)				4-3-4 N=7						
						3-3-3 N=6						
			5			4-5-3 N=8						
8.0						2-2-2 N=4						
		SANDY SILT (ML), brown and tan, soft	10	▽								
12.0						3-4-5 N=9			1.5 (HP)			
		SANDY LEAN CLAY (CL), tan and gray, stiff	15									
17.0						42-50/2"						
		SANDY SILT (ML), gray, hard, (Partially Weathered Rock)	20									
20.0		***Boring Terminated at 20 Feet***										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *12' (End of Day)*

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-17-2018 | Boring Completed: 07-18-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-17

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0469° Longitude: -81.1665°

DEPTH	GRAPHIC LOG	DESCRIPTION	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)									
		SILTY SAND (SM), fine to medium grained, brown, loose, (residuum)			3-4-4 N=8						
3.0		**SILTY SAND (SM)**, fine to medium grained, brown, medium dense to dense			11-9-12 N=21						
5					7-11-13 N=24						
10					5-19-14 N=33						
12.0		**SANDY SILT (ML)**, brown and tan, stiff	▽								
15					3-5-6 N=11						
17.0		**SANDY SILT (ML)**, gray, hard, (Partially Weathered Rock)									
20.0					36-50/2"						
20		***Boring Terminated at 20 Feet***									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *13' (End of Day)*

▽ *13' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-17-2018 | Boring Completed: 07-18-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-18

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0461° Longitude: -81.1669°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (3 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense to loose, (residuum)				6-9-5 N=14						
			5			3-4-5 N=9						
						2-2-2 N=4						
8.0												
		SILTY SAND (SM), fine to medium grained, tan and gray, very dense, (Partially Weathered Rock)	10			3-16-50/3"						
						50/2"						
			15									
						50/2"						
21.0			20									
		Auger Refusal at 21 ft. - Begin Coring **BIOTITE SCHIST**, light gray, slightly to moderately fractured, moderately weathered, medium strong					40	40				
			25				52	43				
30.0			30									
		Coring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

Not recorded due to drilling method

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-17-2018 | Boring Completed: 07-18-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-19

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0475° Longitude: -81.1682°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense, (alluvium)				5-6-5 N=11						
3.0												
		SANDY LEAN CLAY (CL), mottled (brown, tan, gray), soft				WOH-2-2 N=4			0.5 (HP)			
			5									
						WOH-2-1 N=3			0.25 (HP)			
8.0												
		SANDY SILT (ML), tan and gray, hard, (Partially Weathered Rock)				8-9-50/3"						
			10									
						50/2"						
			15	▽								
17.0												
		Auger Refusal at 17 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *15' (End of Day)*

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-17-2018 | Boring Completed: 07-18-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-20

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0485° Longitude: -81.1701°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (3 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense, (residuum)				5-8-7 N=15				9		
						4-9-9 N=18				11		
			5			9-6-6 N=12						
8.0		**SANDY SILT (ML)**, brown and tan, very stiff to stiff				7-12-10 N=22				18		
			10	▽								
				▽		4-4-7 N=11				22		
17.0		**SANDY SILT (ML)**, gray, hard, (Partially Weathered Rock)	15									
20.0		***Boring Terminated at 20 Feet***	20			27-37-50/2"						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *14' (End of Day)*

▽ *12' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-17-2018 | Boring Completed: 07-18-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-21

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.049° Longitude: -81.1726°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (3 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense, (residuum)				3-5-7 N=12						
3.0		**SANDY SILT (ML)**, brown and tan, medium stiff to stiff				2-2-3 N=5						
			5	▽		WOH-2-3 N=5						
						3-5-6 N=11						
			10									
						5-5-4 N=9						
17.0			15	▽								
		SANDY SILT (ML), brown and tan, hard				9-15-18 N=33						
20.0			20									
		Boring Terminated at 20 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *17' (End of Day)*

▽ *7' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-17-2018 | Boring Completed: 07-18-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-22

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0486° Longitude: -81.1753°

DEPTH	GRAPHIC LOG	DESCRIPTION	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)									
		SILTY SAND (SM), fine to medium grained, brown, medium dense to loose, (residuum)			5-6-6 N=12						
					4-4-4 N=8						
5					3-4-3 N=7						
					7-3-4 N=7						
10			▽								
			▽		3-2-3 N=5				28	NP	20
15											
17.0		**SILTY SAND (SM)**, fine to medium grained, tan, very dense, (Partially Weathered Rock)			23-50/3"						
20.0		***Boring Terminated at 20 Feet***									
20											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *15' (End of Day)*

▽ *12' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-18-2018 | Boring Completed: 07-19-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-23

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0485° Longitude: -81.1797°

DEPTH	GRAPHIC LOG	DESCRIPTION	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (3 inches)									
		SILTY SAND (SM), fine to medium grained, brown, loose, (alluvium)			3-4-3 N=7						
					4-3-4 N=7						
5.5		**SANDY LEAN CLAY (CL)**, mottled (brown, tan, gray), soft to very soft			4-2-2 N=4			0.5 (HP)			
					1-1-1 N=2			0.25 (HP)	36	30-28-2	51
12.0		**SANDY SILT (ML)**, gray to tan, hard	▽		17-18-25 N=43						
					17-19-38 N=57						
20.0		***Boring Terminated at 20 Feet***									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *15' (End of Day)*

▽ *12' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-18-2018 | Boring Completed: 07-19-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-24

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0478° Longitude: -81.1832°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (3 inches)										
		SILTY SAND (SM), fine to medium grained, brown, loose to medium dense, (residuum)				4-2-5 N=7						
						8-6-7 N=13						
5.5		**WELL GRADED SAND WITH SILT (SW-SM)**, fine to medium grained, brown, loose	5			4-3-3 N=6						
						4-4-4 N=8				5		6
12.0		**SANDY SILT (ML)**, brown and tan, very stiff	10	▽								
			15	▽		5-7-9 N=16						
17.0		**SANDY SILT (ML)**, brown and tan, (Partially Weathered Rock)										
20.0			20			50/2"						
		Boring Terminated at 20 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *15' (End of Day)*

▽ *12' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-18-2018 | Boring Completed: 07-19-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-25

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0499° Longitude: -81.1846°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.5		**TOPSOIL**, (6 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense, (residuum)			X	5-7-8 N=15						
					X	4-5-7 N=12						
5.5		**SANDY SILT (ML)**, brown and tan, stiff to medium stiff	5									
					X	4-5-6 N=11						
				▽								
					X	2-3-3 N=6						
12.0		**SANDY SILT (ML)**, brown and tan, very stiff to hard	10									
					X	6-8-9 N=17						
			15	▽								
20.0					X	13-15-18 N=33						
		Boring Terminated at 20 Feet	20									

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

▽ *17' (End of Day)*

▽ *8' (After 24 Hours)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-18-2018 | Boring Completed: 07-19-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-26

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0514° Longitude: -81.1855°

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense, (residuum)				8-11-15 N=26				10		
						13-10-8 N=18						
5.5		**SANDY SILT (ML)**, brown and tan, very stiff to stiff	5			5-9-11 N=20				18		
						4-4-5 N=9						
12.0		**SANDY SILT (ML)**, gray, hard, (Partially Weathered Rock)	10			50/2"				4		
14.6		***Auger Refusal at 14.6 ft - Begin Coring)*** **BIOTITE SCHIST**, light gray, extremely fractured, moderately weathered, medium strong	15				88	76				
18.4		***Coring Terminated at 18.4 Feet***										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-18-2018 | Boring Completed: 07-19-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-27

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0525° Longitude: -81.1853°

DEPTH	GRAPHIC LOG	DESCRIPTION	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.3		**TOPSOIL**, (4 inches)										
		SILTY SAND (SM), fine to medium grained, brown, medium dense to dense, (residuum)				5-7-8 N=15						
						7-7-7 N=14						
			5			9-18-17 N=35						
8.0						38-50/2"						
		SILTY SAND (SM), fine to medium grained, tan, very dense	10									
						50/4"						
18.0			15									
		Auger Refusal at 18 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-18-2018 | Boring Completed: 07-19-2018

Drill Rig: CME-45C | Driller: B. Hyatt

Project No.: 73185026

BORING LOG NO. B-28

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0535° Longitude: -81.1862°

DEPTH	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
SILTY SAND (SM), with rock fragments, fine to medium grained, light brown, medium dense to dense, (residuum)					8-8-14 N=22						
					14-16-14 N=30						
		5			20-22-21 N=43						
8.0			▽								
SILTY SAND (SM), with rock fragments, fine to medium grained, light brown, medium dense to very dense, (Partially Weathered Rock)					50/4"						
12.0		10									
Auger Refusal at 12 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

▽ *8' (After 6 Days)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-27-2018 | Boring Completed: 08-02-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-28A

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LOCATION See Exploration Plan Latitude: 34.0535° Longitude: -81.1862° DEPTH Offset boring drilled 10 feet South of B-28	5 10	▽								
	11.0 ***Auger Refusal at 11 Feet***										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

▽ *8' (After 6 Days)*

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-27-2018 | Boring Completed: 07-27-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-29

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0535° Longitude: -81.186°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), fine to medium grained, light gray, medium dense, (residuum)										
	2.5				20-15-11 N=26						
	SILTY SAND (SM), fine to coarse grained, light gray, very dense, (Partially Weathered Rock)										
	3.8				50/3"						
	Auger Refusal at 3.8 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-27-2018 | Boring Completed: 08-02-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-29A

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LOCATION See Exploration Plan Latitude: 34.0535° Longitude: -81.186° DEPTH										
	Offset boring drilled 10 feet South of B-29										
	1.5 ***Auger Refusal at 1.5 Feet***										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 07-27-2018 | Boring Completed: 08-02-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

BORING LOG NO. B-30

PROJECT: Lower Saluda Relief Sewer

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SITE: Various
Irmo, South Carolina

LOCATION See Exploration Plan

Latitude: 34.0539° Longitude: -81.1864°

DEPTH	GRAPHIC LOG	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	REC (%)	RQD (%)	LABORATORY HP (tsf)	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.0											
	SILTY SAND, fine to medium grained, light reddish brown, loose to medium dense, (residuum)			X	2-3-3 N=6						
				X	6-6-4 N=10						
5.0		5									
	SILTY SAND, fine to medium grained, light reddish brown, loose										
				X	5-4-5 N=9						
8.0											
	SILTY SAND, fine to coarse grained, light brownish gray, very dense, (Partially weathered rock)			X	14-50-50/4"						
9.5	***Auger Refusal at 9.5 Feet***										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
2-1/4" Hollow Stem Auger

Abandonment Method:
Boring backfilled with Auger Cuttings at end of day

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Elevations were interpolated from a topographic site plan.

Notes:

WATER LEVEL OBSERVATIONS

No free water observed at end of day

No free water observed at time of closure

Terracon
521 Clemson Rd
Columbia, SC

Boring Started: 08-15-2018 | Boring Completed: 08-15-2018

Drill Rig: CME-55 | Driller: A. McGuire

Project No.: 73185026

Summary of Laboratory Results

BORING ID	Depth (Ft.)	Soil Classification USCS	% Fines	Liquid Limit	Plastic Limit	Plasticity Index	Water Content (%)
B-2	3.5 - 5	SANDY LEAN CLAY(CL)	57.6	38	19	19	11
B-2	8.5 - 10	LEAN CLAY with SAND(CL)	71.2	39	17	22	21
B-2	23.5 - 24.166		20.7				6
B-3	23.5 - 23.6667						11
B-5	1 - 2.5		51.0				14
B-5	6 - 7.5	SILTY SAND(SM)	49.4	22	20	2	20
B-5	18.5 - 20		59.7				18
B-9	13.5 - 15	SILTY SAND(SM)	39.5	NP	NP	NP	37
B-10	1 - 2.5						16
B-10	6 - 7.5						22
B-10	13.5 - 13.6667						7
B-15	1 - 2.5		34.7				8
B-15	6 - 7.5		34.4				10
B-15	13.5 - 14.75		34.5				5
B-20	1 - 2.5						9
B-20	3.5 - 5						11
B-20	8.5 - 10						18
B-20	13.5 - 15						22
B-22	13.5 - 15	SILTY SAND(SM)	19.9	NP	NP	NP	28
B-23	8.5 - 10	SANDY SILT(ML)	50.8	30	28	2	36
B-24	8.5 - 10		6.1				5
B-26	1 - 2.5						10
B-26	6 - 7.5						18
B-26	13.5 - 13.6667						4

PROJECT: Lower Saluda Relief Sewer

PROJECT NUMBER: 73185026

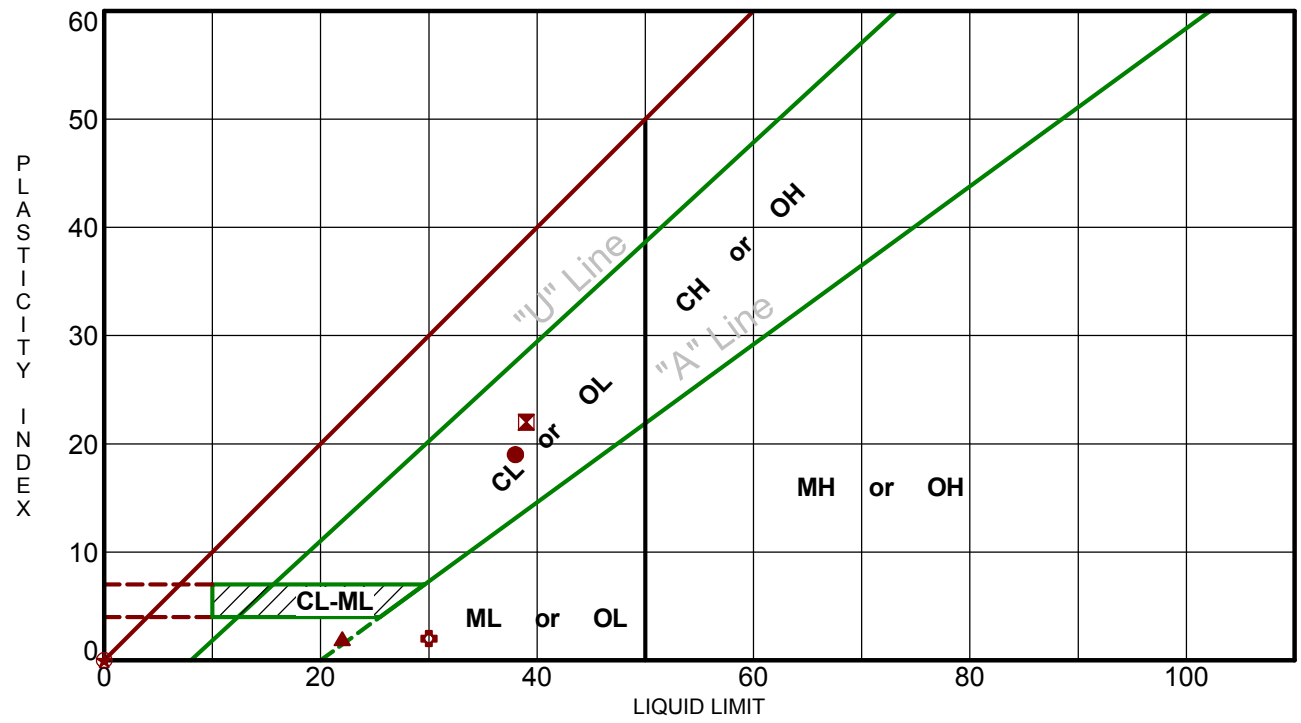
SITE: Various
Columbia, South Carolina

Terracon
521 Clemson Rd
Columbia, SC

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	B-2	3.5 - 5	38	19	19	58	CL	SANDY LEAN CLAY
⊠	B-2	8.5 - 10	39	17	22	71	CL	LEAN CLAY with SAND
▲	B-5	6 - 7.5	22	20	2	49	SM	SILTY SAND
★	B-9	13.5 - 15	NP	NP	NP	40	SM	SILTY SAND
⊙	B-22	13.5 - 15	NP	NP	NP	20	SM	SILTY SAND
✿	B-23	8.5 - 10	30	28	2	51	ML	SANDY SILT

PROJECT: Lower Saluda Relief Sewer

PROJECT NUMBER: 73185026

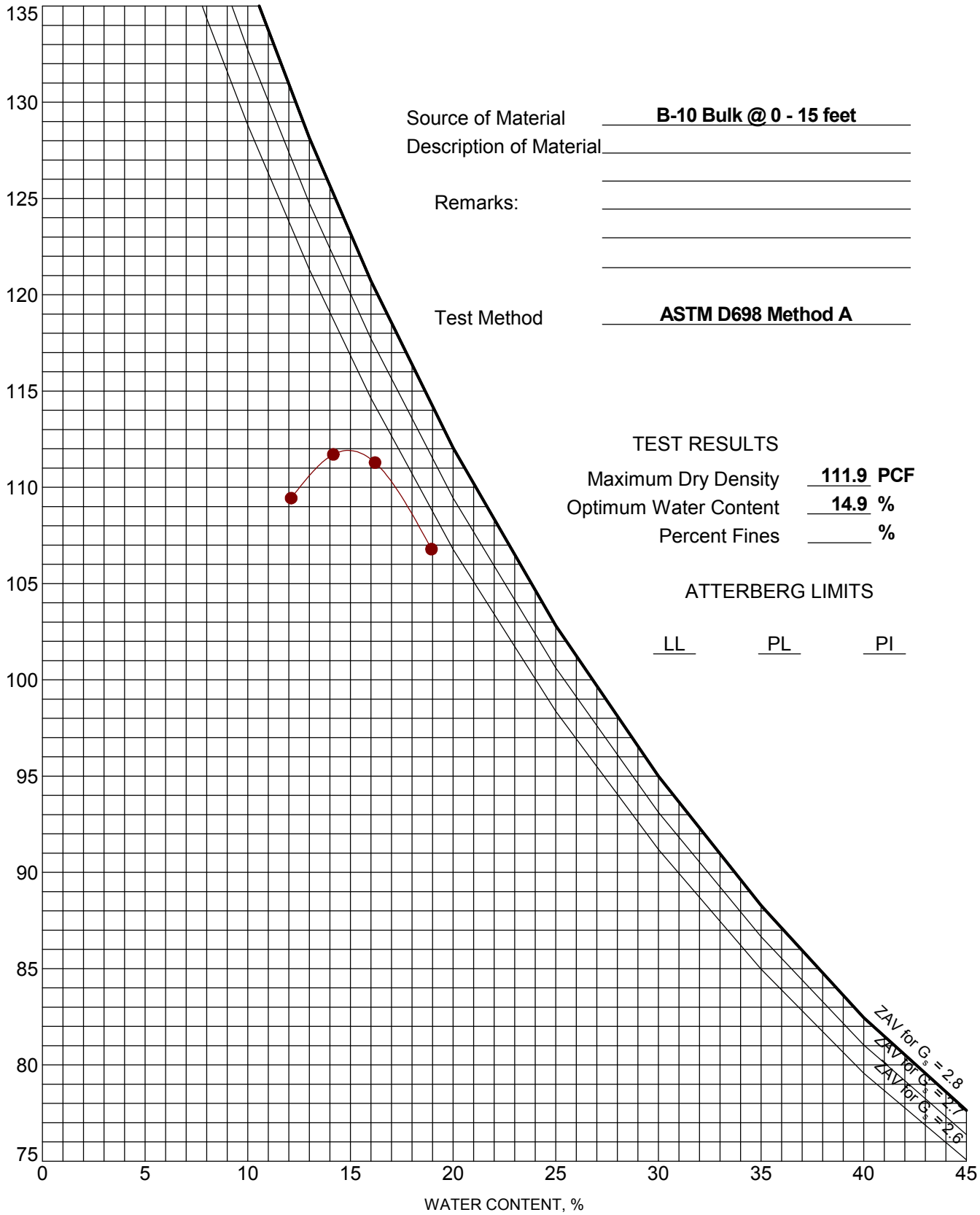
SITE: Various
Columbia, South Carolina

Terracon
521 Clemson Rd
Columbia, SC

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B-10 Bulk @ 0 - 15 feet**

Description of Material:

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**111.9**	**PCF**
Optimum Water Content	**14.9**	**%**
Percent Fines		**%**

ATTERBERG LIMITS

LL	PL	PI

PROJECT: Lower Saluda Relief Sewer

PROJECT NUMBER: 73185026

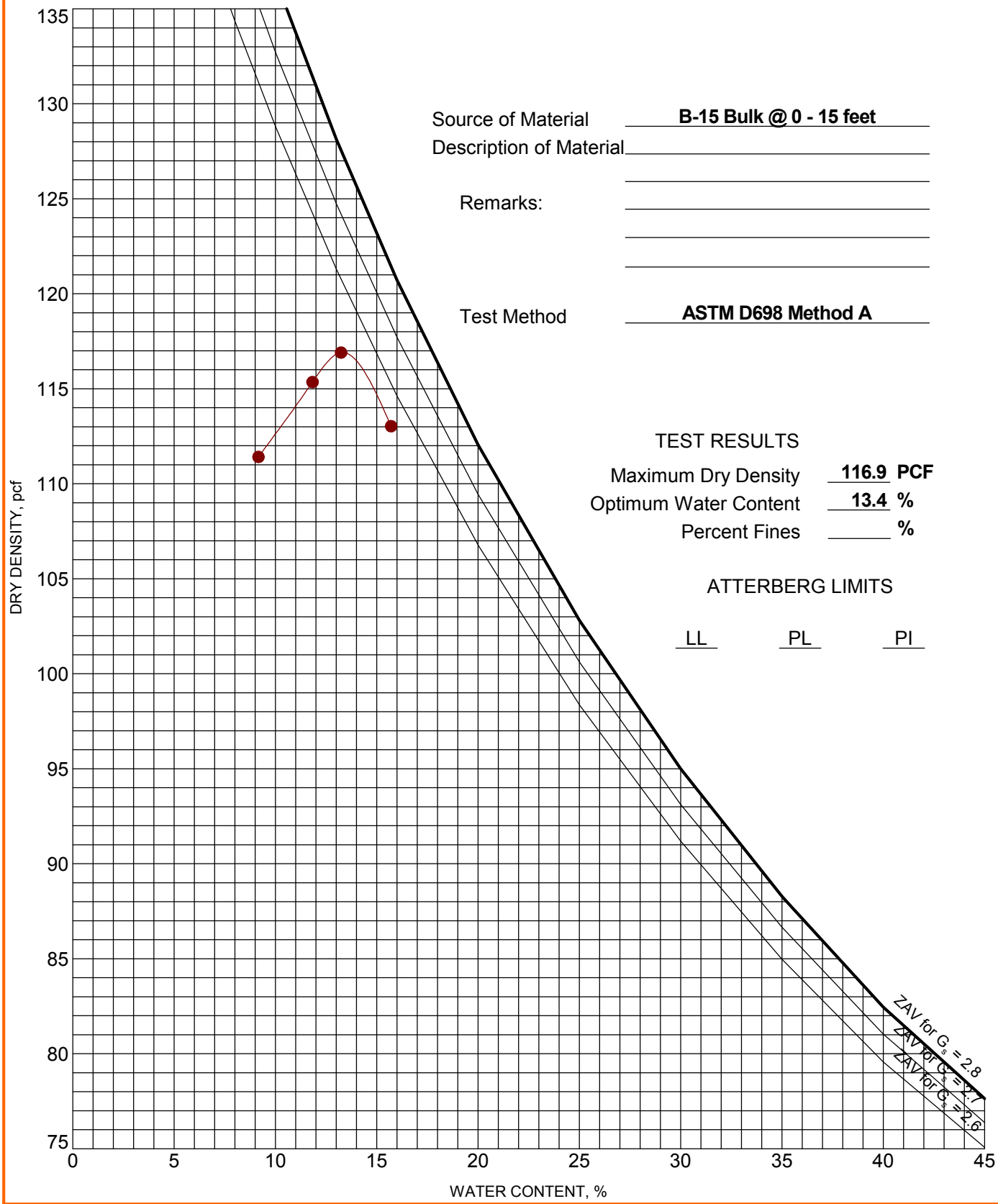
SITE: Various
Columbia, South Carolina

Terracon
521 Clemson Rd
Columbia, SC

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B-15 Bulk @ 0 - 15 feet**

Description of Material:

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**116.9**	**PCF**
Optimum Water Content	**13.4**	**%**
Percent Fines		**%**

ATTERBERG LIMITS

LL	PL	PI

PROJECT: Lower Saluda Relief Sewer

PROJECT NUMBER: 73185026

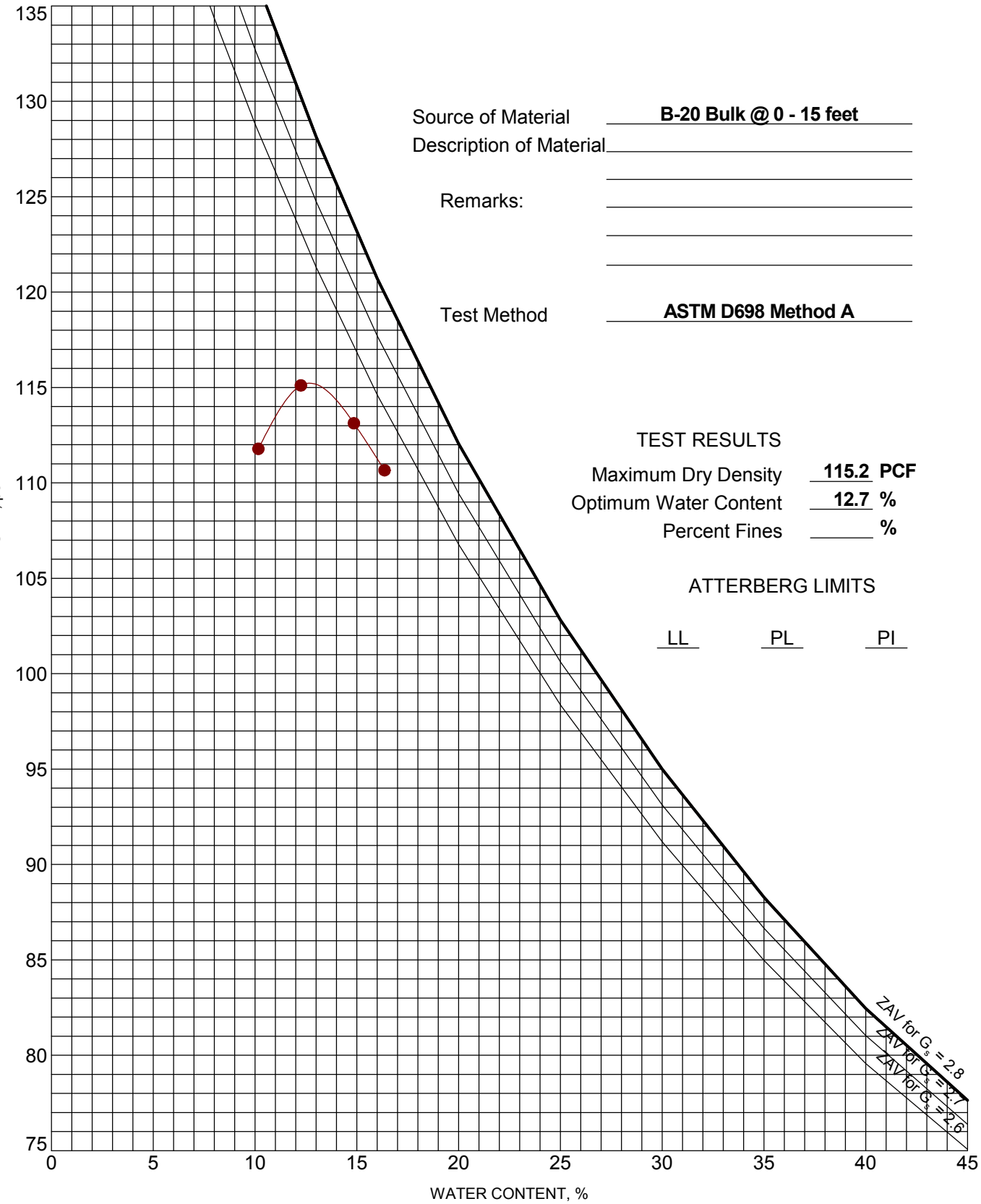
SITE: Various
Columbia, South Carolina

Terracon
521 Clemson Rd
Columbia, SC

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B-20 Bulk @ 0 - 15 feet**

Description of Material:

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**115.2**	**PCF**
Optimum Water Content	**12.7**	**%**
Percent Fines		**%**

ATTERBERG LIMITS

LL	PL	PI

PROJECT: Lower Saluda Relief Sewer

PROJECT NUMBER: 73185026

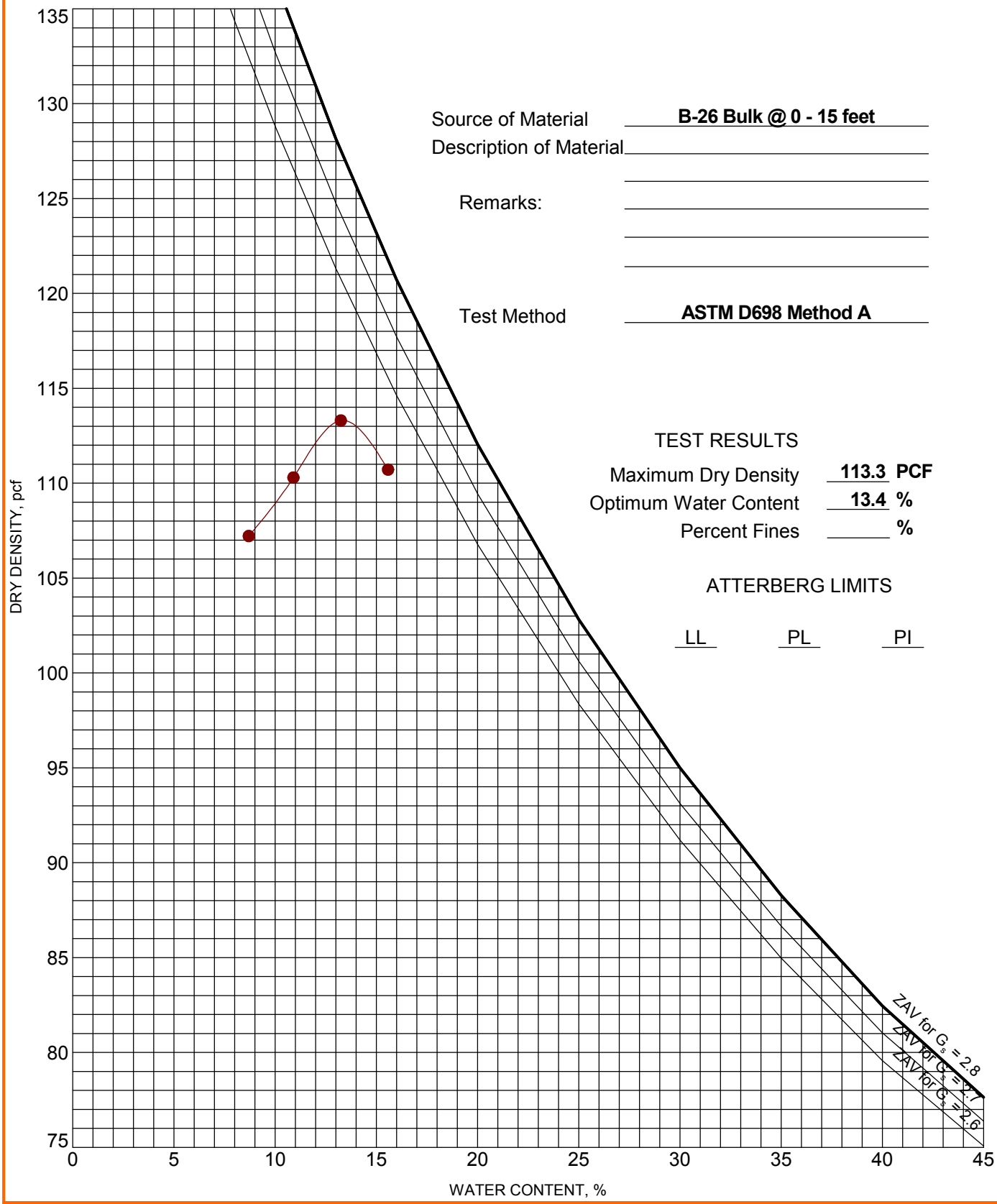
SITE: Various
Columbia, South Carolina

Terracon
521 Clemson Rd
Columbia, SC

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

MOISTURE-DENSITY RELATIONSHIP

ASTM D698/D1557



Source of Material: **B-26 Bulk @ 0 - 15 feet**

Description of Material:

Remarks:

Test Method: **ASTM D698 Method A**

TEST RESULTS

Maximum Dry Density	**113.3**	**PCF**
Optimum Water Content	**13.4**	**%**
Percent Fines		**%**

ATTERBERG LIMITS

LL	PL	PI

PROJECT: Lower Saluda Relief Sewer

PROJECT NUMBER: 73185026

SITE: Various
Columbia, South Carolina

Terracon
521 Clemson Rd
Columbia, SC

CLIENT: 4D Engineering, LLC
Lexington, South Carolina

SUPPORTING INFORMATION

UNIFIED SOIL CLASSIFICATION SYSTEM

Lower Saluda Relief Sewer and Major Pipe Rehabilitation ■ Irmo, SC

August 16, 2018 ■ Terracon Project No. 73185026

Terracon GeoReport

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 ≥ 4 and 1 ≤ Cc ≤ 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 ≥ 6 and 1 ≤ Cc ≤ 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"		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-inch (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.

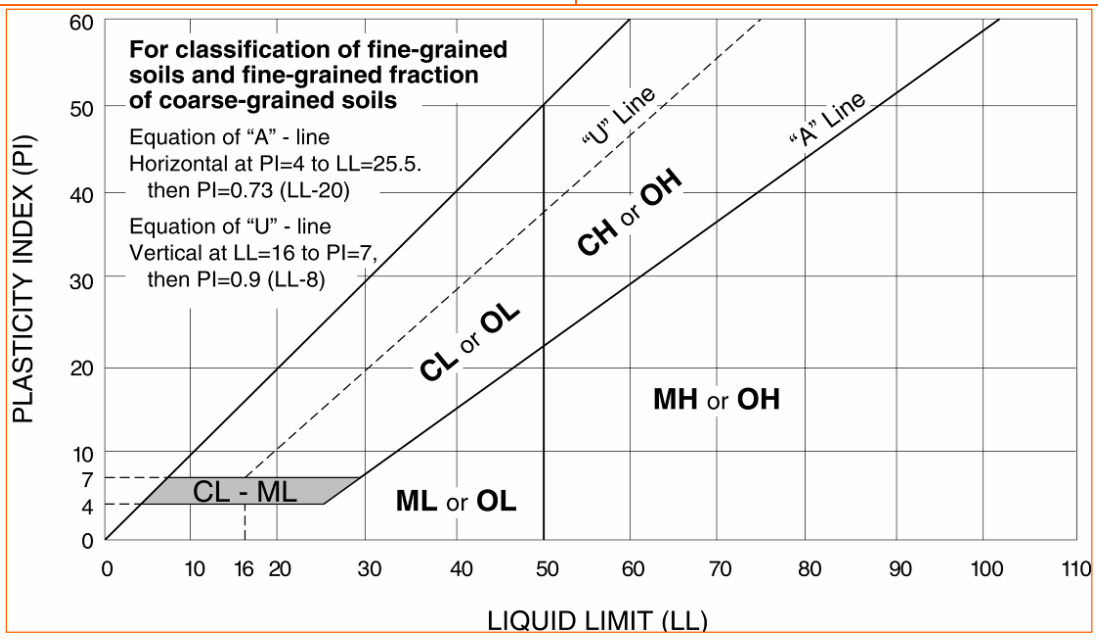
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



DESCRIPTION OF ROCK PROPERTIES

Lower Saluda Relief Sewer and Major Pipe Rehabilitation ■ Irmo, SC

August 16, 2018 ■ Terracon Project No. 73185026

WEATHERING	
Term	**Description**
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

STRENGTH OR HARDNESS		
Description	**Field Identification**	**Uniaxial Compressive Strength, psi (MPa)**
Extremely weak	Indented by thumbnail	40-150 (0.3-1)
Very weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	150-700 (1-5)
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	700-4,000 (5-30)
Medium strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer	4,000-7,000 (30-50)
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	7,000-15,000 (50-100)
Very strong	Specimen requires many blows of geological hammer to fracture it	15,000-36,000 (100-250)
Extremely strong	Specimen can only be chipped with geological hammer	>36,000 (>250)

DISCONTINUITY DESCRIPTION			
Fracture Spacing (Joints, Faults, Other Fractures)		**Bedding Spacing (May Include Foliation or Banding)**	
Description	**Spacing**	**Description**	**Spacing**
Extremely close	< ¾ in (<19 mm)	**Laminated**	< ½ in (<12 mm)
Very close	¾ in – 2-1/2 in (19 - 60 mm)	**Very thin**	½ in – 2 in (12 – 50 mm)
Close	2-1/2 in – 8 in (60 – 200 mm)	**Thin**	2 in – 1 ft. (50 – 300 mm)
Moderate	8 in – 2 ft. (200 – 600 mm)	**Medium**	1 ft. – 3 ft. (300 – 900 mm)
Wide	2 ft. – 6 ft. (600 mm – 2.0 m)	**Thick**	3 ft. – 10 ft. (900 mm – 3 m)
Very Wide	6 ft. – 20 ft. (2.0 – 6 m)	**Massive**	> 10 ft. (3 m)

Discontinuity Orientation (Angle): Measure the angle of discontinuity relative to a plane perpendicular to the longitudinal axis of the core. (For most cases, the core axis is vertical; therefore, the plane perpendicular to the core axis is horizontal.) For example, a horizontal bedding plane would have a 0-degree angle.

ROCK QUALITY DESIGNATION (RQD) [1]	
Description	**RQD Value (%)**
Very Poor	0 - 25
Poor	25 – 50
Fair	50 – 75
Good	75 – 90
Excellent	90 - 100

1. The combined length of all sound and intact core segments equal to or greater than 4 inches in length, expressed as a percentage of the total core run length.

Reference: U.S. Department of Transportation, Federal Highway Administration, Publication No FHWA-NHI-10-034, December 2009
Technical Manual for Design and Construction of Road Tunnels – Civil Elements

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Appendix B: References

Shop Drawing; Saluda River PS, Grinder Structure Weir Gate; October 1, 2012

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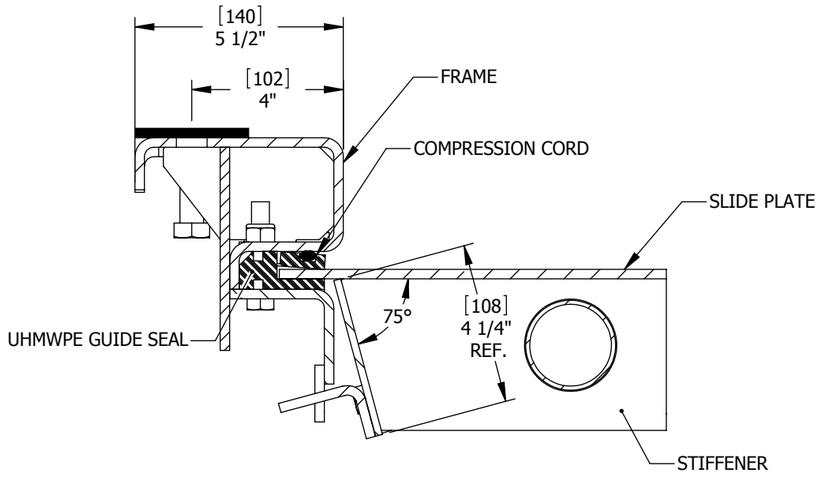
SERIES 40

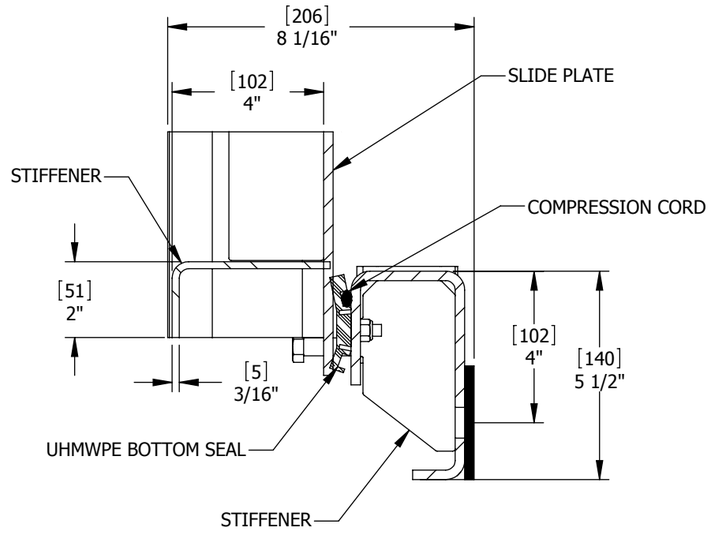
STAINLESS STEEL
WEIR GATES

DOWNWARD-OPENING WEIR GATES

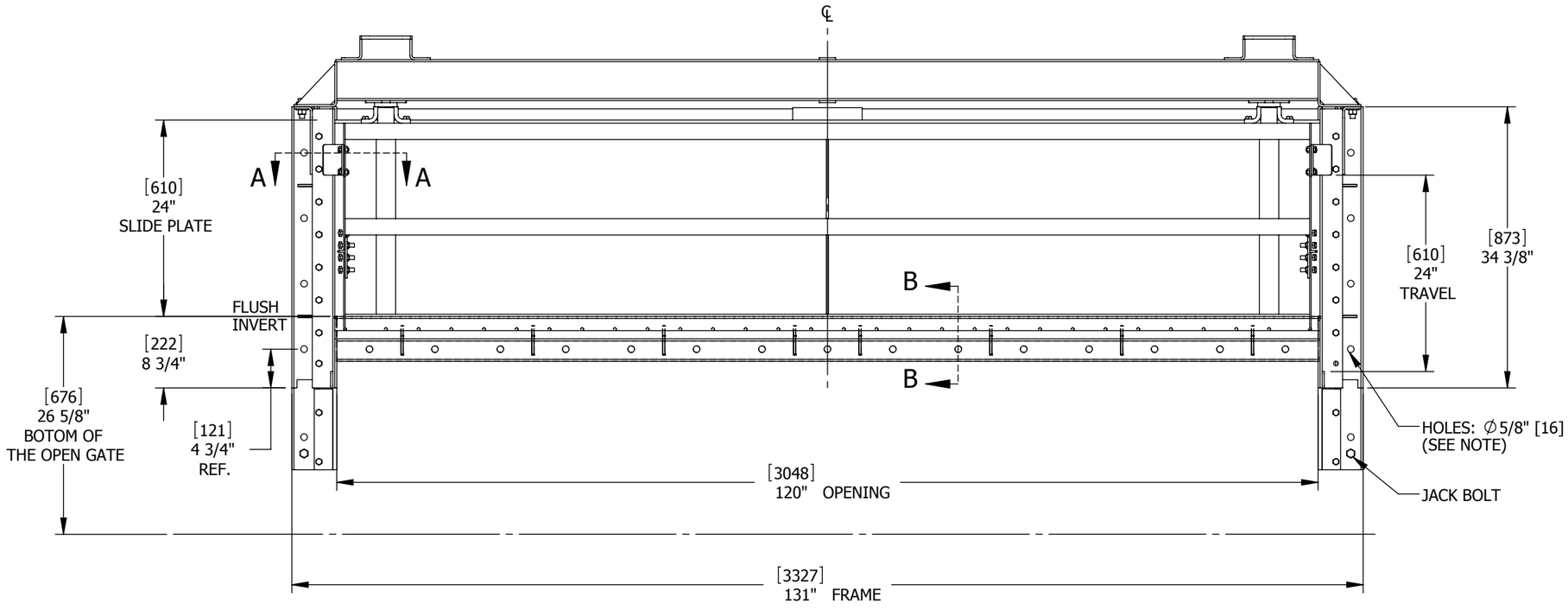


SECTION A-A

Tag No:
GT-2011-5
Install Location: Grinder Diversion Structure
ARCO



SECTION B-B



NOTE: 316 S.S. ANCHOR STUDS (Ø5/8 X 6 1/2 LG.) INCLUDED FOR 5 DEPTH.
INSTALLER PROVIDES EPOXY ADHESIVE. HILTI HIT-HY 150 MAX OR EQUAL.

TOLÉRANCES	
ANGLE	: ±1°
FRACTION	: ±1/8" [3mm]
.XX	: ±0.015"
.XXX	: ±0.005"

DRAWING BY: Devin Thayer		MODEL: 402-120x24-K-CW	MATERIAL: 304L S.S. QTY: 1
PART No.: V402C024XB300	DATE: 10/1/2012	IDENTIFICATION:	
UNITS [mm] INCHES	TITLE: V404 CW tige 1.50 et - double tige (m.p.unique)-5120195-07	DRAWING No.: 5120195-07-1	PAGE:

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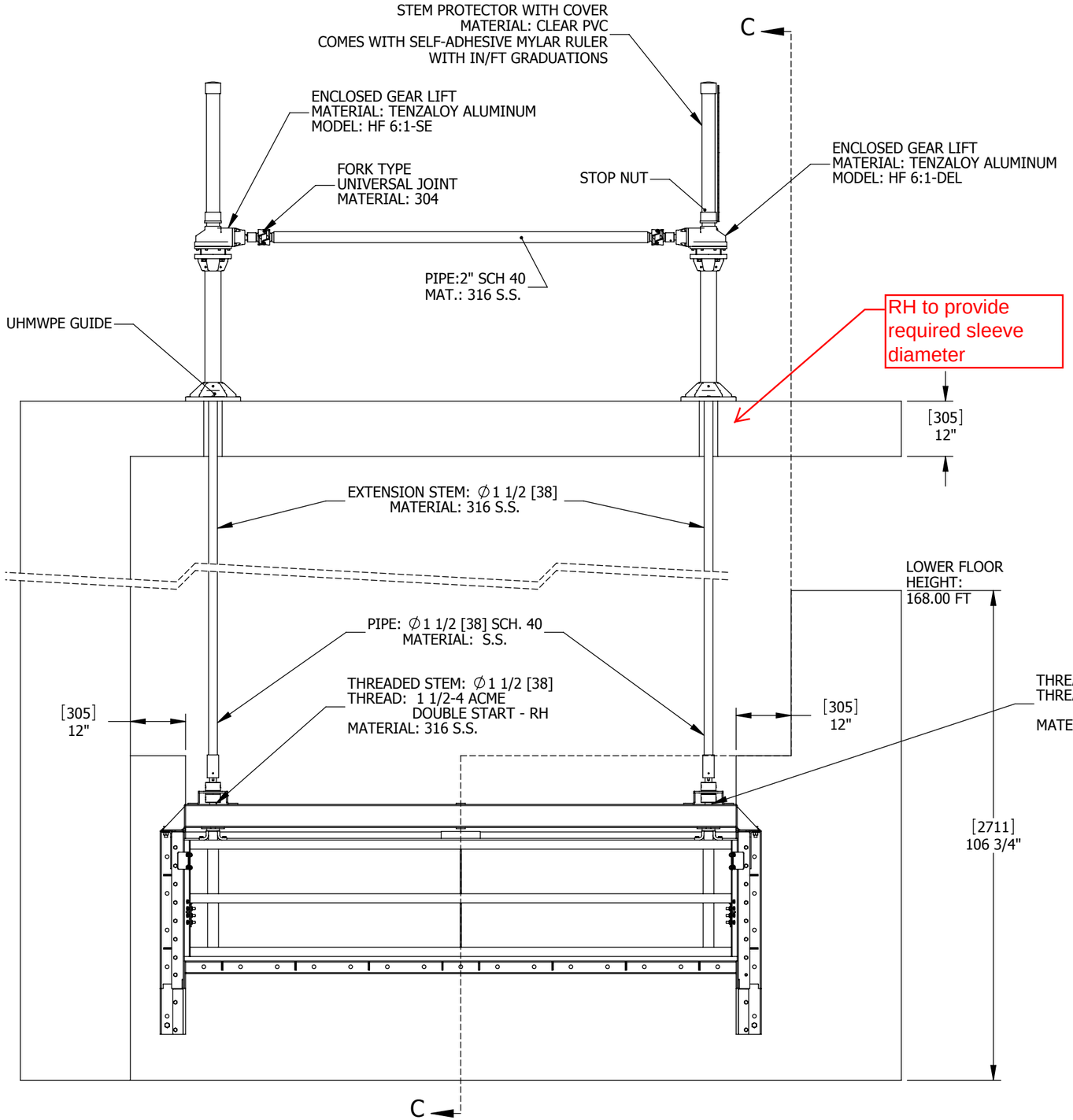
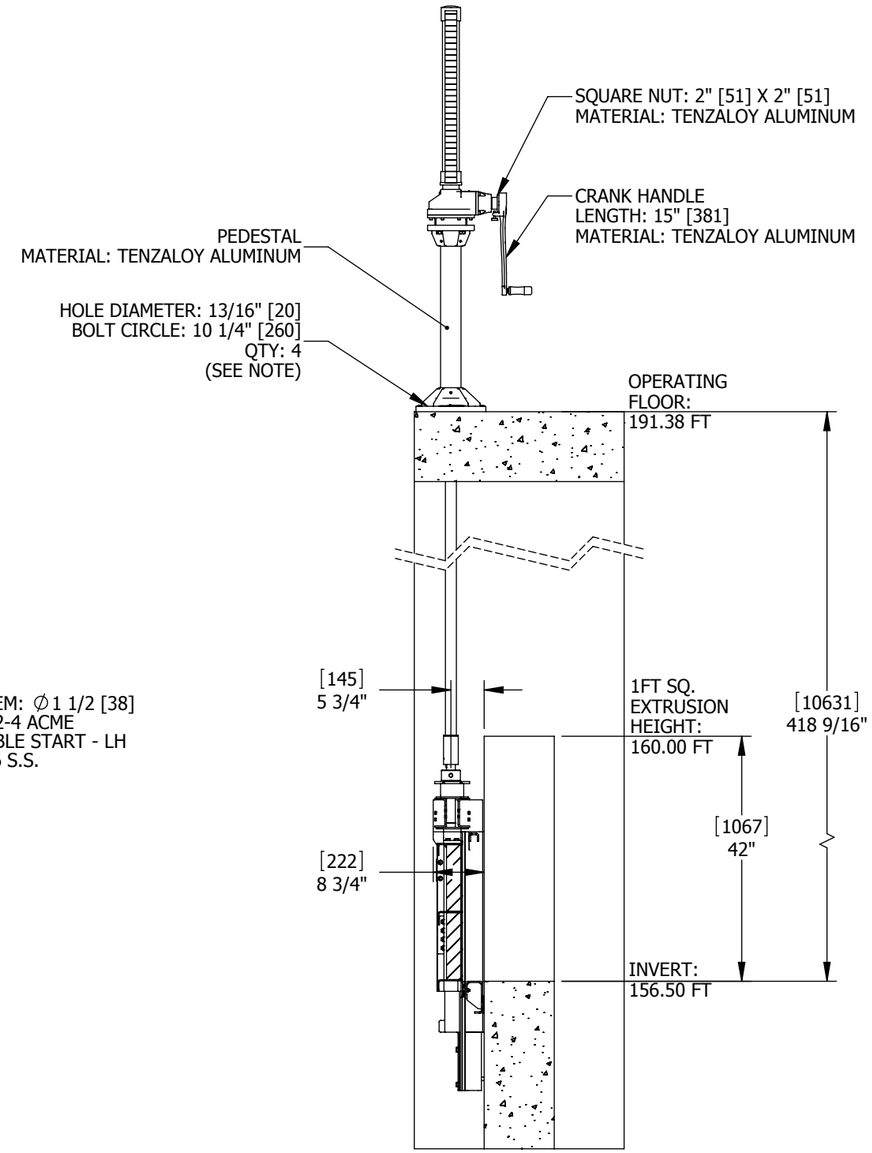
SERIES 40

STAINLESS STEEL
WEIR GATES

DOWNWARD-OPENING WEIR GATES





NOTE: 316 S.S. ANCHOR STUDS (Ø5/8 X 6 1/2 LG.) INCLUDED FOR 5 DEPTH.
INSTALLER PROVIDES EPOXY ADHESIVE. HILTI HIT-HY 150 MAX OR EQUAL.

TOLÉRANCES	
ANGLE	: ±1°
FRACTION	: ±1/8" [3mm]
.XX	: ±0.015"
.XXX	: ±0.005"

DRAWING BY: Devin Thayer		MODEL: 402-120x24-K-CW	MATERIAL: 304L S.S.	QTY: 1
PART No.: V402C024XB300	DATE: 10/1/2012	IDENTIFICATION:		
UNITS [mm] INCHES	TITLE: V404 CW tige 1.50 et - double tige (m.p.unique)-5120195-07	DRAWING No.: 5120195-07-2	PAGE:	

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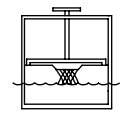
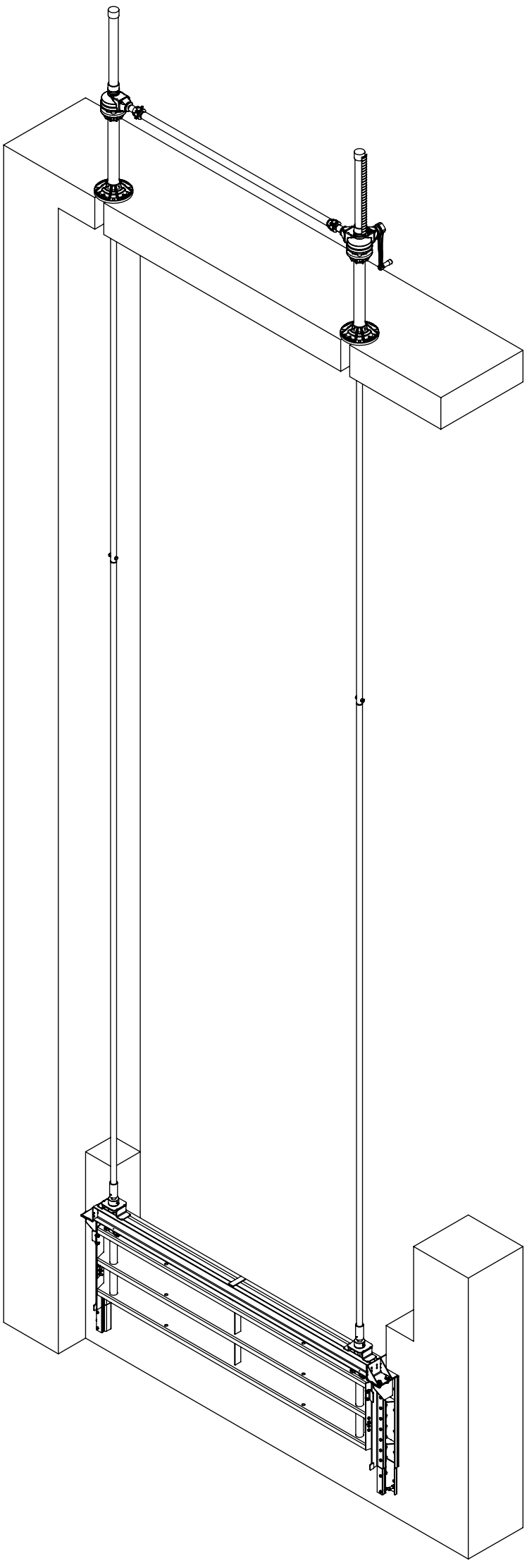
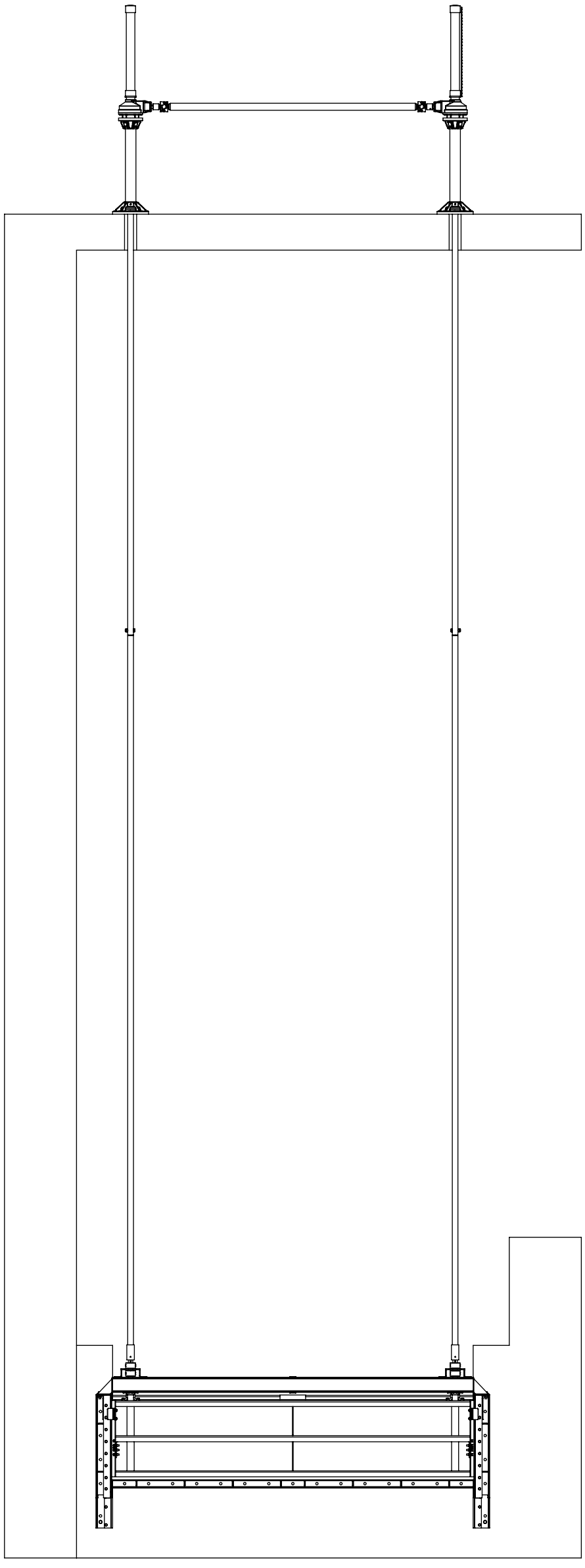
SERIES 40

STAINLESS STEEL
WEIR GATES
DOWNWARD-OPENING WEIR GATES







TOLÉRANCES ANGLE : ±1° FRACTION : ±1/8" [3mm] .XX : ±0.015" .XXX : ±0.005"	DRAWING BY: Devin Thayer	DATE: 10/1/2012	MODEL: 402-120x24-K-CW	MATERIAL: 304L S.S. QTY: 1
	PART No.: V402C024XB300		IDENTIFICATION:	
	UNITS [mm] INCHES	TITLE: V404 CW tige 1.50 et - double tige (m.p.unique)-5120195-07	DRAWING No.: 5120195-07-3	PAGE:

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Appendix C: Permits

1. SCDHEC Wastewater Construction Permit WW042220, Expires 1/21/2023
2. SCDHEC NPDES General Permit Coverage Approval SCR10Z546
3. Lexington County Approval of Land Disturbance Permit 2000078, Expires 1/29/2025
4. SCDOT Encroachment Permit 231648
5. USACE Application for Activities Affecting Waters of the United States **(Approval Pending)**

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SCDHEC Wastewater Construction Permit WW042220, Expires 1/21/2023

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Wastewater Construction Permit
Bureau of Water

dhec
Healthy People. Healthy Communities.

PROJECT NAME: Lower Saluda Relief Sewer and Maj Pipe Rehab	COUNTY: Richland
LOCATION: St. Andrews Rd., Columbia, SC 29201	

PERMISSION IS HEREBY GRANTED TO: John Riggs
City of Columbia
1136 Washington Street
Columbia, SC29201

For the construction of a sanitary sewer system in accordance with the construction plans, specifications, design calculations and the Construction Permit Application signed by James Mazzel, Brown and Caldwell, Registered Professional Engineer, S.C Registration Number: 20953.

Project Description: Installation of 2175 LF of 42" sewer main, 16199 OF of 36" sewer main, 134 LF of 8" sewer main, rehab of 35 existing manholes, pipe burst of 1386 LF of 27" sewer to 36" sewer main, CIPP lining of approximately 655 LF of 36" sewer and 1070 LF of 30" sewer main.

TREATMENT FACILITY: The wastewater will be discharged to the COLUMBIA METRO PLANT - SC0020940 at a design flow rate of 0 GPD.

STANDARD CONDITION:

NOTE: In accepting this permit, the owner agrees to the admission of properly authorized persons at all reasonable hours for the purpose of sampling and inspection. This is a permit for construction only and does not constitute DHEC approval, temporary or otherwise, to place the system in operation. An Approval to Place in Operation is required and can be obtained following the completion of construction by contacting the Midlands EA Columbia at 803-896-0620. Additional permits may be required prior to construction (e.g., Stormwater).

SPECIAL CONDITIONS:
NONE

PERMIT NUMBER:	WW042220
ISSUANCE DATE:	January 21, 2020
EXPIRATION DATES:	Construction must be completed and the Approval to Place in Operation granted prior to January 21, 2023 or this permit will expire.

Douglas B. Kinard, P.E., Director
Drinking Water Protection Division

LOWER SALUDA RELIEF SEWER
AND
MAJOR PIPE REHABILITATION

SS7428

811 Know what's below. Call before you dig.

UTILITIES PROTECTION CENTER
THREE WORKING DAYS BEFORE YOU DIG
SOUTH CAROLINA - 1-800-922-0983

*****UTILITY WARNING:*****
THE UNDERGROUND UTILITIES SHOWN HAVE BEEN LOCATED FROM FIELD SURVEY INFORMATION AND EXISTING DRAWINGS. THE ENGINEER/SURVEYOR MAKES NO GAURANTEE THAT THE UNDERGROUND UTILITIES SHOWN COMPRISE ALL SUCH UTILITIES IN THE AREA, EITHER IN SERVICE OR ABANDONED. THE ENGINEER/SURVEYOR FURTHER DOES NOT WARRANT THAT THE UNDERGROUND UTILITIES SHOWN ARE IN THE EXACT LOCATION INDICATED ALTHOUGH HE DOES CERTIFY THAT THEY ARE LOCATED AS ACCURATELY AS POSSIBLE FROM THE INFORMATION AVAILABLE. THE ENGINEER/SURVEYOR HAS NOT PHYSICALLY LOCATED THE UNDERGROUND UTILITIES.

Columbia Water
Drinking Water • Wastewater • Stormwater

SC Department of Health & Environmental Control, Bureau of Water
DRINKING WATER & RECREATIONAL WATERS PROTECTION
WATER & WASTEWATER CONSTRUCTION
APPROVED FOR CONSTRUCTION ONLY
(Subject to any provisions which may appear in the construction permit)
Final written approval for operation must be obtained from DHEC after completion of construction.
☐ WATER PERMIT ☑ WASTEWATER PERMIT ☐ COMBINED PERMITS

Water Permit #	Date	Reviewer
WW042280	11/21/20	MRK
Wastewater Permit #	Date	Reviewer

MAYOR
STEPHEN K. BENJAMIN

CITY COUNCIL
SAM DAVIS
TAMEIKA I. DEVINE
MOE BADDOURAH
HOWARD E. DUVALL, JR.
EDWARD H. MCDOWELL, JR.
DANIEL J. RICKENMANN

CITY MANAGER
TERESA B. WILSON

ASSISTANT CITY MANAGER OF COLUMBIA WATER
CLINT SHEALY, P.E.

DIRECTOR OF UTILITIES
JOSEPH D. JACO, P.E.

DIRECTOR OF ENGINEERING
DANA R. HIGGINS, P.E.

Clean Water 2020
Columbia's Clear Vision For Clean Water

NOT FOR CONSTRUCTION

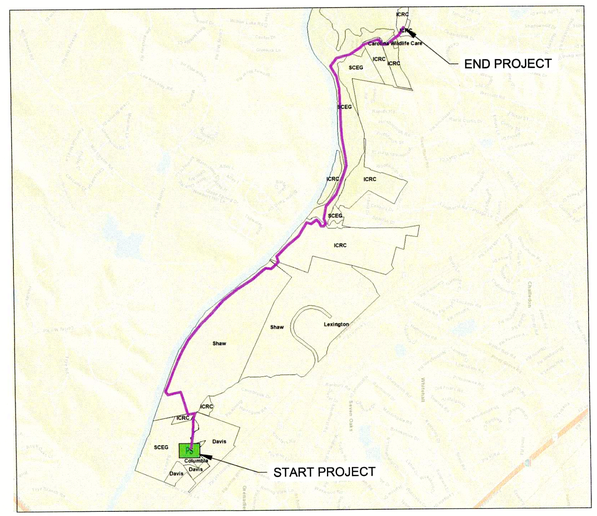
95% DESIGN SUBMITTAL FOR PERMITTING

NOVEMBER 2019

PREPARED BY:

Brown AND Caldwell
Environmental Engineering and Consulting
250 Berryhill Road, Suite 104, Columbia, SC 29210 803-873-9701

4D ENGINEERING
"SUPERIOR COMPREHENSIVE ENGINEERING SOLUTIONS"
WWW.4DENGR.COM
CIVIL ENGINEERING



LOCATION MAP
NTS

SCDHEC NPDES General Permit Coverage Approval SCR10Z546

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dhec
Healthy People. Healthy Communities

February 10, 2020

John Riggs
City of Columbia
1136 Washington Street
Columbia, SC 29201

RE: Lower Saluda Relief Sewer, Lexington County
NPDES Coverage Number: SCR10Z546

Dear John Riggs:

The Department of Health and Environmental Control (Department or DHEC) has received approval of and the Notice of Intent for the above-referenced project from **LEXINGTON COUNTY**. Based on your submission of this documentation and in accordance with the NPDES General Permit for Stormwater Discharges from Construction Activities SCR100000 (CGP), this project has been granted coverage under the CGP on **February 10, 2020**. This project's general permit coverage number is **SCR10Z546**. The total disturbed area for this site is **27.6 acres**.

An as-built survey(s), signed and sealed by a S.C. Licensed Land Surveyor or Professional Engineer, should be submitted to **LEXINGTON COUNTY** for all detention structure(s) on this site. The survey(s) should show grades, contours, and depths for all structure(s) and should include the elevations and dimensions of all outlet structures, including but not limited to pipes, orifices, risers, weirs, and emergency spillways. A statement signed by the project's S.C. Registered Engineer indicating that the structure(s) was installed and is operating as shown on approved plans and in approved calculations is required. If the elevations or dimensions of the structures listed above do not match those used in the approved plans, provide a certification statement signed by the project's S.C. Registered Engineer indicating that the structure, as built, will function as shown in approved calculations. A new analysis of the structure (routing) may be necessary. The as-built survey and/ or analysis must be accepted by **LEXINGTON COUNTY** before a Notice of Termination (NOT) can be submitted to the Department.

The CGP can be downloaded at the following website: http://www.scdhec.gov/Environment/docs/CGP-permit.pdf or you may request a copy from us via email (stormwatercgp@dhec.sc.gov). You are responsible for ensuring your contractor(s) complies with the approved SWPPP and the minimum requirements of the CGP. Also, you are responsible for overall compliance with the Storm Water Management and Sediment Reduction Act of 1991 (1991 Act), SC Pollution Control Act, and the Federal Clean Water Act (CWA). Failure to comply with the approved SWPPP or applicable statutes and regulations may result in enforcement actions.

You must notify this DHEC EQC Regional Office prior to starting any land-disturbing activity. The address and telephone number of the EQC office are as follows:

Midlands EA Columbia
State Park Health Center
Columbia, SC 29203
803-896-0620

Inspections of this site must be performed by qualified personnel as described in Section 4.2.E of the CGP.

You should be aware that this approval is only applicable for the Stormwater Pollution Prevention Plan (SWPPP) that was submitted for this project. Any additional construction or land disturbing activity beyond the scope of the approved plans is not authorized. Any future work for this project not shown on the stamped, approved plans will require that you submit another site plan for review and approval. All major modifications require review and approval by **LEXINGTON COUNTY**; the Department must be notified in writing by **LEXINGTON COUNTY** of the approval of major modifications if the disturbed area changes. Minor modifications to the approved SWPPP may be made by the SWPPP preparer and do not require review and approval by the Department; these changes should be signed and dated by the SWPPP preparer. If you have a question about whether a modification is major or minor, contact the Stormwater Permitting Section at (843) 953-4300.

A copy of the stamped, approved SWPPP (including a copy the CGP, contractor certifications, inspection records, rainfall data, etc), NOI, and CGP coverage letter from DHEC must be retained and available at the construction site (or accessible within 30 minutes during normal business hours) from the date of commencement of construction activities to the date of final stabilization. If an on-site location is unavailable to store the SWPPP when no personnel are present, notice of the plan's location must be posted near the main entrance at the construction site.

All contractors who will conduct land-disturbing activities at the site must complete a Contractor Certification Form. You are also responsible for listing all contractors in the SWPPP and for holding a pre-construction conference with each contractor before they can conduct land-disturbing activity at the site.

The Department may conduct periodic inspections of your site. Any violations found during these inspections may result in enforcement action.

This NPDES coverage should be terminated by the permittee when one of the conditions listed in Section 5.1 of the CGP has been met. You must submit a Notice of Termination (NOT) to cancel your NPDES coverage under the CGP. Please see section 5.1 of the CGP for additional information required to be submitted with the NOT.

You are responsible for obtaining any other federal, state, or local permit that may be required for this project. In particular, any permits through the U.S. Army Corps of Engineers for the placement of fill material in Waters of the United States. Please note we have not sent a copy of this letter to any county or city building official. You must send a copy of this letter to these agencies, if necessary.

If material excavated during construction activities leaves the site, a mine operating permit may be needed. You are responsible for contacting the Mining and Reclamation Section to determine if a mining permit is required for the site. The Mining and Reclamation Section can be reached at (803)898-1362 or via e-mail at AskMines@dhec.sc.gov.

Please see the enclosed "Guide to Board Review" document for information about the procedures for appealing this NPDES coverage.

If you have any questions or cannot access the referenced websites, please call me at 803-898-3973.

Sincerely,

Eve Leitzsey

Eve I Leitzsey
Stormwater Permitting Section

CC: Justin P Waring, 4D Engineering LLC
Midlands EA Columbia

South Carolina Board of Health and Environmental Control
Guide to Board Review
Pursuant to S.C. Code Ann. § 44-1-60

The decision of the South Carolina Department of Health and Environmental Control (Department) becomes the final agency decision fifteen (15) calendar days after notice of the decision has been mailed to the applicant, permittee, licensee and affected persons who have requested in writing to be notified, unless a written request for final review accompanied by a filing fee in the amount of $100 is filed with Department by the applicant, permittee, licensee or affected person.

Applicants, permittees, licensees, and affected parties are encouraged to engage in mediation or settlement discussions during the final review process.

If the Board declines in writing to schedule a final review conference, the Department's decision becomes the final agency decision and an applicant, permittee, licensee, or affected person may request a contested case hearing before the Administrative Law Court within thirty (30) calendar days after notice is mailed that the Board declined to hold a final review conference. In matters pertaining to decisions under the South Carolina Mining Act, appeals should be made to the South Carolina Mining Council.

I. Filing of Request for Final Review

1. A written Request for Final Review (RFR) and the required filing fee of one hundred dollars ($100) must be received by Clerk of the Board within fifteen (15) calendar days after notice of the staff decision has been mailed to the applicant, permittee, licensee, or affected persons. If the 15th day occurs on a weekend or State holiday, the RFR must be received by the Clerk on the next working day. RFRs will not be accepted after 5:00 p.m.
2. RFRs shall be in writing and should include, at a minimum, the following information:
   - The grounds for amending, modifying, or rescinding the staff decision;
   - a statement of any significant issues or factors the Board should consider in deciding how to handle the matter;
   - the relief requested;
   - a copy of the decision for which review is requested; and
   - mailing address, email address, if applicable, and phone number(s) at which the requestor can be contacted.
3. RFRs should be filed in person or by mail at the following address:
   South Carolina Board of Health and Environmental Control
   Attention: Clerk of the Board
   2600 Bull Street
   Columbia, South Carolina 29201
   Alternatively, RFR's may be filed with the Clerk by facsimile (803-898-3393) or by electronic mail (boardclerk@dhec.sc.gov).
4. The filing fee may be paid by cash, check or credit card and must be received by the 15th day.
5. If there is any perceived discrepancy in compliance with this RFR filing procedure, the Clerk should consult with the Chairman or, if the Chairman is unavailable, the Vice-Chairman. The Chairman or the Vice-Chairman will determine whether the RFR is timely and properly filed and direct the Clerk to (1) process the RFR for consideration by the Board or (2) return the RFR and filing fee to the requestor with a cover letter explaining why the RFR was not timely or properly filed. Processing an RFR for consideration by the Board shall not be interpreted as a waiver of any claim or defense by the agency in subsequent proceedings concerning the RFR.
6. If the RFR will be processed for Board consideration, the Clerk will send an Acknowledgement of RFR to the Requestor and the applicant, permittee, or licensee, if other than the Requestor. All personal and financial identifying information will be redacted from the RFR and accompanying documentation before the RFR is released to the Board, Department staff or the public.
7. If an RFR pertains to an emergency order, the Clerk will, upon receipt, immediately provide a copy of the RFR to all Board members. The Chairman, or in his or her absence, the Vice-Chairman shall based on the circumstances, decide whether to refer the RFR to the RFR Committee for expedited review or to decline in writing to schedule a Final Review Conference. If the Chairman or Vice-Chairman determines review by the RFR Committee is appropriate, the Clerk will forward a copy of the RFR to Department staff and Office of General Counsel. A Department response and RFR Committee review will be provided on an expedited schedule defined by the Chairman or Vice-Chairman.
8. The Clerk will email the RFR to staff and Office of General Counsel and request a Department Response within eight (8) working days. Upon receipt of the Department Response, the Clerk will forward the RFR and Department Response to all Board members for review, and all Board members will confirm receipt of the RFR to the Clerk by email. If a Board member does not confirm receipt of the RFR within a twenty-four (24) hour period, the Clerk will contact the Board member and confirm receipt. If a Board member believes the RFR should be considered by the RFR Committee, he or she will respond to the Clerk's email within forty-eight (48) hours and will request further review. If no Board member requests further review of the RFR within the forty-eight (48) hour period, the Clerk will send a letter by certified mail to the Requestor, with copy by

regular mail to the applicant, permittee, or licensee, if not the Requestor, stating the Board will not hold a Final Review Conference. Contested case guidance will be included within the letter.
NOTE: If the time periods described above end on a weekend or State holiday, the time is automatically extended to 5:00 p.m. on the next business day.

9. If the RFR is to be considered by the RFR Committee, the Clerk will notify the Presiding Member of the RFR Committee and the Chairman that further review is requested by the Board. RFR Committee meetings are open to the public and will be public noticed at least 24 hours in advance.
10. Following RFR Committee or Board consideration of the RFR, if it is determined no Conference will be held, the Clerk will send a letter by certified mail to the Requestor, with copy by regular mail to the applicant, permittee, or licensee, if not the Requestor, stating the Board will not hold a Conference. Contested case guidance will be included within the letter.

II. Final Review Conference Scheduling

1. If a Conference will be held, the Clerk will send a letter by certified mail to the Requestor, with copy by regular mail to the applicant, permittee, or licensee, if not the Requestor, informing the Requestor of the determination.
2. The Clerk will request Department staff provide the Administrative Record.
3. The Clerk will send Notice of Final Review Conference to the parties at least ten (10) days before the Conference. The Conference will be publically noticed and should:
   - include the place, date and time of the Conference;
   - state the presentation times allowed in the Conference;
   - state evidence may be presented at the Conference;
   - if the conference will be held by committee, include a copy of the Chairman's order appointing the committee; and
   - inform the Requestor of his or her right to request a transcript of the proceedings of the Conference prepared at Requestor's expense.
4. If a party requests a transcript of the proceedings of the Conference and agrees to pay all related costs in writing, including costs for the transcript, the Clerk will schedule a court reporter for the Conference.

III. Final Review Conference and Decision

1. The order of presentation in the Conference will, subject to the presiding officer's discretion, be as follows:
   - Department staff will provide an overview of the staff decision and the applicable law to include [10 minutes]:
     - Type of decision (permit, enforcement, etc.) and description of the program.
     - Parties
     - Description of facility/site
     - Applicable statutes and regulations
     - Decision and materials relied upon in the administrative record to support the staff decision.
   - Requestor(s) will state the reasons for protesting the staff decision and may provide evidence to support amending, modifying, or rescinding the staff decision. [15 minutes] *NOTE: The burden of proof is on the Requestor(s)*
   - Rebuttal by Department staff [15 minutes]
   - Rebuttal by Requestor(s) [10 minutes]

   Note: Times noted in brackets are for information only and are superseded by times stated in the Notice of Final Review Conference or by the presiding officer.
2. Parties may present evidence during the conference; however, the rules of evidence do not apply.
3. At any time during the conference, the officers conducting the Conference may request additional information and may question the Requestor, the staff, and anyone else providing information at the Conference.
4. The presiding officer, in his or her sole discretion, may allow additional time for presentations and may impose time limits on the Conference.
5. All Conferences are open to the public.
6. The officers may deliberate in closed session.
7. The officers may announce the decision at the conclusion of the Conference or it may be reserved for consideration.
8. The Clerk will mail the written final agency decision (FAD) to parties within 30 days after the Conference. The written decision must explain the basis for the decision and inform the parties of their right to request a contested case hearing before the Administrative Law Court or in matters pertaining to decisions under the South Carolina Mining Act, to request a hearing before the South Carolina Mining Council. The FAD will be sent by certified mail, return receipt requested.
9. Communications may also be sent by electronic mail, in addition to the forms stated herein, when electronic mail addresses are provided to the Clerk.

The above information is provided as a courtesy; parties are responsible for complying with all applicable legal requirements.

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Lexington County Approval of Land Disturbance Permit 2000078, Expires 1/29/2025

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SCDOT Encroachment Permit 231648

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COUNTY OF LEXINGTON

COMMUNITY DEVELOPMENT DEPARTMENT
LAND DEVELOPMENT

APPROVAL OF LAND DISTURBANCE

Wednesday, January 29, 2020

John Riggs
City of Columbia
1136 Washington Street
Columbia, SC 29201

RECEIVED
JAN 31 2020
STORMWATER & DAMS
PERMITTING DIVISION

Reference: **Lower Saluda Relief Sewer**
Project Name

Commercial
Project Type

003696-05-008
TMS#

John Riggs
Land Disturbance Applicant

2000078
Land Disturbance Permit #

Dear John Riggs

The plans and specifications for the above Development received1/29/2020 are hereby approved for sediment and erosion control, storm drainage, and issuance of a Land Disturbance Permit under the Stormwater Management and Sediment Control Ordinance for Lexington County. After proper posting of the Land Disturbance Permit card on the site, the proposed land disturbance may be started. This approval shall be voided if the development is inactive for a period of twenty-four (24) consecutive months; a new Land Disturbance Permit will then be required. If the work authorized has not been completed within 5 years of this Permit date, this Land Disturbance Permit shall be voided and a new Land Disturbance Permit will be required. Any revisions to the site work shall first be submitted to the Department of Community Development/Land Development for approval.

The Land Disturbance Permit applicant shall be responsible for supervising contractors and carrying out the site work in accordance with the approved plans and specifications, including the following conditions.

LEXINGTON COUNTY REQUIRES THAT THE APPLICANT OR HIS AGENT NOTIFY THE LEXINGTON COUNTY STORMWATER MANAGER OR A REPRESENTATIVE 48 HOURS PRIOR TO ANY SITE PREPARATION AND/OR CONSTRUCTION WORK. IF NOTICE IS NOT RECEIVED 48 HOURS PRIOR TO CONSTRUCTIONSTARTING THIS LAND DISTURBANCE PERMIT WILL BECOME NULLAND VOID.

PERMIT CONDITIONS

A pre-construction meeting must be held by all parties involved before any work onsite begins.

Sediment and erosion control measures depicted on the approved plans shall be installed prior to initiation of proposed grading/construction. These measures shall be adequately maintained through the construction process. Additional measures, as required, shall be installed if it becomes evident that erosion is not adequately contained and sedimentation of adjacent properties or streets is imminent.

Prior to final site inspection, building inspection, or a CO, the project engineer must provide our office with a signed and recorded pond maintenance agreement if needed, an as-built of the roads, ponds, drainage, etc. and as-built calculations including but not limited to stage-storage volumes, elevations and dimensions of all outlet structures, drainage, etc. and an analysis of the pond (routing) for all storms 2 thru 100 year.

Prior to final inspection, disturbed areas not covered by permanent structures shall achieve final stabilization. Final stabilization is defined as a uniform (e.g., evenlydistributed, without large bare areas) vegetative cover with a density of 70 percent natural vegetation or equivalent permanent stabilization measures (such as the use of landscaping mulch, riprap, pavement, and gravel) have been implemented to provide effective cover for exposed areas not stabilized with vegetation.

An encroachment permit shall be obtained prior to construction from the South Carolina Department of Transportation and/or the County of Lexington Public Works for work proposed in their right-of-way (ROW).

If applicable please see 3rd page for additional permit conditions.

Issuance of this Land Disturbance Permit does not imply approval of related Land Disturbance Permits, Zoning Permits, Building Permits, or Plats, which may be required subsequently for the completion of this development.

Respectfully,

Brandon Corder
Lexington County Community Development Department
Land Development

cc:

DHEC Stormwater Permitting
SCDOT
Engineering File

City of Columbia

RECEIVED

JAN 31 2020

STORMWATER & DAMS PERMITTING DIVISION

D H E C

South Carolina Department of Health and Environmental Control

NOTICE OF INTENT (NOI)

For Coverage(s) of Primary Permittees Under South Carolina NPDES General Permit For Stormwater Discharges From Construction Activities SCR100000

(Maintain As Part of On-Site SWPPP)

For Official Use Only
File Number: _____
Permit Number: SCR10 2546
Submittal Package Complete: _____

*Submission of this Notice of Intent constitutes notice that the Applicant identified in Section II intends to be authorized as a Primary Permittee in the state of South Carolina under NPDES General Permit SCR1000000. **Fees required for review and NPDES coverage of each application type are as listed on page 2 of the Instructions.***

SOUTH CAROLINA
DEPT OF HEALTH AND ENVIRONMENTAL CONTROL
ENVIRONMENTAL QUALITY CONTROL
STORMWATER PERMITTING SECTION
APPROVED - FOR CONSTRUCTION ONLY
DHEC PERMIT #: SCR102546
FILE #: _____
DATE ISSUED: 2-10-2020
BY: Eric Wolfe

Date: January 14, 2020
Project/Site Name: Lower Saluda Relief Sewer **County:** Lexington County
(Modification or Change of Information Only) **Prior Approved NPDES Permit or File Number:** _____

Do you want this project to be considered for the Expedited Review Program (ERP)? ☐Yes or ☑No (See instructions)

I. Notice of Intent (NOI) Application Type(s)

A. **Project (Application/Review) Type(s)** (Select **ALL** that apply):
☑New Project (Initial Notification) ☐ Ongoing Project: ☐Permitted or ☐ Un-Permitted
☐ Late Notification ☐ Low Impact Development (LID) or Project Design Above Regulatory Requirements
☐New Owner/Operator or Company Name Change **(see instructions, attach Form A (Transfer of Ownership))**
☐Major Modification: **(see instructions, attach Form B (Major Modifications))**
☑MS4 Project Review
☐Ocean and Coastal Resource Management (OCRM) Review
☐Change of Information/Other (Specify): _____

B. If Applicable, identify the entity designated as **MS4 Reviewer and MS4 Operator** (i.e., Lexington County, City of Greer, etc.): **MS4 Reviewer** Lexington County **MS4 Operator** Lexington County

II. Primary Permittee Information ☐ Change of Information

☐ Person or ☑ Company | If a Company, are you a ☐ Lending Institution or ☑ Government Entity? Company EIN **(If applicable)**: EIN: 57-6000229

A. **Primary Permittee Name:** City of Columbia
Mailing Address: 1136 Washington Street City: Columbia State: SC Zip: 29201
Phone: 803-528-4238 Fax: _____ Email Address: John.Riggs@ColumbiaSC.gov

B. **Contact /ODSA Name** (If different from above OR if owner is a company): John Riggs
Mailing Address: 1136 Washington Street City: Columbia State: SC Zip: 29201
Phone: 803-528-4238 Fax: _____ Email Address: John.Riggs@ColumbiaSC.gov

C. **Property Owner Name** (If different from above): _____
Mailing Address: _____ City: _____ State: _____ Zip: _____
Phone: _____ Fax: _____ Email Address: _____

III. Comprehensive Stormwater Pollution Prevention Plan (C-SWPPP) Preparer Information ☐ Change of Information

A. **C-SWPPP Preparer Name:** Justin P Waring
B. **Registered Professional** ☑Engineer ☐Landscape Architect ☐Tier B Land Surveyor **S. C. Registration #:** 28702
C. **Company/Firm Name:** 4D Engineering LLC **S. C. COA #:** 4701
Mailing Address: 603 South Lake Drive City: Lexington State: SC Zip: 29072
Phone: 803-356-0909 Fax: _____ Email Address: Justin@4DEngr.com

IV. Project/Site Information ☐ Change of Information

A. **Type of Construction Activity(ies)** (Select **ALL** that apply):
☐Commercial ☐Industrial ☐Institutional ☐Mass Grading ☑Linear ☑Utility/Infrastructure
☐Residential: Single-family ☐ Residential: Multi-family ☐Multi-use (Commercial & Residential)
☐Site Preparation (No New Impervious Area) ☐ Other (Specify) _____

B. **Site Address/Location** (street address, nearest intersection, etc.) Approx. 125' West of Bush River Rd and Wescott Rd
City/Town (If in limits): N/A Zip Code: 29212
Latitude: 34 ° 02 ' 20 " N Longitude: - 81 ° 09 ' 27 " W (Source): ☐GPS ☑ Web Site: google.com
Tax Map Number (s) (List all): 003696-05-008; 003696-05-004; 003696-05-010; 003696-05-003; 003500-01-005; 002799-04-001; 002799-04-016; 002798-05-002; 002798-05-004; 002798-03-022; 002798-03-006 002798-03-005; 002798-03-024; 002798-02-051

C. Is this site located on **Indian Land?** ☐ Yes ☑ No

D. **Proposed Start Date:** December 2020 **Proposed Completion Date:** December 2022

E. **Disturbed Area** (nearest tenth of an acre): 27.6 **Total Area** (acres): 27.6

F. **Modification Only:**(nearest tenth of an acre): **Disturbed Area: Current (Approved) Area:** _____
Disturbed Area Change (Increase Only): _____ **Total Disturbed Area (After Change):** _____

G. Is this project part of a **Larger Common Plan for Development or Sale (LCP)**? ☐ Yes ☑ No
LCP/ Overall Development Name: _____ Check here if this is the **First Phase.** ☐

Previous State Permit/File Number: _____ **Previous NPDES Coverage Number:** SCR10 _____

H. Any **Flooding Problems** exist downstream of or adjacent to this site? ☐ Yes ☑ No (If yes, provide detailed description of flooding problems and applicable floodway/flood zone information in the C-SWPPP).

I. Active **S.C. DHEC Warning Notice, Notice to Comply or Notice of Violation** for this site or LCP? ☐ Yes ☑ No

J. List Relevant **State and Federal Environmental Permits or Approvals** applied for or obtained for this site (e.g., **RCRA, USACOE, Nationwide**, etc.). **If None, list None.**
NONE

K. **Any Waiver(s)/Variances/Exceptions Requested for this Project?** (If yes, identify below and include **Waiver Request and Justifications** in the C-SWPPP for each proposed request).

1. Small Construction Activity Waiver(s) From NPDES permitting **(Section 1.4 & Appendix B)**? ☐ Yes ☑ No
If yes, Identify requested waiver: ☐ Rainfall Erosivity Waiver ☐ TMDL Waiver ☐ Equivalent Analysis Waiver

2. Detention Waiver **(72-302(B)**? ☐ Yes ☑ No | 3. Other (Specify): _____

V. Waterbody Information (Attach additional sheet(s) as needed) ☐ Change of Information

A. **Receiving Waterbody(s) (RWB) Information** (List the nearest and next nearest receiving waterbodies to which the sites stormwater discharges will drain. If stormwater discharges drain to multiple waterbodies, list all such waterbodies).

1. Name of Receiving Waterbodies (RWB)	2. Distance to RWB (feet)	3. Classification of RWB
a. Nearest: SALUDA RIVER	100'	TPGT
b. Next Nearest: CONGAREE RIVER	42,500'	FW
c. Coastal Zone ONLY: Coastal Receiving Water (CRW): _____		Not Applicable
d. Other Waterbodies: _____		

B. **Waters of the U.S. / State Information** (Attach additional sheet(s) as needed)

Waters of the U.S./ State	1. On the site?	2. Delineated/ Identified?	3. Impacts?	4. Amount of impacts
a. Jurisdictional wetlands	☑ Yes ☐ No	☑ Yes ☐ No	☑ Yes ☐ No	0.33 Ac
b. Non-Jurisdictional wetlands	☐ Yes ☑ No	☐ Yes ☑ No	☑ Yes ☐ No	_____ Ac
c. Other Water(s): _____	☐ Yes ☑ No	☐ Yes ☐ No	☐ Yes ☐ No	_____ Ac _____ Feet
d. Coastal Zone ONLY: Direct Critical Area	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	_____ Ac _____ Feet

5. If yes for Impacts in B.3, describe each impact and activity, and list all permits (e.g., USACOE Nationwide Permit, DHEC General Permit) and certifications that have been applied for or obtained for each impact:
See attached letter from Environmental Permitting Consultants, Inc. for descriptions of wetlands.

C. **S.C. Navigable Waters (SCNW) Information (Section 2.6.5)** The Department will address any issues related to State Navigable Waters' Program under SC Regulation 19-450 during the review of the C-SWPPP for activities that will **NOT** require a 404 permit or a 401 certification. (Attach additional sheet(s) as needed).

1. **Are S. C. Navigable Waters (SCNW) on the site:** ☐ Yes ☑ No
a. If **no**, do not complete this question. Proceed to Section D (Impaired Waterbodies).
b. If **yes**, provide the name of S.C. Navigable Waters (SCNW) on the site: _____

2. If **yes for C.1**, will construction activities cross over or occur in, under, or thru the SCNW? ☐ Yes ☐ No
If yes, describe SCNW activities (e.g., road crossing, sub-aqueous utility line, temporary or permanent structures, etc.) and proceed to Section C.3: _____

3. Identify permits providing coverage of SCNW activities proposed for your site. If NONE, list none.

Permits/Certifications	Permit or Certification No.	Corresponding Covered SCNW Activity(ies)
a. DHEC General/ Other DHEC Permit	NONE	
b. USACOE **404 Permit or 401 Certification**	NONE	
c. **SCNW Permit** If applied for or issued, identify **Date applied for or issued:** _____	NONE	☐ **All Activities** or ☐ **Some Activities (Describe):**

d. If a SCNW Permit has NOT been applied for provide an additional plan sheet that shows plan and profile views (drawn to scale) of the SCNW and associated activities. Include a description of all proposed activities on this plan.

D. **Impaired Waterbodies Information** (Attach additional sheet(s) as needed)

1. 303(d) Listed Impaired Waterbodies

a. Name of Nearest DHEC Water Quality Monitoring Stations (WQMS)(s) that receives stormwater from your construction site and/or thru an MS4 and the Name of the Corresponding Waterbody?		b. Is this WQMS(s) listed on the most current 303(d) List? If No, proceed to Section 2 of this table. If Yes, complete items c thru f.	c. List the pollutant(s) identified as "CAUSES" of the impairment	d. Will any pollutants causing the impairment be present in your site's construction stormwater discharges?	e. If yes for d, list the "USE SUPPORT" impairment(s) affected by the pollutant(s) identified in c.
Nearest DHEC WQMS(s)	Corresponding Waterbody				
S-149	SALUDA RIVER	☑ Yes ☐ No	FC	☐ Yes ☑ No	
S-298	SALUDA RIVER	☑ Yes ☐ No	ECOLI	☐ Yes ☑ No	
		☐ Yes ☐ No		☐ Yes ☐ No	

f. If yes for d above, will use of the BMPs proposed for your project ensure the site's discharges will NOT contribute to or cause further WQS violations for the impairment(s) listed in c? ☑ Yes ☐ No
(NOTE: If no for f, this site is NOT eligible for coverage under the CGP). See Instructions.

2. TMDL Impaired Waterbodies

a. Name of Nearest DHEC Water Quality Monitoring Stations (WQMS)(s) that receives stormwater from your construction site and/or thru an MS4?	b. Has a TMDL(s) been developed for this WQMS(s)? If No, identify as such below and proceed to Section VI. If Yes, complete items c thru f of this table.	c. If yes for b, what pollutants are listed as "CAUSES" or causing the impairment?	d. If yes for b, has the standard been "ATTAINED" or "Fully Supported" for the impairment(s)?	e. If no for d (Not Attained), will any pollutants causing the impairment be present in your site's construction stormwater discharges?
S-149	☑ Yes ☐ No	FC	☑ Yes ☐ No	☐ Yes ☐ No
	☐ Yes ☑ No		☐ Yes ☐ No	☐ Yes ☐ No
	☐ Yes ☐ No		☐ Yes ☐ No	☐ Yes ☐ No

f. If yes for e above, are your discharges consistent with the assumptions and requirements of the TMDL(s)? ☑ Yes ☐ No
(NOTE: If no for f, this site is NOT eligible for coverage under the CGP). See Instructions.

VI. Signatures and Certifications DO NOT SIGN IN BLACK INK! **Read the Certifications below (in entirety). Provide date, printed name, and signatures below.** If you are a New Owner/Operator, as Primary Permittee you must also sign and date the applicable Comprehensive SWPPP Acceptance & Compliance Agreement below.

C-SWPPP PREPARER: "One copy of the C-SWPPP, all specifications and supporting calculations, forms, and reports are herewith submitted and made a part of this application. I have placed my signature and seal on the design documents submitted signifying that I accept responsibility for the design of the system. Further, I certify to the best of my knowledge and belief that the design is consistent with the requirements of Title 48, Chapter 14 of the Code of Laws of SC, 1976 as amended, pursuant to Regulation 72-300 et seq. (if applicable), and in accordance with the terms and conditions of SCR100000." **(This should be the person identified in Section III).**

Justin P. Waring — Justin P. Waring — 28702

Printed Name of C-SWPPP Preparer | **Signature of C-SWPPP Preparer** | **S. C. Registration #**

PRIMARY PERMITTEE: "I or I (on behalf of my company and its contractors and agents), as the case may be, certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I understand that DHEC enforcement actions may be taken if the terms and conditions of the C-SWPPP are not met and I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

"I or I (on behalf of my company and its contractors and agents), as the case may be, also hereby certify that all land-disturbing construction and associated activity pertaining to this site shall be accomplished pursuant to and in keeping with the terms and conditions of the approved plans and SCR100000. I also certify that a responsible person will be assigned to the project for day-to-day control. I hereby grant authorization to the to S. C. Department of Health and Environmental Control (DHEC) and/or the local implementing agency the right of access to the site at all times for the purpose of on site inspections during the course of construction and to perform maintenance inspections following the completion of the land-disturbing activity." **(See Section 122.22 of S.C. Reg. 61-9 for signatory authority information.)** Having understood the above information, I am signing this certification as Primary Permittee to the aforementioned NPDES general permit."

John Riggs — Wastewater Project Manager

Printed Name of Primary Permittee | **Title/Position**

Signature of Primary Permittee | 12-30-19 **Date Signed**

200077165

SCDOT

JAN 29 2020

Application for Encroachment Permit

S.C. Department of Transportation

Form 637 (Rev 09/2015)

PERMIT #231648

Contact Information

Applicant: City of Columbia

Street: 1136 Washington St.

City: Columbia

State: SC **Zip Code:** 29201

Phone: (803)528-4238 **Fax:**

Email: John.Riggs@ColumbiaSC.gov

Contact: c/o Justin Waring, 4D Engineering, justin@4dengr.c

Project Location

Primary County: Lexington

County	Road Name
Lexington	Bush River Rd (S-107)

1. Type of Encroachment: SEWER

The City of Columbia is proposing the construction of a 36" gravity sanitary sewer main encased in a 48" steel casing and is proposed to be Jack and Bored under Bush River Road.

2. Description of Location:

The proposed encroachment is located near the entrance of Saluda Shoals Park and is approximately 125 feet west of the intersection of Bush River Road and Wescott Road, please see attached project location maps.

(Attach sketch indicating roadway features such as: pavement width, shoulder width, sidewalk and curb and gutter location, significant drainage structure, north arrow, right of way width, and location of the proposed encroachment with respect to the roadway centerline and the nearest intersecting road on the State system.)

Please make sure that line is minimum 20-ft horizontal distance from the bridge approach slab edge.

Customer Agreement

3. **The undersigned applicant hereby requests the SCDOT to permit encroachment on the SCDOT right of way as described herein. It is expressly understood that the encroachment, if and when constructed, shall be installed in accordance with the sketch attached hereto and made a part hereof. The applicant agrees to comply with and be bound by the SCDOT's "A Policy for Accommodating Utilities on Highways Rights of way", "Standard Specifications for Highway Construction", the "General Provisions" and "Special Provisions", attached hereto or made a part hereof by reference, during the installation, operation and maintenance of said encroachment within the SCDOT's Right of Way. DISCHARGES OF STORM WATER AND NON-STORM WATER: Work within State Highway right-of-way shall be conducted in compliance with all applicable requirements of the National Pollutant Discharge Elimination System (NPDES) permit(s) issued to the Department of Transportation (Department), to govern the discharge of storm water and non-storm water from its properties. Work shall also be in compliance with all other applicable Federal, State and Local laws and regulations, and with the Department's Encroachment Permits Manual and encroachment permit. The encroachment permit will not be issued until the applicant has received an NPDES construction permit from SC Department of Health and Environmental Control.**

The applicant agrees to comply with all current SCDOT Standards Specifications for Highway Construction including all Supplemental Technical Specifications. The applicant hereby further agrees, and binds his/her/its heirs, personal representatives, successors, assigns, to assume any and all liability for accidents or injuries to persons, or damage to property, including the highway, that may be caused by the construction, maintenance, use, moving or removing of the physical appurtenances contemplated herein.

Applicant's Name: John Riggs **Date:**
(Please print or type)

Applicant's Sig: Jack Riggs **Title:**

For Office Use Only

For Office Use Only

In accordance with your request and subject to all the provisions, terms, conditions, and restrictions stated in the application and the general and special provisions attached hereto, the SCDOT hereby approves your application for an encroachment permit. This permit shall become null and void unless the work contemplated herein shall have been completed prior to:

☐ **See Attached Special Provision and/or Permit Requirements**

NPDES Permit Nbr:

(Date received by res. Maint. Engr.) (SCDOT Approval) 1/31/2020 (Date)

General Provisions

Application for Encroachment Permit
General Provisions

1. **DEFINITIONS: The word "Permittee" used herein shall mean the name of the person, firm, or corporation to whom this permit is addressed, his, her, its, heirs, personal representatives, successors and assigns. The word "DEPARTMENT" shall mean the South Carolina Department of Transportation.**
2. **NOTICE PRIOR TO STARTING WORK: Before starting the work contemplated herein within the limits of the highway right of way, the Department's Resident Maintenance Engineer in the county in which the proposed work is located shall be notified 24 hours in advance so that he may be present while the work is under way.**
3. **PERMIT SUBJECT TO INSPECTION: This permit shall be kept at the site of the work at all times while said work is under way and must be shown to any representative of the Department or law enforcement officer on demand.**
4. **PROTECTION OF HIGHWAY TRAFFIC: The applicant shall be responsible for the protection of the highway traffic at all times during the construction, maintenance, removing or moving of the encroachment permitted herein. Detours, barricades, warning signs and flagmen, as necessary,**
   shall be provided by and at the expense of the Permittee and shall be in accordance with the "Manual on Uniform Traffic Control Devices" (MUTCD). The work shall be planned and carried out so that there will be the least possible inconvenience to the motoring public. The Permittee agrees to observe all rules and regulations of the Department while carrying on the work contemplated herein and take all other precautions that circumstances warrant.
5. **STANDARDS OF CONSTRUCTION: All work shall conform to the Department's standards of construction and shall be performed in a workman-like manner. The applicant shall make adequate provisions for maintaining the proper drainage of the highway as it may be affected by the encroachment permitted herein. All work shall be subject to the supervision and satisfaction of the Department.**
6. **FUTURE MOVING OF PHYSICAL APPURTENANCES: If, in the opinion of the State Highway Engineer, it should ever become necessary to move or remove the physical appurtenances, or any part thereof contemplated herein, on account of change in location of the highway, widening of the highway, or for any other sufficient reason, such moving shall be done on demand of the Department at the expense of the Permittee.**
7. **RESTORATION OF HIGHWAY FACILITIES UPON MOVING OR REMOVING OF PHYSICAL APPURTENANCES: If, and when, the physical appurtenances contemplated herein shall be moved or removed, either on the demand of the Department or at the option of the Permittee, the highway and facilities shall immediately be restored to their original condition at the expense of the Permittee.**
8. **COSTS: All work in connection with the construction, maintenance, moving or removing of the physical appurtenances contemplated herein shall be done by and at the expense of the Permittee.**
9. **ADDITIONAL PERMISSIONS:**
   (a) It is distinctly understood that this permit does not in any way grant or release any rights lawfully possessed by the abutting property owners. The Permittee shall secure any such rights, as necessary, from said abutting property owners.
   (b) The Permittee shall be responsible for obtaining all other approvals or permits necessary for installation of the encroachment from other government entities.

(c) There shall be no excavation of soil nearer than two feet to any public utility line or appurtenant facility except with the consent of the owner thereof, or except upon special permission of this Department after an opportunity to be heard is given the owner of such line or appurtenant facility.

10. **ADDITIONAL WORK PERFORMANCE:**

(a) All crossings over the highway shall be constructed in accordance with "Specifications for Overhead Crossings of Light and Power Transmission Lines and Telegraph Lines over each other and over Highway Rights of Way in South Carolina," as approved by the Public Service Commission of South Carolina and effective as of date of this permit.

(b) All tunneling, boring, or jacking shall be done in such a way as not to disturb the highway surfacing.

(c) No pavement shall be cut unless specifically authorized herein.

(d) No excavation shall be nearer than three feet to the edge of pavement unless specifically authorized herein.

(e) Underground facilities will be located at minimum depths as defined in the "Utility Accommodations Manual" for the transmittant, generally as follows: 4 feet minimum for hazardous or dangerous transmittant, 3 feet minimum for other lines. The Department may approve shallower depths if adequate protection is provided. Such approval must be obtained in writing.

(f) Service and other small diameter pipes shall be jacked, driven, or otherwise forced underneath the pavements on any surfaced road without disturbing the pavement. The section under the highway pavement and within a distance of three (3) feet on either side shall be continuous without joints.

11. **ACCESS:**

(a) Permittee is responsible for maintaining reasonable access to private driveways during construction.

(b) It is expressly provided that, with respect to any limited access highway, the Permittee shall not have or gain access from the main traveled way of the highway, or the on or off ramps to such facility, except upon approval by the Department.

12. **DRIVEWAYS:**

(a) The existing crown of the highway shall be continued to the outside shoulder line of the highway.

(b) If the driveway or approach is concrete pavement, the pavement shall be constructed at least 6 inches thick and with a minimum of class 2500 concrete. There shall be a bituminous expansion joint, not less than 3/4 inches in thickness, placed between the highway paving and the paving of the approach for the full width of the approach.

13. **BEAUTIFICATION:**

(a) All trees, plants, flowers, etc. shall be placed in accordance with the provisions specifically stipulated herein.

(b) All trees, plants, flowers, etc. shall be maintained by, and at the expense of, the Permittee and the provisions of this permit shall become null and void, if and when said Permittee ceases to maintain aid trees, plants, flowers, etc.

14. **AS-BUILT PLANS:**

(a) The applicant shall provide the Department with survey-quality as-built plans in accordance with the requirements set forth in the Department's "A Policy for Accommodating Utilities on Highway Rights of Way".

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USACE Application for Activities Affecting Waters of the United States **(Approval Pending)**

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Joint Federal and State Application Form
For Activities Affecting Waters of the United States
Or Critical Areas of the State of South Carolina

This Space for Official Use Only
Application No. _____
Date Received _____
Project Manager _____
Watershed # _____

Authorities: 33 USC 401, 33 USC 403, 33 USC 407, 33 USC 408, 33 USC 1341, 33 USC 1344, 33 USC 1413 and Section 48-39-10 et. Seq of the South Carolina Code of Laws. These laws require permits for activities in, or affecting, navigable waters of the United States, the discharge of dredged or fill material into waters of the United States, and the transportation of dredged material for the purpose of dumping it into ocean waters. The Corps of Engineers and the State of South Carolina have established a joint application process for activities requiring both Federal and State review or approval. Under this joint process, you may use this form, together with the required drawings and supporting information, to apply for both the Federal and/or State permit(s).

Drawings and Supplemental Information Requirements: In addition to the information on this form, you must submit a set of drawings and, in some cases, additional information. A completed application form together with all required drawings and supplemental information is required before an application can be considered complete. See the attached instruction sheets for details regarding these requirements. You may attach additional sheets if necessary to provide complete information.

1. Applicant Last Name: Riggs		11. Agent Last Name (agent is not required): Belanger	
2. Applicant First Name: John		12. Agent First Name: Laura	
3. Applicant Company Name: City of Columbia		13. Agent Company Name: Environmental Permitting Consultants, Inc.	
4. Applicant Mailing Address: 1136 Washington St.		14. Agent Mailing Address: PO Box 3744	
5. Applicant City: Columbia		15. Agent City: Greenville	
6. Applicant State: SC	7. Applicant Zip: 29217	16. Agent State: SC	17. Agent Zip: 29608
8. Applicant Area Code and Phone No.: 803-528-4238		18. Agent Area Code and Phone No.: 864-271-3040	
9. Applicant Fax No.:		19. Agent Fax No.:	
10. Applicant E-mail: John. Riggs@columbiasc.gov		20. Agent E-mail: laura@enviropermit.com	
21. Project Name: Lower Saluda River Relief Sewer		22. Project Street Address: 5600 Bush River Rd, 6071 St. Andrews Rd., 1035 Garden Valley Ln.	
23. Project City: Columbia	24. Project County: Lexington	25. Project Zip Code: 29212	26. Nearest Waterbody:
27. Tax Parcel ID:		28. Property Size (acres): 28.03	
29. Latitude: 34.043483		30. Longitude: -81.163333	

31. Directions to Project Site (Include Street Numbers, Street Names, and Landmarks and attach additional sheet if necessary):
The project is located within existing sanitary sewer right of ways (SSROW), spanning approximately 3.6 miles, beginning north of Bush River Road and extending into Saluda Shoals Park, and ending west of Garden Valley Lane at the water treatment plant. The location of the approximate project area center is 34.043483o N, -81.163333o E, and approximate project addresses for the western portion, middle and eastern portions are; 5600 Bush River Road, Columbia, SC 29212; 6071 St. Andrews Road Columbia, SC 29212 (Saluda Shoals Park); and 1035 Garden Valley Lane, Columbia, SC 29210.

32. Description of the Overall Project and of Each Activity in or Affecting U.S. Waters or State Critical Areas (attach additional sheets if needed)
The overall project involves the construction of a relief sanitary sewerline that runs adjacent to an existing line from the Saluda River Pump Station, along the Saluda River, through Saluda Shoals Park and terminating at Bush River Rd. The construction of the SS line will involve six (6) temporary impacts totaling 151 linear feet and two (2) permanent impacts for the placement of rock cross vanes for stabilization.

33. Overall Project Purpose and the Basic Purpose of Each Activity In or Affecting U.S. Waters (attach additional sheets if needed):
The overall project purpose is part of the City's work to improve sanitary sewer conditions city wide, reducing the likelihood of future releases of effluent into streams and rivers.

34. Type and quantity of Materials to Be Discharged

Dirt or Topsoil:	_____	☐ cubic yards
Clean Sand:	_____	☐ cubic yards
Mud:	_____	☐ cubic yards
Clay:	_____	☐ cubic yards
Gravel, Rock, or Stone:	22	☐ cubic yards
Concrete:	_____	☐ cubic yards
Other (describe):	_____	☐ cubic yards
TOTAL:	22	cubic yards

35. Type and Quantity of Impacts to U.S. Waters (including wetlands).

Filling:	_____	☐ acres	☐ sq.ft.	_____	☐ cubic yards
Backfill & Bedding:	0.05	■ acres	☐ sq.ft	_____	☐ cubic yards
Landclearing:	_____	☐ acres	☐ sq.ft	_____	☐ cubic yards
Dredging:	_____	☐ acres	☐ sq.ft.	_____	☐ cubic yards
Flooding:	_____	☐ acres	☐ sq.ft.	_____	☐ cubic yards
Draining/Excavation:	_____	☐ acres	☐ sq.ft.	_____	☐ cubic yards
Shading:	_____	☐ acres	☐ sq.ft.	_____	☐ cubic yards
TOTALS:	0.05	acres	_____ sq.ft.	_____	cubic yards

36. Individually list wetland impacts including mechanized clearing, fill, excavation, flooding, draining, shading, etc. and attach a site map with location of each impact (attach additional sheets if needed).

Impact No.	Wetland Type	Distance to Receiving Water body (LF)	Purpose of Impact (road crossing, impoundment, flooding, etc)	Impact Size (acres)
n/a				
			Total Wetland Impacts (acres)	

37. Individually list all seasonal and perennial stream impacts and attach a site map with location of each impact (attach additional sheets)

Impact No.	Seasonal or Perennial Flow	Average Stream Width (LF)	Impact Type (road crossing, impoundment, flooding, etc)	Impact Length (LF)
see attached				
			Total Stream Impacts (Linear Feet)	

38. Have you commenced work on the project site? ☐ YES ■ NO If yes, describe all work that has occurred and provide dates.

39. Describe measures taken to avoid and minimize impacts to Waters of the United States:

Crossing S2 was engineered to be a direction bore in order to avoid impact. Crossings S1, S3, S4 and S7 will be backfill and bed with return to natural contours in order to minimize impact. These will only be temporary impacts, with work being completed in less than 7 days.

40. Provide a brief description of the proposed mitigation plan to compensate for impacts to aquatic resources or provide justification as to why mitigation should not be required (Attach a copy of the proposed mitigation plan for review).

Due to the temporary nature of the majority of impacts, and the minimal amount of permanent impacts, no mitigation is proposed.

41. See the attached sheet to list the names and addresses of adjacent property owners.

42. List all Corps Permit Authorizations and other Federal , State, or Local Certifications, Approvals, Denials received for work described in this application.

A jurisdictional delineation report was submitted 1/14/2020 under SAC 2019-00775.

43. Authorization of Agent. I hereby authorize the agent whose name is given on page one of this application to act in my behalf in the processing of this application and to furnish supplemental information in support of this application. [1]

Applicant's Signature 8-17-2020 Date

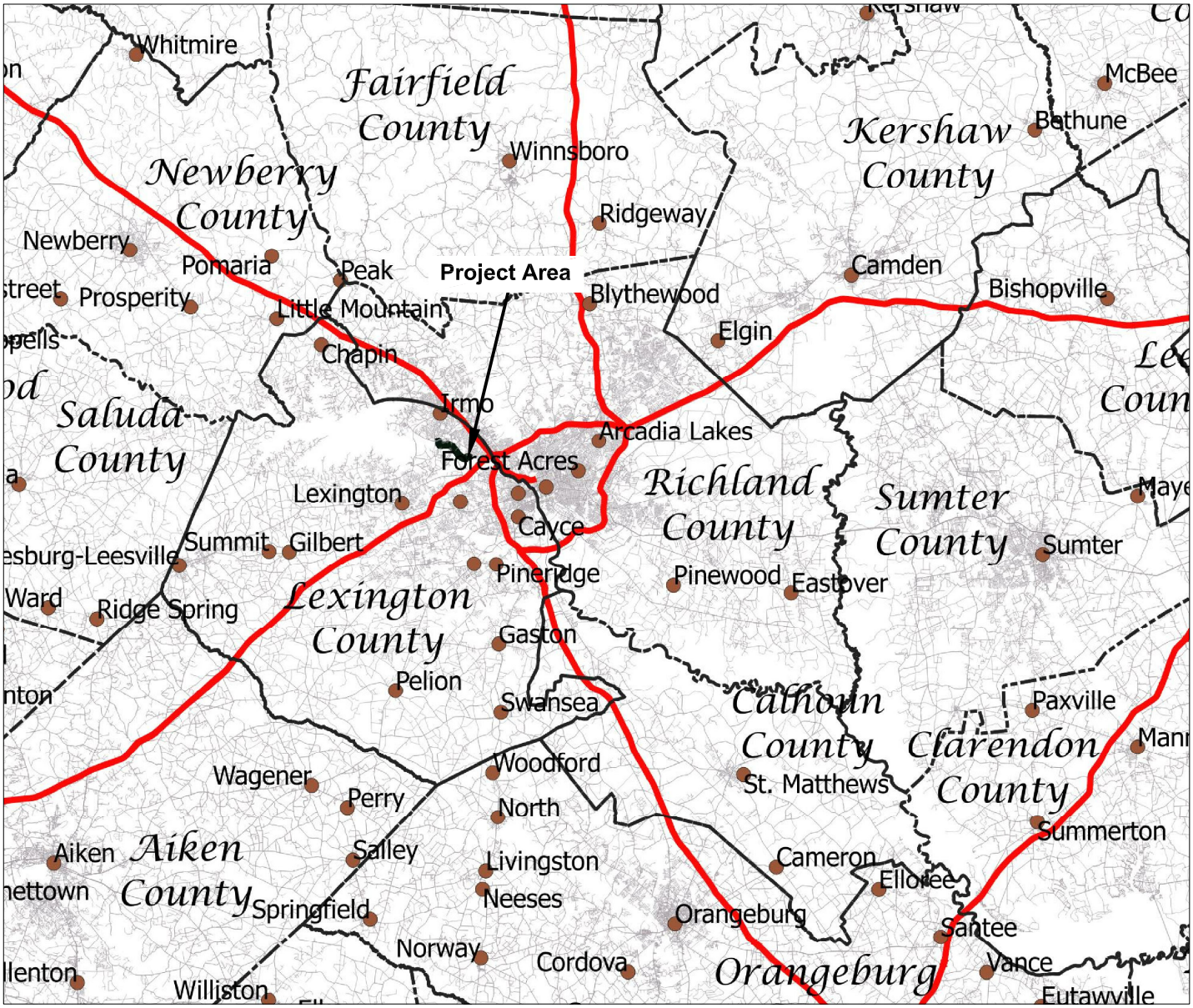
44. Certification. Application is hereby made for a permit or permits to authorize the work and uses of the work as described in this application. I certify that the information in this application is complete and accurate. I further certify that I possess the authority to undertake the work described herein or am acting as the duly authorized agent for the applicant. [1]

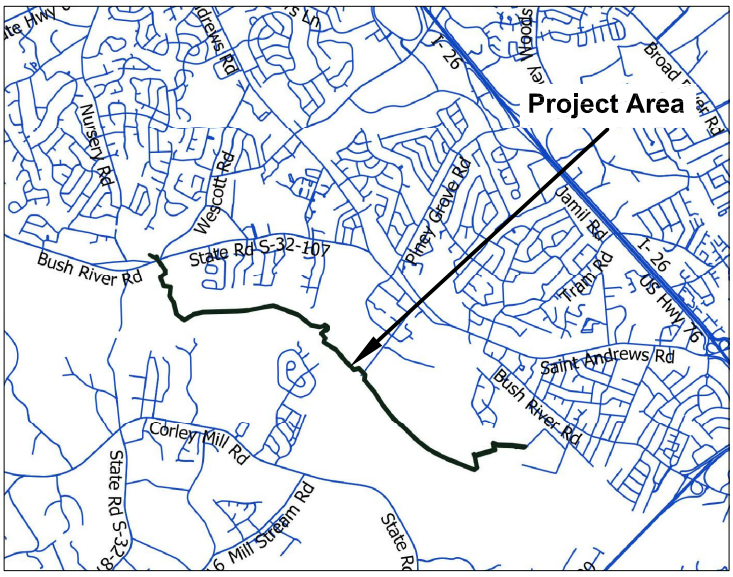
Applicant's Signature 8-17-2020 Date

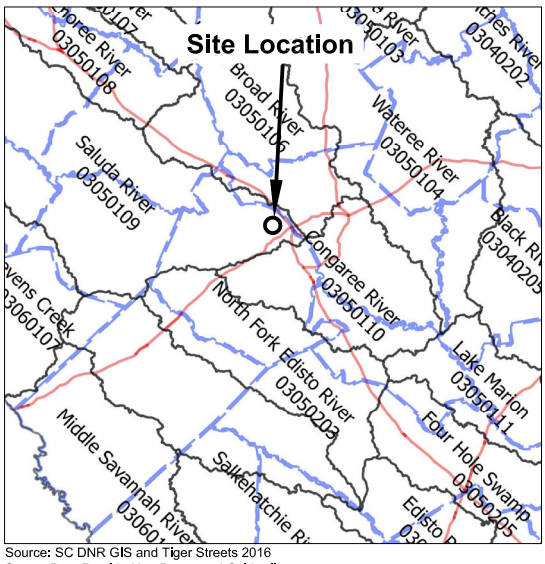
Agent's Signature 8/10/2020 Date

[1] **The application must be signed by the person who desires to undertake the proposed activity or it may be signed by a duly authorized agent if the authorization statement in blocks 11 and 43 have been completed and signed. 18 U.S.C. Section 1001 provides that: Whoever, in any manner within the jurisdiction of any department of the United States knowingly and willfully falsifies, conceals, or covers up any trick, scheme, or disguises a material fact or makes any false, fictitious or fraudulent statements or representations or makes or uses any false writing or document knowing same to contain any false, fictitious or fraudulent statements or entry, shall be fined not more than $10,000 or imprisoned not more than five years or both.**

Impact No.	Seasonal or Perennial	Average Stream Width	Impact Type	Impact Duration	Impact Length
S1	Perennial	10	backfill nad bed	temporary	33
S3	Perennial	16	backfill and bed	temporary	25
S4	Perennial	16	backfill and bed	temporary	28
S5	Perennial	19	backfill and bed, cross vane	permenant	20
S6	Perennial	12	backfill and bed, cross vane	permenant	20
S7	Perennial	23	backfill and bed	temporary	25







Source: SC DNR GIS and Tiger Streets 2016
Survey Data Provided by: Brown and Caldwell

Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = NTS feet

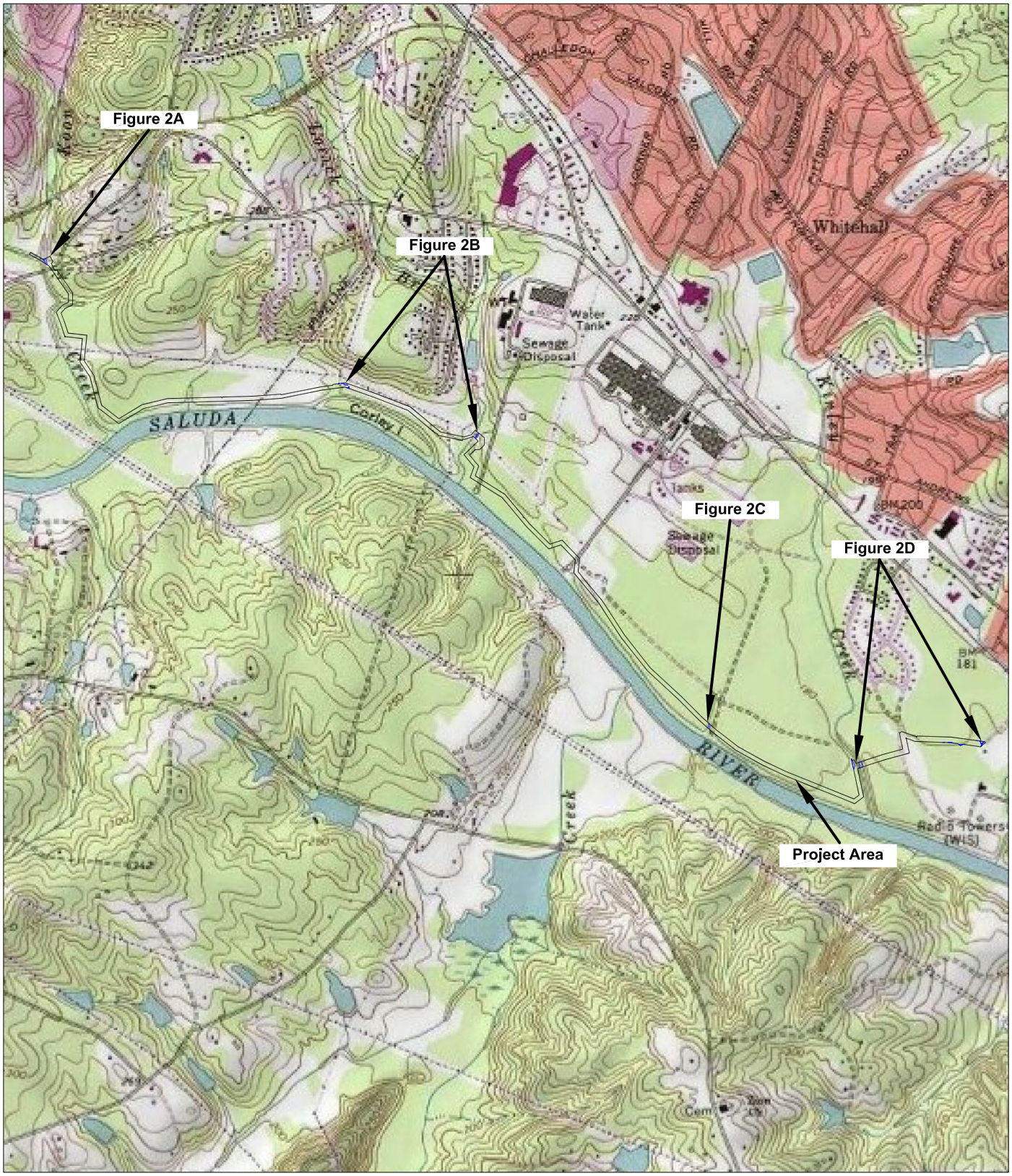
DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Location Map

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.

1



Source:https://gis.dhec.sc.gov/watersheds/
Survey Data Provided by: Brown and Caldwell
GPS Data Provided by: EPC, Inc.

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GRAPHIC SCALE

1 inch = 2000 feet

DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Water Features USGS Topo Entire

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.

2

Source:https://gis.dhec.sc.gov/watersheds/
Survey Data Provided by: Brown and Caldwell
GPS Data Provided by: EPC, Inc.

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Fax: (864) 235-9299

GRAPHIC SCALE
1 inch = 400 feet

DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Water Features USGS Topo

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
2A

Source:https://gis.dhec.sc.gov/watersheds/
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GPS Data Provided by: EPC, Inc.

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GRAPHIC SCALE
1 inch = 400 feet

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DATE:	20200103
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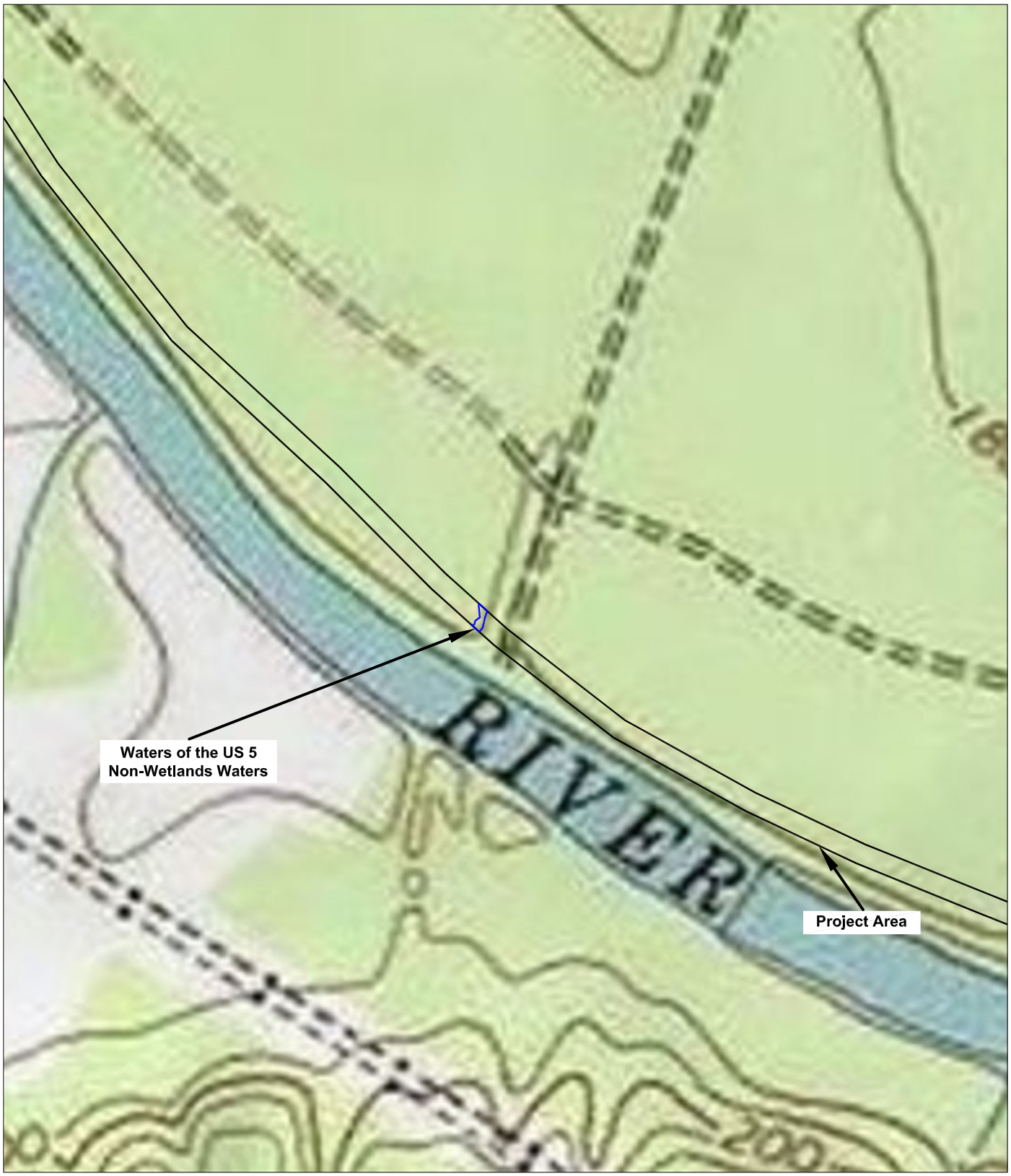
Water Features USGS Topo

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
2B



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GRAPHIC SCALE
1 inch = 400 feet

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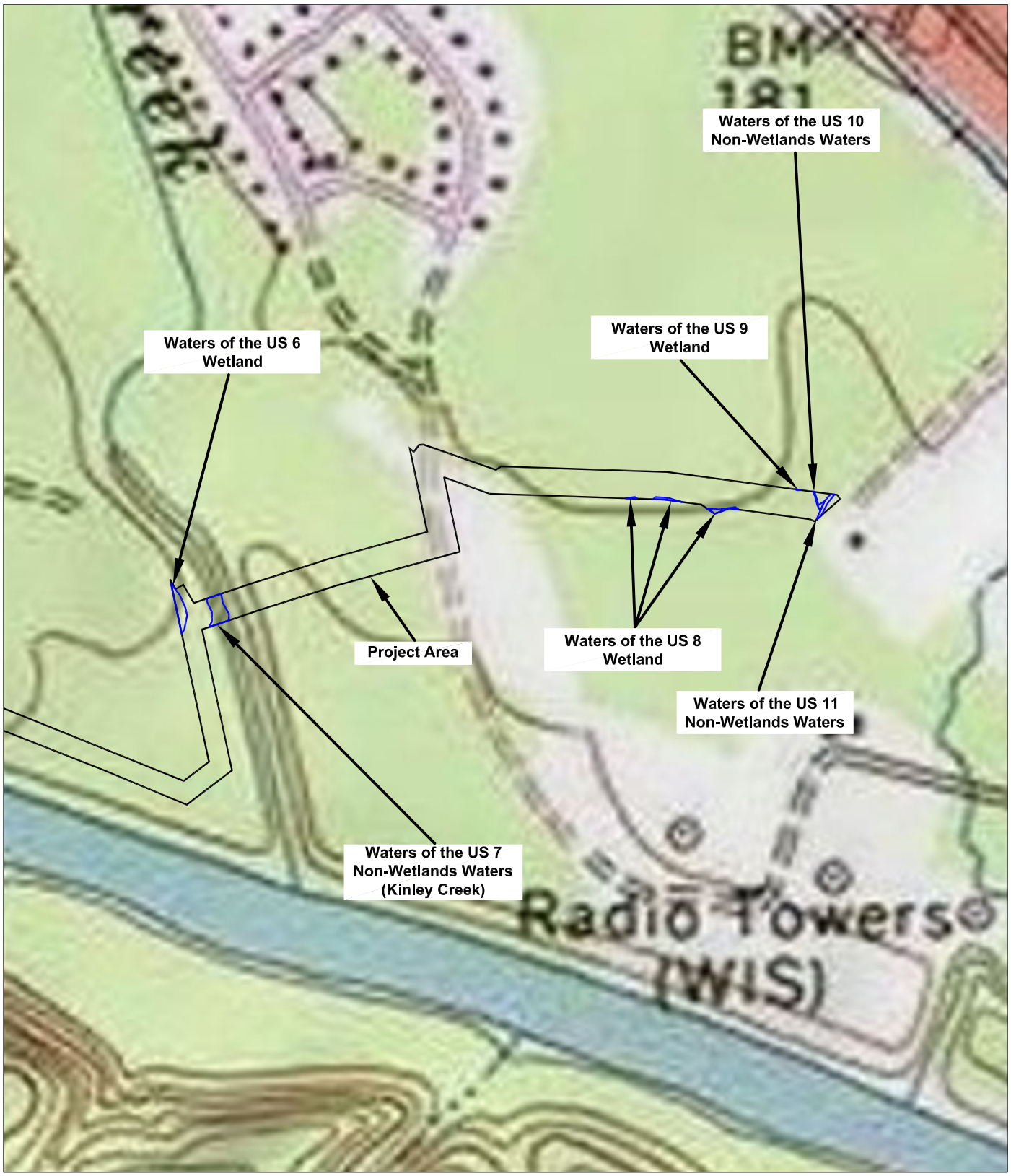
Water Features USGS Topo

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
2C



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GRAPHIC SCALE
1 inch = 400 feet

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DATE:	20200103
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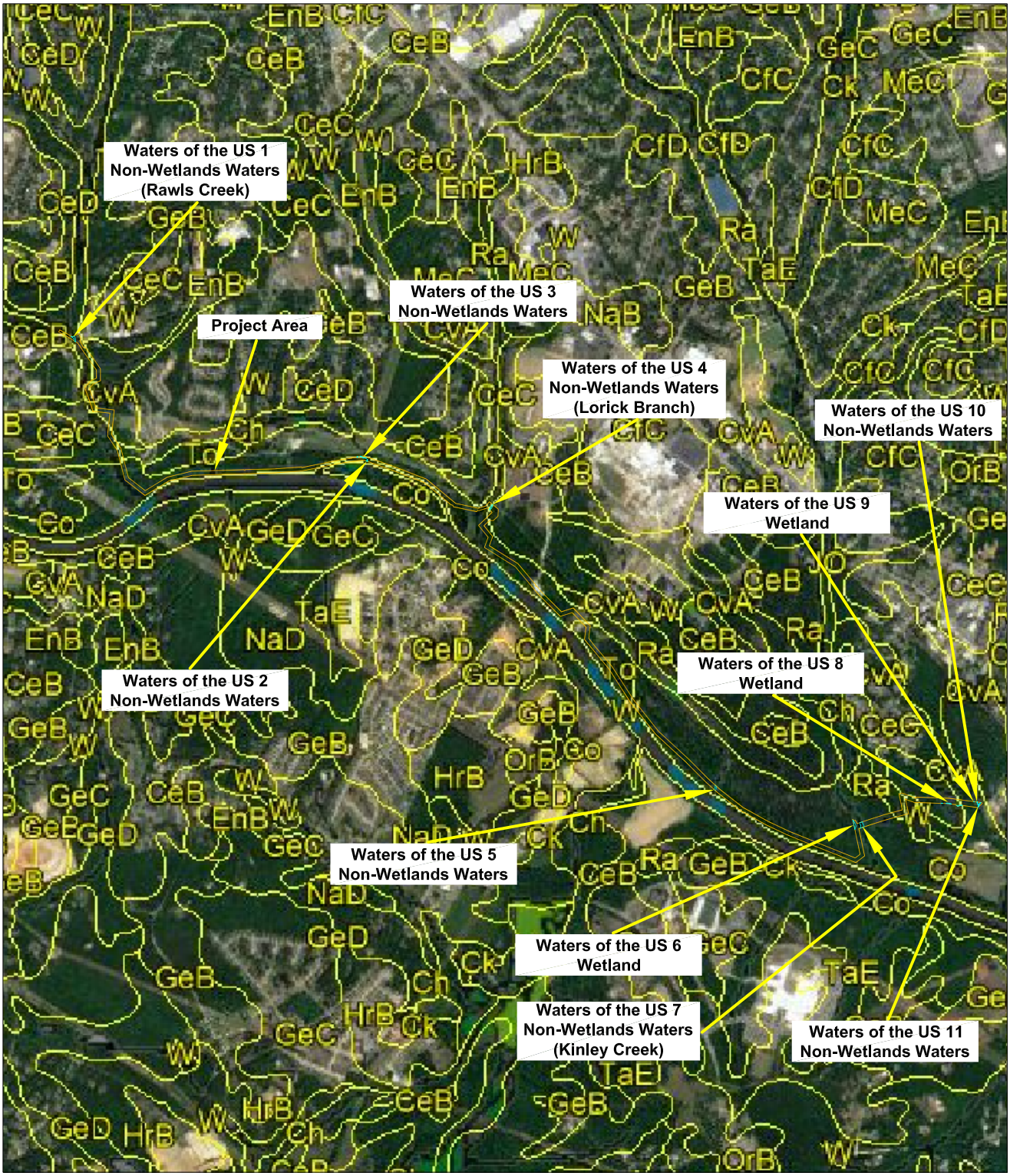
Water Features USGS Topo

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
2D



Source: Soil Survey Staff. The Gridded Soil Survey Geographic (SSURGO) Database for SC, USDA NRCS Available online at http://datagateway.nrcs.usda.gov/. Accessed October 24, 2019.
USFWS National Wetlands Inventory (NWI), last updated October 8, 2019.
Google Maps - 2018 Aerial
Survey Data Provided by: Brown and Caldwell
GPS Data Provided by: EPC, Inc.

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GRAPHIC SCALE
1 inch = 2200 feet

DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Water Features Soil/NWI

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
3

Source: Soil Survey Staff. The Gridded Soil Survey Geographic (SSURGO) Database for SC, USDA NRCS Available online at http://datagateway.nrcs.usda.gov/. Accessed October 24, 2019.
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GRAPHIC SCALE
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Water Features Soil/NWI

Lower Saluda Relief Sewer JWD
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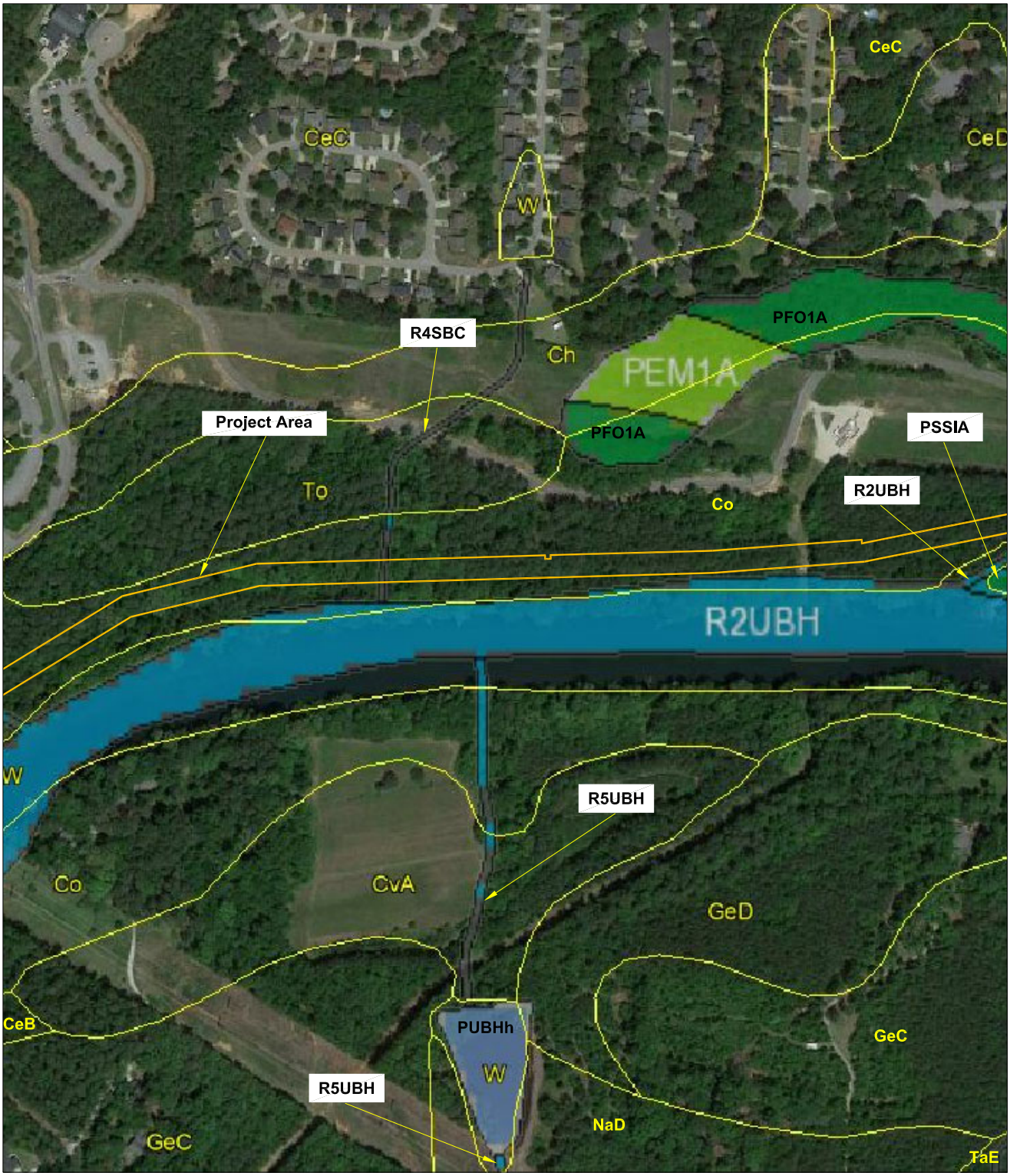
Lexington County, South Carolina

SHEET NO.
3A



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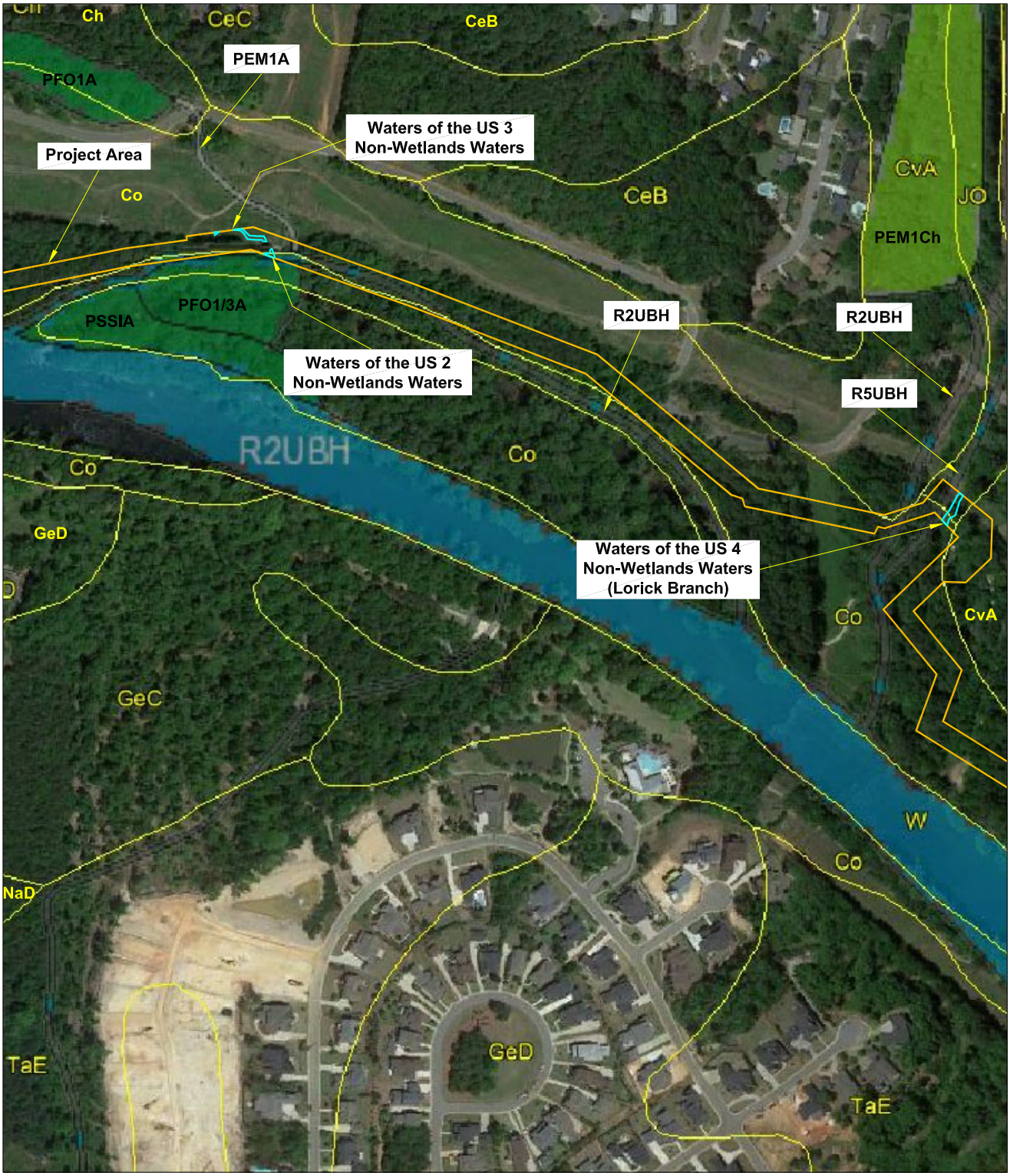

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Water Features Soil/NWI

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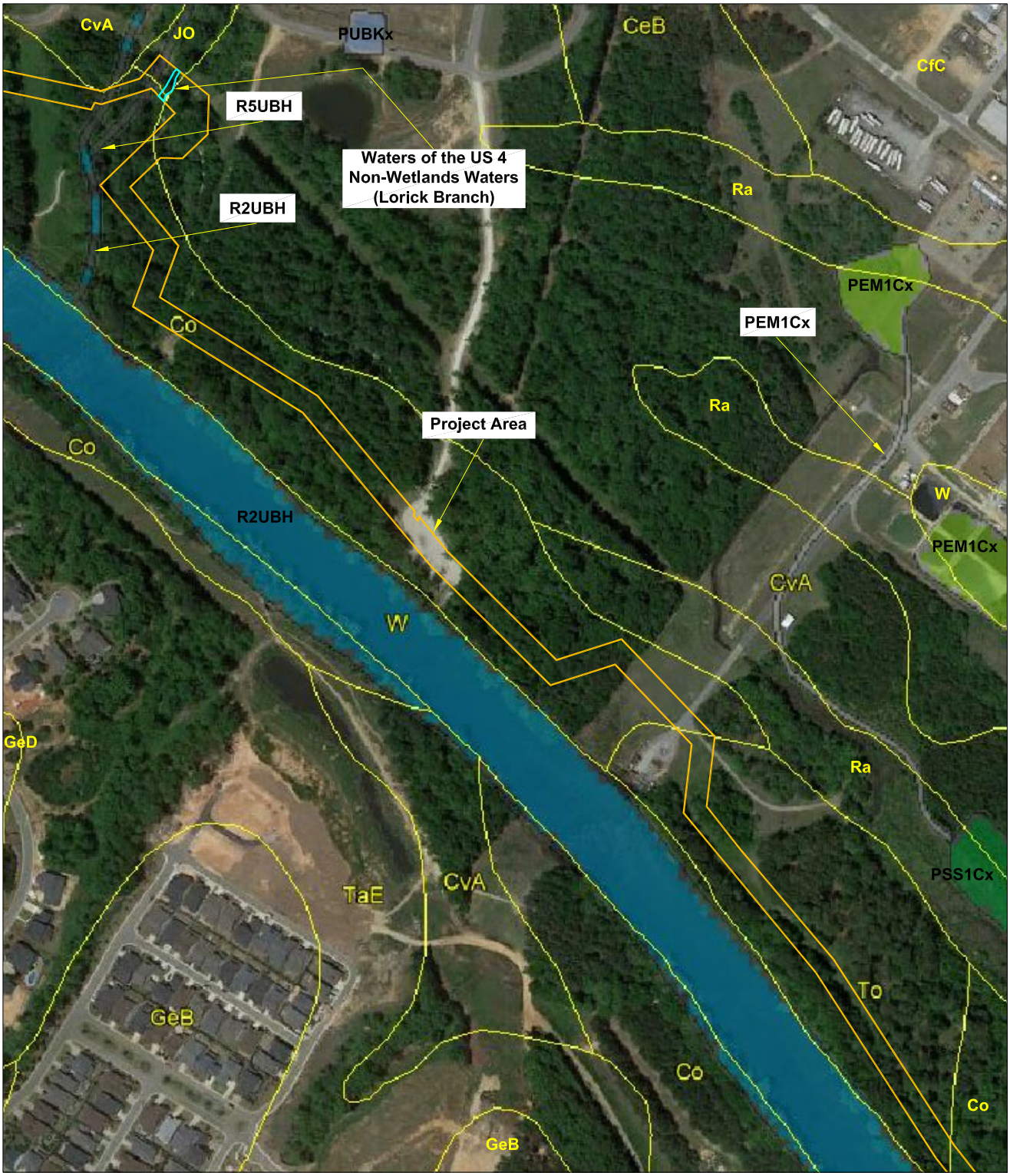
SHEET NO.
3C



Source: Soil Survey Staff. The Gridded Soil Survey Geographic (SSURGO) Database for SC, USDA NRCS Available online at http://datagateway.nrcs.usda.gov/. Accessed October 24, 2019.
USFWS National Wetlands Inventory (NWI), last updated October 8, 2019.
Google Maps - 2018 Aerial
Survey Data Provided by: Brown and Caldwell
GPS Data Provided by: EPC, Inc.

Environmental Permitting Consultants, Inc.
Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

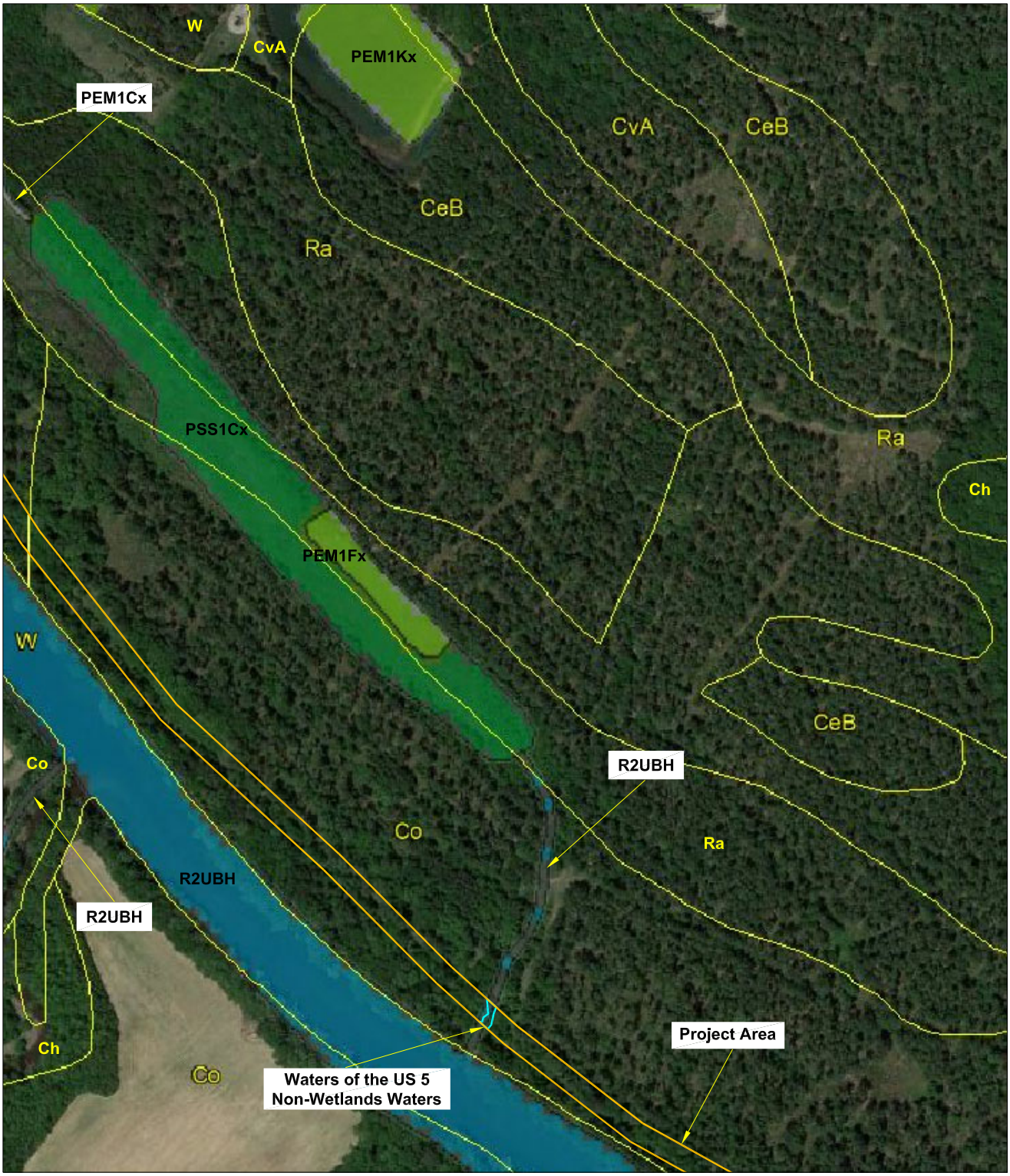
GRAPHIC SCALE
1 inch = 400 feet

DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Water Features Soil/NWI

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
3D



Source: Soil Survey Staff. The Gridded Soil Survey Geographic (SSURGO) Database for SC, USDA NRCS Available online at http://datagateway.nrcs.usda.gov/. Accessed October 24, 2019.
USFWS National Wetlands Inventory (NWI), last updated October 8, 2019.
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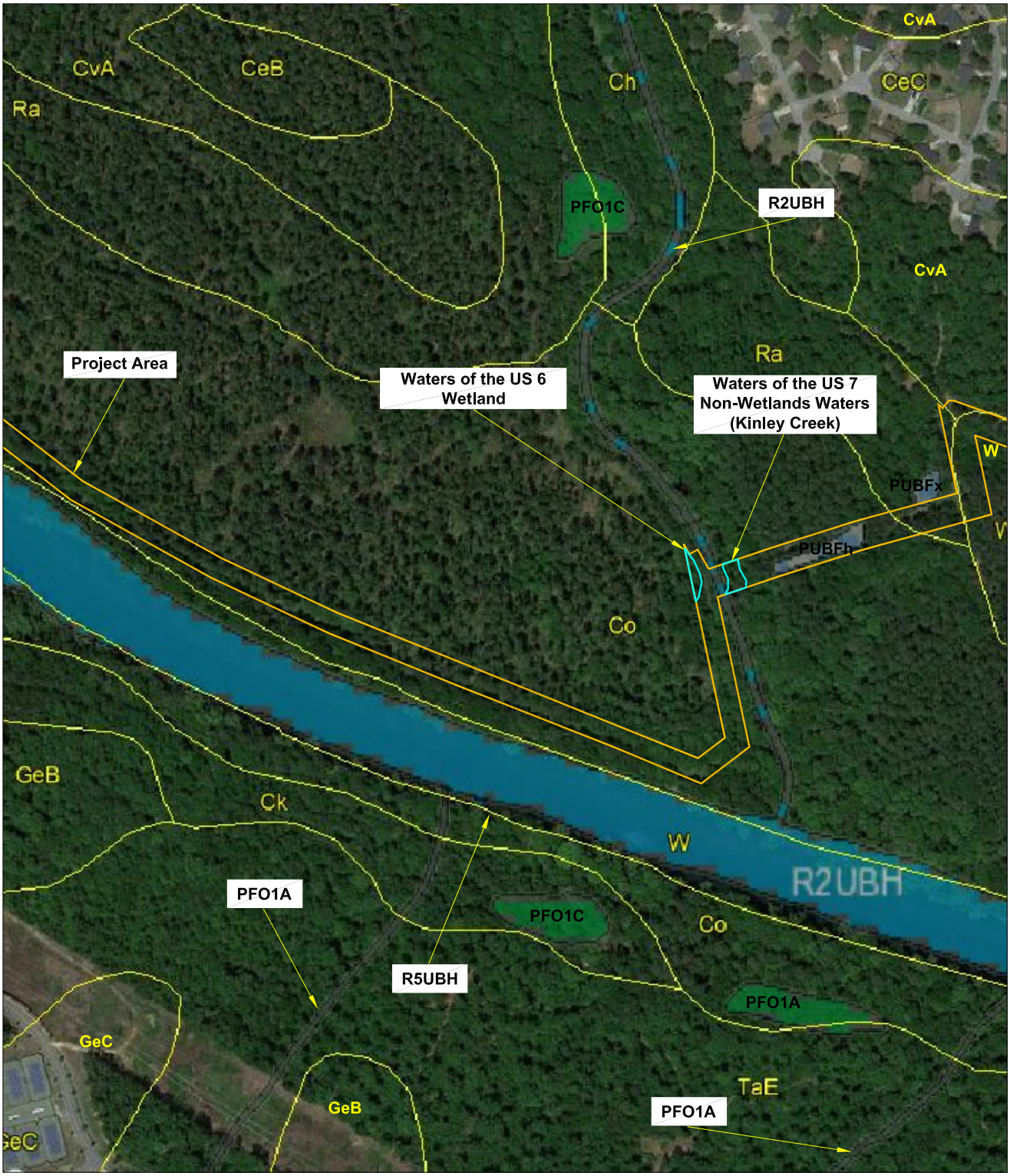
GRAPHIC SCALE
1 inch = 400 feet

DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Water Features Soil/NWI

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
3E



Source: Soil Survey Staff. The Gridded Soil Survey Geographic (SSURGO) Database for SC, USDA NRCS Available online at http://datagateway.nrcs.usda.gov/. Accessed October 24, 2019.
USFWS National Wetlands Inventory (NWI), last updated October 8, 2019.
Google Maps - 2018 Aerial
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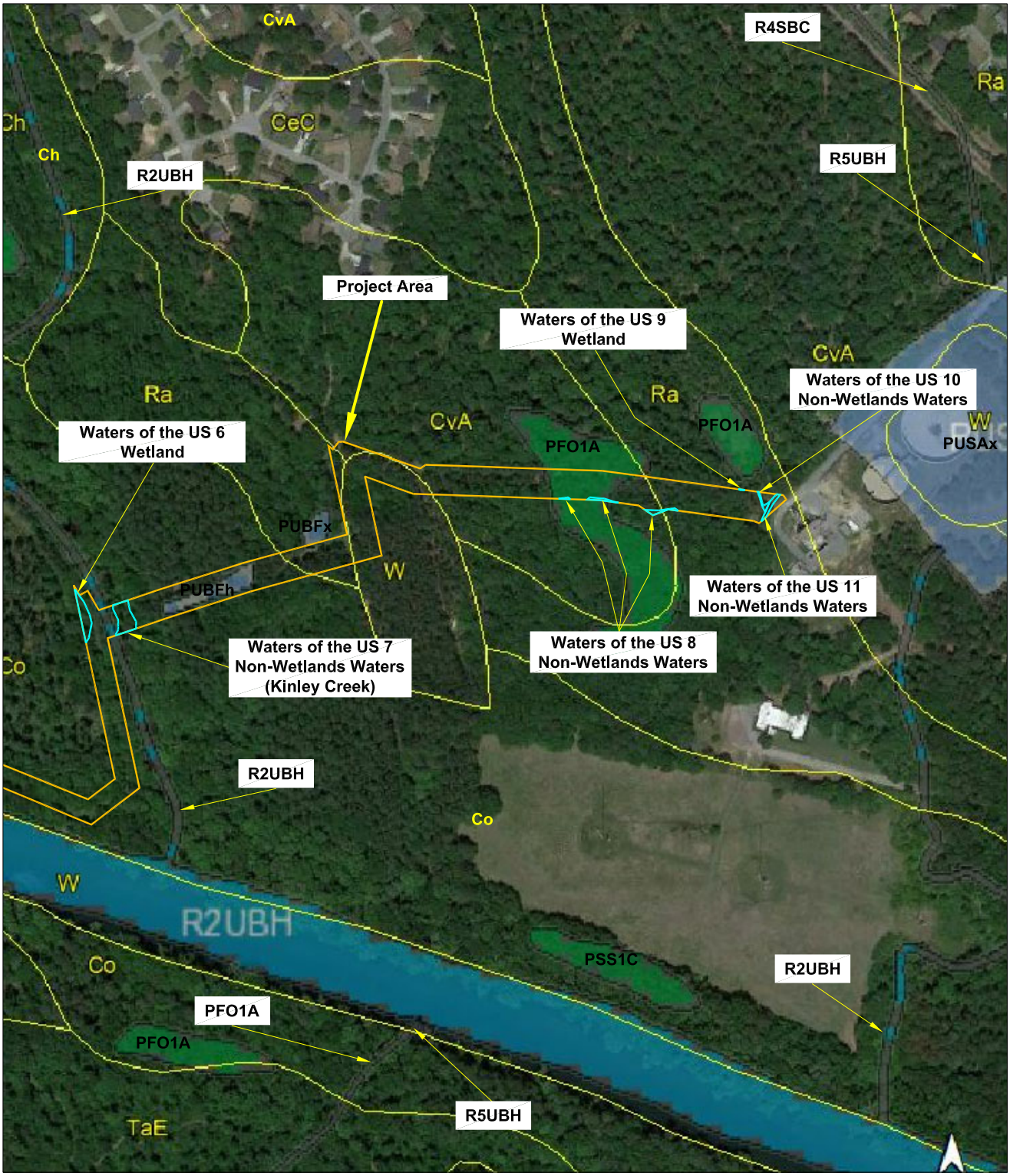
GRAPHIC SCALE
1 inch = 400 feet

DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Water Features Soil/NWI

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
3F



Source: Soil Survey Staff. The Gridded Soil Survey Geographic (SSURGO) Database for SC, USDA NRCS Available online at http://datagateway.nrcs.usda.gov/. Accessed October 24, 2019.
USFWS National Wetlands Inventory (NWI), last updated October 8, 2019.
Google Maps - 2018 Aerial
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Phone: (864) 271-3040
Fax: (864) 235-9299

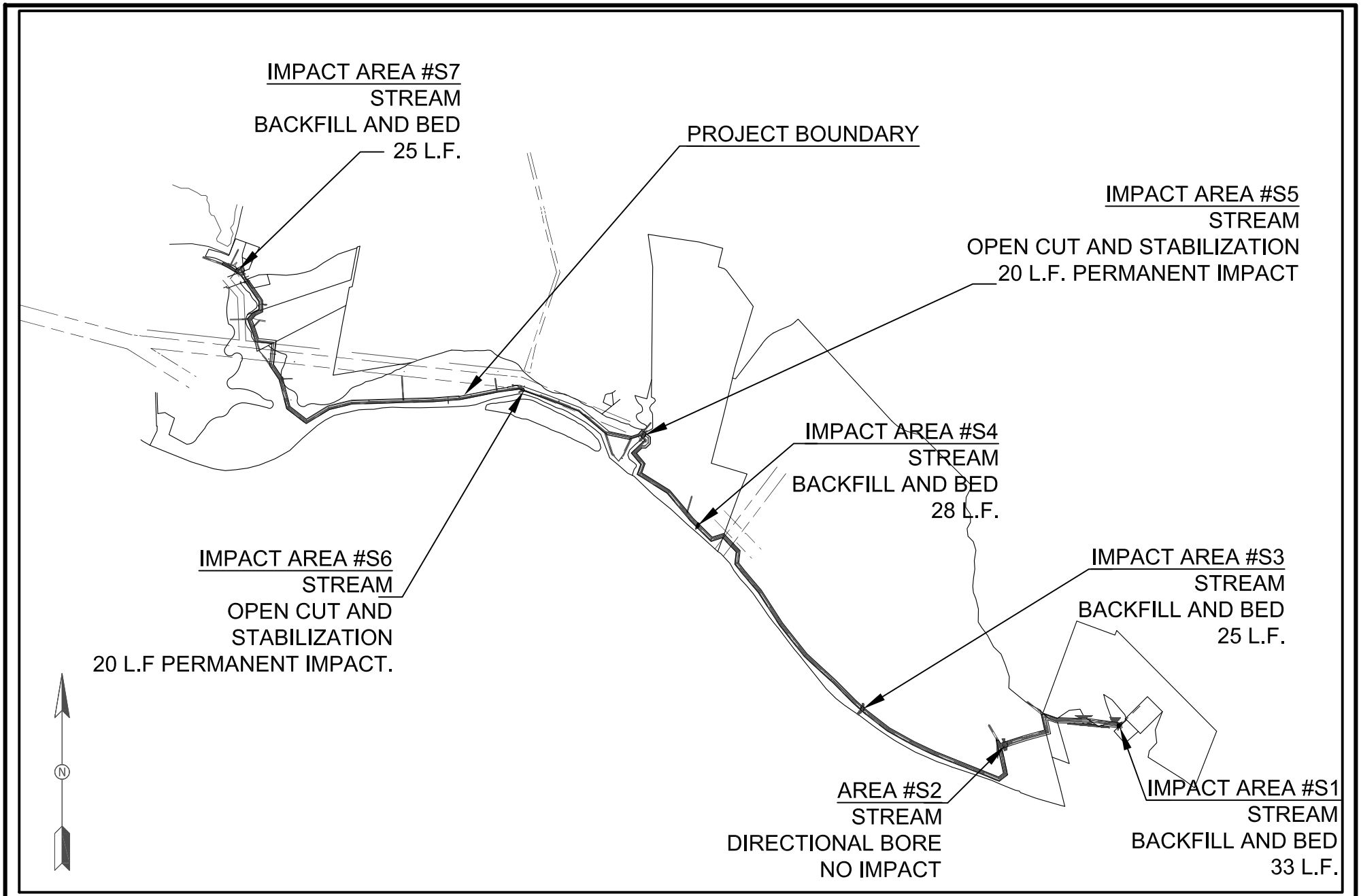
GRAPHIC SCALE
1 inch = 400 feet

DRAWN BY:	MME
DATE:	20200103
EPC PROJECT NO.:	1585

Water Features Soil/NWI

Lower Saluda Relief Sewer JWD
City of Columbia
Lexington County, South Carolina

SHEET NO.
3G



Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 2000 feet

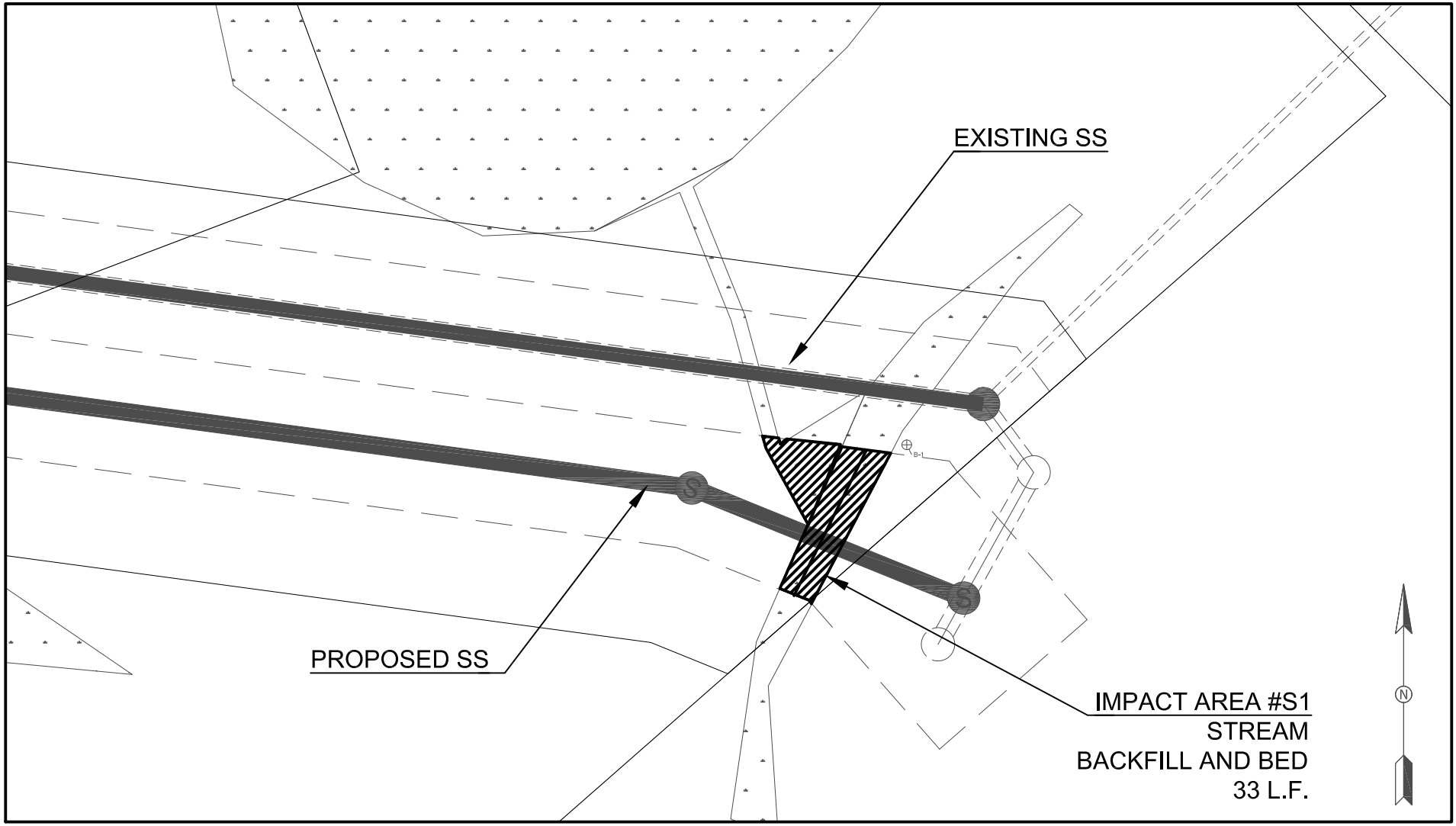
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

OVERVIEW

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

4



Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 30 feet

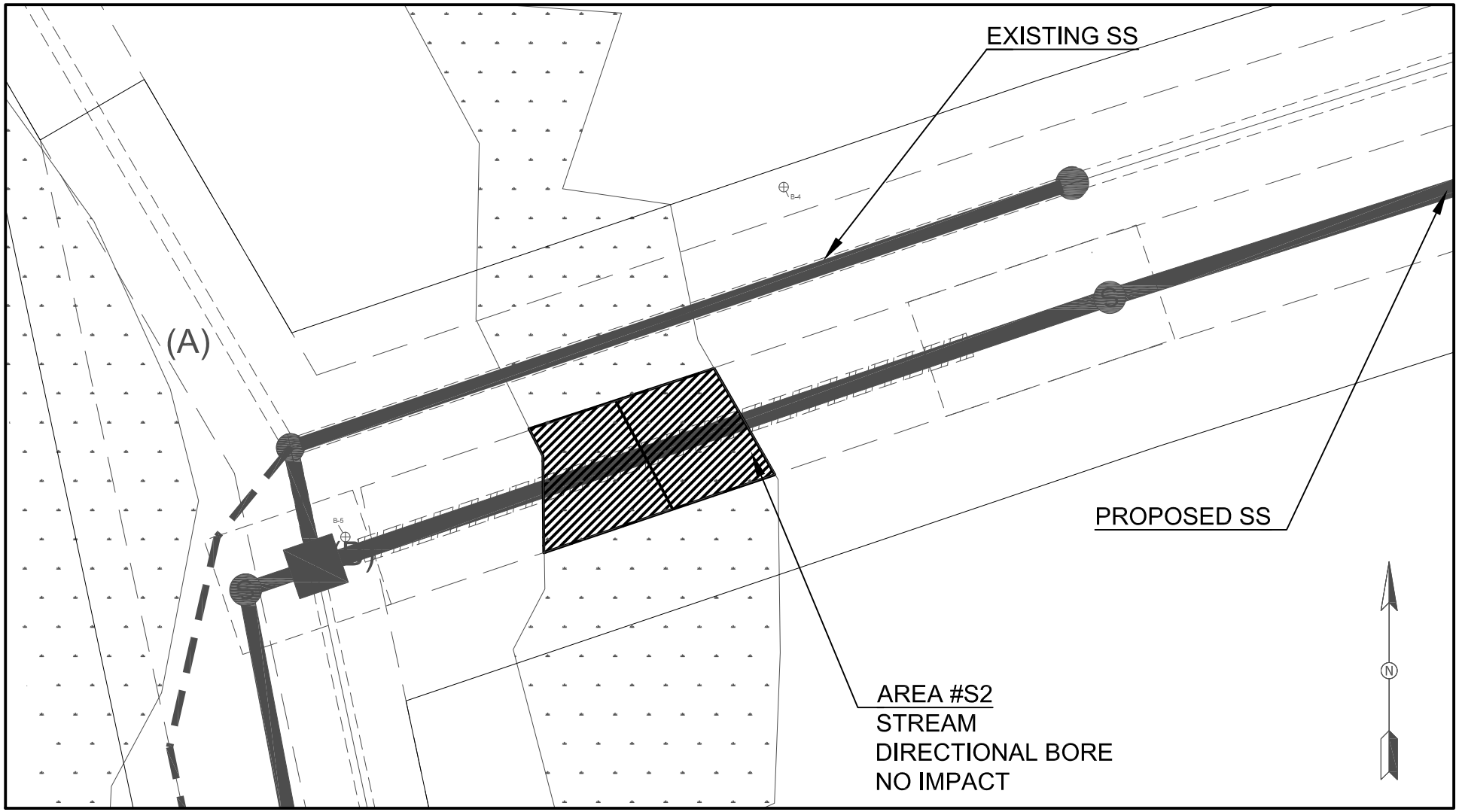
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S1 IMPACT DETAIL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

5



Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 30 feet

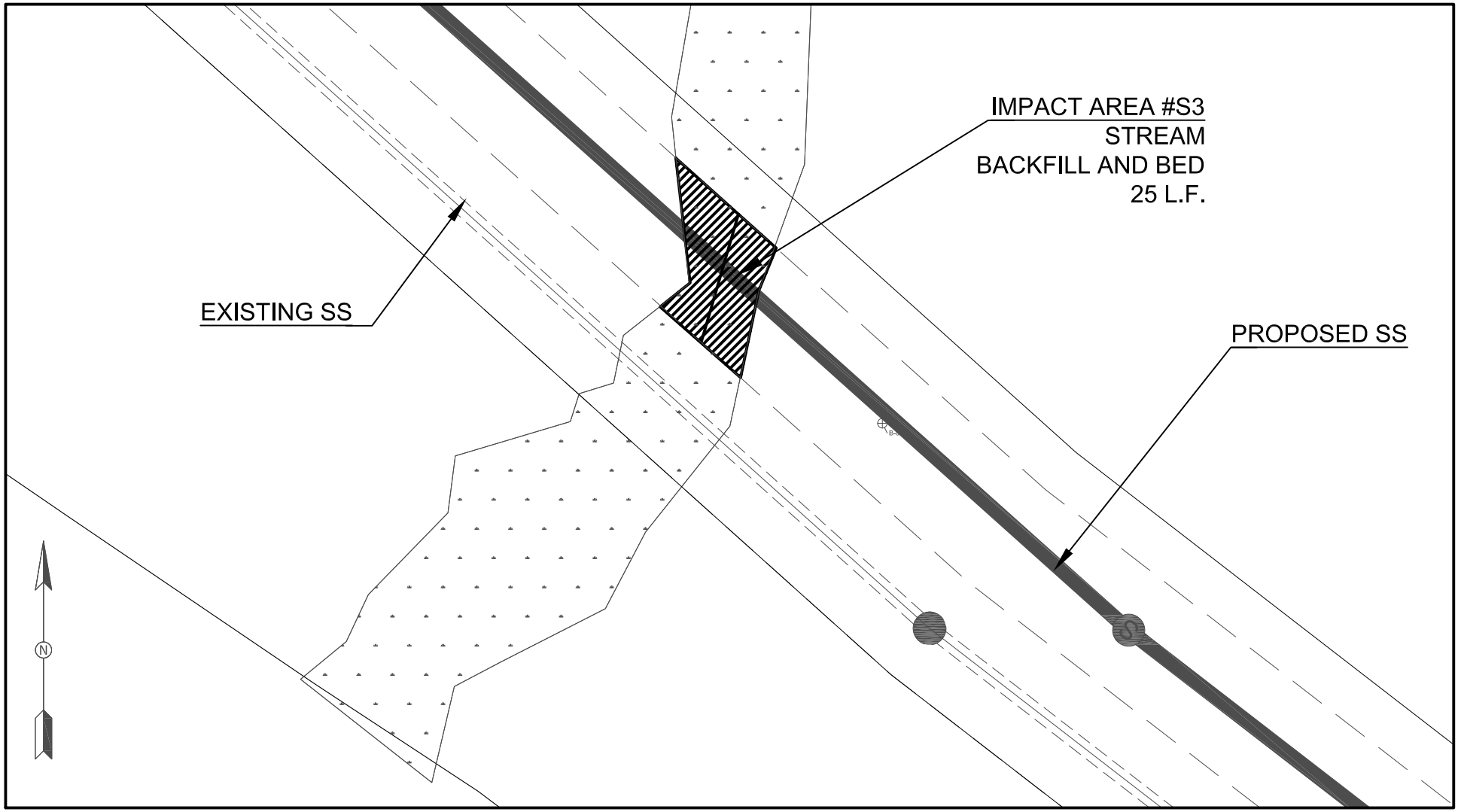
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S2 IMPACT DETAIL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

6



Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 30 feet

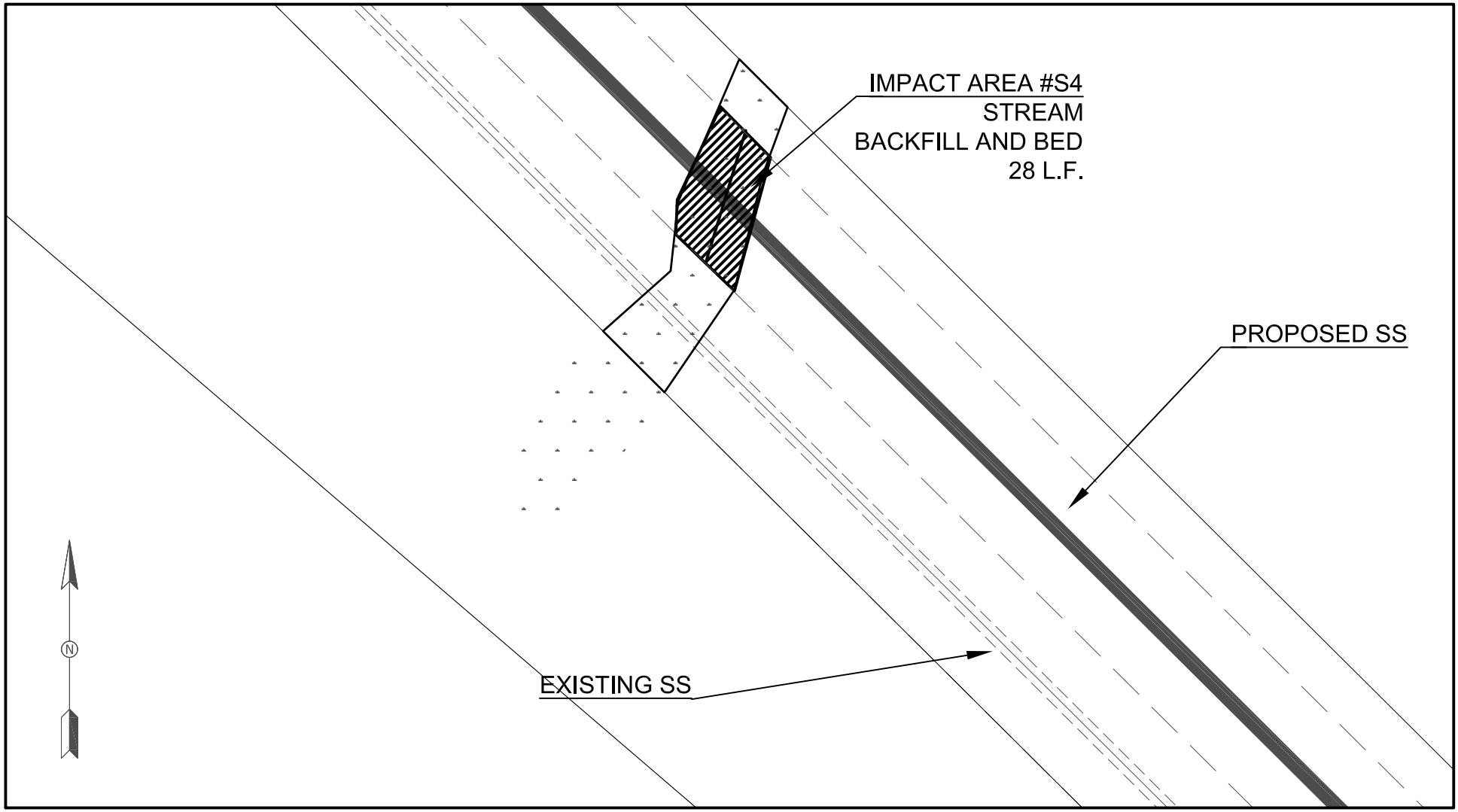
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S3 IMPACT DETAIL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

7



Environmental Permitting Consultants, Inc.

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Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 30 feet

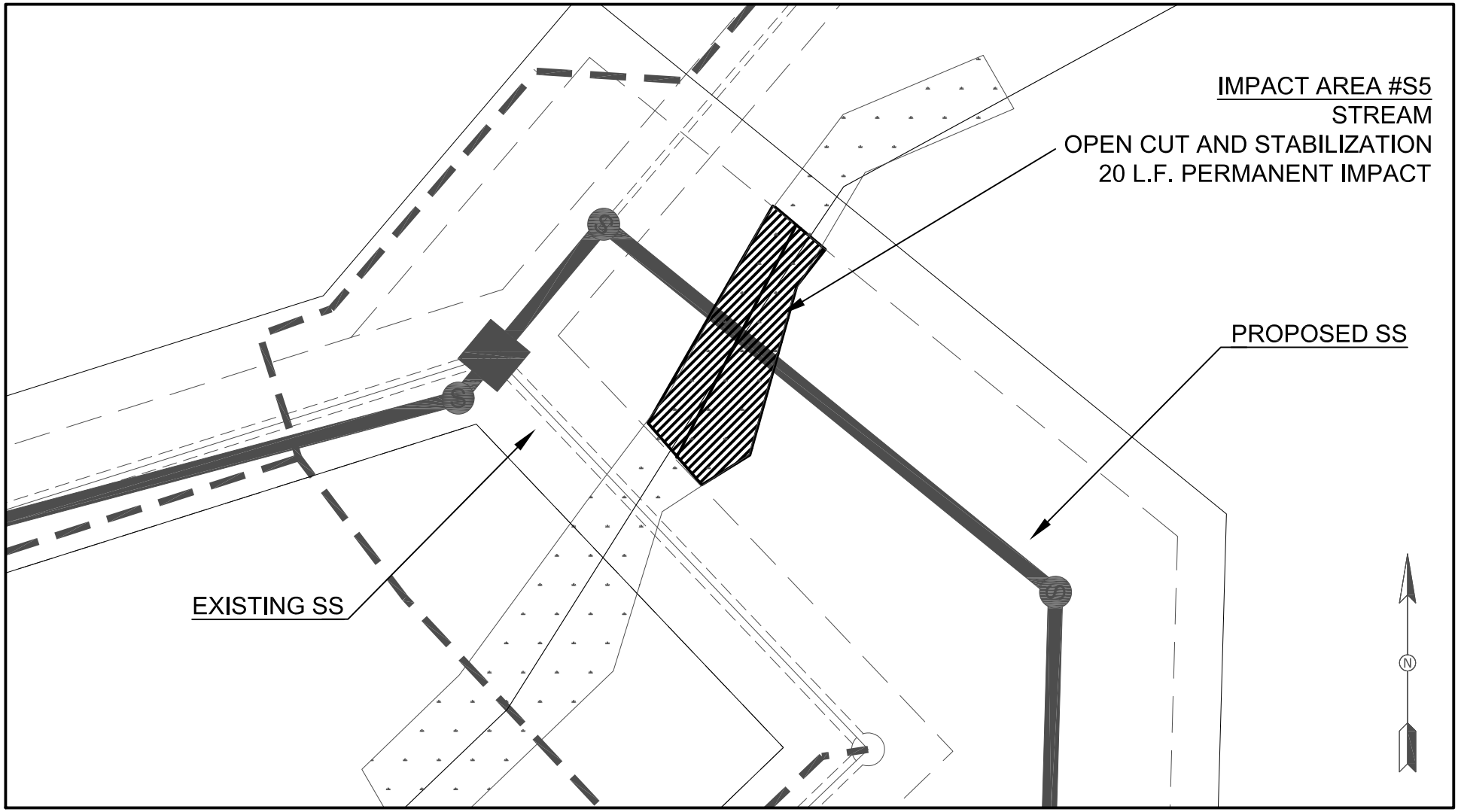
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S4 IMPACT DETAIL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

8



Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 30 feet

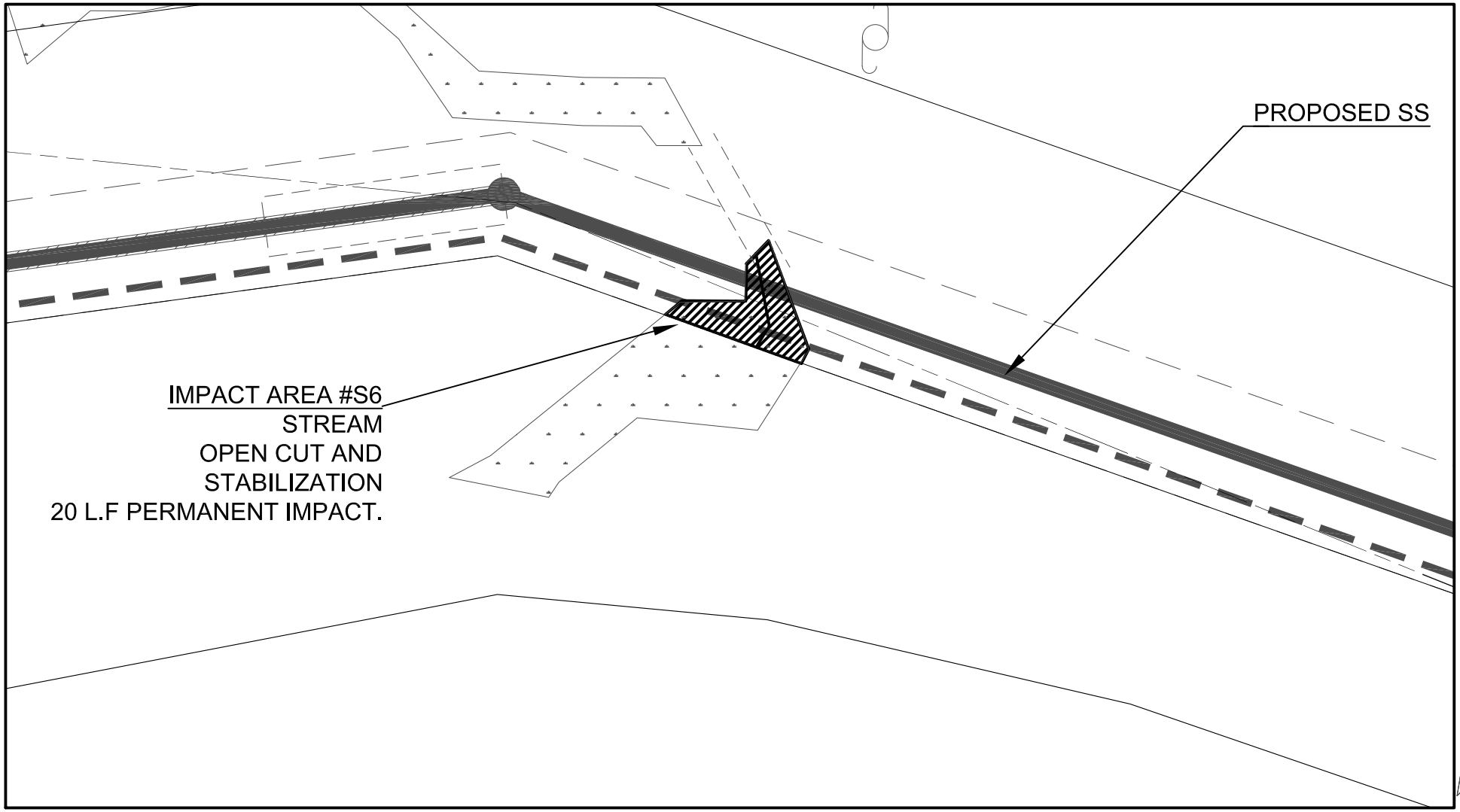
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S5 IMPACT DETAIL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

9



Environmental Permitting Consultants, Inc.

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Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 30 feet

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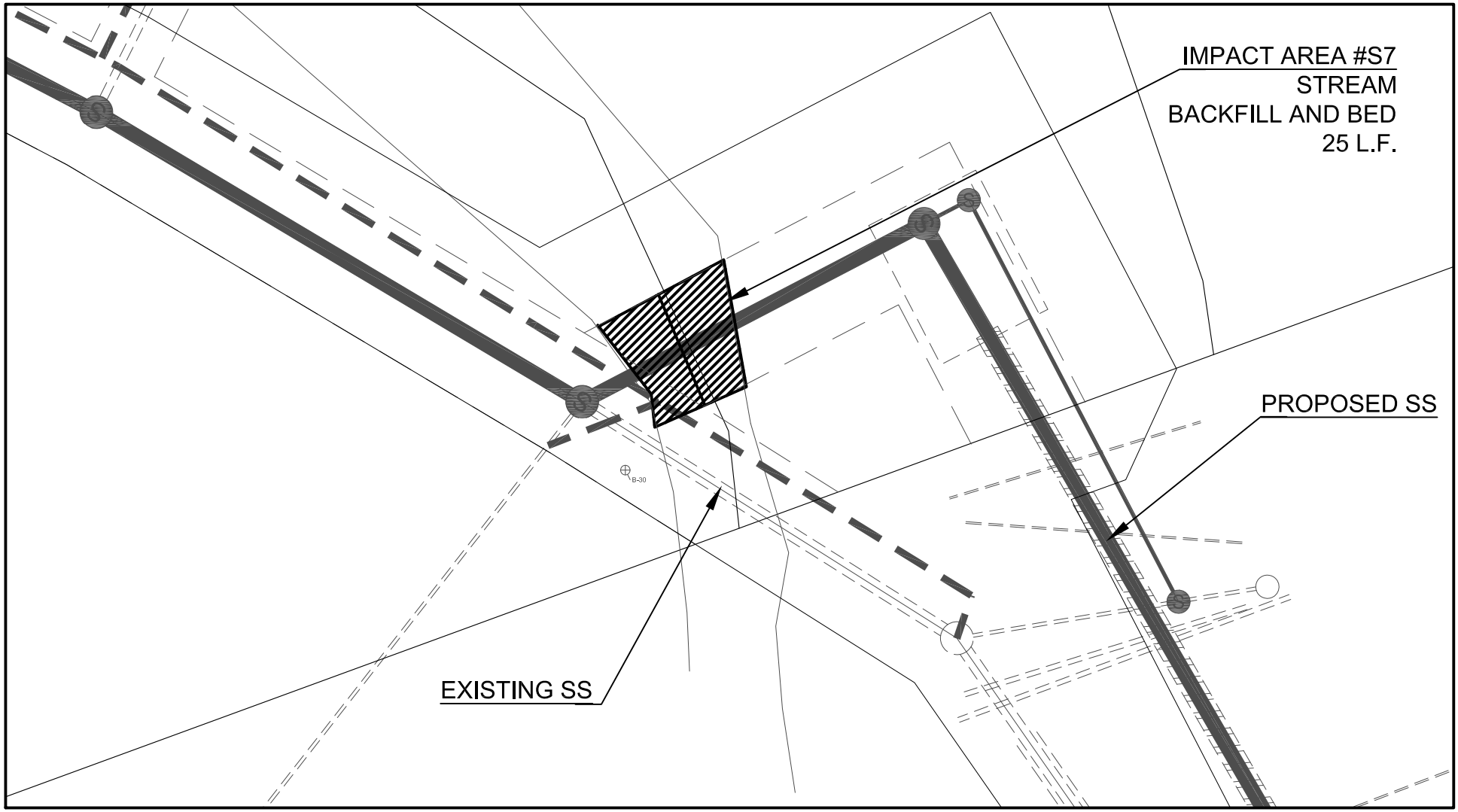
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S6 IMPACT DETAIL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

10



Environmental Permitting Consultants, Inc.
Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = 30 feet

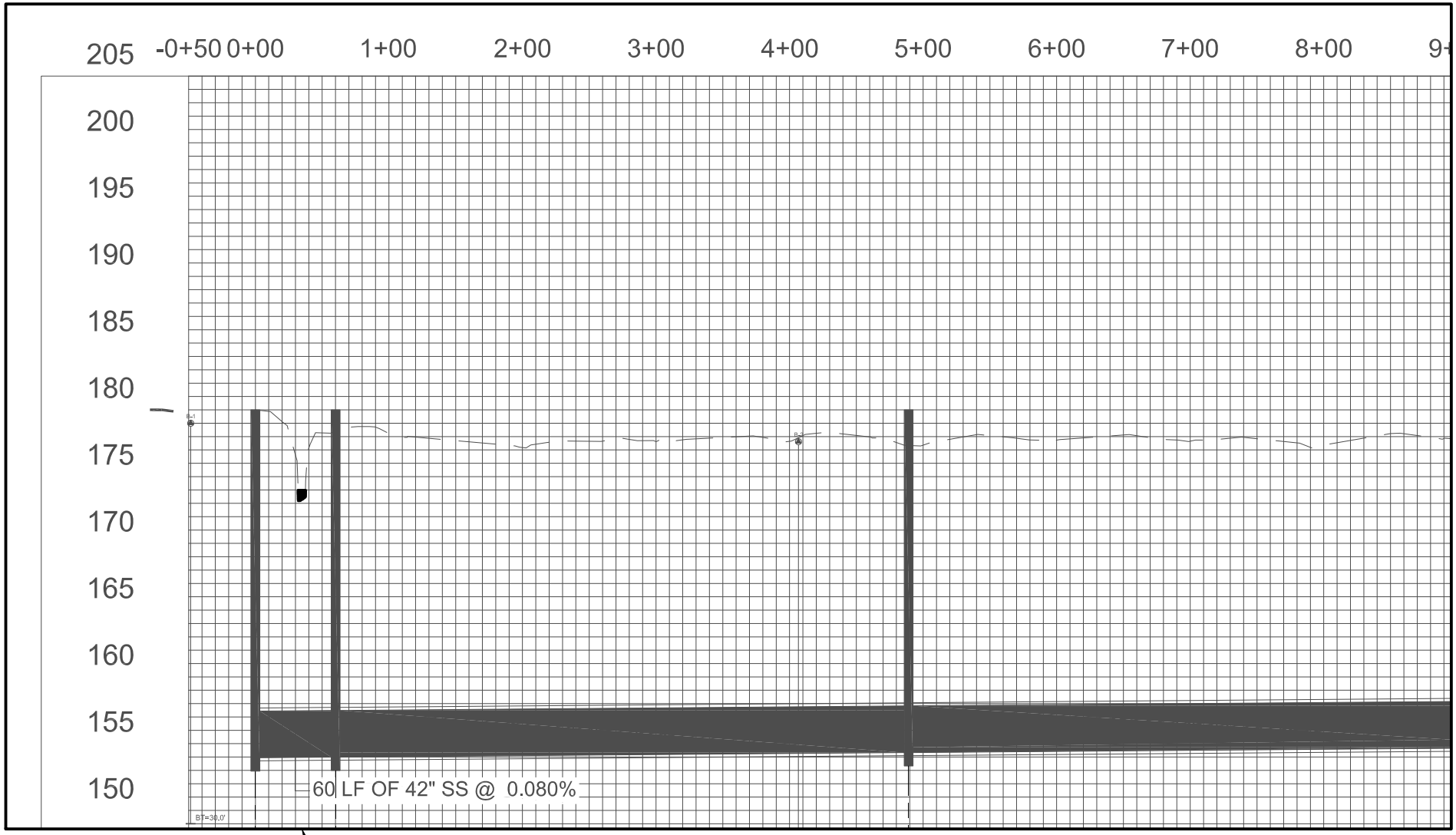
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S7 IMPACT DETAIL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

11



IMPACT AREA #S1
STREAM
BACKFILL AND BED
33 L.F.

Environmental Permitting Consultants, Inc.
Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = NTS feet

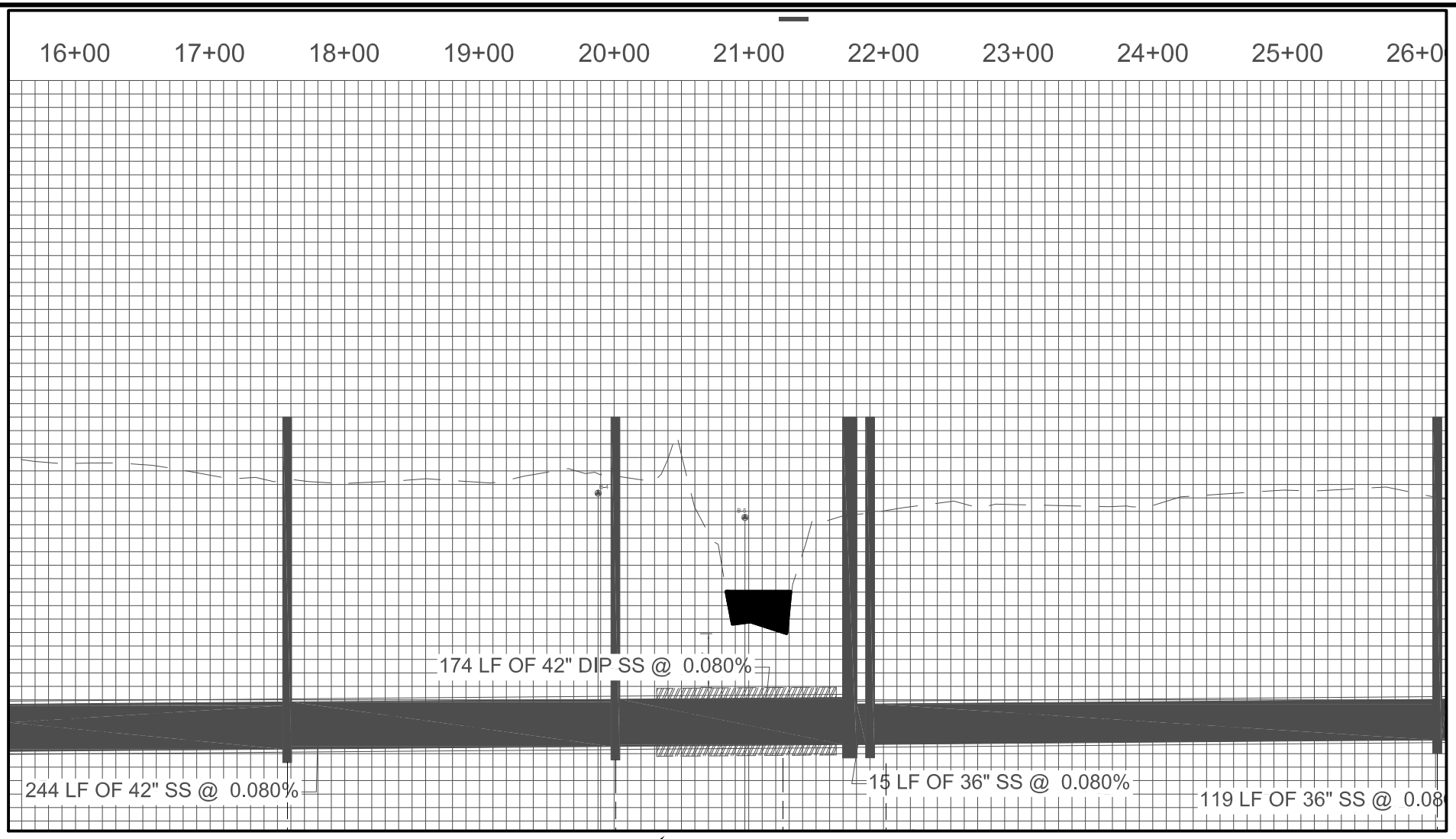
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S1 CROSS SECTION

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

12



IMPACT AREA #S2
STREAM
DIRECTIONAL BORE
NO IMPACT

Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = NTS feet

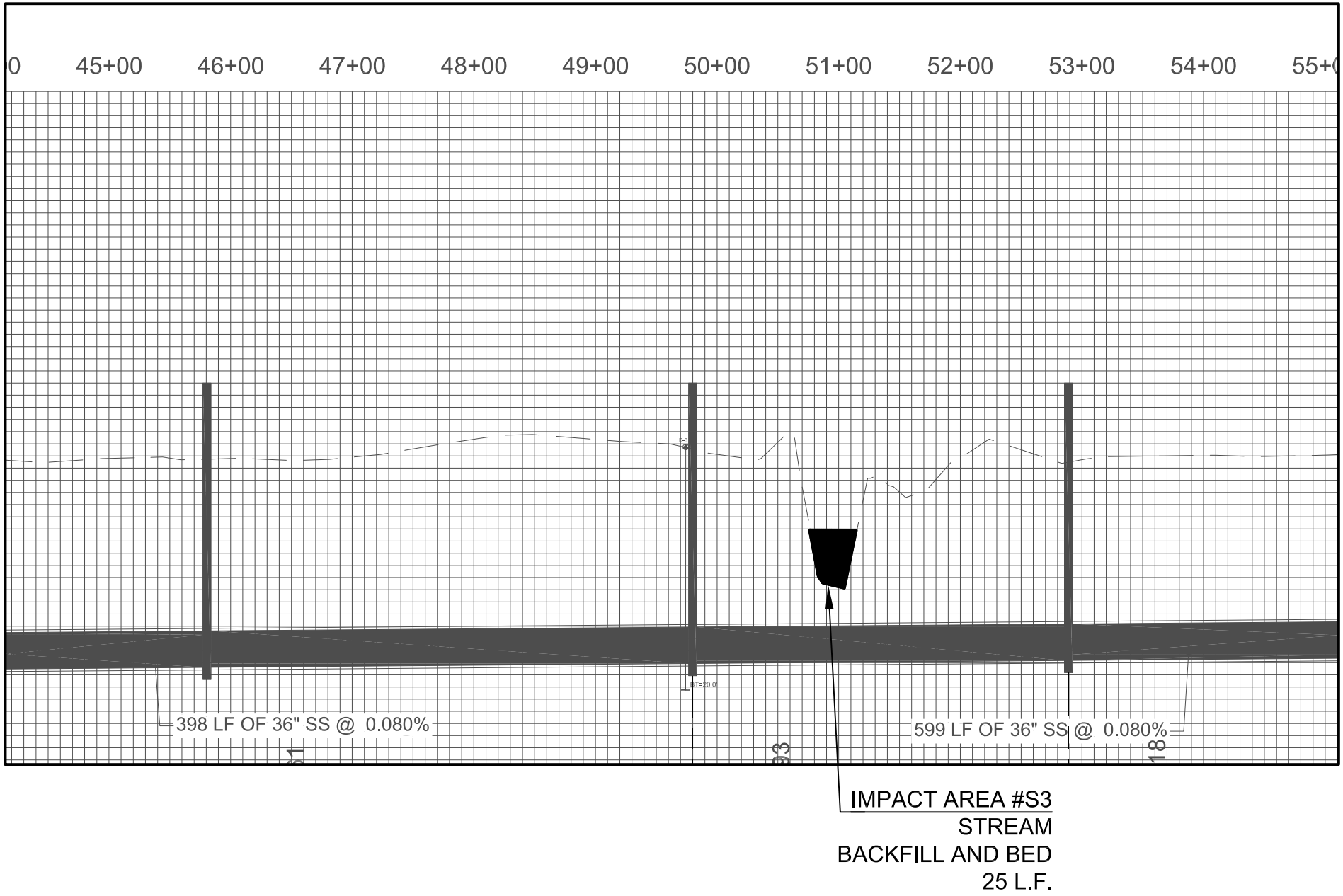
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S2 CROSS SECTION

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

13



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GRAPHIC SCALE

1 inch = NTS feet

DRAWN BY:	LHB
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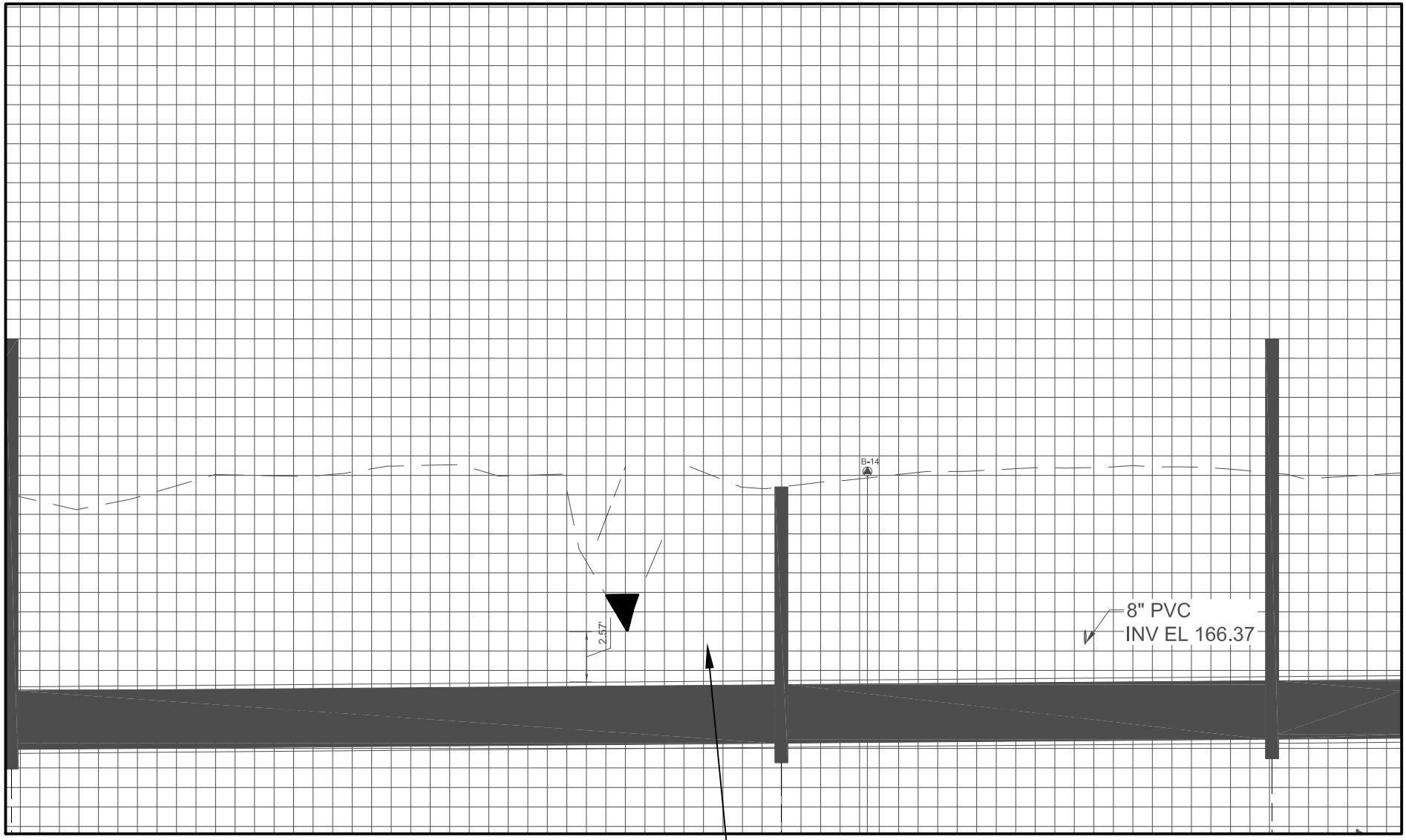
EPC PROJECT NO.:	1585

S3 CROSS SECTION

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

14



IMPACT AREA #S4
STREAM
BACKFILL AND BED
28 L.F.

Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = NTS feet

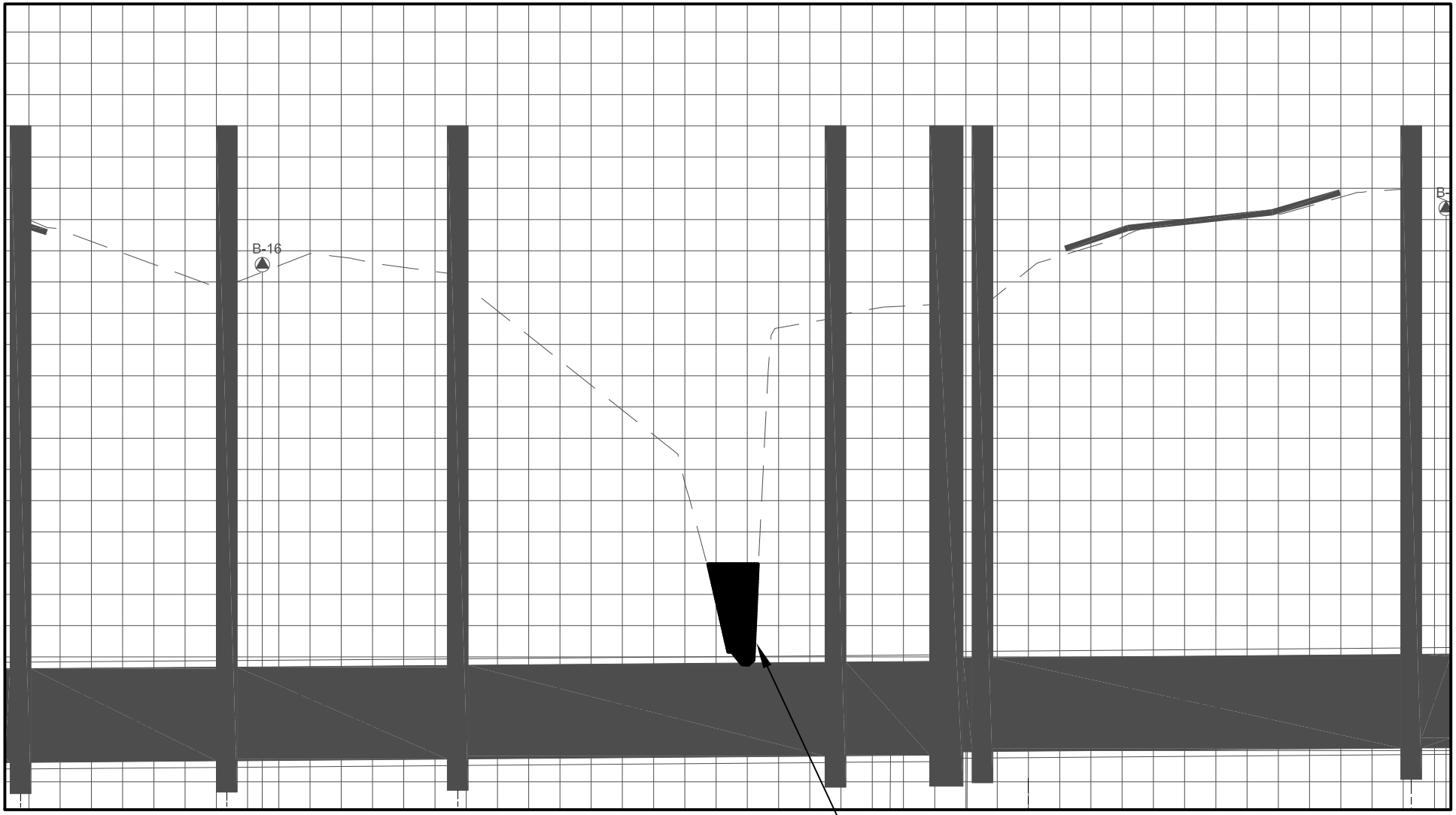
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S4 CROSS SECTION

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

15



IMPACT AREA #S5
STREAM
OPEN CUT AND STABILIZATION
53 L.F.

Environmental Permitting Consultants, Inc.
Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = NTS feet

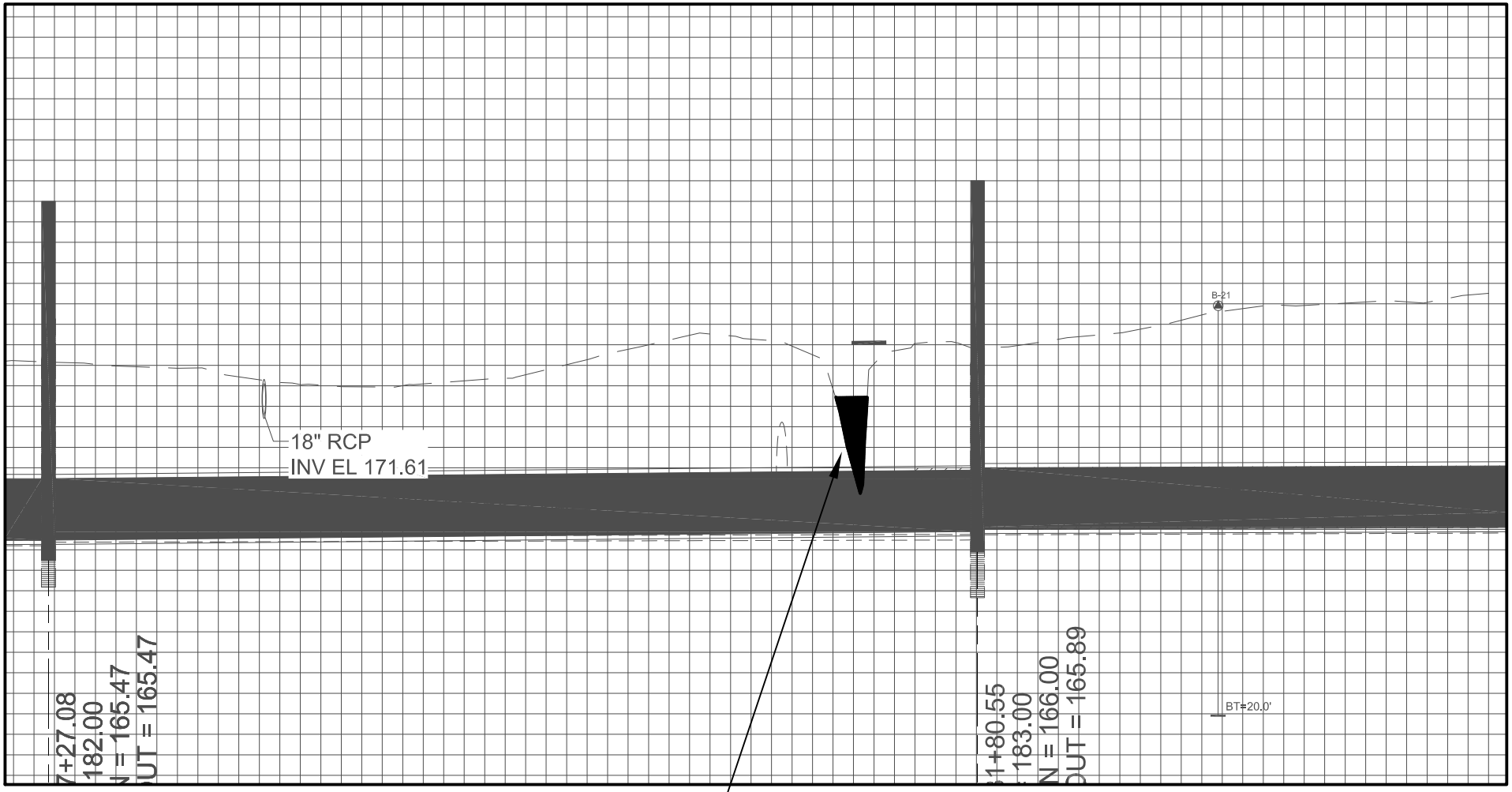
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S5 CROSS SECTION

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

16



IMPACT AREA #S6
STREAM
OPEN CUT AND
STABILIZATION
20 L.F.

Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = NTS feet

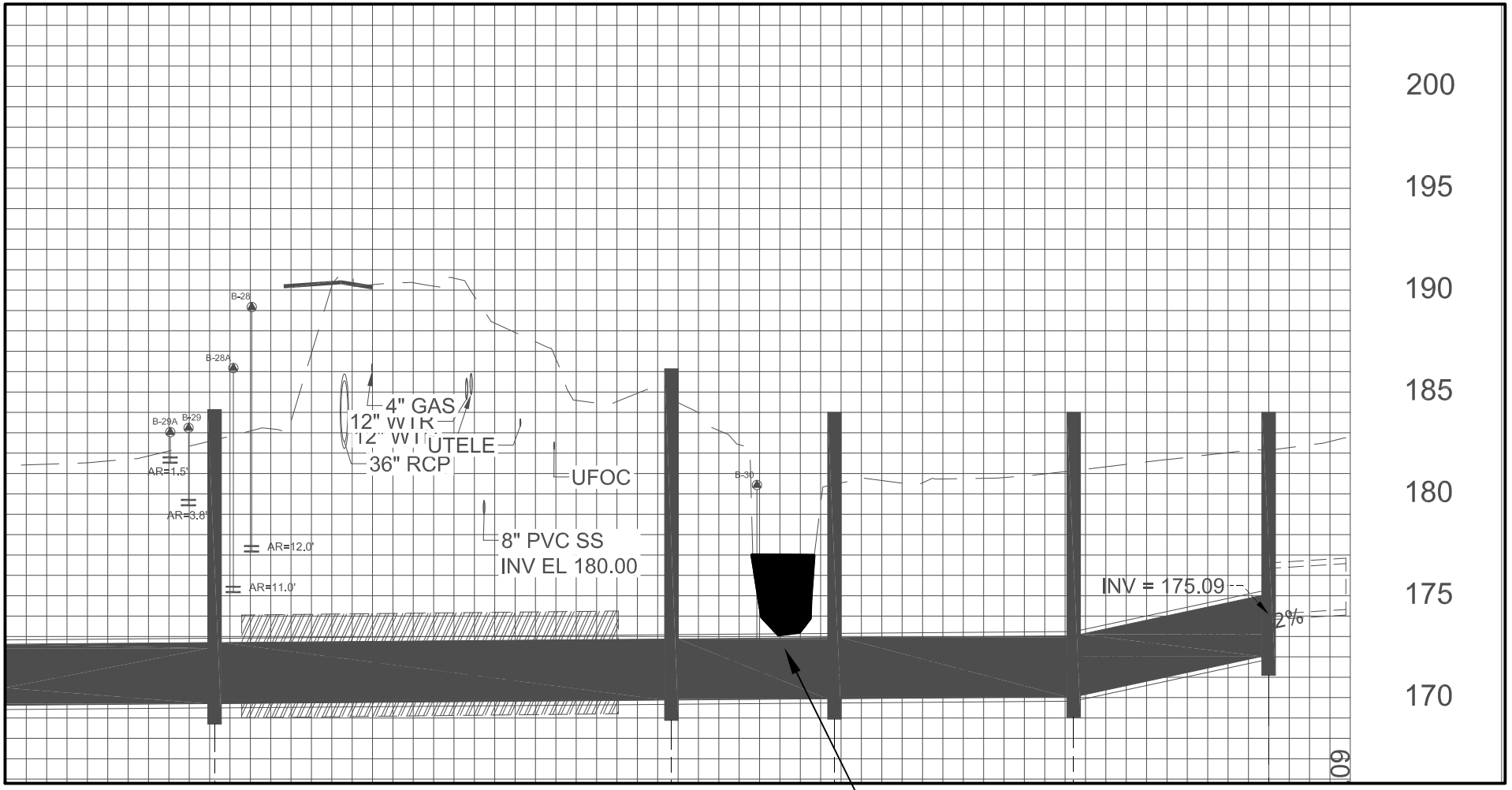
DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

S6 CROSS SECTION

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

17



IMPACT AREA #S7
STREAM
BACKFILL AND BED
25 L.F.

Environmental Permitting Consultants, Inc.

Post Office Box 3744
Greenville, SC 29608
Phone: (864) 271-3040
Fax: (864) 235-9299

GRAPHIC SCALE

1 inch = NTS feet

DRAWN BY:	LHB
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EPC PROJECT NO.:	1585

S7 CROSS SECTION

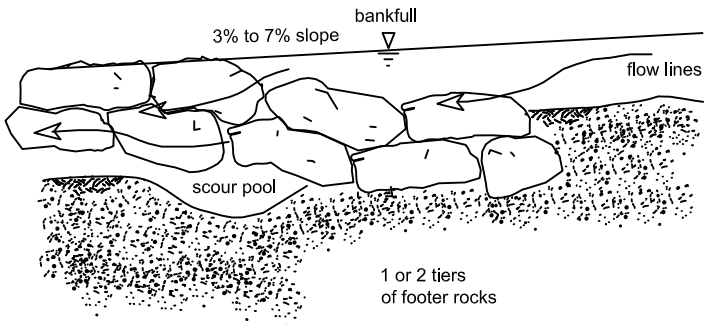
LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

18

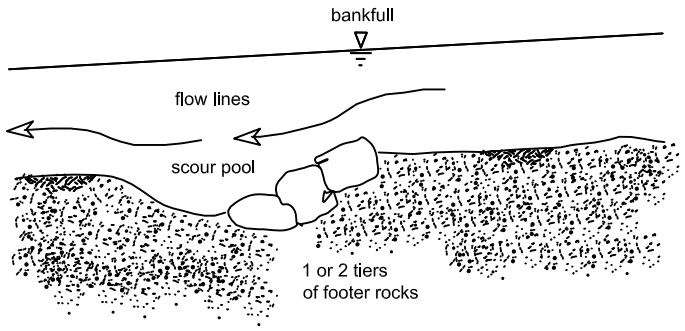
DETAIL - CROSS VANE

PROFILE VIEW OF VANE ARM



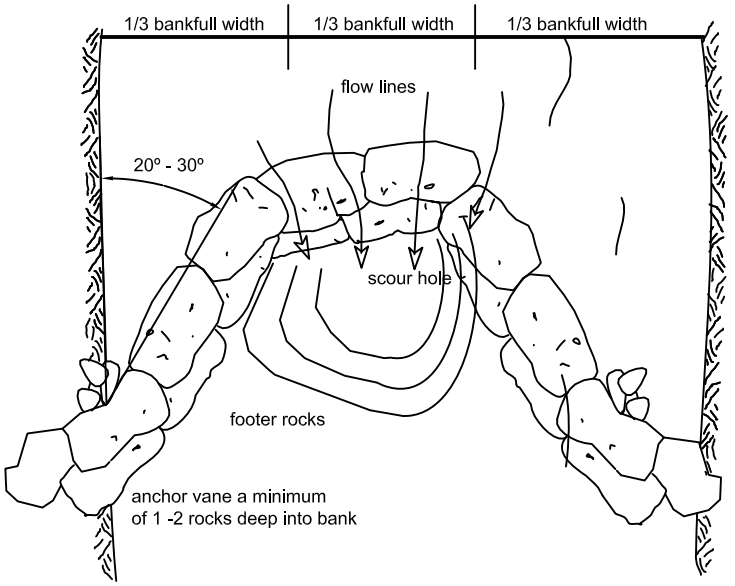
Section & Plan Views Adapted from Rosgen (1999)

PROFILE VIEW OF CROSS VANE



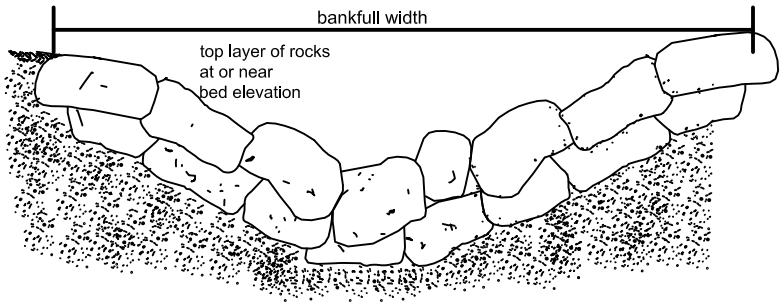
Section & Plan Views Adapted from Rosgen (1999)

PLAN VIEW: CROSS VANE



Section & Plan Views Adapted from Rosgen (1999)

SECTION VIEW: CROSS VANE



Section & Plan Views Adapted from Rosgen (1999)

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GRAPHIC SCALE

1 inch = NTS feet

DRAWN BY:	LHB
DATE:	3AUG2020
EPC PROJECT NO.:	1585

STABILIZATION TYPICAL

LOWER SALUDA SEWER RELIEF
CITY OF COLUMBIA
LEXINGTON COUNTY

SHEET NO.

19

Appendix D: Easements

1. Easement #1: Davis Family Real Estate, LLC, TMS #003696-05-004
2. Easement #2: Dominion Energy South Carolina, Inc., TMS #003696-05-010 **(Pending)**
3. Easement #3: Irmo-Chapin Recreation Commission, TMS #003696-05-003
4. Easement #4: Shaw Industries Group, Inc., TMS #003500-01-055
5. Easement #5: Irmo-Chapin Recreation Commission, TMS #002799-04-016
6. Easement #6: Dominion Energy South Carolina, Inc., TMS #002798-05-002 **(Pending)**
7. Easement #7: Dominion Energy South Carolina, Inc., TMS #002798-03-022 **(Pending)**
8. Easement #8: Irmo-Chapin Recreation Commission, TMS #002798-03-006
9. Easement #9: Irmo-Chapin Recreation Commission, TMS #002798-03-005
10. Easement #10: Carolina Wildlife Care, Inc., TMS #002798-03-024 **(Pending)**
11. Easement #11: Irmo-Chapin Recreation Commission, TMS #002798-02-051
12. Easement #12: Irmo-Chapin Recreation Commission, TMS #002798-02-042

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Easement #1:

Davis Family Real Estate, LLC

TMS #003696-05-004

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **DAVIS FAMILY REAL ESTATE, LLC** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, a permanent, exclusive easement **variable (139' x 255.23' x 148.68') feet in width**, also a 10' temporary easement for construction purposes only, together with the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located at 1029 Garden Valley Lane, Columbia, SC 29210, and being further identified as a portion of Lexington County tax map number TMS #003696-05-004, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

A permanent, exclusive easement for a sanitary sewer main, variable (139' X 255.23' X 148.68') feet in width and having the following perimeter measurements: beginning at the southern property corner of the subject property and extending therefrom in a northwesterly direction along the southernmost/southwestern property line of the subject property, for a distance of one hundred forty-eight and sixty-eight hundredths (148.68) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of two hundred fifty-five and twenty-three hundredths (255.23) feet to intersect the southernmost/southeastern property line of the subject property; thence turning and extending therefrom along the innermost southeastern property line of the subject property, for a distance of one hundred thirty-nine (139) feet to intersect the southern property corner of the subject property, also being the point of beginning; thence terminating. Be all measurements a little more or less.

Also, a 10' temporary construction easement as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

This easement being more clearly shown and delineated on an easement drawing for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 1 of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell, Inc., Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

APPROVED AS TO FORM

Legal Department City of Columbia, SC

A copy of said easement drawing being attached hereto and made a part hereof as Exhibit “A”.

CMA

Easement 1 of 12

(THE REMAINDER OF THIS PAGE INTENTIONALLY LEFT BLANK)

TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns to warrant and forever defend all and singular the said premises unto the Grantee, its successors and assigns against the Grantor and Grantor's successors and assigns and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS the hand and seal of the Grantor by the undersigned this 17th day of April, 2020

DAVIS FAMILY REAL ESTATE, LLC

WITNESSES:

(1st Witness Signature)

(2nd Witness Signature)

By: _____

Name: J Edwin Davis, III

Title: _____

STATE OF SOUTH CAROLINA)

ACKNOWLEDGMENT

COUNTY OF)

The foregoing instrument was acknowledged before me this 17 day of April, 2020 by Allana M DeLozier (Name and Title of Officer) of Irmo, S.C. (City and State) on behalf of the within-named Grantor.

Allana M DeLozier
(Notary's Signature)

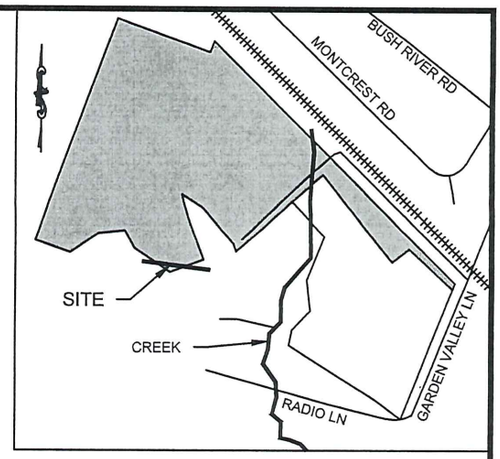
NOTARY PUBLIC FOR STATE OF South Carolina
(State)

MY COMMISSION EXPIRES June 26th 2025
(Date)

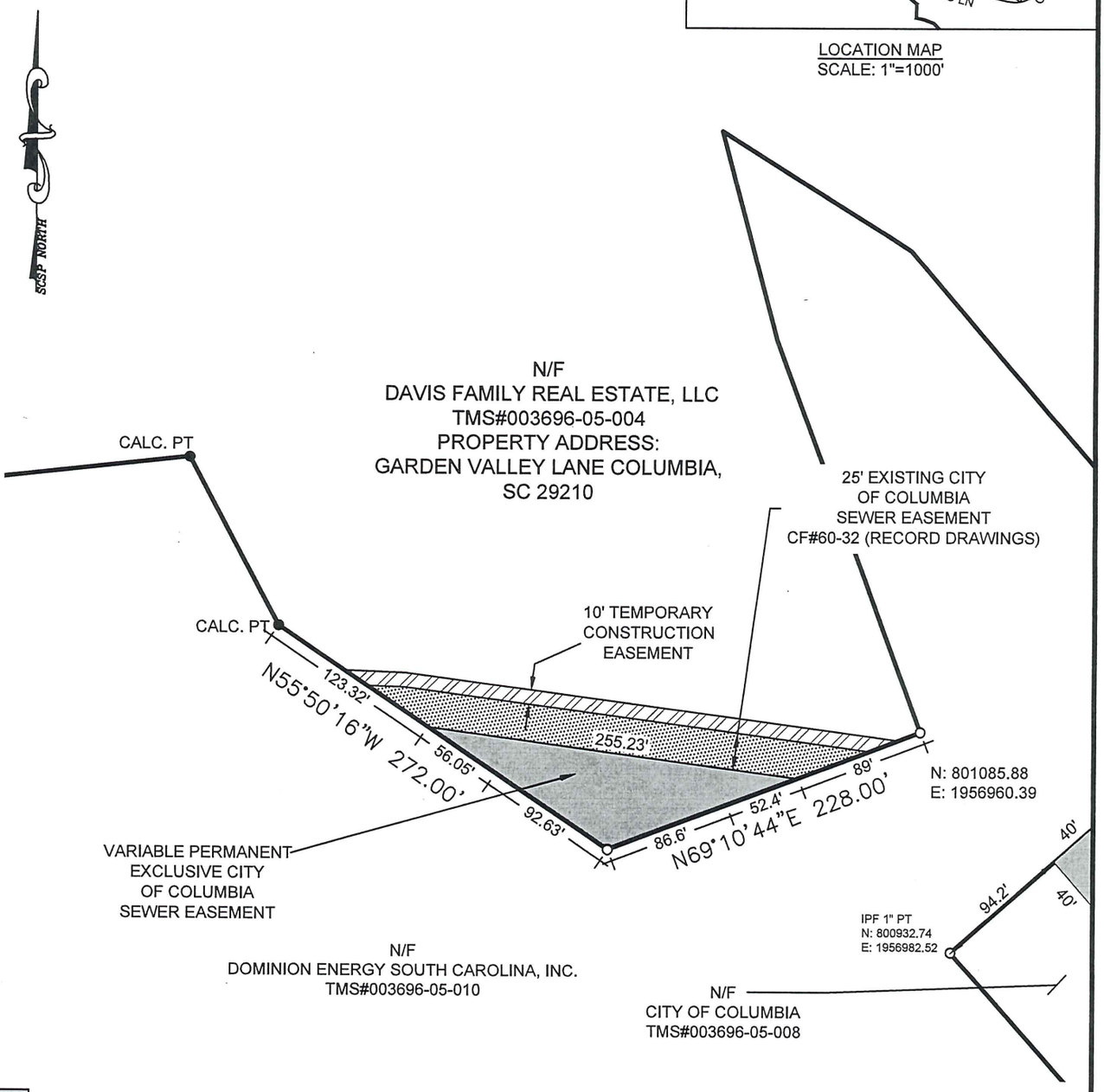
ALLANA M DELOZIER NOTARY PUBLIC SOUTH CAROLINA

REFERENCES:

- PLAT PREPARED FOR JESSE E. DAVIS, JR. BY BARBER, KEELS, & ASSOCIATES, ENGINEERS. DATED AUGUST 17, 1954. RECORDED IN LEXINGTON COUNTY ROD IN PLAT BOOK 26G PAGE 47.
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
SCALE: 1"=1000'



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 0.12AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.14AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: DAVIS FAMILY REAL ESATE, LLC
ADDRESS: 1029 GARDEN VALLEY LANE
COLUMBIA, SC 29210

CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY: CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH
PROJECT NAME: LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION		
CIP # SS7428		EXHIBIT 1 OF 12
		DATE: 12/06/2019

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Easement #2:

Dominion Energy South Carolina, Inc.

TMS #003696-05-010 (Pending)

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Easement #3:

Irmo-Chapin Recreation Commission

TMS #003696-05-003

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **IRMO-CHAPIN RECREATION COMMISSION f/k/a IRMO-CHAPIN RECREATION DISTRICT** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, a permanent, exclusive easement **twenty-five (25') feet in width**, also a 20' temporary easement for construction purposes only, also a 10' temporary easement for construction purposes only, together with the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located at Bronte Road, Columbia, SC 29210, and being further identified as a portion of Lexington County tax map number TMS #003696-05-003, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

A permanent, exclusive easement for a sanitary sewer main, twenty-five (25') feet in width and having the following perimeter measurements: beginning at a point located sixty-six and fifty-four hundredths (66.54) feet southeast of the intersection of the southwestern property corner of Lexington County TMS #003696-05-004, n/f Davis Family Real Estate LLC, the southeastern property corner of Lexington County TMS #003633-03-035, n/f Irmo-Chapin Recreation Commission Commission and the northwestern property corner of Lexington County TMS #003696-05-010, n/f Dominion Energy South Carolina, Inc. and extending therefrom in a southeasterly direction along the common boundary of the northeastern property line of the subject property and the southwestern property line of Lexington County TMS #003696-05-010, n/f Dominion Energy South Carolina, Inc., for a distance of seventy and thirty-nine hundredths (70.39) feet to a point; thence turning and extending therefrom in a northeasterly direction along the subject property, for a distance of fifty-nine and thirteen hundredths (59.13) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of two hundred thirty-five and one hundredth (235.01) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of forty-six and eighty-five hundredths (46.85) feet to intersect the common boundary of the southwestern property line of the subject property and the northeastern property line of Lexington County TMS #003500-01-55, n/f Shaw Industries Group, LLC at a point located three hundred seventy-two and forty-two hundredths (372.42) feet southeast of the northeastern property corner of Lexington County TMS #003500-01-55, n/f Shaw Industries Group, LLC; thence turning and extending

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Legal Department City of Columbia, SC

therefrom in a northwesterly direction along said common boundary along the southwestern property line of the subject property, for a distance of twenty five (25) feet to a point; thence turning and extending therefrom in a northeasterly direction along the subject property, for a distance of twenty-two and eighty-six hundredths (22.86) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property, for a distance of two hundred fifty-seven and eighty-four hundredths (257.84) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of thirty-seven and twenty-four hundredths (37.24) feet to a point, also being the point of beginning; thence terminating. Be all measurements a little more or less.

Also, a 20' temporary construction easement and a 10' temporary construction easement, as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

This easement being more clearly shown and delineated on an easement drawing for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 3 of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell , Inc., Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

A copy of said easement drawing being attached hereto and made a part hereof as Exhibit "A".

CMA

Easement 3 of 12

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TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns to warrant and forever defend all and singular the said premises unto the Grantee, its successors and assigns against the Grantor and Grantor's successors and assigns and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS the hand and seal of the Grantor by the undersigned this 6th day of October, 20__.

IRMO-CHAPIN RECREATION COMMISSION
f/k/a IRMO-CHAPIN RECREATION DISTRICT

WITNESSES:

(1st Witness Signature)

(2nd Witness Signature)

By: _____

Name: Mark Smyers

Title: Executive Director

STATE OF SOUTH CAROLINA)

ACKNOWLEDGMENT

COUNTY OF)

The foregoing instrument was acknowledged before me this 6 day of OCTOBER, 20__ by MARK SMYERS (Name and Title of Officer) of LEXINGTON, SC (City and State) on behalf of the within-named Grantor.

_____
(Notary's Signature)

NOTARY PUBLIC FOR STATE OF SOUTH CAROLINA (State)

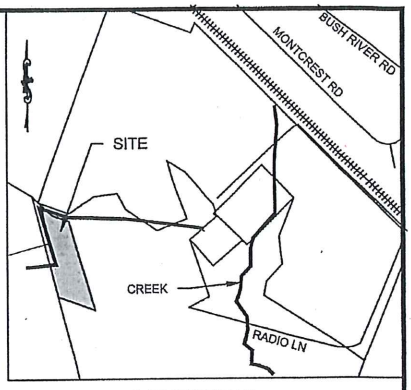
MY COMMISSION EXPIRES NOV. 9, 2020 (Date)

ATTORNEY CERTIFICATION

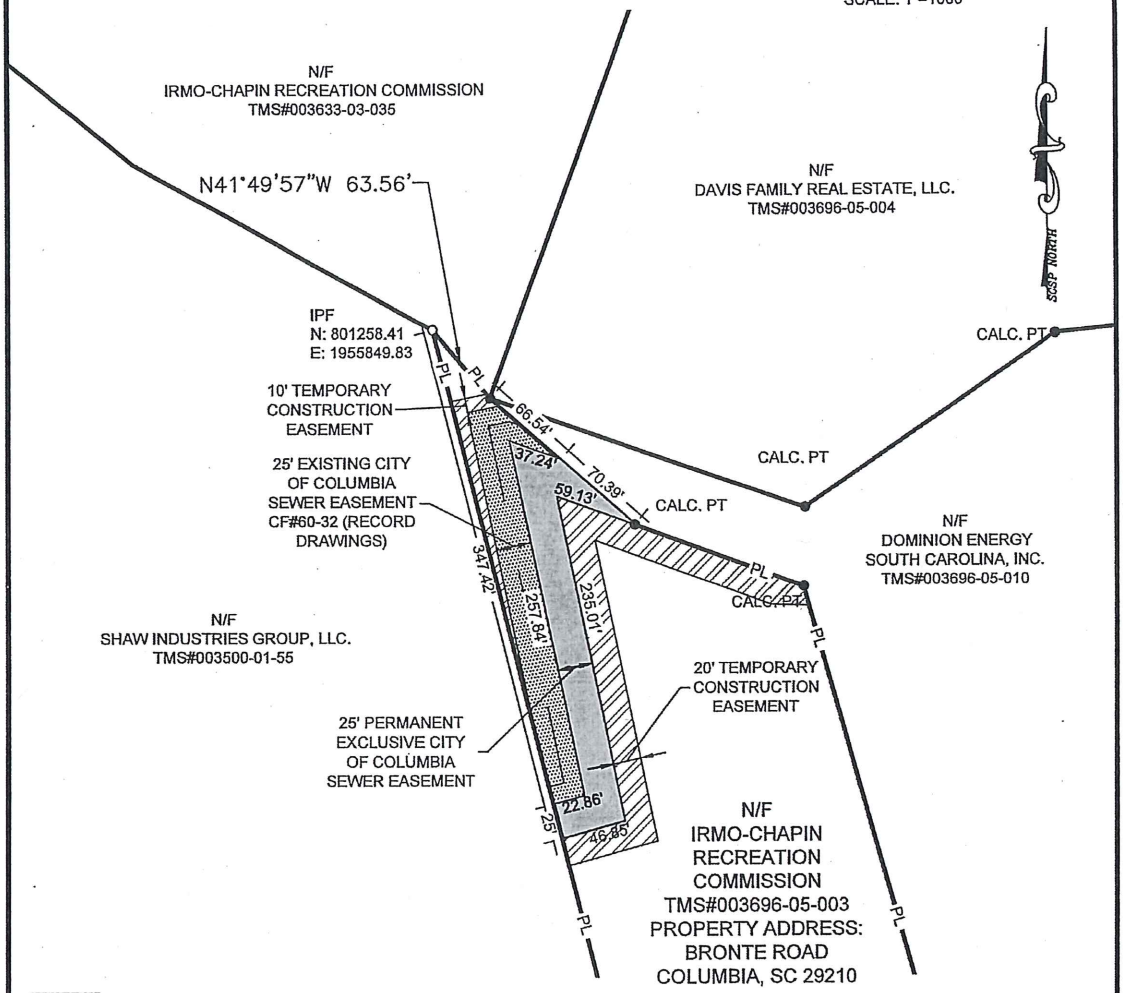
I, James Edward Bradley, an attorney licensed to practice in the State of South Carolina, do hereby certify that I supervised the execution of the attached Lower Saluda Relief Sanitary Sewer and Rehabilitation; CIP Project #SS7428 with **IRMO-CHAPIN RECREATION COMMISSION** as Grantor and the City of Columbia, as Grantee, this 6th day of October, 20 20.

REFERENCES:

- ALTA/ACSM LAND TITLE SURVEY. PREPARED FOR HONEYWELL INTERNATIONAL, INC. BY COX AND DINKINS. DATED DECEMBER 16, 2003.RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 746 PAGE 6 .
- EXHIBIT "A" . PARTIAL PLAT OF LANDS OF W. BUTLER HOOK OPT. 1076 & WM. FRESHLEY OPT. 1078. BY SOUTH CAROLINA ELECTRIC & GAS CO. DATED NOVEMBER 6, 1963. RECORDED IN LEXINGTON COUNTY ROD IN PLAT BOOK 66G PAGE 104.
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
SCALE: 1"=1000'



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 0.19AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.24AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISSION
ADDRESS: 200 LEISURE LN
COLUMBIA, SC 29210

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 3 OF 12
CF#250-481	DATE: 12/06/2019

Easement #4:

Shaw Industries Group, Inc.

TMS #003500-01-055

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **SHAW INDUSTRIES GROUP, INC.** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, ①a permanent, exclusive easement **twenty-five (25') feet in width** and ②a permanent, exclusive easement **twenty-five (25') feet in width**, also, 10' temporary easements for construction purposes only, and a variable width (0' to 10') temporary easement for construction purposes only, to include the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located at St. Andrews Road, Columbia, SC 29210, and being further identified as a portion of Lexington County tax map number TMS #003500-01-055, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

①

Sheets 4A and 4B

A permanent, exclusive easement for a sanitary sewer main, twenty-five (25') feet in width and having the following perimeter measurements: beginning on the subject property along the common boundary of the northeastern property line of the subject property and the southwestern property line of Lexington County TMS #003696-05-003, n/f Irmo-Chapin Recreation Commission, at a point located three hundred forty-seven and forty-two hundredths (347.42) feet southeast of the northeastern property corner of the subject property and extending therefrom in a southwesterly direction along the southeastern boundary of an existing 25' City of Columbia sanitary sewer easement (CF# 60-32) , for a distance of seven hundred nine and fifty-four hundredths (709.54) feet to a point; thence turning and extending therefrom in a southeasterly direction along the northeastern boundary of said existing 25' City of Columbia sanitary sewer easement (CF#60-32), for a distance of twenty-five and seventeen hundredths (25.17) feet to a point; thence turning and extending therefrom in a northeasterly direction along the subject property, for a distance of seven hundred eleven and forty-eight hundredths (711.48) feet to intersect the common boundary of the northeastern property line of the subject property and the southwestern property line of Lexington County TMS #003696-05-003, n/f Irmo-Chapin Recreation Commission at a point located three

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Legal Department City of Columbia, SC

hundred seventy-two and forty-two hundredths (372.42) feet southeast of the northeastern property corner of the subject property; thence turning and extending therefrom in a northwesterly direction along said common boundary along the northeastern property line of the subject property, for a distance of twenty-five (25) feet to a point, also being the point of beginning; thence terminating. Be all measurements a little more or less.

②

Sheets 4B, 4C, 4D, 4E, 4F, 4G, 4H and 4I

A permanent, exclusive easement for a sanitary sewer main, twenty-five (25') feet in width and having the following perimeter measurements: beginning on the subject property at a point located one hundred nine and fifty-three hundredths (109.53) feet N82°28'49"E of a calculated point (N:800179.82; E: 195110.61) located along the southwestern property boundary of the subject property and extending therefrom in a northwesterly direction along the northeastern boundary of an existing 25' City of Columbia sanitary sewer easement (CF# 60-32), for a distance of five thousand three hundred thirty-one and fifty-eight hundredths (5331.58) feet to a point; thence turning and extending therefrom in a northeasterly direction along the subject property, for a distance of one hundred eighty-nine and two tenths (189.2) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property, for a distance of three hundred nineteen and fifty-five hundredths (319.55) feet to intersect the common boundary of the southwesternmost/ northwestern property line of the subject property and the southeastern property line of Lexington County TMS #002799-04-016, n/f Irmo-Chapin Recreation Commission at a point located two hundred forty-nine and nineteen hundredths (249.19) feet northeast of the southernmost property corner of Lexington County TMS #002799-04-016, n/f Irmo-Chapin Recreation Commission; thence turning and extending therefrom in a northeasterly direction along said southwesternmost/ northwestern property line of the subject property corner, for a distance of twenty-seven and eighty-five hundredths (27.85) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of three hundred forty-three and six tenths (343.6) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of one hundred ninety and sixty-five hundredths (190.65) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of five thousand two hundred ninety-one and fourteen hundredths (5291.14) feet to a point; thence turning and extending therefrom in a northeasterly direction along the subject property, for a distance of one hundred three and seven tenths (103.7) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property, for a distance of five hundred thirteen and five tenths (513.5) feet to a point; thence turning and extending therefrom in a southeasterly direction along the southwestern boundary of an existing 25' City of Columbia sanitary sewer easement (CF# 60-32), for a distance of eighty and twelve hundredths (80.12) feet to a point; thence turning and extending therefrom in a southeasterly direction along the common boundary of the said existing 25' City of Columbia sanitary sewer easement (CF# 60-32), for a distance of four hundred fifty-three and one tenth (453.1) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of one hundred thirty-three and nine tenths (133.9) feet to a point; also being the point of beginning; thence terminating.

Also, 10' temporary construction easements as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

These easements being more clearly shown and delineated on easement drawings for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 4A, 4B, 4C, 4D, 4E, 4F, 4G, 4H & 4I of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell, Inc., Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

Copies of said easement drawings being attached hereto and made a part hereof as Exhibit "A".

CMA

Easement 4 of 12

CONDITIONS OF EASEMENT:

The following conditions are made a part hereof:

1) The Grantee or any of its guests, agents, contractors, employees, licensees or invitees shall exercise commercially reasonable efforts to minimize the disruption to Grantor or any occupants of the property owned by Grantor in connection with any exercise hereunder.
2) Grantee shall take all reasonable actions and implement all protections necessary to ensure that all actions taken in connection with this easement agreement, and all equipment, materials and substances generated, used or brought upon the easement areas described herein, pose no material threat to the safety of persons or the environment.
3) Grantor shall not be responsible for any of the costs and expenses associated with the constructing, operating, reconstructing or maintain the sanitary sewer main or this easement or any other cost or expense relating to Grantee's use of this easement

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TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns unto the Grantee, its successors and assigns without warranty.

WITNESS the hand and seal of the Grantor by the undersigned this 20th day of April, 2020.

SHAW INDUSTRIES GROUP, INC.

By: _____

Name: KENNETH G. JACKSON, E.V.P.

Title: and Chief Financial Officer

WITNESSES:

_____
(1st Witness Signature)

Sandy Ward
(2nd Witness Signature)

Georgia
STATE OF ~~SOUTH CAROLINA~~)

ACKNOWLEDGMENT

COUNTY OF Whitfield)

The foregoing instrument was acknowledged before me this 20 day of April, 2020 by Kenneth G. Jackson (Name and Title of Officer) of Dalton, GA (City and State) on behalf of the within-named Grantor.

Debra Ann Roy
(Notary's Signature)

NOTARY PUBLIC FOR STATE OF _____ (State)

MY COMMISSION EXPIRES _____ (Date)

DEBRA ANN ROY
Notary Public
Whitfield County, State of GA
My Comm. Expires Sept. 8, 2021

DEBRA ANN ROY NOTARY PUBLIC MY COMMISSION EXPIRES SEPT. 8, 2021 WHITFIELD COUNTY, GEORGIA

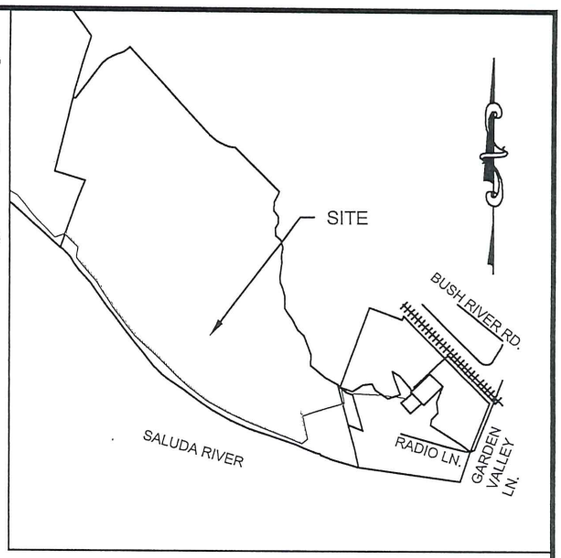
ATTORNEY CERTIFICATION

I, Frederick L. Hooper, III, an attorney licensed to practice in the State of Georgia, do hereby certify that I supervised the execution of the attached Lower Saluda Relief Sanitary Sewer and Rehabilitation: CIP Project #SS7428 with **SHAW INDUSTRIES GROUP, INC.** as Grantor and the City of Columbia, as Grantee, this 20th day of April, 2020.

FREDERICK L. HOOPER, III
ASSISTANT SECRETARY

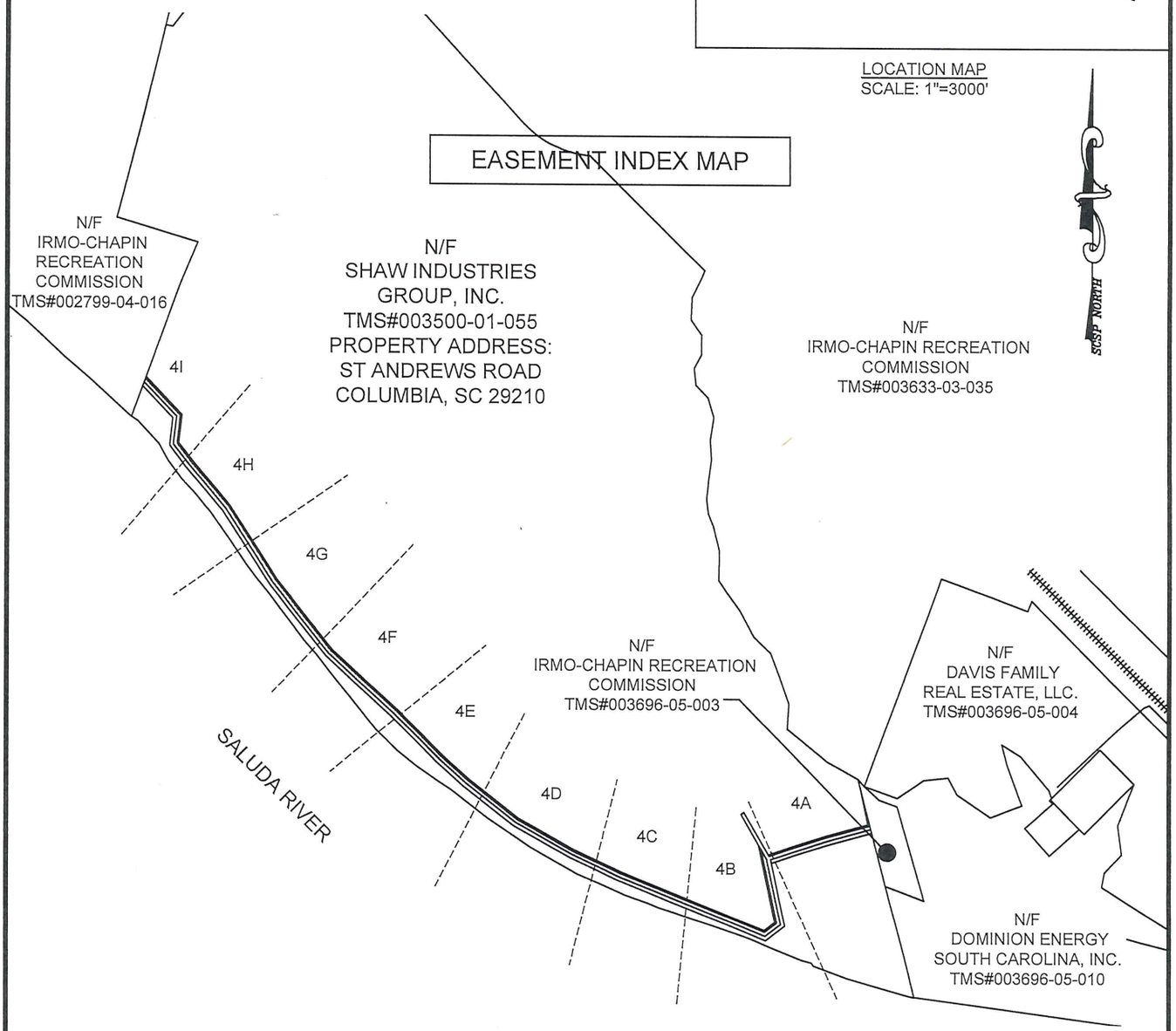
REFERENCES:

- ALTA/ACSM LAND TITLE SURVEY. PREPARED FOR HONEYWELL INTERNATIONAL, INC. DATED DECEMBER 16, 2003 . BY COX AND DINKINS. DATED DECEMBER 16, 2003. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 746 PAGE 6.
- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY COX AND DINKINS. DATED AUGUST 26, 2004. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 783 PAGE 5 .
- EXHIBIT "A" . PARTIAL PLAT OF LANDS OF W. BUTLER HOOK OPT. 1076 & WM. FRESHLEY OPT. 1078. BY SOUTH CAROLINA ELECTRIC & GAS CO. DATED NOVEMBER 6, 1963. RECORDED IN LEXINGTON COUNTY ROD IN PLAT BOOK 66G PAGE 104.
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
SCALE: 1"=3000'

EASEMENT INDEX MAP



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 4.10AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 1000'

1000 0 500 1000 2000

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: SHAW INDUSTRIES GROUP, INC.
ADDRESS: PO BOX 2128
616 EAST WALNUT AVE
DALTON, GA 30722

CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4 OF 12
	DATE: 12/06/2019

REFERENCES:

- ALTA/ACSM LAND TITLE SURVEY. PREPARED FOR HONEYWELL INTERNATIONAL, INC. BY COX AND DINKINS. DATED DECEMBER 16, 2003. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 746 PAGE 6.
- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY COX AND DINKINS. DATED AUGUST 26, 2004. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 783 PAGE 5 .
- EXHIBIT "A" . PARTIAL PLAT OF LANDS OF W. BUTLER HOOK OPT. 1076 & WM. FRESHLEY OPT. 1078. BY SOUTH CAROLINA ELECTRIC & GAS CO. DATED NOVEMBER 6, 1963. RECORDED IN LEXINGTON COUNTY ROD IN PLAT BOOK 66G PAGE 104.
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- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
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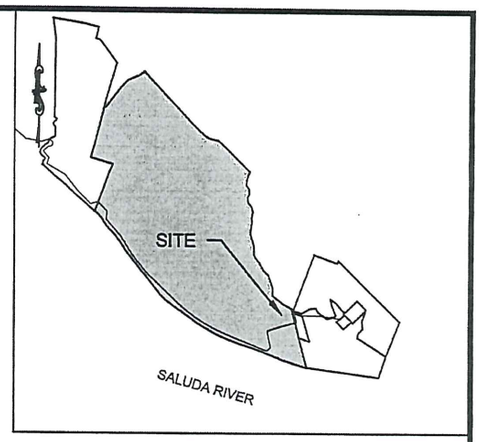
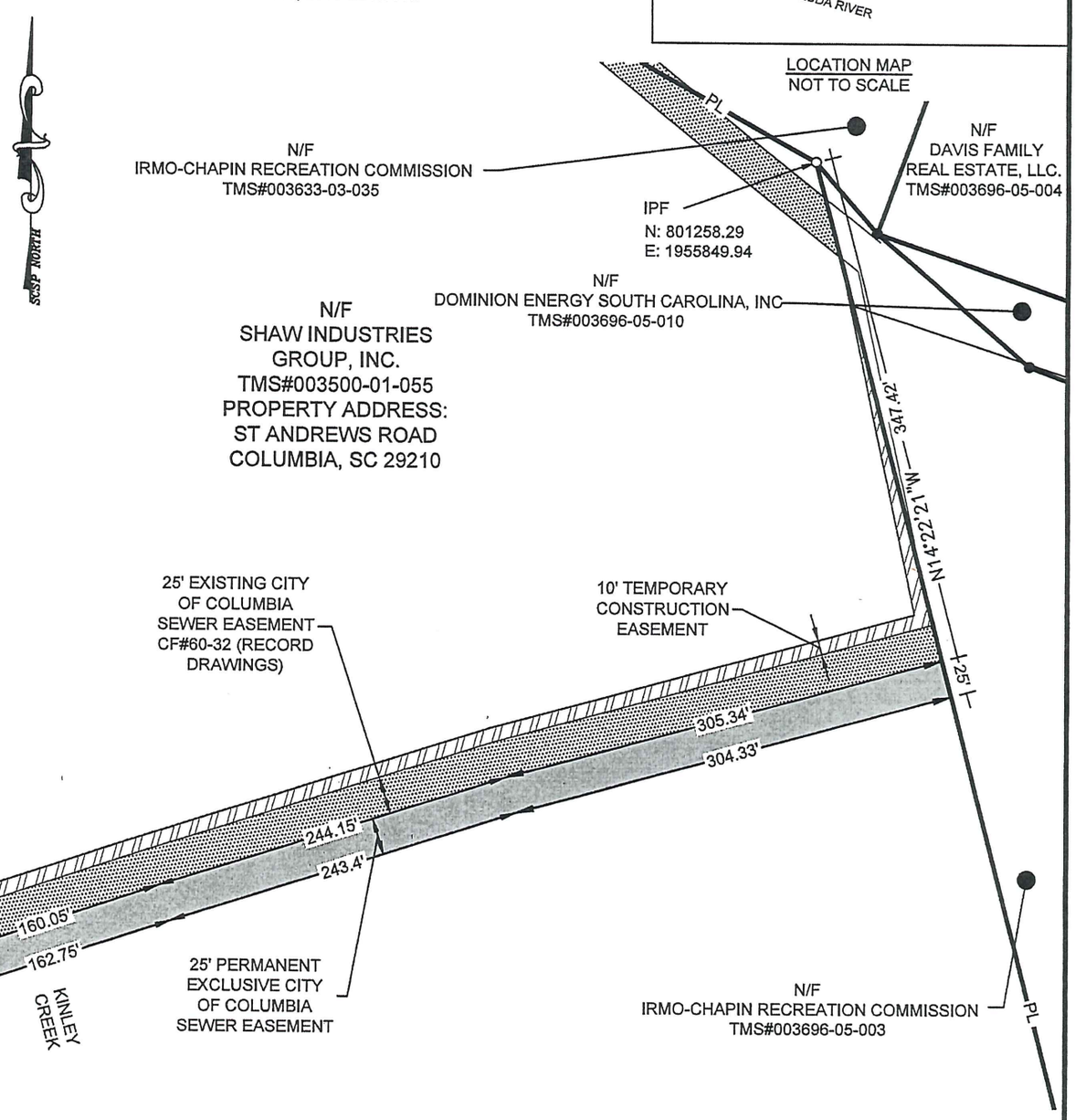


LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 4.10AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: SHAW INDUSTRIES GROUP, INC.
ADDRESS: PO BOX 2128
616 EAST WALNUT AVE
DALTON, GA 30722

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4A OF 12
	DATE: 12/06/2019

CF#250-481

REFERENCES:

- ALTA/ACSM LAND TITLE SURVEY. PREPARED FOR HONEYWELL INTERNATIONAL, INC. BY COX AND DINKINS. DATED DECEMBER 16, 2003. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 746 PAGE 6.
- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY COX AND DINKINS. DATED AUGUST 26, 2004. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 783 PAGE 5 .
- EXHIBIT "A" . PARTIAL PLAT OF LANDS OF W. BUTLER HOOK OPT. 1076 & WM. FRESHLEY OPT. 1078. BY SOUTH CAROLINA ELECTRIC & GAS CO. DATED NOVEMBER 6, 1963. RECORDED IN LEXINGTON COUNTY ROD IN PLAT BOOK 66G PAGE 104.
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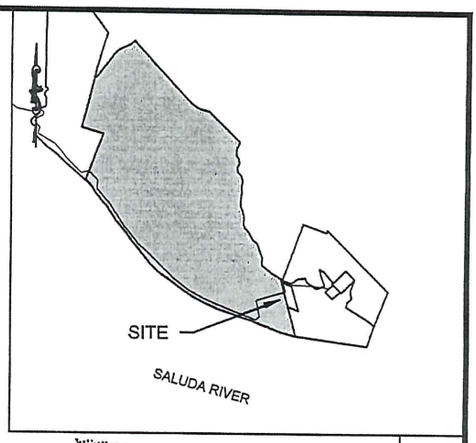
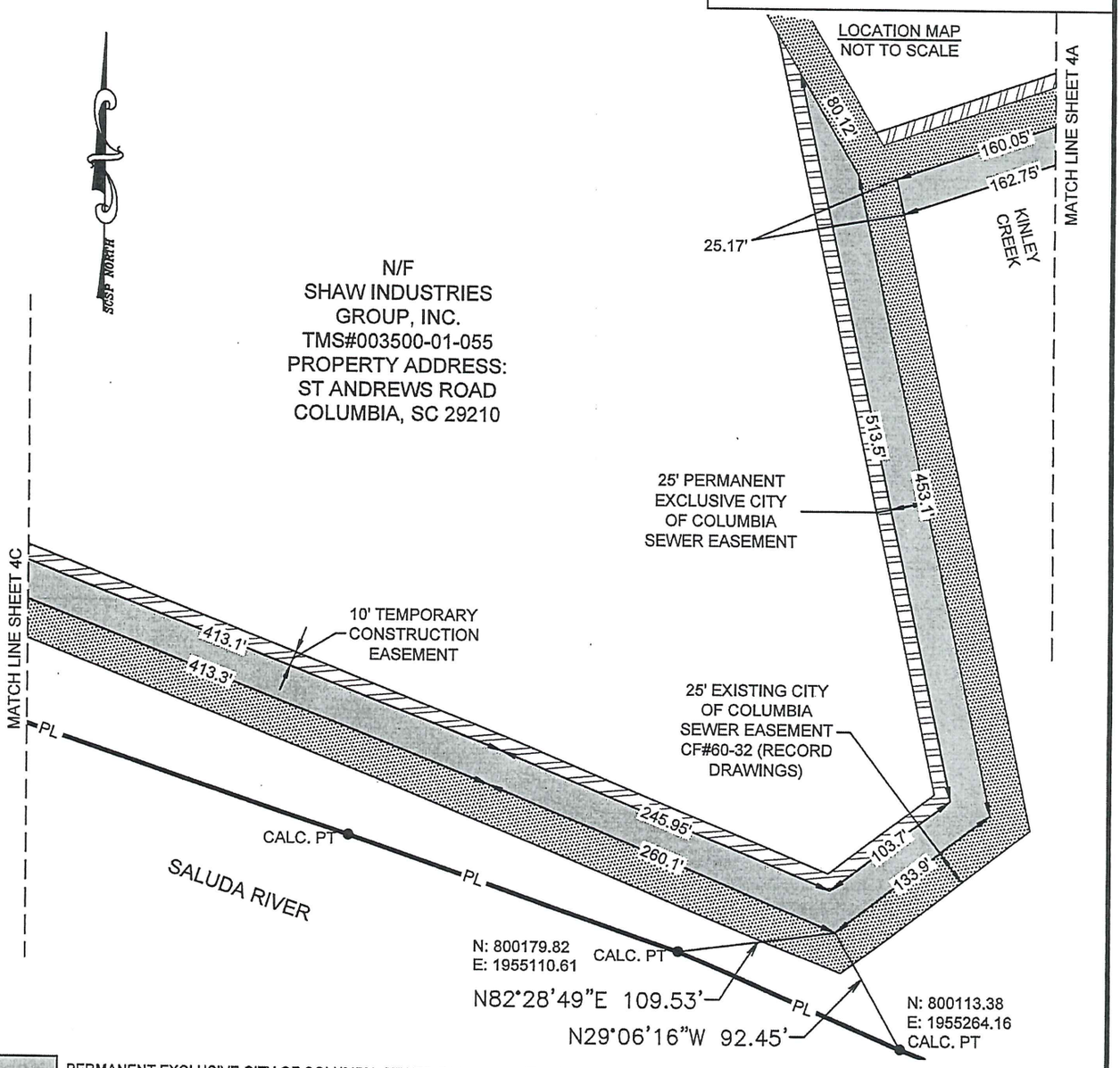
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 4.10AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: SHAW INDUSTRIES GROUP, INC.
ADDRESS: PO BOX 2128
616 EAST WALNUT AVE
DALTON, GA 30722

CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4B OF 12
	DATE: 12/06/2019

REFERENCES:

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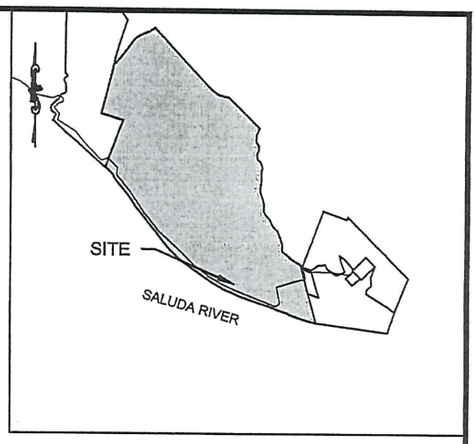
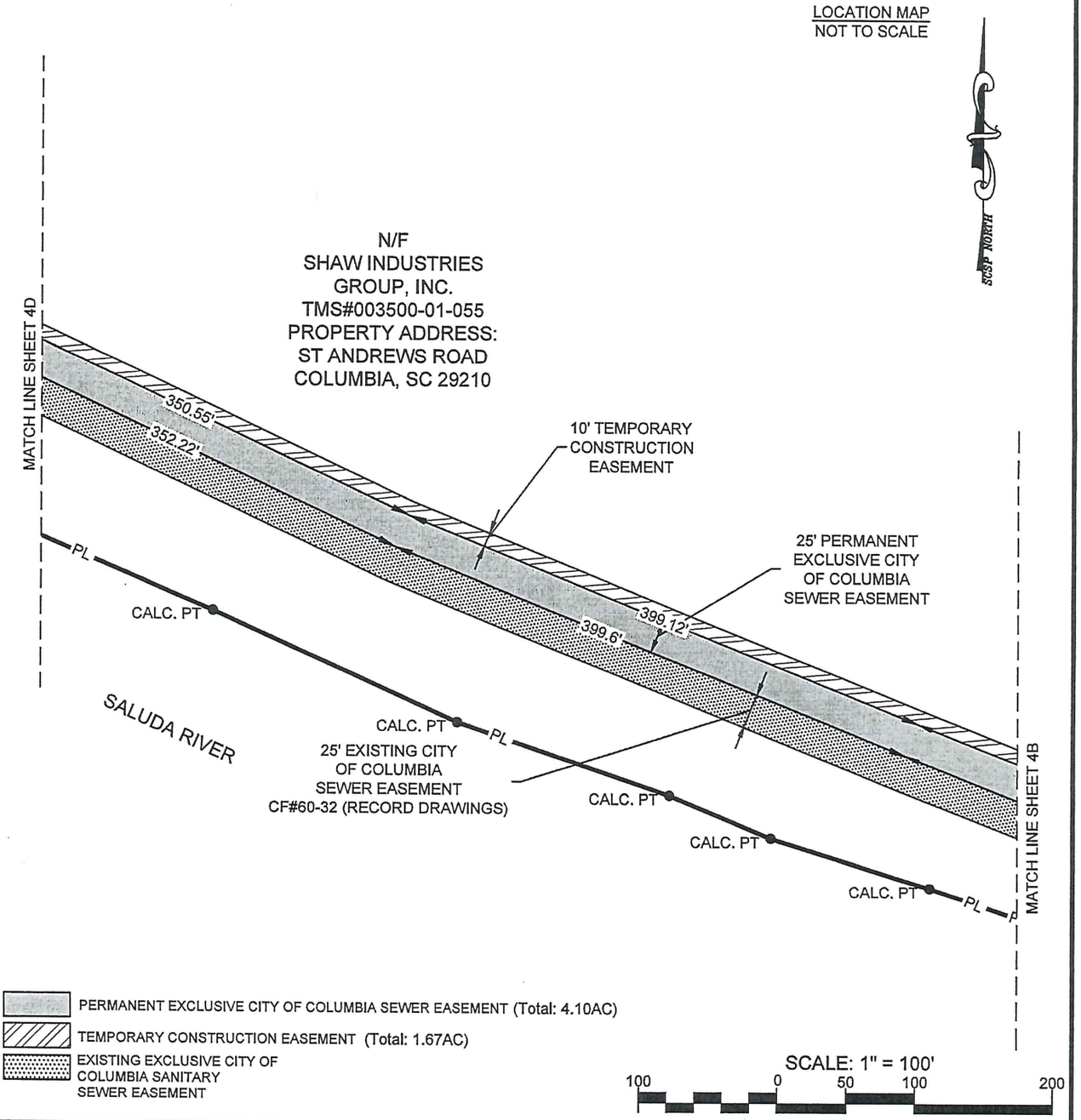


LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 4.10AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

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DALTON, GA 30722

CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH
PROJECT NAME LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION		
CIP # SS7428		EXHIBIT 4C OF 12
		DATE: 12/06/2019

REFERENCES:

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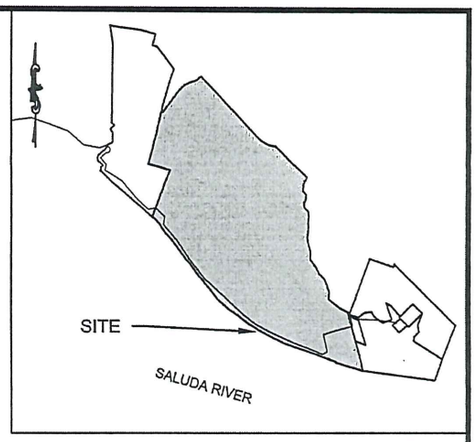
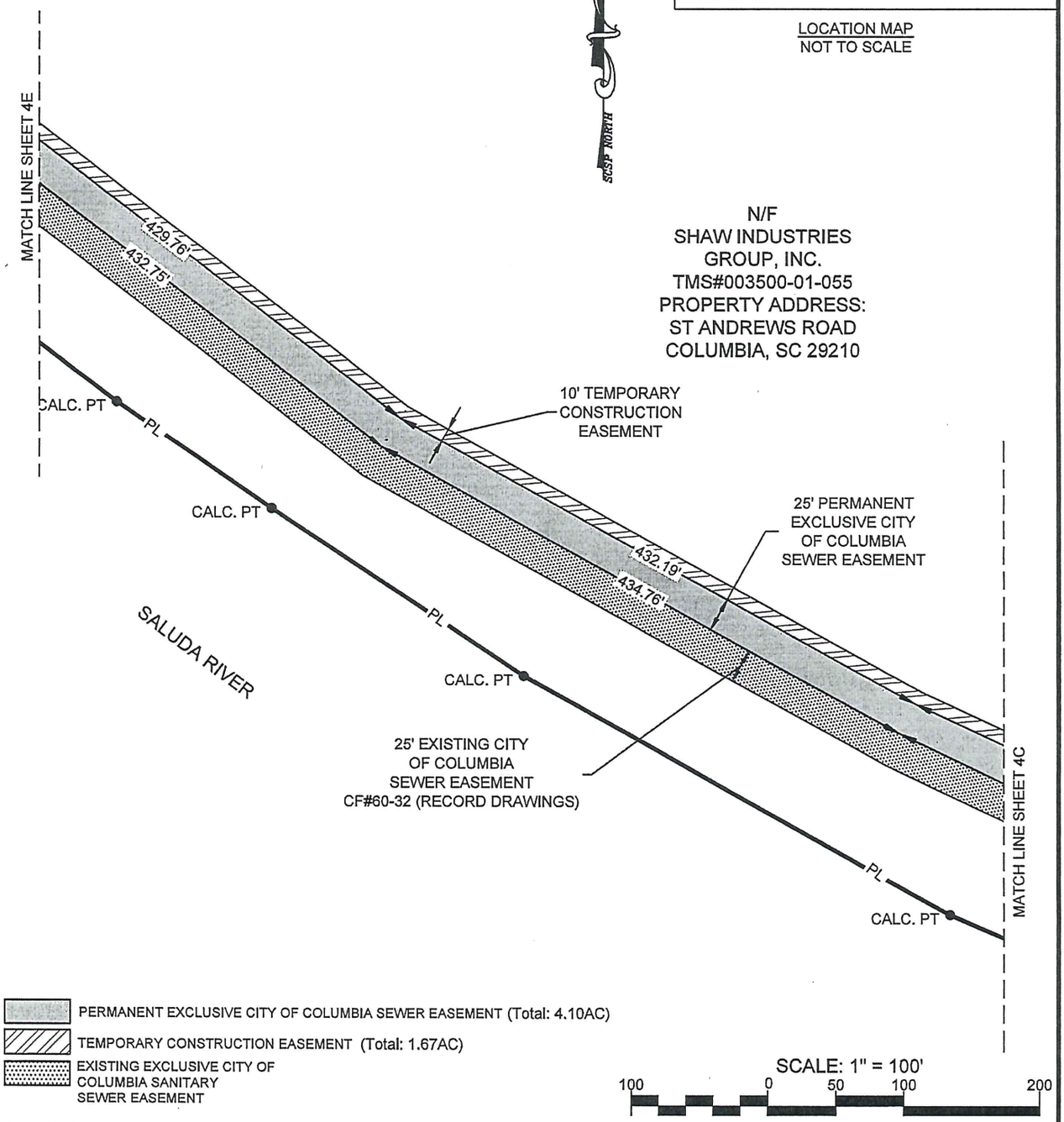


LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 4.10AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

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CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4D OF 12
	DATE: 12/06/2019

REFERENCES:

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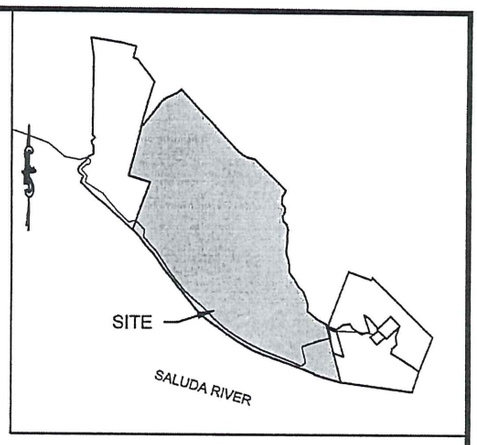
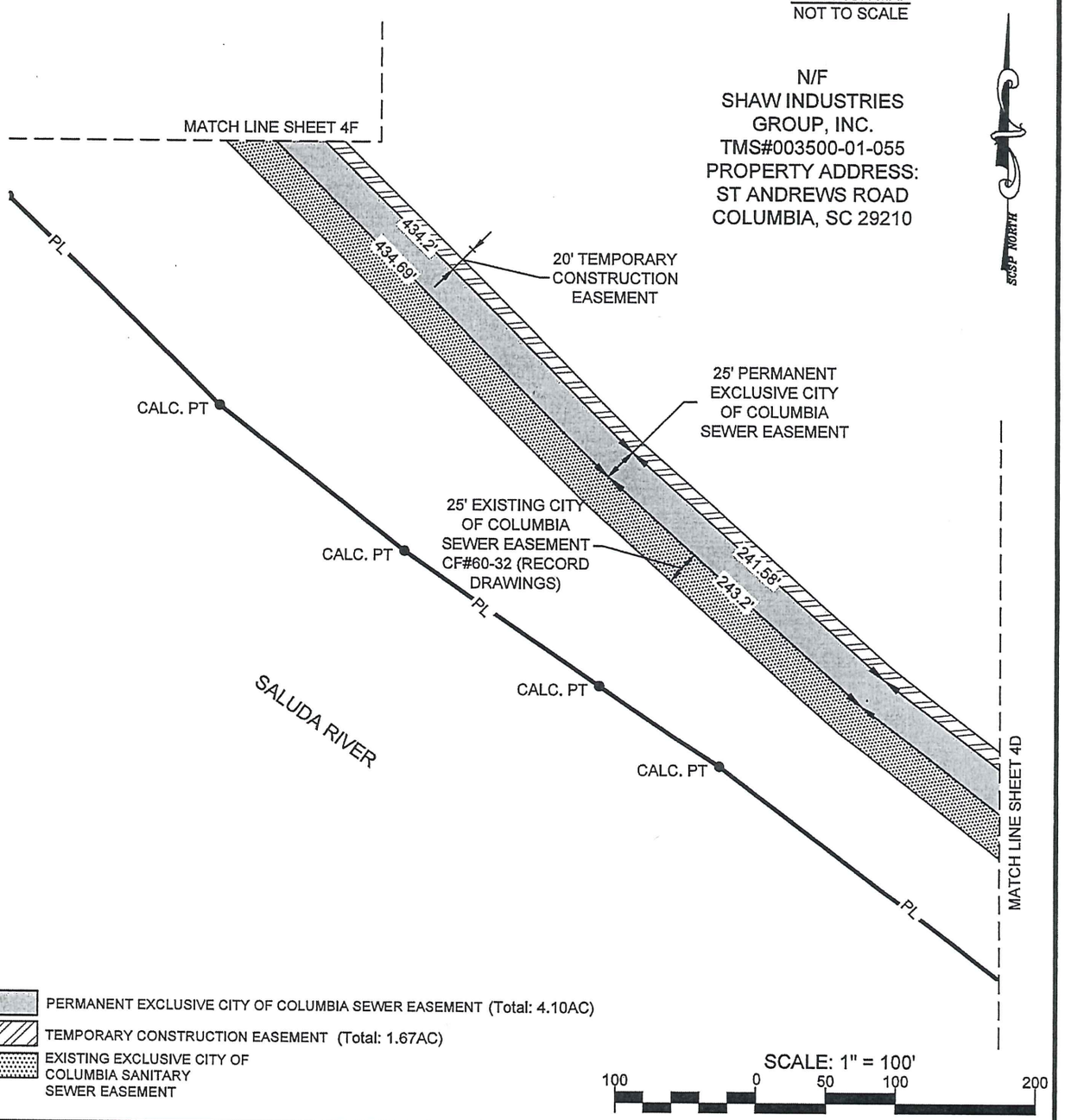


LOCATION MAP
NOT TO SCALE



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TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

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CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4E OF 12
	DATE: 12/06/2019

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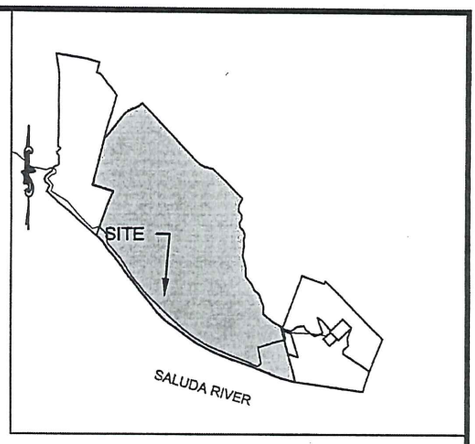

LOCATION MAP
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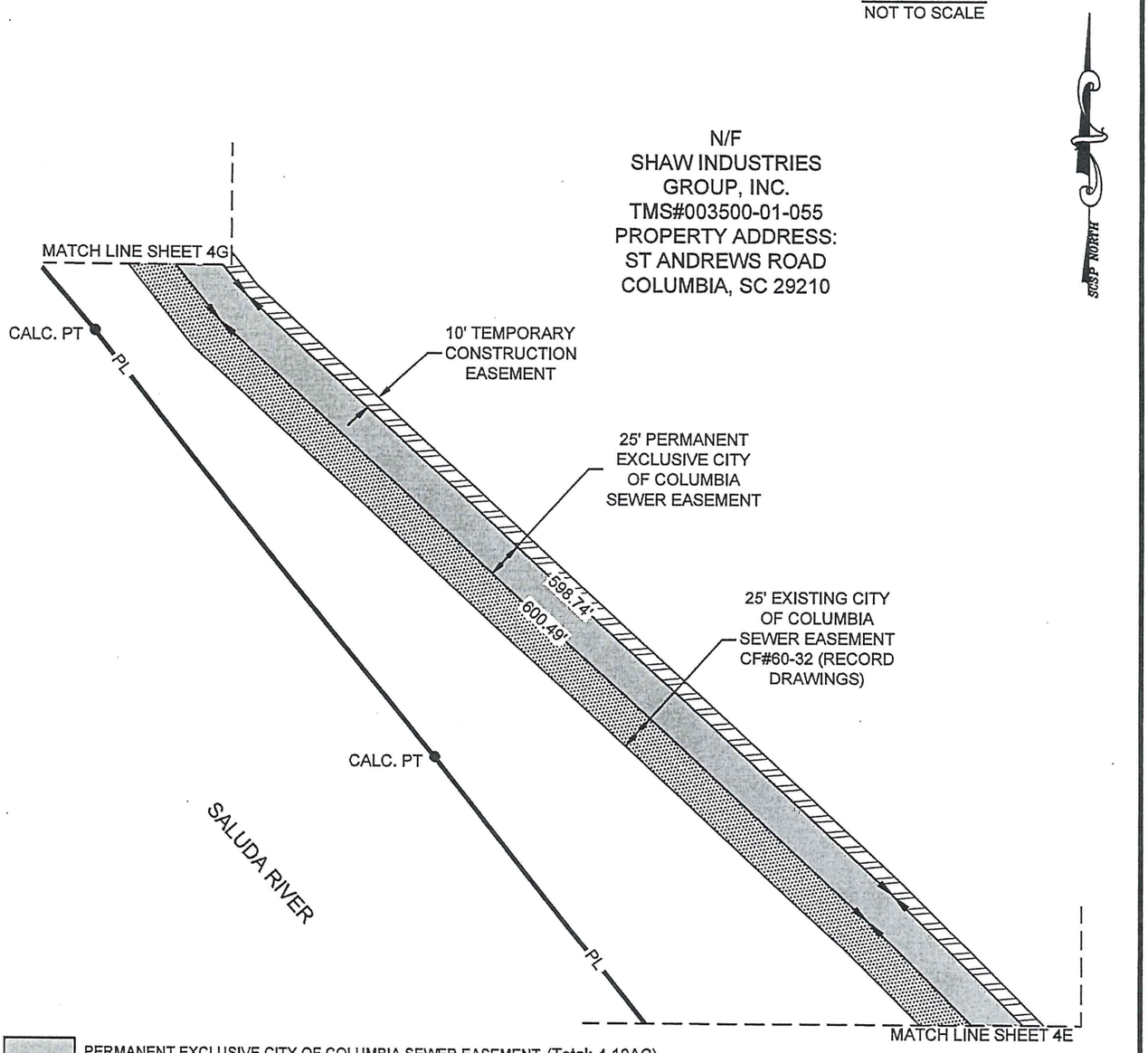

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TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

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EASEMENT EXHIBIT

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CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4F OF 12
	DATE: 12/06/2019

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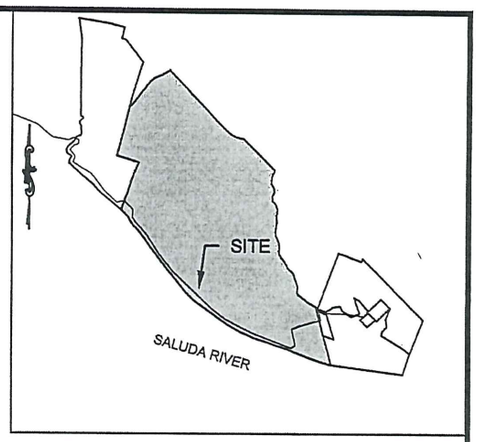
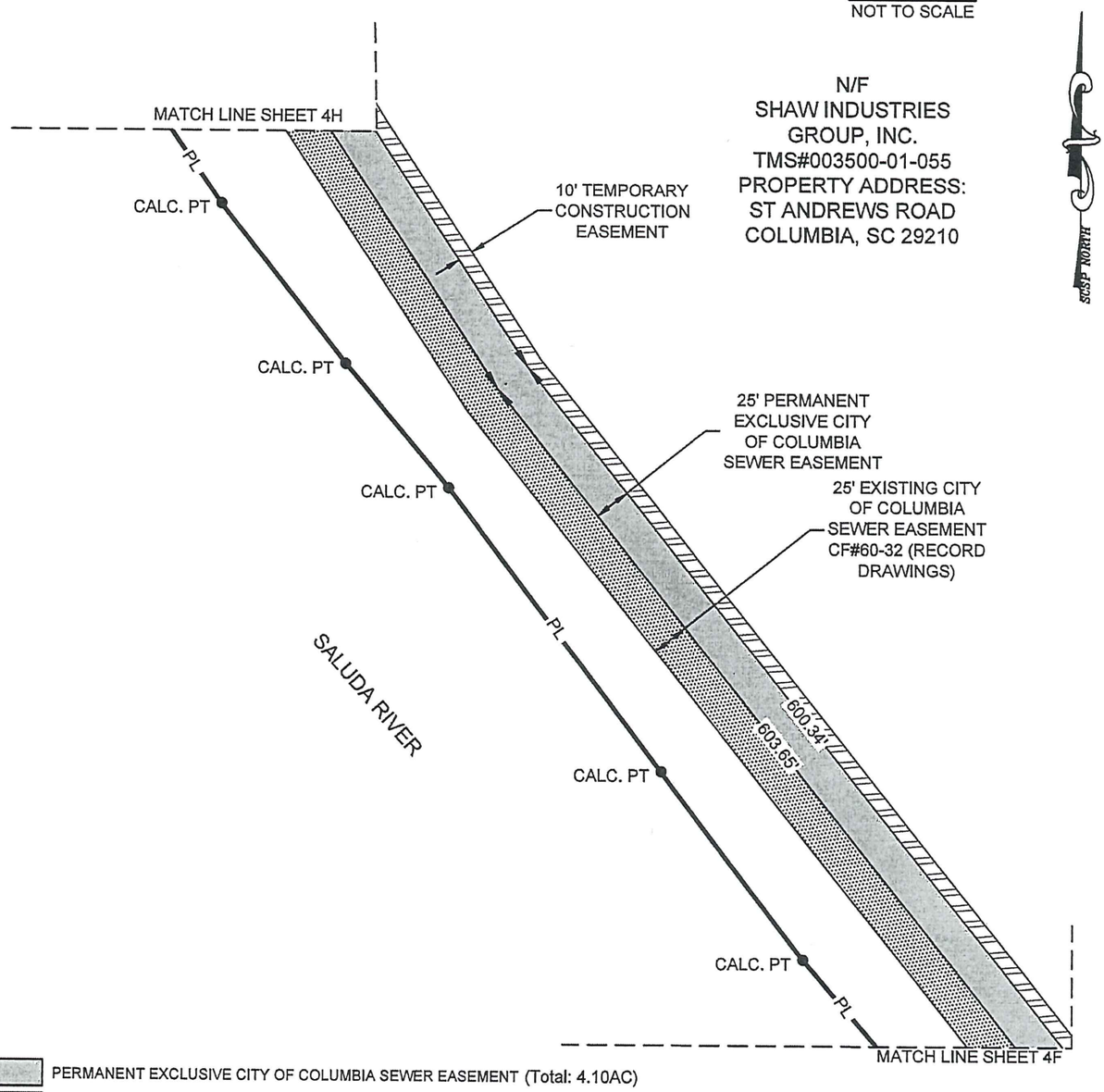


LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 4.10AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 1.67AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

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EASEMENT EXHIBIT

OWNER: SHAW INDUSTRIES GROUP, INC.
ADDRESS: PO BOX 2128
616 EAST WALNUT AVE
DALTON, GA 30722

CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4G OF 12
	DATE: 12/06/2019

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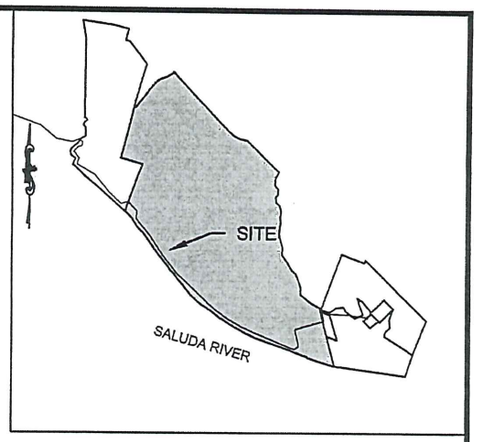
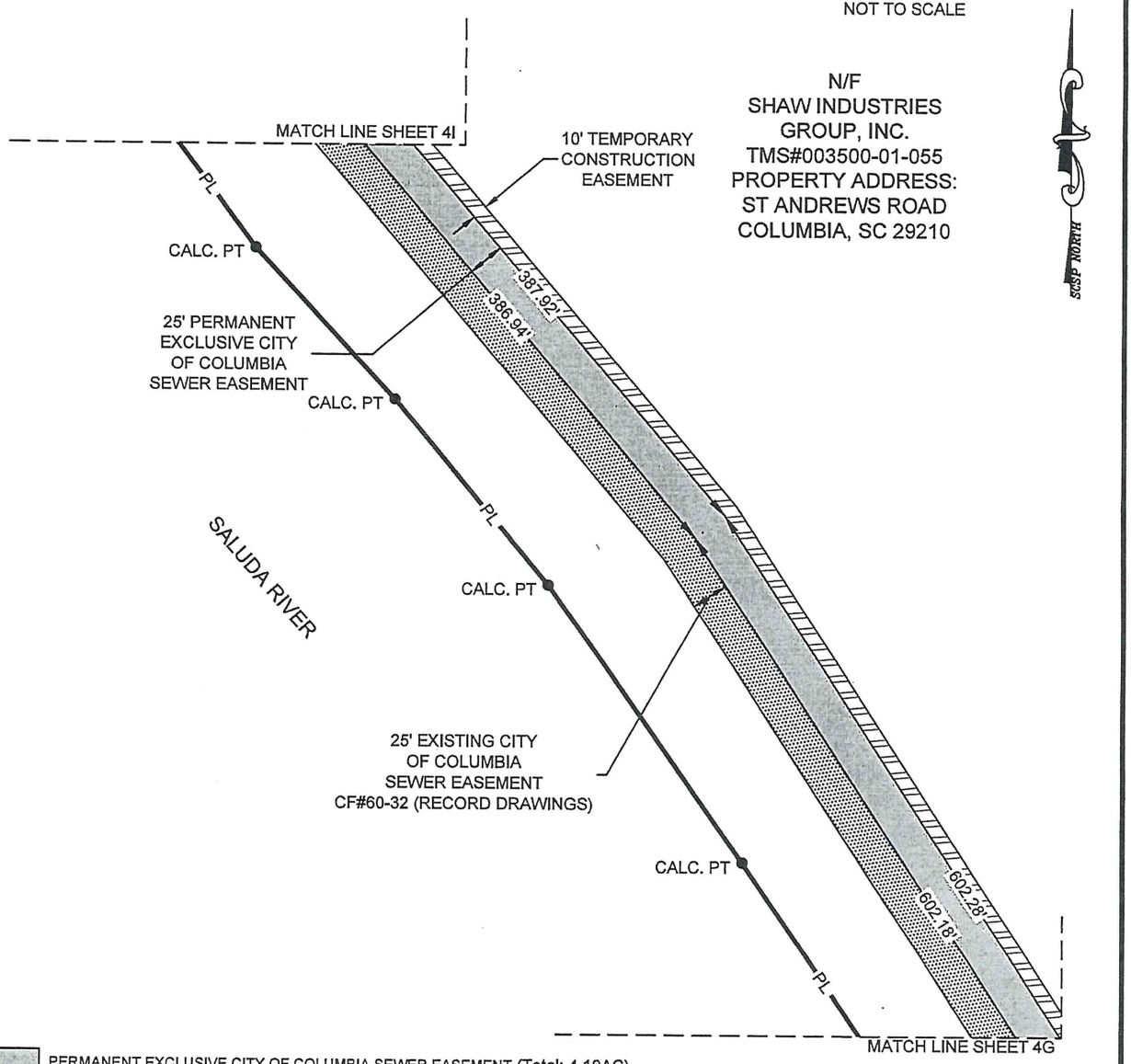


LOCATION MAP
NOT TO SCALE



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SCALE: 1" = 100'

100 0 50 100 200

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CITY OF COLUMBIA
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PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4H OF 12
	DATE: 12/06/2019

CF#250-481

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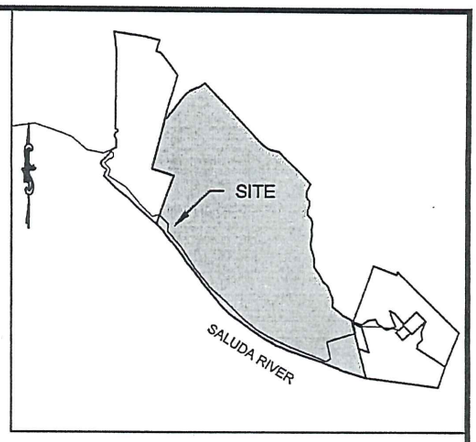
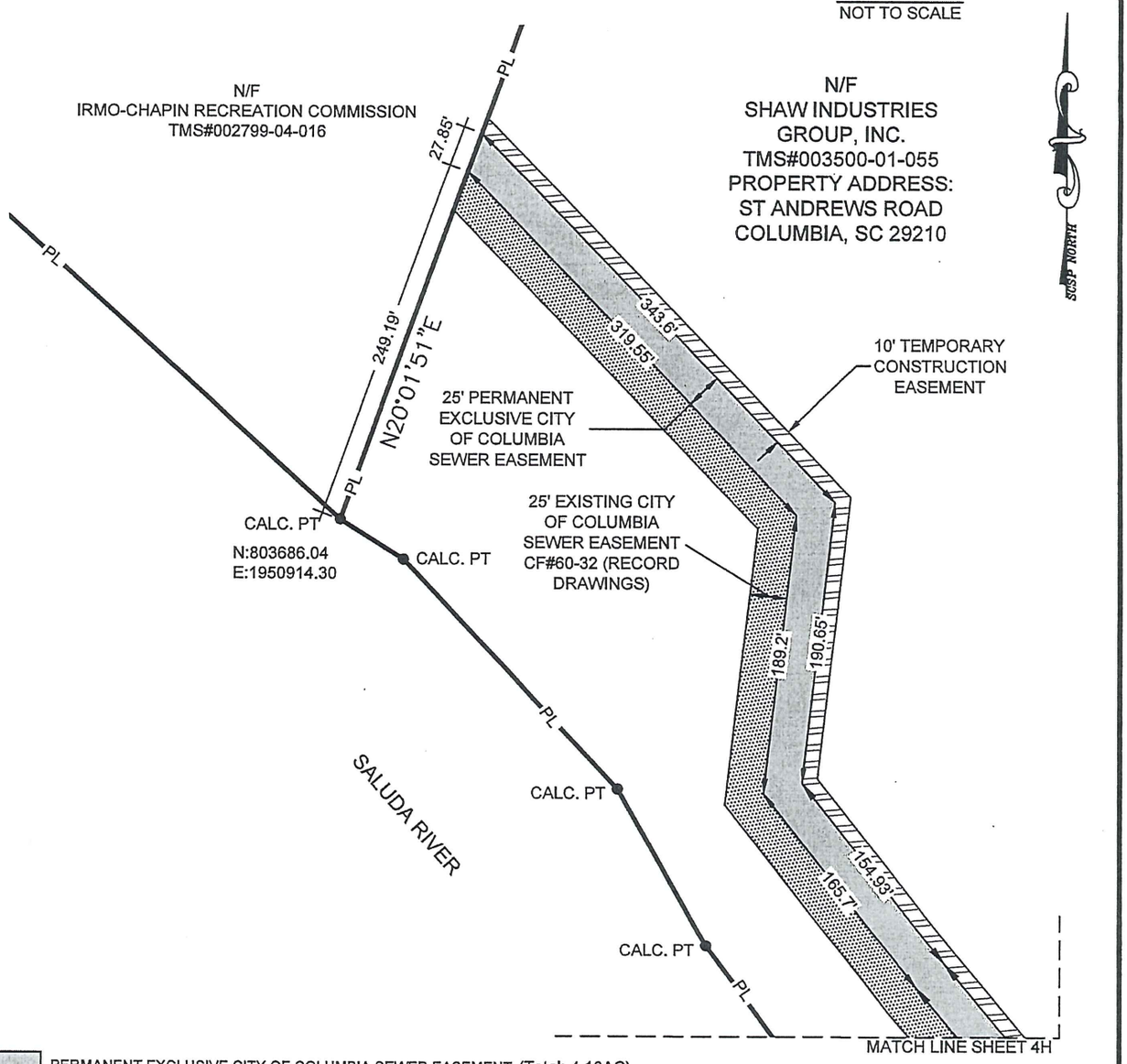


LOCATION MAP
NOT TO SCALE



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EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

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EASEMENT EXHIBIT

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CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
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SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 4I OF 12
	DATE: 12/06/2019

CF#250-481

Easement #5:

Irmo-Chapin Recreation Commission

TMS #002799-04-016

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **IRMO-CHAPIN RECREATION COMMISSION F/K/A IRMO-CHAPIN RECREATION DISTRICT** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, a permanent, exclusive easement **variable (25' to 53.47') feet in width**, also a 10' temporary easement for construction purposes only, also a 10' temporary easement for construction purposes only, together with the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located near Bush River Road, Columbia, SC 29210, and being further identified as a portion of Lexington County tax map number TMS #002799-04-016, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

Sheet 5A of 12

A permanent, exclusive easement for a sanitary sewer main, variable (25' to 53.47') feet in width and having the following perimeter measurements: beginning on the subject property at a point located two hundred forty-nine and nineteen hundredths (249.19) feet northeast of the southernmost property corner of the subject property and extending therefrom in a northwesterly direction along the subject property, for a distance of seven and eighty-two hundredths (7.82) feet to a point; thence turning and extending therefrom in a southwesterly direction parallel to the northwestern boundary of an existing 25' City of Columbia sanitary sewer easement (CF# 60-32), for a distance of one hundred eighty-four and forty-five hundredths (184.45) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property, parallel to said 25' City sewer easement and crossing an existing 15' City of Columbia sanitary sewer easement (CF #239-12E), for a distance of four hundred thirty-nine and fifteen hundredths (439.15) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property parallel to the northeastern boundary of said 25' City sewer easement, for a distance of five hundred forty-five and eighty-five hundredths (545.85) feet to a point (Sheet 5B of 12); thence turning and extending therefrom in a northwesterly direction along the subject property parallel to the northeastern boundary of said 25' City sewer easement, for a distance of five hundred twenty-seven and two tenths (527.2) feet to a point (Sheet 5C of 12); thence turning and extending therefrom in a northeasterly direction along the subject property and parallel to the southeastern boundary of the said 25' City sanitary sewer easement, for a distance of

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Legal Department City of Columbia, SC

one hundred fifty-six and seven tenths (156.7) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property and parallel to the northeastern boundary of the said 25' City sewer easement, for a distance of two hundred eighteen and seventy-five hundredths (218.75) feet to a point; thence turning and extending therefrom in a northeasterly direction along the subject property and parallel to the northeastern boundary of the said 25' City sewer easement, for a distance of two hundred eighty-three and eighty-five hundredths (283.85) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property and parallel to the northeastern boundary of the said 25' City sewer easement, for a distance of eighty-five and thirty-six hundredths (85.36) feet to intersect the common boundary of the southeastern property line of Lexington County TMS #002798-05-002, n/f Dominion Energy South Carolina, Inc., and Lorick Branch and the northwestern property line of the subject property; thence turning and extending therefrom in a northeasterly direction along said common boundary of the northwestern property line of the subject property, and the southeastern property line of said TMS #002798-05-002, and Lorick Branch, for a distance of fifty-three and forty-seven hundredths (53.47) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of ninety-eight and three tenths (98.3) feet to a point; thence turning and extending therefrom in a southerly direction along the subject property, for a distance of ninety-six and forty-nine hundredths (96.49) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of eighty-six and six tenths (86.6) feet to a point; thence turning and extending therefrom in a westerly direction along the subject property for a distance of sixty (60) feet to a point; thence turning and extending therefrom in southwesterly direction along the subject property, for a distance of one hundred twenty-seven and five tenths (127.5) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of two hundred nine and ninety-five hundredths (209.95) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of one hundred fifty and seven tenths (150.7) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property for a distance of five hundred ten and nine tenths (510.9) feet to a point (Sheet 5B of 12); thence turning and extending therefrom in a southeasterly direction along the subject property and crossing an existing 15' City of Columbia sanitary sewer easement (CF #239-12E), for a distance of five hundred forty-eight and three tenths (548.3) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of four hundred twenty-two and fifty-five hundredths (422.55) feet to a point; thence turning and extending therefrom in a northeasterly direction along the subject property, for a distance of one hundred eighty-four and eighty-five hundredths (184.85) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of eleven and seventeen hundredths (11.17) feet to intersect the southeastern property line of the subject property at a point located two hundred seventy-seven and four hundredths (277.04) feet northeast of the southernmost property corner of the subject property; thence turning and extending therefrom in a southwesterly direction along said property line, for a distance of twenty-seven and eighty-five hundredths (27.85) feet to a point, also being the point of beginning; thence terminating. Be all measurements a little more or less.

Also, 10' temporary construction easements, as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

This easement being more clearly shown and delineated on an easement drawing for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 5A, 5B and 5C of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell, Inc., Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

A copy of said easement drawing being attached hereto and made a part hereof as Exhibit "A".

TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns to warrant and forever defend all and singular the said premises unto the Grantee, its successors and assigns against the Grantor and Grantor's successors and assigns and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS the hand and seal of the Grantor by the undersigned this 6th day of October, 2020.

IRMO-CHAPIN RECREATION DISTRICT

WITNESSES:

(1st Witness Signature)

(2nd Witness Signature)

By: _____

Name: Mark Smyers

Title: Executive Director

STATE OF SOUTH CAROLINA)

ACKNOWLEDGMENT

COUNTY OF LEXINGTON)

The foregoing instrument was acknowledged before me this 6 day of OCTOBER, 2020 by MARK SMYERS (Name and Title of Officer) of LEXINGTON, SC (City and State) on behalf of the within-named Grantor.

(Notary's Signature)

NOTARY PUBLIC FOR STATE OF SOUTH CAROLINA (State)

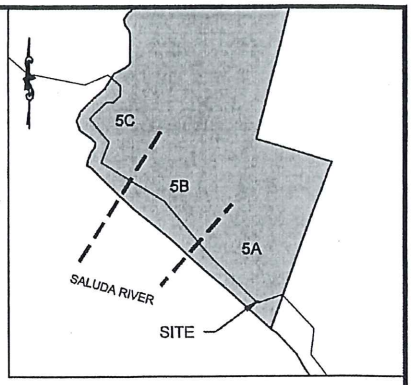
MY COMMISSION EXPIRES NOV. 9, 2020 (Date)

ATTORNEY CERTIFICATION

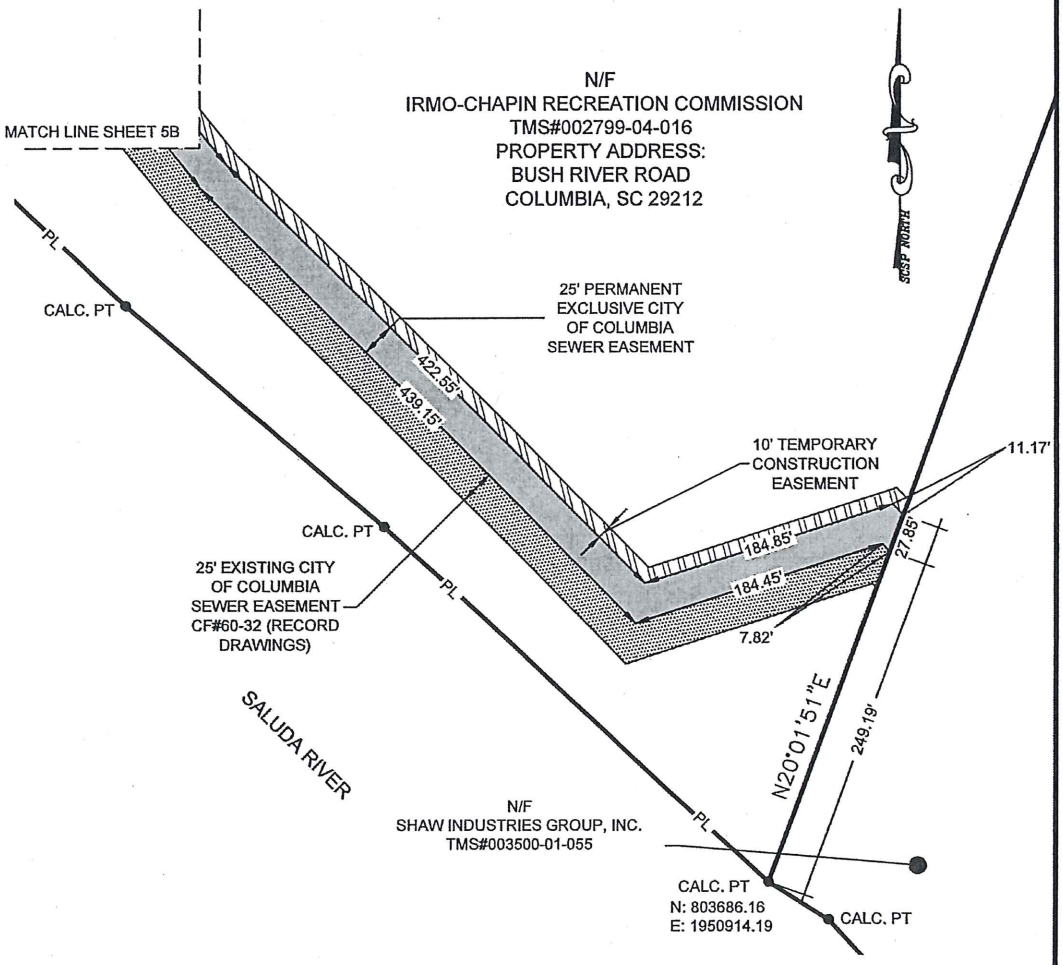
I, James Edward Bradley, an attorney licensed to practice in the State of South Carolina, do hereby certify that I supervised the execution of the attached Lower Saluda Relief Sanitary Sewer and Rehabilitation; CIP Project #SS7428 with **IRMO-CHAPIN RECREATION COMMISSION f/k/a IRMO-CHAPIN RECREATION DISTRICT** as Grantor and the City of Columbia, as Grantee, this 6th day of October, 2020.

REFERENCES:

- ALTA/ACSM LAND TITLE SURVEY. PREPARED FOR HONEYWELL INTERNATIONAL, INC. BY COX AND DINKINS. DATED DECEMBER 16, 2003. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 746 PAGE 6.
- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY COX AND DINKINS. DATED AUGUST 26, 2004. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 783 PAGE 5 .
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
SCALE: 1"=1000'



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 1..61AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.57AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISION
ADDRESS: 5605 BUSH RIVER ROAD
COLUMBIA, SC 29212

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

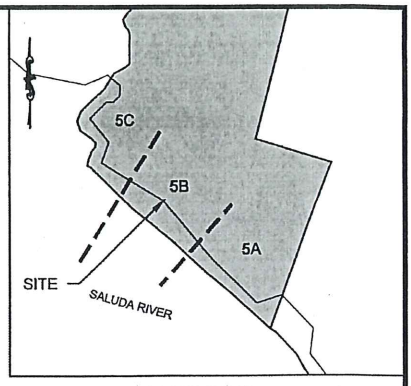
PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 5A OF 12
	DATE: 12/06/2019

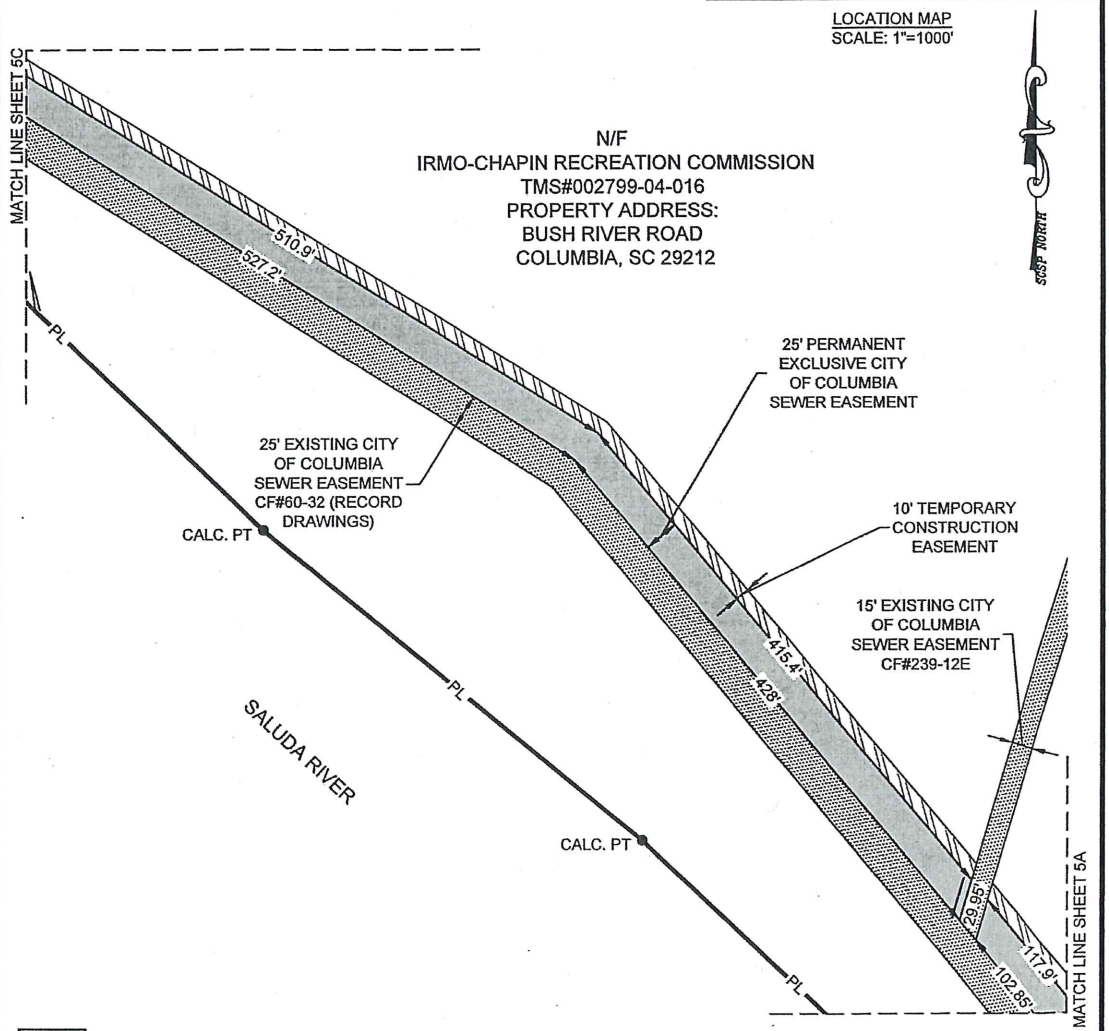
CF#250-481

REFERENCES:

- ALTA/ACSM LAND TITLE SURVEY. PREPARED FOR HONEYWELL INTERNATIONAL, INC. BY COX AND DINKINS. DATED DECEMBER 16, 2003. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 746 PAGE 6.
- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY COX AND DINKINS. DATED AUGUST 26, 2004. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 783 PAGE 5 .
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
SCALE: 1"=1000'



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 1.61AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.57AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISION
ADDRESS: 5605 BUSH RIVER ROAD
COLUMBIA, SC 29212

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

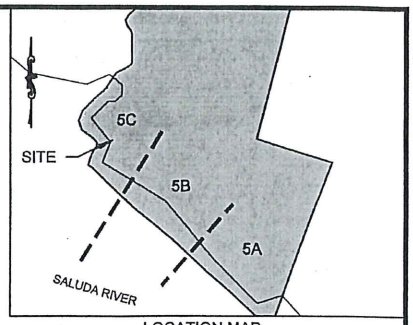
PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 5B OF 12
	DATE: 12/06/2019

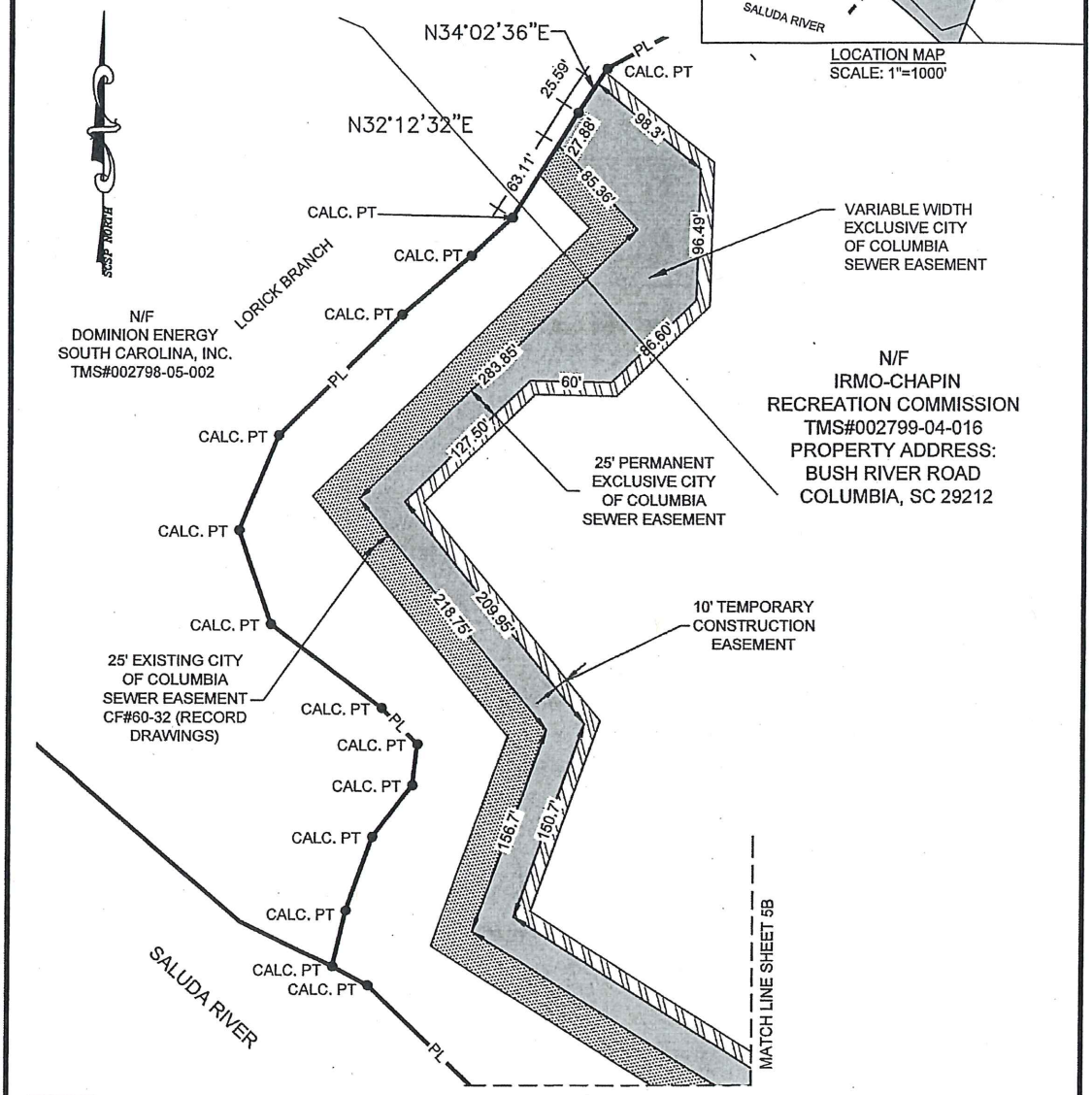
CF#250-481

REFERENCES:

- ALTA/ACSM LAND TITLE SURVEY. PREPARED FOR HONEYWELL INTERNATIONAL, INC. BY COX AND DINKINS. DATED DECEMBER 16, 2003. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 746 PAGE 6.
- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY COX AND DINKINS. DATED AUGUST 26, 2004. RECORDED IN LEXINGTON COUNTY ROD ON SLIDE 783 PAGE 5 .
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
SCALE: 1"=1000'



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 1.61AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.57AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISION
ADDRESS: 5605 BUSH RIVER ROAD
COLUMBIA, SC 29212

CF#250-481

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 5C OF 12
	DATE: 12/06/2019

Easement #6:

Dominion Energy South Carolina, Inc.

TMS #002798-05-002

(Pending)

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Easement #7:

Dominion Energy South Carolina, Inc.

TMS #002798-03-022

(Pending)

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Easement #8:

Irmo-Chapin Recreation Commission

TMS #002798-03-006

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **IRMO-CHAPIN RECREATION COMMISSION** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, a permanent, exclusive easement **twenty-five (25') feet in width**, also a 10' temporary easement for construction purposes only, together with the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located at 5605 Bush River Road, Columbia, SC 29212, and being further identified as a portion of Lexington County tax map number TMS #002798-03-006, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

A permanent, exclusive easement for a sanitary sewer main, twenty-five (25) feet in width and having the following perimeter measurements: beginning on the subject property along the common boundary of the southeastern property line of the subject property and a northwestern property line of Lexington County TMS #002798-03-022, n/f Dominion Energy South Carolina, Inc. at a point located two hundred fifty-six and sixty-three hundredths (256.63) feet northeast of the southwestern property corner of the subject property and extending therefrom in a northwesterly/ more northerly direction along the subject property, for a distance of two hundred twenty-five and ninety-five hundredths (225.95) feet to a point; thence turning and extending therefrom in a northwesterly direction along the northeastern boundary of an existing 25' City of Columbia sanitary sewer easement (CF# 60-32), for a distance of three hundred seventy-two and twenty-five (372.25) feet to a point; thence turning and extending therefrom in a northeasterly direction along the southeastern boundary of the said existing 25' City sanitary sewer easement, for a distance of one hundred thirteen and five tenths (113.5) feet to a point; thence turning and extending therefrom in a northeasterly direction along the southeastern boundary of said 25' City sewer easement, for a distance of one hundred seven and six tenths (107.6) feet to a point; thence turning and extending therefrom in a northerly direction along the subject property, for a distance of four and eighty-five hundredths (4.85) feet to intersect the northwestern property line of the subject property at a point located two hundred eleven and twenty-five hundredths (211.25) feet northeast of the westernmost property corner of the subject property; thence turning and extending therefrom in a northeasterly direction along the northwestern property line of the subject property, for a distance of twenty-six and three tenths (26.3) feet to a point; thence turning and extending therefrom in a southerly direction along the subject property, for a distance of twenty-eight and eighty-two hundredths (28.82) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of one

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Legal Department City of Columbia, SC

hundred eighteen and three tenths (118.3) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of ninety-three and four tenths (93.4) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of three hundred forty-two and two tenths (342.2) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of two hundred forty-seven and fifty-five hundredths (247.55) feet to intersect the southeastern property line of the subject property at a point located three hundred one and eighty-nine hundredths (301.89) feet northeast of the southwestern property corner of the subject property; thence turning and extending therefrom in a southwesterly direction along the southeastern property line of the subject property, for a distance of forty-five and twenty-six hundredths (45.26) feet to a point, also being the point of beginning; thence terminating. Be all measurements a little more or less.

Also, a 10' temporary construction easement, as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

This easement being more clearly shown and delineated on an easement drawing for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 8 of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell, Inc., Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

A copy of said easement drawing being attached hereto and made a part hereof as Exhibit "A".

CMA

Easement 8 of 12

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TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns to warrant and forever defend all and singular the said premises unto the Grantee, its successors and assigns against the Grantor and Grantor's successors and assigns and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS the hand and seal of the Grantor by the undersigned this 6th day of October, 2020.

IRMO-CHAPIN RECREATION COMMISSION

WITNESSES:

(1st Witness Signature)

(2nd Witness Signature)

By: _____

Name: Mark Smyers

Title: Executive Director

STATE OF SOUTH CAROLINA)

ACKNOWLEDGMENT

COUNTY OF)

The foregoing instrument was acknowledged before me this 6 day of OCTOBER, 2020 by MARK SMYERS (Name and Title of Officer) of LEXINGTON, SC (City and State) on behalf of the within-named Grantor.

_____ (Notary's Signature)

NOTARY PUBLIC FOR STATE OF SOUTH CAROLINA (State)

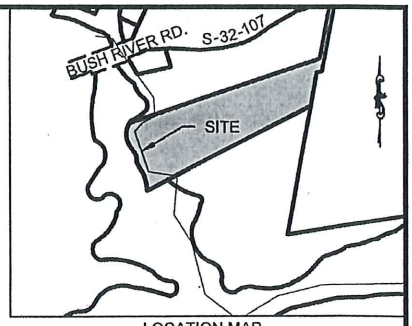
MY COMMISSION EXPIRES NOV. 9, 2020 (Date)

ATTORNEY CERTIFICATION

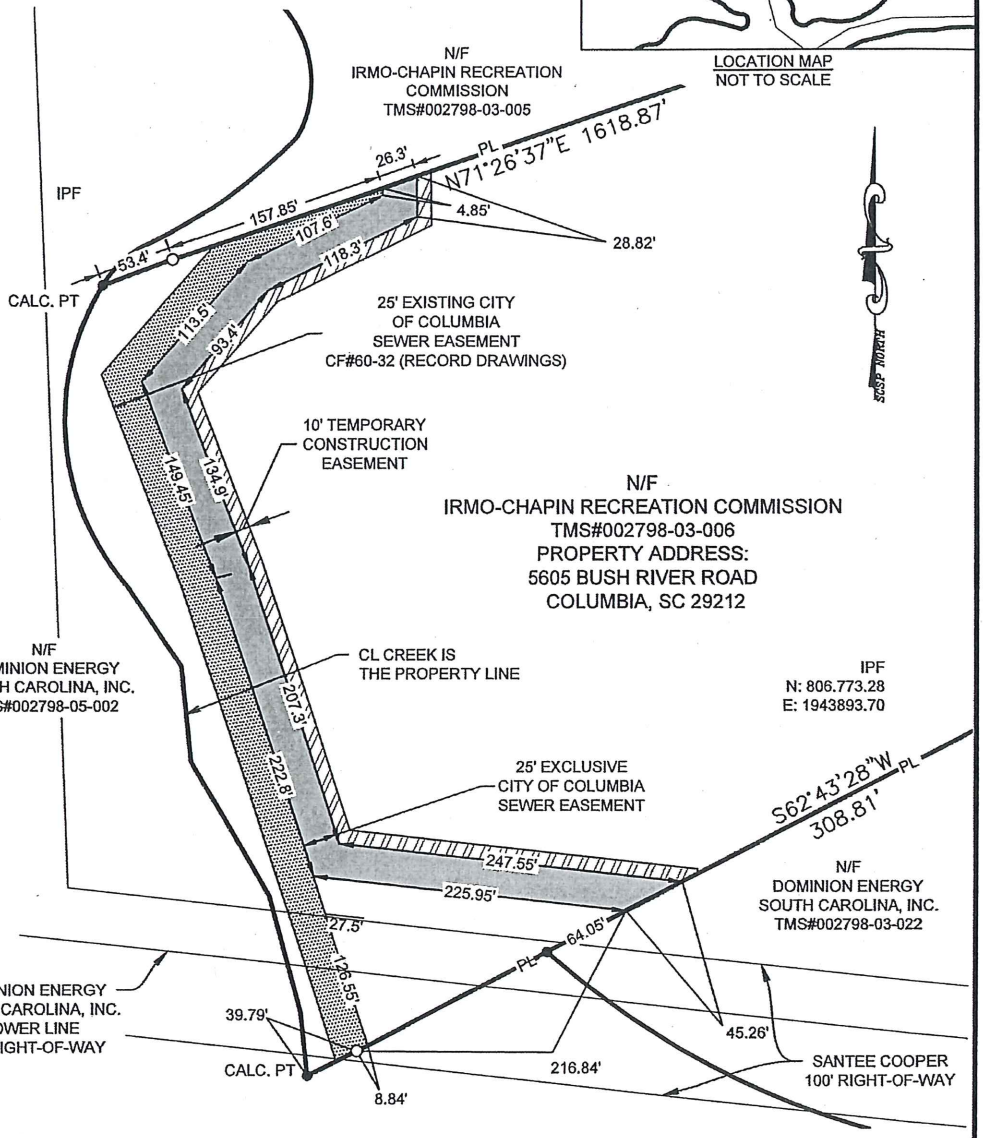
I, JAMES MARSHALL BRADLEY, an attorney licensed to practice in the State of SOUTH CAROLINA, do hereby certify that I supervised the execution of the attached Lower Saluda Relief Sanitary Sewer and Rehabilitation; CIP Project #SS7428 with **IRMO-CHAPIN RECREATION DISTRICT** as Grantor and the City of Columbia, as Grantee, this 6th day of OCTOBER, 2020.

REFERENCES:

- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY RICHARD C. YONGUE. DATED APRIL 8, 1992. RECORDED IN LEXINGTON COUNTY ROD ON PLAT BOOK 251G PAGE 105 .
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 0.47AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.19AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISSION
ADDRESS: 200 LEISURE LN
COLUMBIA, SC 29210

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 8 OF 12
	DATE: 12/06/2019

CF#250-481

Easement #9:

Irmo-Chapin Recreation Commission

TMS #002798-03-005

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **IRMO-CHAPIN RECREATION COMMISSION** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, a permanent, exclusive easement **variable (16.09' to 26.3') feet in width**, also a 10' temporary easement for construction purposes only, together with the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located at Bush River Road, Columbia, SC 29212, being the site of Saluda Shoals Park, and being further identified as a portion of Lexington County tax map number TMS #002798-03-005, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

A permanent, exclusive easement for a sanitary sewer main, twenty-five (25) feet in width and having the following perimeter measurements: beginning on the subject property at a point located two hundred eleven and twenty-five hundredths (211.25) feet northeast of the southwestern property corner of the subject property and extending therefrom in a northeasterly direction along the subject property, for a distance of one hundred forty and fifteen hundredths (140.15) feet to a point; thence turning and extending therefrom in a northwesterly direction along the subject property, for a distance of three hundred seventy and five tenths (370.5) feet to intersect the common boundary of southeastern right-of-way of Bush River Road and the northwestern property line of the subject property; thence turning and extending therefrom in a northeasterly direction along the common boundary of the southeastern right-of-way of Bush River Road and the northwestern property line of the subject property, for a distance of sixteen and nine hundredths (16.09) feet to intersect the common boundary of the innermost northeastern property corner of the subject property and the southwestern property line of Lexington County TMS #002798-03-024, n/f Carolina Wildlife Care Inc.; thence turning and extending therefrom in a southeasterly direction along the common boundary of the northeastern property line of the subject property and the southwestern property line of said Lexington County TMS #002798-03-024, for a distance of one hundred thirty-one and seventy-five hundredths (131.75) feet to a point; thence turning and extending therefrom in an easterly direction along the common boundary of the northwestern property line of the subject property and the southeastern property line of said Lexington County TMS #002798-03-024, for a distance of twenty-three and six tenths (23.6) feet to a point; thence turning and extending therefrom in a southeasterly direction along the

APPROVED AS TO FORM

Legal Department City of Columbia, SC

subject property, for a distance of two hundred thirty-four (234) feet to a point; thence turning and extending therefrom in a southerly direction along the subject property, for a distance of one hundred thirty-nine and sixty-five hundredths (139.65) feet to the intersect the common boundary of the southeastern property line of the subject property and the northwestern property line of Lexington County TMS #002798-03-006, n/f Irmo-Chapin Recreation Commission at a point located two hundred thirty-seven and fifty-five hundredths (237.55) feet northeast of the southwestern property corner of the subject property; thence turning and extending therefrom in a southwesterly direction along the southeastern property line of the subject property, for a distance of twenty-six and three tenths (26.3) feet to a point, also being the point of beginning; thence terminating. Be all measurements a little more or less.

Also, a 10' temporary construction easement as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

This easement being more clearly shown and delineated on an easement drawing for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 9 of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell, Inc., Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

A copy of said easement drawing being attached hereto and made a part hereof as Exhibit "A".

CMA

Easement 9 of 12

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TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns to warrant and forever defend all and singular the said premises unto the Grantee, its successors and assigns against the Grantor and Grantor's successors and assigns and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS the hand and seal of the Grantor by the undersigned this 6th day of October, 2020.

IRMO-CHAPIN RECREATION COMMISSION

WITNESSES:

(1st Witness Signature)

(2nd Witness Signature)

By: _____

Name: Mark Smyers

Title: Executive Director

STATE OF SOUTH CAROLINA)

ACKNOWLEDGMENT

COUNTY OF LEXINGTON)

The foregoing instrument was acknowledged before me this 6 day of OCTOBER, 2020 by MARK SMYERS (Name and Title of Officer) of LEXINGTON, SC (City and State) on behalf of the within-named Grantor.

(Notary's Signature)

NOTARY PUBLIC FOR STATE OF SOUTH CAROLINA (State)

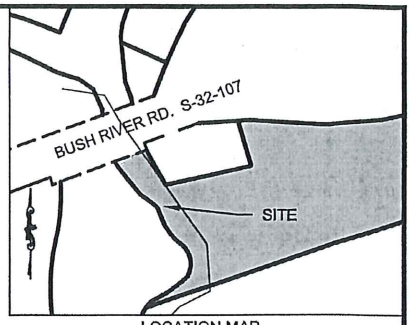
MY COMMISSION EXPIRES NOV. 9, 2020 (Date)

ATTORNEY CERTIFICATION

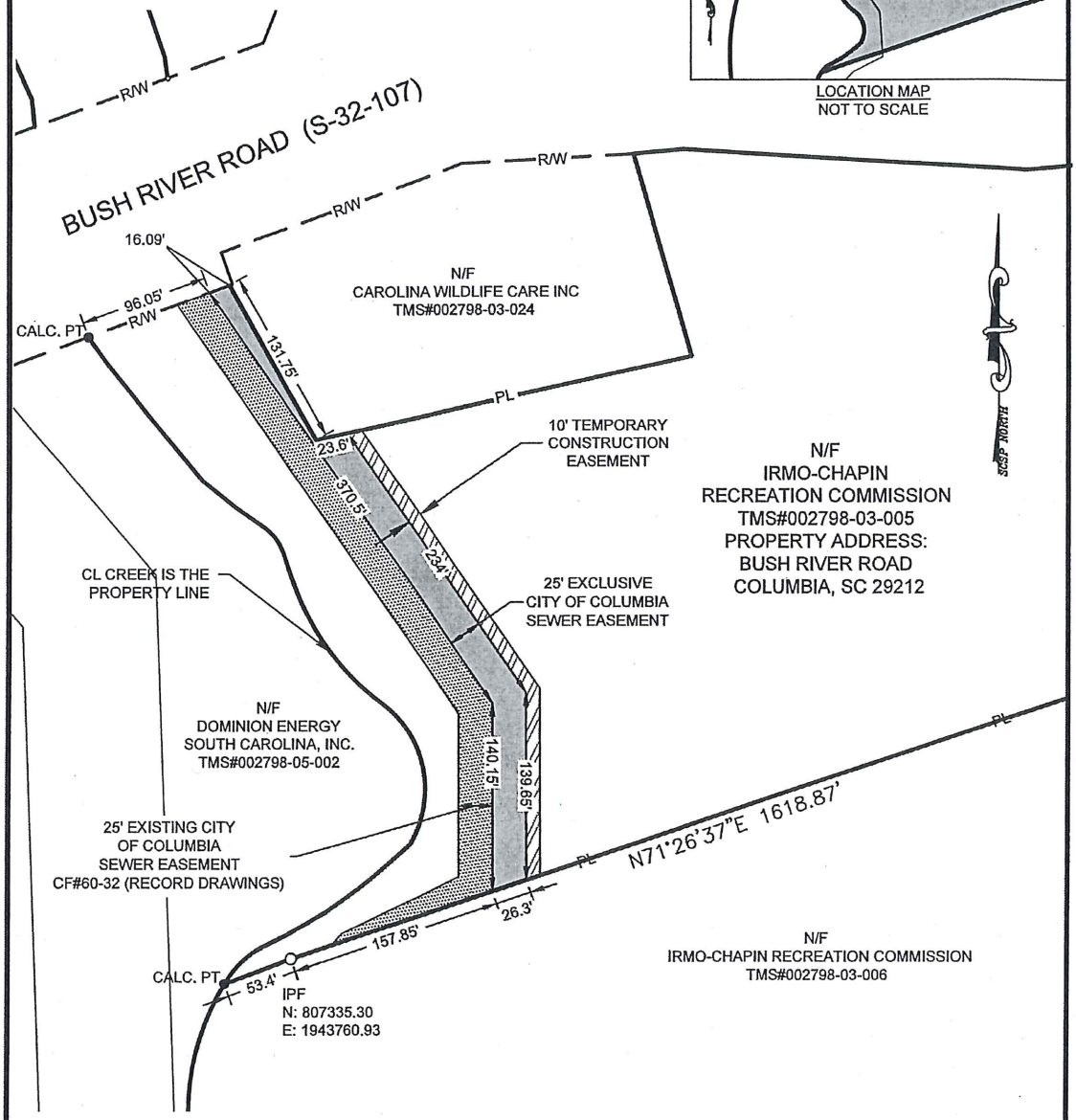
I, JAMES EDWARD BRADLEY, an attorney licensed to practice in the State of SOUTH CAROLINA, do hereby certify that I supervised the execution of the attached Lower Saluda Relief Sanitary Sewer and Rehabilitation; CIP Project #SS7428 with **IRMO-CHAPIN RECREATION COMMISSION** as Grantor and the City of Columbia, as Grantee, this 6th day of OCTOBER, 20 20.

REFERENCES:

- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY RICHARD C. YONGUE. DATED APRIL 8, 1992. RECORDED IN LEXINGTON COUNTY ROD ON PLAT BOOK 251G PAGE 105 .
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 0.24AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.09AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 100'

100 0 50 100 200

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISSION
ADDRESS: 200 LEISURE LN
COLUMBIA, SC 29210

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 100'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 9 OF 12
	DATE: 12/06/2019

CF#250-481

Easement #10:

Carolina Wildlife Care, Inc.

TMS #002798-03-024

(Pending)

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Easement #11:

Irmo-Chapin Recreation Commission

TMS #002798-02-051

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **IRMO-CHAPIN RECREATION COMMISSION** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, a permanent, exclusive easement **twenty-five (25') feet in width**, also a 20' temporary easement for construction purposes only, together with the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located near Bush River Road, Columbia, SC 29212, and being further identified as a portion of Lexington County tax map number TMS #002798-02-051, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

A permanent, exclusive easement for a sanitary sewer main, twenty-five (25) feet in width and having the following perimeter measurements: beginning on common boundary of the subject property at a point located fifty-three and seven tenths (53.7) feet southwest of the southeastern property corner of the subject property and the southwestern property corner of Lexington County TMS #002798-02-060, n/f Lads & Lassies, Inc and extending therefrom in a northwesterly direction along the subject property, for a distance of thirty-two and sixty-five hundredths (32.65) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of forty-three and two hundredths (43.02) feet to intersect the common boundary of the innermost southwestern property line of the subject property and the northeastern property line of Lexington County TMS #002798-02-042; thence turning and extending therefrom in a northwesterly direction along the innermost southwestern property line of the subject property, for a distance of twenty-five and five hundredths (25.05) feet to a point; thence turning and extending therefrom in northeasterly direction along the subject property, for a distance of sixty-six and eight tenths (66.8) feet to a point; thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of sixty and nine tenths (60.9) feet to intersect the common boundary of the southeastern property line of the subject property and the northwestern right-of-way of Bush River Road (S-32-107) at a point located twenty-eight and five tenths (28.5) feet southwest of the southeastern property corner of the subject property; thence turning and extending therefrom along said the southeastern property line of the subject property and the northwestern right-of-way of Bush River Road, for a distance of twenty-five and two tenths (25.2) feet to a point, also being the point of beginning; thence terminating. Be all measurements a little more or less.

APPROVED AS TO FORM

Legal Department City of Columbia, SC

Also, a 20' temporary construction easement, as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

This easement being more clearly shown and delineated on an easement drawing for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 11 of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell, Inc., Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

A copy of said easement drawing being attached hereto and made a part hereof as Exhibit "A".

CMA

Easement 11 of 12

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TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns to warrant and forever defend all and singular the said premises unto the Grantee, its successors and assigns against the Grantor and Grantor's successors and assigns and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS the hand and seal of the Grantor by the undersigned this 6th day of October, 2020.

IRMO-CHAPIN RECREATION COMMISSION

WITNESSES:

(1st Witness Signature)

(2nd Witness Signature)

By: _____

Name: Mark Smyers

Title: Executive Director

STATE OF SOUTH CAROLINA)

ACKNOWLEDGMENT

COUNTY OF LEXINGTON)

The foregoing instrument was acknowledged before me this 6 day of OCTOBER, 2020 by MARK SMYERS (Name and Title of Officer) of LEXINGTON, SC (City and State) on behalf of the within-named Grantor.

_____
(Notary's Signature)

NOTARY PUBLIC FOR STATE OF SOUTH CAROLINA (State)

MY COMMISSION EXPIRES NOV. 9, 2020 (Date)

ATTORNEY CERTIFICATION

I, James Edwards Bradley, an attorney licensed to practice in the State of SOUTH CAROLINA, do hereby certify that I supervised the execution of the attached LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION, CIP PROJECT #SS7428 with **IRMO-CHAPIN RECREATION COMMISSION** as Grantor and the City of Columbia, as Grantee, this 6th day of October, 20 20.

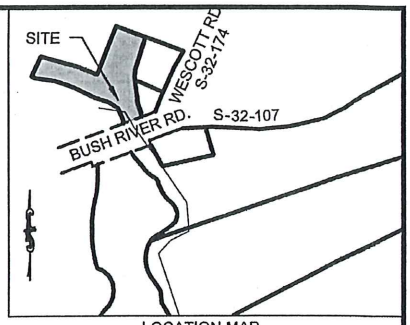
State Bar or License Number 66130

An attorney was not used to certify the easement documents

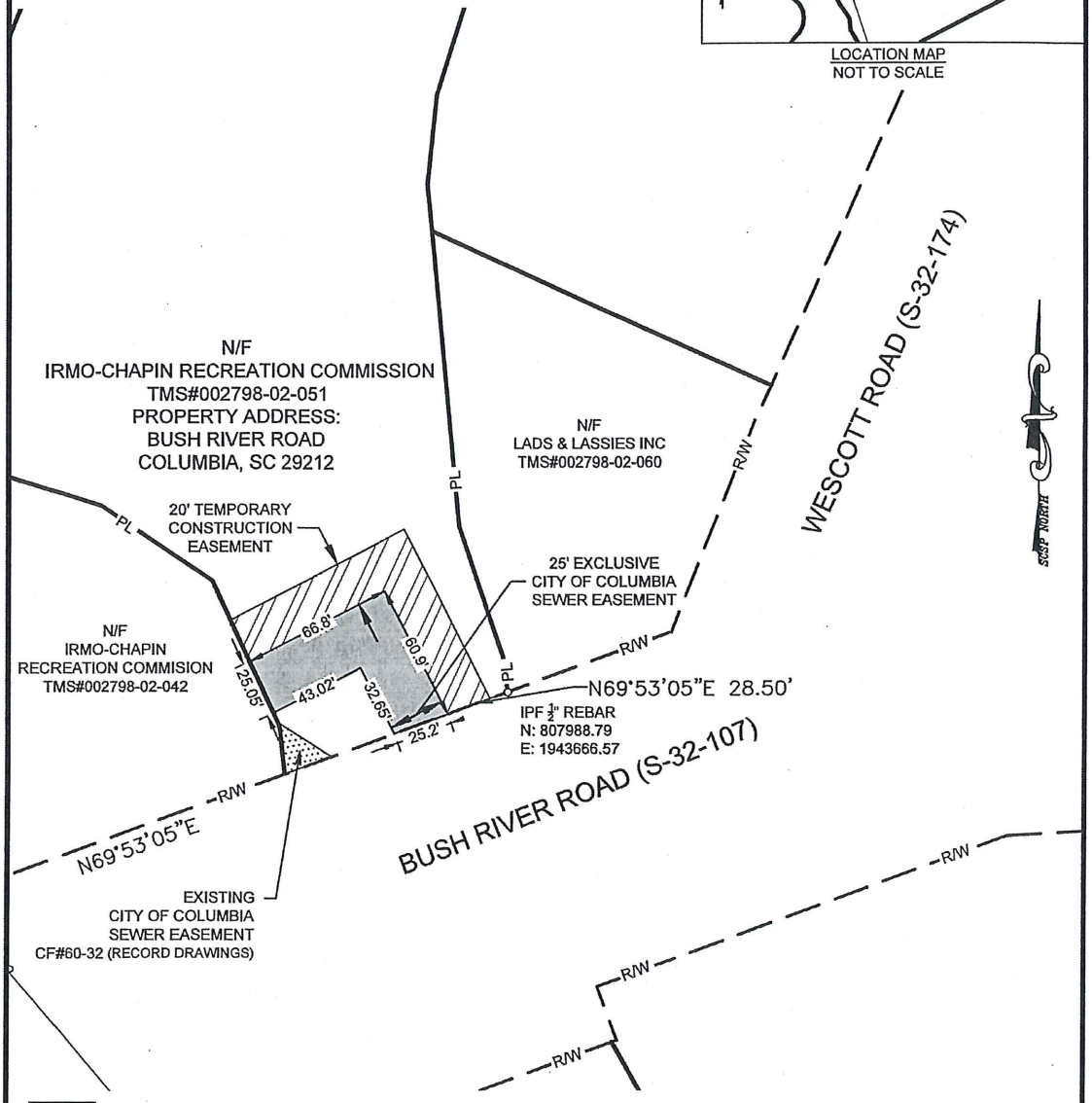
Jay S. Downs

REFERENCES:

- PLAT PREPARED FOR IRMO-CHAPIN RECREATION COMMISSION. BY CIVIL ENGINEERING OF COLUMBIA. DATED DECEMBER 22, 1993. RECORDED IN LEXINGTON COUNTY ROD ON PLAT BOOK 265 PAGE 126.
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- SCDOT FILE 32.117B SHEET 8.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
NOT TO SCALE



PERMANENT EXCLUSIVE CITY OF COLUMBIA SEWER EASEMENT (Total: 0.06AC)

TEMPORARY CONSTRUCTION EASEMENT (Total: 0.07AC)

EXISTING EXCLUSIVE CITY OF COLUMBIA SANITARY SEWER EASEMENT

SCALE: 1" = 60'

120 0 30 60 120

- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISSION
ADDRESS: 200 LEISURE LN
COLUMBIA, SC 29210

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 60'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH

PROJECT NAME
LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION

CIP # SS7428	EXHIBIT 11 OF 12
	DATE: 12/06/2019

CF#250-481

Easement #12:

Irmo-Chapin Recreation Commission

TMS #002798-02-042

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STATE OF SOUTH CAROLINA)

EASEMENT

COUNTY OF LEXINGTON)

For and in consideration of the sum of One ($1.00) Dollar, each to the other paid, the receipt of which is hereby acknowledged, **IRMO-CHAPIN RECREATION COMMISSION** (also hereinafter to as "Grantor") does hereby grant unto the **CITY OF COLUMBIA** (also hereinafter referred to as "Grantee"), its successors and assigns, a permanent, exclusive easement **variable (18.74' x 29.24' x 34.11') feet in width**, also a variable (10' to 20') feet in width temporary easement for construction purposes only, together with the right of ingress and egress at all times for the purpose of constructing, operating, reconstructing and maintaining a **sanitary sewer main** and with the right to remove shrubbery, trees and other growth from the easement area provided that the property will be restored as nearly as practicable to its original condition upon completion of the construction and any trees which must be removed shall be moved from the premises, and any damaged shrubbery will be replaced with the same variety from nursery stock, said easement to run through the property which Grantor owns or in which Grantor has an interest, situate, lying and being:

In the State of South Carolina, County of Lexington, near the City of Columbia, located at 5600 Bush River Road, Columbia, SC 29212, and being further identified as a portion of Lexington County tax map number TMS #002798-02-042, as shown on tax maps prepared by the office of the Lexington County Tax Assessor, 2019 Edition.

A permanent, exclusive easement for a sanitary sewer main, variable (18.74' x 29.24' x 34.11') feet in width and having the following perimeter measurements: beginning on the subject property along the common boundary of the northeastern northwestern property line of the subject property and the southernmost southwestern property line of Lexington County TMS# 002798-02-051, n/f Irmo-Chapin Recreation Commission at a point located one hundred two and seventy-one hundredths (102.71) feet S82°34'19"W of the southeastern property corner of the Lexington County TMS# 002798-02-051, n/f Irmo-Chapin Recreation Commission, and extending therefrom in a northwesterly direction along the said northeastern property line of the subject property and along said common boundary, for a distance of twenty-nine and twenty-four hundredths (29.24) feet to a point; thence turning and extending therefrom in a southwesterly direction along the subject property, for a distance of eighteen and seventy-four hundredths (18.74) feet to intersect the northeastern boundary of an existing 25' City of Columbia sanitary sewer easement (CF# 60-33); thence turning and extending therefrom in a southeasterly direction along the subject property, for a distance of thirty-four and eleven hundredths (34.11) feet to a point, also being the point of beginning; thence terminating. Be all measurements a little more or less.

Also, a variable (10' to 20') feet in width temporary construction easement, as more clearly shown on the attached Exhibit "A". Said temporary easement shall expire upon completion of this project, subject to resurrection upon circumstances posing a danger to health and safety.

APPROVED AS TO FORM

Legal Department City of Columbia, SC

This easement being more clearly shown and delineated on an easement drawing for Lower Saluda Relief Sanitary Sewer and Rehabilitation, CIP Project #SS7428, drawing 12 of 12, dated December 6, 2019, prepared by Chao and Associates, Inc. on behalf of Brown and Caldwell, Project Engineer, prepared for the City of Columbia, South Carolina and being on file in the office of the Department of Engineering, City of Columbia, South Carolina under CF #250-481.

A copy of said easement drawing being attached hereto and made a part hereof as Exhibit "A".

CMA

Easement 12 of 12

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TO HAVE AND TO HOLD the aforesaid rights to the Grantee, its successors and assigns, as aforesaid, forever.

And the Grantor does hereby bind the Grantor and Grantor's successors and assigns to warrant and forever defend all and singular the said premises unto the Grantee, its successors and assigns against the Grantor and Grantor's successors and assigns and against every person whomsoever lawfully claiming, or to claim, the same or any part thereof.

WITNESS the hand and seal of the Grantor by the undersigned this 6 day of Oct., 2020.

IRMO-CHAPIN RECREATION COMMISSION

WITNESSES:

(1st Witness Signature)

(2nd Witness Signature)

By: _____

Name: Mark Smyers

Title: Executive Director

STATE OF SOUTH CAROLINA)

ACKNOWLEDGMENT

COUNTY OF LEXINGTON)

The foregoing instrument was acknowledged before me this 6 day of OCTOBER, 2020 by MARK SMYERS (Name and Title of Officer) of LEXINGTON, SC (City and State) on behalf of the within-named Grantor.

(Notary's Signature)

NOTARY PUBLIC FOR STATE OF SOUTH CAROLINA (State)

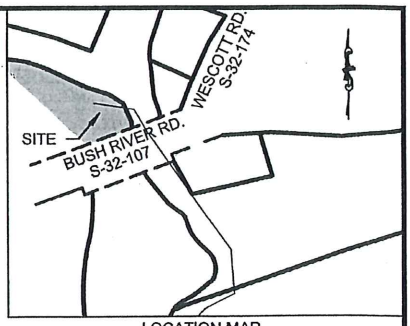
MY COMMISSION EXPIRES NOV. 9, 2020 (Date)

ATTORNEY CERTIFICATION

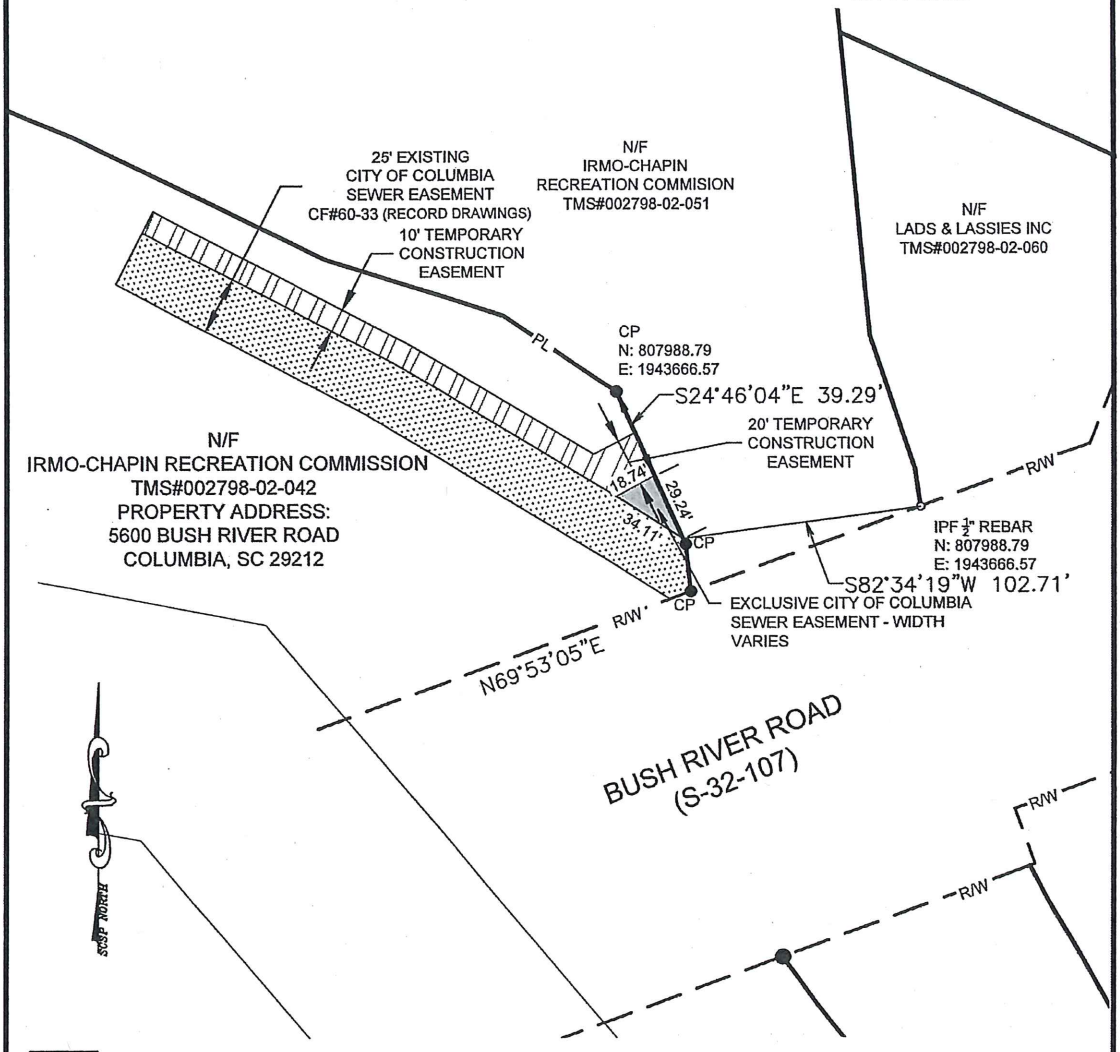
I, James Edward Bradley, an attorney licensed to practice in the State of South Carolina, do hereby certify that I supervised the execution of the attached Lower Saluda Relief Sanitary Sewer and Rehabilitation; CIP Project #SS7428 with **IRMO-CHAPIN RECREATION COMMISSION** as Grantor and the City of Columbia, as Grantee, this 6th day of October, 2020.

REFERENCES:

- PLAT PREPARED FOR MICHAEL J. MUNGO. BY BELTER & SMITH, INC. DATED OCTOBER 19, 1971. RECORDED IN LEXINGTON COUNTY ROD ON PLAT BOOK 190G PAGE 78.
- LOWER SALUDA RELIEF SEWER (CITY CIP SS7428) PRELIMINARY ENGINEERING REPORT PREPARED FOR THE CITY OF COLUMBIA BY BROWN AND CALDWELL. DATED FEBRUARY 2019.
- SCDOT FILE 32.117B SHEET 8.
- HORIZONTAL COORDINATES (NAD 83) AND ELEVATIONS (NAVD 88) BASED ON NGS MONUMENT LEX 59. PID: DF3786 NORTH: 803986.62, EAST: 1956400.90
- LEXINGTON COUNTY TAX MAP SHEET 003696; 2019 EDITION.



LOCATION MAP
NOT TO SCALE



- OWNERSHIP AND TAX MAP INFORMATION TAKEN FROM LEXINGTON COUNTY GIS WEBSITE; 2019 EDITION.

EASEMENT EXHIBIT

OWNER: IRMO-CHAPIN RECREATION COMMISSION
ADDRESS: 200 LEISURE LN
COLUMBIA, SC 29210

CITY OF COLUMBIA
DEPARMENT OF ENGINEERING
COLUMBIA, SOUTH CAROLINA

SCALE: 1"= 60'	PREPARED BY CHAO AND ASSOCIATES, INC. CONSULTING ENGINEERS & SURVEYORS PROJECT ENGINEER: BROWN AND CALDWELL, INC.	DRAWN BY: GHH
PROJECT NAME LOWER SALUDA RELIEF SANITARY SEWER AND REHABILITATION		
CIP # SS7428		EXHIBIT 12 OF 12
		DATE: 12/06/2019

CF#250-481

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