KIAWAH RIVER PLANTATION (KRP) WASTEWATER TREATMENT PLANT (WWTP)

CONTRACT DOCUMENT AND TECHNICAL SPECIFICATIONS

PREPARED FOR:

KIAWAH RIVER PLANTATION HOLDINGS, LP
OCEAN BOULEVARD PROPERTIES, A SOUTH CAROLINA LIMITED PARTNERSHIP

T&H PROJECT NO.
J-25328

ADDENDUM NO. 1 — March 7, 2016

This Addendum forms a part of the Contract Documents

PART I – BID DATE

The Bid Date has been extended to Tuesday March 29, 2016 at 2:00 PM.

PART II – QUESTIONS

1. Section 00 21 13 Instructions to Bidders, Article 11.1 says to include an experience statement with the list of subs and suppliers. The experience statement is not listed as a required submittal in Section 00 41 43 Bid Form, Item 7a. Since subcontractors and suppliers normally aren't determined until very close to bid time as their pricing comes in at the last minute, can the experience statement be provided within a certain amount of time after the time bids are due?

   Answer: Experience statements for subcontractors are not required to be submitted with the bid. Should experience statements be needed after the bid opening, contractor shall provide such for subcontractors which the owner desires.

2. Section 00 41 43 Bid Form, Item 4 includes Alternate #1 but no description is provided. Please clarify the scope of work for Alternate #1.

   Answer: The Bid Form (00 41 43) has been revised and is included with this addendum.

3. Section 00 41 43 Bid Form, Item 5 specifies 510 Days for Substantial and Final Completion. Section 00 52 43 Agreement, Article 3.1 specifies 510 days for Substantial Completion and 540 days for Final Completion. Can you clarify the contract times for Substantial and Final Completion?

   Answer: Bid Form (00 41 43) has been revised and as attached to this addendum. Clarification: 510 consecutive days to substantial completion and 540 consecutive days to final completion.

4. Section 00 41 43 Bid Form, Item 6 specifies $2,000 per day for liquidated damages. Section 00 52 43 Agreement, Article 3.2 specifies $2,500 (in words) and $2,000 (in figures) per for liquidated damages for time expiring after Substantial Completion, and $1,000 per day for

time expiring after Final Completion. Please clarify the liquidated damage amounts associated with the contract times for Substantial and Final Completion.

Answer: Liquidated damages for substantial completion are $2,000.00/day and are $1,000.00/day for final completion.

5. Section 00 41 43 Bid Form, Item 8 refers to a check or bid bond to accompany the bid, however the Invitation to Bid (Article 3) and Section 00 21 13 Instructions to Bidders, Article 8 both indicate a bid bond is not required. Can you confirm that a certified check or bid bond is not required?

   Answer: Bid Form has been revised (see attached). A Bid Bond or Certified Check is <u>not</u> required with the bid.

6. Section 01 00 01 General Requirements, Article 3.05B refers to demolition of the existing plant. This work is not shown in the Drawings. Please clarify what existing facilities are to be demolished and provide record drawings for these facilities.

   Answer: Delete Paragraph 3.05B of Section 01 00 01, "General Requirements".

7. Section 01 15 00 Control of Work, Article 1.12 says that the Owner will provide water for construction and testing purposes. Section 01 00 01 General Requirements, Article 6.04 and Section 03 30 00 Cast-in-Place Concrete, Article 3.12.A.1 both indicate the Contractor is responsible for providing water. Please clarify who is responsible for the cost of water necessary for construction and testing.

   Answer: The Contractor is responsible for the cost of water needed for construction and testing.

8. Section 31 00 00 Earthwork, Article 3.02B says to excavate any unsuitable material encountered to two feet below final grade and replace with suitable material. Can you establish a unit price bid item or allowance amount to pay for undercut and replacement of unsuitable material?

   Answer: A unit price to remove unsuitable material and replace with control fill has been added to the revised bid form. Note: The base bid shall include a set amount of 2,000 cubic yards of such.

9. Section 31 23 19.01 Dewatering, Article 3.04B says to treat water collected from dewatering operations prior to discharge. Are there any hazardous material or contaminated soil/water conditions known to exist at this site?

   Answer: No.

10. Section 31 31 16 specifies Termite Control. Can you provide a list of the structures that require termite treatment?

    Answer: None.

11. Section 31 62 13 Pre-stressed Concrete Piles, Article 1.4.A.2 and 1.4.A.3 refer to unit prices for piles however the Bid Form includes a lump sum line item for piles (Item 11). Will the Bid Form be revised to include a unit price for piles?

    Answer: The Bid Form has been revised (and is attached) to include a unit price for piles which may vary from the quantity specified.

12. The Project Manual includes Sections 08 11 13 Hollow Metal Doors & Frames and 08 61 13 Fiberglass Door and Frames, but the door schedules on Drawings 35-A-06 and 40-A-04 do not indicate the material type for each door. Can you specify the required material for the doors and frames for each door listed in the schedule?

Answer: The exterior doors are to be fiberglass door and frame and the interior doors are to be hollow metal doors and frame. The exterior fiberglass doors and frames are D103, D104, D105 and D201, D202, and D204.

13. The Exterior Window Schedule shown on Drawing 35-A-06 lists four windows with no sizes or specifications (W204 – W207). Can you confirm these four windows are not required?
Answer: They are not required.

14. The WWTP Building has Fiberglass Column Covers surrounding the steel columns on the second floor of the structure (reference Drawing 35-A-04). Can you provide specifications and details for these column covers including a list of acceptable manufacturers?
Answer: See specification section provided. 06 82 00 fiber glass column covers. List of acceptable manufacturers are included in spec.

15. Section 10 71 14 Exterior Shutters, Part 2.1D specifies a high performance Organic Finish for the exterior shutters, however the Exterior Paint Schedule on Drawing 35-A-06 calls for a Sherwin-Williams product. Can you clarify the finish required for the shutters?
Answer: The shutters are to be finished in custom color as per the specifications. The color is to match the Sherwin Williams color in exterior paint schedule.

16. Section 06 82 00 Architectural Fiberglass Column Covers, Part 2.4A specifies butt joints for the column covers, however the item callout on Drawing 35-A-04 specifies a lap joint. Please clarify the type of joint required for the column covers?
Answer: The joints are to be as per specifications. The drawings will be revised.

17. Drawing 35-S-02 includes a reference for Section 7 in the vicinity of the Chemical Room but we have not been able to locate this section view in the drawings. Can you provide a view for Section 7 referenced on 35-S-02?
Answer: The section cut showing #7 does not exist and will be removed from Sheet 35-S-02. Please use detail 2 on Sheet 35-S-08 for that part of the chemical room.

18. The Sequence of Construction in Section 01 00 01 Part 3.5 B says, "The demolition and removal of portion of the existing plant shall occur after a permit to operate the new facility is received…" For scheduling purposes, how long do you anticipate it taking for the Owner to receive the operating permit and issue written notice to the Contractor?
Answer: Paragraph 3.5B of Section 01 00 01, "General Requirements", is hereby deleted. Upon submittal to DHEC, it generally takes two weeks to receive a permit to operate back from DHEC provided all submittals are in order.

19. Drawings 35-S-03 and 35-S-04 indicate four (4) locations for Davit Crane sleeves.
    a. Is the Contractor required to provide a davit crane?
    b. If a davit crane is required, please provide specifications.
Answer: Yes the contractor shall provide a portable davit (hoist) which can be used at each location but will generally be stored in the equipment support room to protect it from the elements. The portable hoist shall be equivalent to series DB as manufactured by Halliday Products Inc. of Orlando, Florida. The unit shall be sized to facilitate equipment placement and removal. The portable hoist shall be all T-304 stainless steel construction with marine grade brake winch and 30 feet (9m) of ¼ inch (7mm) T-304 stainless steel cable with galvanized safety hook. The davit arm shall adjust in 1 inch (25mm) increments from 24 to 36 inches (610 to 914mm) and the overall unit height shall be 60 inches (1.5m). The portable hoist shall be guaranteed against defects in material and or workmanship for a period

of 3 years and shall be suitable to lift the equipment weight and related liquid & accessories.

20. Separate Bid Item A-12" Water Main-Is this an alternate or just want to see it separately?
Answer: The Bid Item A – 12 inch water main is <u>not</u> a bid alternate but the owner needs to see it separately.

21. Spray Fields-Reference is made to certain parameters to Manufacturer recommendations, etc. Can you tell me who you worked with on this part of the project? Rep, etc.? LAS Control Valve Assembly-09-C-04. Doesn't show the Bypass line valves that is shown on 09-C-02. Am I looking at this correctly?
Answer: Bypass on LAS Control Valve assembly is <u>not</u> required.

22. On DWG 09-C-02 there is a 6" Control Valve Assembly (Detailed on DWG 09-C-04) called out on the bottom left hand side of the DWG, is this the same assembly being required for each 6" Spray Distribution Line coming off of the 8" Irrigation Main, there are (13) assemblies shown all together for this Spray field. The Assemblies appear to show a bypass line but the detail doesn't include it.
Answer: There are 13 spray zones that must be controlled individually so there are 13 LAS Control Valve assemblies. LAS Control Valves do not require a bypass. Details for "LAS Control Valve Assembly" on Sheet 09-C-04 show the required arrangement.

23. On DWG 08-C-01 you reference APCO Model No. 606 or Approved Equal, do you have a list of Check Valves that you would consider an Equal or do I need to send in some information to get considered prior to bid?
Answer: We do not have a predetermined list of approval equivalent valves.

24. On DWG 08-C-01 there is a 4" Pressure Relief Valve where you reference Singer Model #106-RPS, will you consider an Equivalent like you are for the Control Valve detailed on DWG 09-C-04?
Answer: An equivalent four-inch Pressure Relief Valve can be considered.

25. While going through the specs, I did not see anything that pertains to the following items:
    a. 16" x 12" Tapping Sleeve on DWG 02-C-02.
    b. Gate Valves (I found a reference on Spec section 40 29 01 that reference AWWA C 500, but nothing else).
    c. Fire Hydrants and Yard Hydrants.
Answer: See Section 33 10 00SC, "Water Utilities", attached to this Bid Addendum.

26. On the treatment facility it calls for a 20' slide gate but does not appear to have enough room to slide back. Is there a detail for gate desired?
Answer: Sheets 06-C-01A and 06-C-03 which show the fence layout has been revised. See revised sheets attached to this Bid Addendum.

27. On the detail sheet there is a 1 5/8" brace rail called out but a 2 ½" top rail. 1 5/8" would be more of a standard for top rail. Please clarify.
Answer: Top Rail should be 1 5/8 inch (1.62 inch diameter). Bottom Rail should be 1 5/8 inch. Corner, Gate, and Terminal Posts should be 3 inches.

28. Also, on the detail sheet it calls for galvanized post but asks for black below gate detail (please clarify). What is the dimension for line post?

Answer: All the fence and all materials shall be black vinyl coated chain link. Line posts shall be 2 3/8 (2.38-inch diameter).

29. There was a lengthy question regarding a requirement in lieu of PCI certification. A statement to clarify is made below.

Answer: Pile manufacturing plants who are not PCI Certified, shall be permitted to supply piles for this project, provided the following conditions are met:

1. ***Plant has established quality control procedures in accordance with PCI MNL-116.***
2. ***Plant has retained an independent testing firm, approved by the engineer of record, to inspect the plant at a minimum of two-week intervals to certify compliance with MNL-116. The inspection reports of these visits, prior to and during pile production for this project, shall be provided to the engineer of record for documentation.***
3. ***Engineer of record shall be notified a minimum of 48 hours prior to the plant inspections and reserves the right to accompany the testing firm during inspection.***

30. Section 03 30 00 Cast-in-Place Concrete, Article 3.3B specifies 7 days or 70% strength prior to removing formwork. We typically see this specified for supported work such as elevated slabs and beams, and we normally are allowed to remove form panels (walls, columns, slab edge forms, etc.) as soon as its removal will not cause damage to the concrete surface. Can you confirm that the duration and strength requirement in Article 3.3B pertains to supported (shored) formwork only?

Answer: The removal of forms from walls, columns and slab edges will be permitted 3 days after pouring.

31. We have some questions regarding the HDPE liner shown on Drawing 07-C-03:
    a. Can your provide specifications for the HDPE liner?
    b. What are the field testing requirements for the liner?
    c. Can you provide a list of acceptable liner manufacturers?
    d. Can you provide specifications and installation details for the geocomposite gas vents?
    e. Please provide the quantity or spacing requirements for the geocomposite gas vents.

    Answer: See Section 33 47 23, "Polyethylene Geomembrane Liner and Geocomposite", is attached.

32. Refer to Drawing 36-S-01 Detail 2 for the Chlorine Contact Tank earthquake drain layout. Note 1 refers to the geotechnical report by Terracon dated 2/6/2015 for specifications for the earthquake drains. Section 02 30 00 Subsurface Investigation, Part 2.01 also refers to this geotechnical report and only portions of the report are provided with the Project Manual. Can you provide the bidders with the complete geotechnical report?

Answer: The complete Geotechnical Report is attached.

33. Section 31 62 13 Prestressed Concrete Piles, Part 3.8B indicates that the Owner is responsible for the cost of inspection and testing of piles. Drawing 01-S-01, Foundations Note 3 says that the Contractor is to engage a geotechnical engineer to conduct pile testing. Please clarify whether a geotechnical engineer is required to administer pile testing and who is responsible for the cost of this service.

Answer: Inspection and testing of piles is a special inspection. The Owner is responsible for special inspections. Note on Sheet 01-S-01 will be revised.

34. Drawing 08-C-01 includes the Effluent Pump Station which is specified to be precast. Will a cast-in-place concrete structure be acceptable in lieu of precast for this structure? If so, can you provide structural details?

Answer: No, it is expected to be a precast structure.

35. Drawing 40-S-03 includes a dumpster in the Centrifuge Building. Who provides this dumpster? If Contractor provides the dumpster, can you provide specifications?

Answer: Utility operator will contact with a handler to provide the containment dumpster shown in Section 1/40-S-03.

36. Drawing 01-G-03, General Note 34 refers to existing landscaping/hardscaping to be removed and reconstructed.
    a. Where are these existing features currently installed?
    b. Without knowing the exact location and extent of these features, it will be difficult to estimate the cost of this work. Can you establish an allowance amount on the Bid Form to cover the cost of any removal/reinstallation work associated with existing landscaping/hardscaping?

Answer: No formal planted landscaping or hardscape exists. Any damage to vegetation not shown to be impacted shall be the responsibility of the contractor to replace.

37. Noticed that Drawings 05-E-01 and 08-E-01 on the Schedule of Drawings aren't included In the Drawings contained in the Link to the Plans and Specs?

Answer: These are sheets which are not within the set. They have been removed from the schedule of drawings.

38. The following drawings are called out in the Schedule of Drawings; however, they were not found in the downloaded files. Please provide:
    a. 08-E-01
    b. I-1.14
    c. I-1.15
    d. I-1.16
    e. I-1.17
    f. I-1.18
    g. I-1.19
    h. I-1.20

Answer: Sheet 08-E-01 is not in the set. Will be detailed from Schedule of Drawings. Sheets I-1.14 thru I-1.19 are Sheets 153-158 of the PDF, "KRP WWTP Bid Set Feb. 1, 2016" – the drawings. There is not a Sheet I-1.20.

39. Drawing 35-A-03 shows a steel column supporting the northeast corner of the control building porch overhang. The column appears to be cast inside the concrete wall for the future basin on the north side of the pre-aeration basins. This column is not shown on structural drawing 35-S-02. Please confirm this column does not need to be installed.

Answer: This column does not need to be installed.

40. On drawings 35-A-02, 50-E-09 and 50-E-10 the number of emergency and exist fixtures do not have the same quantity. Which drawing is correct?

Answer: The electrical drawings, 50-E-09 and 50-E-10 are correct.

41. Please provide the CMU Wall Schedule referenced in detail 10 on 01-S-03.

Answer: There is no CMU reinforcing schedule for this project since all the CMU reinforcing is called out on the sections. Please refer to the appropriate wall section for reinforcing, as well as the typical details for additional requirements.

42. Drawings 35-A-03 and 35-A-13 call out the interior wall between the "Equipment Support Room" and the "Equipment Room" as being wall type B, which is 12" CMU per Drawing 35-A-07. This conflicts with Drawing 35-S-02 where this wall is shown as being 12" thick Cast In Place concrete. Please clarify which is applicable.

Answer: The wall is to be 12" CIP, as per the structural drawing 35-S-02.

43. Drawing 35-A-03 and 35-A-14 call out the interior Chemical Room walls as being wall type B1 which is 3 hour fire rated 12" CMU per drawing 35-A-07. This conflicts with Drawing 35-S-02 where this wall is shown as a 12" thick Cast In Place wall. Please clarify which is applicable.

Answer: The wall is to be 12" CIP, as per the structural drawing 35-S-02.

44. Drawing 35-S-02 has the pipe chase interior walls drawn as CMU which conflicts with drawing 35-A-03 which indicates the pipe chase interior walls are cast-in-place. Please clarify which is applicable.

Answer: The electrical chase walls are to be CMU.

45. Material of doors are not indicated on door schedules for WWT Facility and Centrifugal Building. There is a specification section for both hollow metal doors and fiberglass doors. Please clarify.

Answer: For the WWTF: The exterior doors are to be fiberglass door and frame and the interior doors are to be hollow metal doors and frame. The exterior fiberglass doors and frames are: D103, D104, D105 and D201, D202, and D204.

46. Please provide a specification section for "liquid applied waterproof membrane" which is to be applied before the stucco in multiple call outs; 35-A-07, 35-A-04, 35-A-17.

Answer: In Stucco spec section; see 2.2A Primary Air Barrier Seal.

47. Please provide a specification section for "rigid insulation" used with the gypsum board, wall type D, D1 and D2 from drawing 35-A-07 and 35-A-14.

Answer: In Thermal Insulation spec, see 2.01 Extruded Polystyrene Foam-Plastic Board.

48. Please confirm lockers and benches are not required since none were called out on the drawings.

Answer: Two stacks of lockers are required, each with one tier. The Owner shall select the final location to install the lockers (currently, they are showing the bathroom on Sheet 35-A-04). The lockers shall be equivalent to Tufftec Locker (owner to select color). A bench is not required.

49. Please confirm the wall between the Electrical Room and Mechanical Room is wall type G per Drawing 35-A-04 not wall type F per Drawing 35-A-14.

Answer: Wall between Electrical Room and Mechanical Room is 1 hour rated wall type G.

50. Please confirm the wall between the store room and chemical room, wall type E, is to reach up to the roof line per Section 1 on Drawing 35-A-14 and that the wall between the mechanical room and control room is to reach up to the base of the roof trusses per Section 2 on Drawing 35-A-14.

Answer: Wall type E between Electrical Room and Store Room is to reach to u/s of roof as per Section 1. In this location wall is acting as a sound barrier and a rated partition. Wall type E between Mechanical Room and Control Room does not need to go up to u/s of roof as it is acting as a sound barrier. (To reduce confusion we will change the schedule so this wall will be called E1 and will not be a rated wall).

51. Drawing 36-S-01 calls for the interior of the chlorine contact basin to be coated with a "waterproof coating per the specifications" while Drawing 36-S-02 calls for Raven 405. To eliminate confusion, please confirm the desire is to use Raven 405 per Note 2 on 36-S-02.

Answer: The incorrect painting and coating specification was provided with the bid package. Please see attached for the correct version. The specification controls and the coating to be used for the interior of the chlorine contact basin is a CIM product with primer.

52. Drawing 40-A-02 calls out the CFMF Trusses to be placed at 4'0" O.C. This conflicts with Drawing 40-S-03 where it calls out the CFMF trusses to be placed at 24" O.C. Please clarify which is applicable.

Answer: Truss information as per structural drawing 40-S-03.

53. From the Painting and Coating Specification Section (09 90 00-20): Paint System No. 19 Concrete Tank Waterproof Coating, part b. states the lower 19 feet of Anoxic, Pre-Aeration and Membrane Thickening Basins are to be coated. Paint System No. 20 Concrete Tank Anti- Corrosion Coating, part a. states the top 5 feet of walls of Anoxic, Pre-Aeration and Membrane Thickening Basins are to be coated. The total basin height according to drawing 35-5-06 is 14 feet. Please clarify the coating depths.

Answer: The incorrect painting and coating specification was provided with the bid package. Please see attached for the correct version.

54. Please clarify the difference between "Membrane Thickening Basins" and "MBR" as they are called out separately in Paint System No. 19 (09 90 00-20).

Answer: The incorrect painting and coating specification was provided with the bid package. Please see attached for the correct version.

55. Please identify the RAS Basin called out in Paint System No. 19, part c.

Answer: The incorrect painting and coating specification was provided with the bid package. Please see attached for the correct version.

56. Please provide a paint system for T111 a material identified on the Exterior Finish Schedule on Drawings 35-A-06, 35-A-08 and 35-A-16.

Answer: In spec section provided for Painting and Protective Coatings, see section 3.11 B.

57. Please provide a paint system for the Stucco System referenced in drawings 35-A-04, 35-A-07, and 35-A-16.

Answer: In Stucco specs 09.24.23, integral color in stucco system.

58. Specification Section 31 00 00, defines control and structural fill as soils with max 12% fines, as well as having certain LL and PL requirements. However the Geotechnical Report provided does not include any laboratory analysis to determine if onsite materials will meet the above specification requirements. Please confirm if the onsite soils will be suitable for use as backfill.

Answer: Per the geotechnical report, on-site soils meeting USCS Classification SP, SM, SP-SM (passing #200 < 25%) are usable provided they meet the geotechnical requirements.

59. Specification Section 31 23 23, 2.04 -Controlled Fill. Please confirm the definition of Controlled Fill.
    a. 2.04 A. states that soils may contain no more than 12% passing No. 200 sieve.
    b. 2.04 D. Listed USCS classification type SM, which by definition has a fines content from 12%-50%.
    c. Is soil type SM considered controlled fill?

Answer: Control fill shall have passing #200 < 12%. USCS Classification SP, SM, SP-SM, GP, GW, SW can meet the definition of control fill.

60. Drawing 05-C-03 has notes for proposed all-weather access road. Please verify the detail for this road is shown as "Gravel Section" as found Detail 8, on Drawing 05-C-11. Also, does detail #9 (edging gravel detail) apply to the entire road?

Answer: Detail 8/05-C-11 is the applicable detail for the all-weather access roads. Detail 9/05-C-11 does not apply to the edge of the roads but to gravel access in the Plant and Effluent Pond Fencing.

61. Please verify if there are any grade changes for the all-weather access road. The provided drawings with the stone hatching pattern makes it difficult to read any contour lines within the road. If no grade changes are required, please confirm if any undercutting and replacement will be required.

Answer: There are no proposed grade changes provided the gravel surface has positive drainage off the travel way.

62. Drawing 05-C-03 has a note with leader stating "Clean out Existing Ditch (Typ.). Please clarify scope of work to be done to ditch. Example (a) If removal of muck only, please identify approximate depth of organics Contractors will expect to encounter. (b) If intent is to widen and increase ditch depth, please provide proposed ditch dimensions.

Answer: Remove blockages to promote a positive flow in the ditches. Ditch configuration to remain as it exists.

63. Specification 31 62 13 - Prestressed Concrete Piles - Section 1.4 A.3. Discusses a unit price per length for piles which shall be used if pile lengths are required to be adjusted. The current bid form does not have a pile length line item, please provide.

Answer: A line item for pile price per unit length will be added to the bid form.

64. Drawing 05-L-02, Planting / Irrigation Notes, #26- discusses an Alternate Bid Item for "Soil Moist Transplant". Please confirm this Bid Alternate requirement is not required, as the current bid form does not show this.

Answer: Confirmed. Note 26 on Sheet 05-L-02 is hereby deleted.

65. Please confirm that rebar doweling from piles into the foundation slab is not required. No doweling is shown on the structural details nor is it discussed in the structural notes or Pile Specification.

Answer: Confirmed.

66. Please confirm horizontal louver blinds are not required since none were called out on the drawings.

Answer: Horizontal louver blinds (Owner to select color) are required for each exterior window.

67. Please clarify the location(s) where tiling work per Section 09 30 00 will be required. We have not been able to locate any tiling shown on the Drawings.

Answer: Tile in the bathroom on upper level to 5 feet A.F.F.

68. Drawings 35-S-04 and 36-S-01 indicate aluminum stairs at the WWTF and Chlorine Contact Tanks. Section 05 51 00 Metal Stairs specifies steel metal pan stairs. Please clarify the type of stairs required at these locations.

Answer: The stairs accessing the operations building (northwest corner of building) are to be metal pan stairs. The set of stairs accessing the eastern end of the basins, next to the influent screens is aluminum. The stairs at the chlorine contact basin is also aluminum. Aluminum stairs are to be designed and provided by the fabricator.

69. The Table of Contents includes Section 08 54 13 for Fiberglass Windows, but these specifications are not included in the Project Manual. If fiberglass windows are required, please provide specifications and clarify where they should be installed.

Answer: All windows are Anderson A Series fiberglass windows. Fiberglass Window, Specification Section 08 54 13, is attached.

70. Section 10 80 00 Miscellaneous Specialties, Part 2.02 specifies lockers. Can you provide the sizes, quantity and installation location for the lockers specified here?

Answer: See response to question 48.

71. Section 09 90 00 Painting and Protective Coatings, Paragraph 3.10,I,1,b. specifies coating of the lower 19 feet of the basin walls. The Structural Drawings (35-S-06 and 35-S-07) indicate these walls are 14' tall. Please clarify the coating requirements for these walls.

Answer: The incorrect painting and coating specification was provided with the bid package. Please see attached for the correct version.

72. Refer to Section 09 90 00 Painting and Protective Coatings. Paragraph 3.10,I,1,b. specifies coating of the lower 19 feet of the Membrane Thickening Basins. Paragraph 3.10,I,1,c. specifies coating of the entire wall height of the MBR. We are assuming the Membrane Thickening Basins and MBR are the same facility. Please clarify the MBR wall coating requirements.

Answer: The incorrect painting and coating specification was provided with the bid package. Please see attached for the correct version.

73. Section 09 90 00 Paragraph 3.10, I,1,c. specifies coating of an RAS Basin. Where is this facility located?

Answer: The incorrect painting and coating specification was provided with the bid package. Please see attached for the correct version.

74. The contract documents state that the bids prices must remain valid for 150 days, however there appears to be no intent to publically open and read aloud the submitted bid amounts. We request that the proposals be publically opened and base bid amounts

read aloud immediately after the bidding deadline expires. This will allow all bidders to understand how they did, and not keep resources required to build the project on hold for 150 days just in case awarded the job. If selected to build the job, we will commit all necessary resources to make it a success, but if we are not going to build the job, we need to know immediately so we can work on finding other projects for those resources. Please open the bids at 2:00 and read the values listed on 00 41 43 page 3.

Answer: This is acceptable to the owner. Bids submitted will be read aloud.

75. The lengthy fifty item bid form (Exhibit A) creates unnecessary trouble on bid day and, due to its complexity, forces the bidders to write down less-than-accurate numbers to minimize the amount of math required in the final minutes of the bid. It also subjects bidders to math mistakes which can, once corrected, cost the correct low bidder the job, or award the project to a higher-cost bidder who's math mistake results in a lower overall cost. Whether this information is desired for comparison between bidders, as preliminary schedule of values, or as a precursor for scope-reduction if the budget is exceeded, this level of detail puts the bidder in an unnecessary risky situation and should be avoided. Since the accuracy of the information presented on Exhibit A will be inaccurate, and therefore of no value, we request that only the pricing on 00 41 43 page 3 be submitted at 2:00 and Exhibit A be submitted electronically by the **two low bidders** only, within twenty four hours after the bid opening.

Answer: This is acceptable to the owner. The bid form has been revised to reflect such. The two low bidders shall submit schedule of valves formerly shown on exhibit A and a list of subcontractors and suppliers within twenty four hours after the bid opening.

76. From our Bonding Agent:

a. The instructions for the performance and payment bond forms, pages 39 and 45 respectively, specify a **resident** agent countersignature. As a point of note, all 50 states have legally eliminated the resident agent countersignature requirement. Countersignatures by licensed agents can still be required. I am a licensed South Carolina **non-resident** agent. This resident agent countersignature requirement is not binding and should be removed from the language to eliminate confusion later on. Please revise accordingly.
Answer: Bonds should be countersigned by a South Carolina licensed agent.

b. Page 114 SC-5.04.B7, paragraph 7 states "Bonding surety shall be located in the state in which the work is being performed." This language needs to be eliminated as it is unnecessary and furthermore, CNA, Liberty have advised that the do not have offices in South Carolina and Thomas McGee does not maintain an office in South Carolina either. Frankly, we are not certain if any of the large national sureties have a surety office in South Carolina. This is a nonessential requirement that serves no real business purpose since we are all properly licensed to conduct business in the state. Please revise accordingly.
Answer: Bonds must be issued by a surety company licensed to do business in South Carolina.

77. It appears some layers were not formatted properly as the Structural plans do not have drawing numbers and many sections are not labeled, can they be resent with the proper sheet numbers, labels, missing sections.

Answer: We are not sure why they didn't print correctly because on the screen they are fine. Therefore a pdf of the structural drawings have been attached to

the addendum. See attached for structural set. Revised structural sheets are noted in Part III: Revisions, item 2.

78. There is a blank unnamed sheet that appears to be sheet 1-S-01, structural details, can you please provide.

Answer: We are not sure why they didn't print correctly because on the screen they are fine. Therefore a pdf of the structural drawings have been attached to the addendum. See attached for structural set.

PART III: REVISIONS

1. Specifications

A. *Section 09 90 00 – Painting and Protective Coatings* is replaced with the attached revised specification.

B. *Section 05 41 00 – Cold-Formed Steel Framing* is replaced with the attached revised specification.

C. *Section 06 82 00 – Architectural Fiberglass Column Covers* is replaced with the attached revised specification.

D. *Section 46 33 00 – Chemical Metering Solids (Sodium Hypochlorite) and Related Equipment*. Add Item H under Paragraph 2.01. "H. The pre-approved manufacturer is Millon Roy."

E. *Section 46 23 66 – Dewatering Container*. Replace Item 12 in Paragraph 2.03A with the following:

1. "One piece diamond plate aluminum lid, hinged to the top back of the container shall be provided. This lid shall have two hinged rubber panels that cover openings on both sides of the aluminum lid, the purpose of which is to allow the plant personnel to inspect and/or clean the interior of the container without removing the aluminum lid. The aluminum lid shall be provided with two aluminum 4" nipples, one of which shall be located in the middle of the lid and provide an entry way for the waste material to enter the container, the other of which will provide an exit point for odors that may accumulate in the dewatering container. Included with the lid shall be easily removable hose cuffs that fit over the 4" nipples and flexible hose that attach to the hose cuffs and in turn to pipes, one from the odor removal system and one from the waste material generating device."

2. Drawings

A. Replaced Sheets below with attached:
1. Cover Sheet
2. 01-G-01
3. 01-G-02
4. 05-C-01
5. 05-C-02

6. 05-C-03
7. 05-C-05
8. 05-C-05A
9. 05-C-14
10. 06-C-01
11. 06-C-01A
12. 06-C-02
13. 06-C-03
14. 35-D-02
15. 35-S-04
16. 40-D-01
17. 40-D-02

B. Sheet 40-A-04 – Door schedule; Height for Door D100 shall be 14'-0".

3. Contract Documents

A. Replace "Bid Form" with revised Section 00 41 43 "Bid Form" attached.

B. Include with the "Bid Form" the attached listing of proposed subcontractors and supplies.

PART IV: NEW DOCUMENTS

1. Specification; new specification sections are:

A. 33 10 00 SC – Water Utilities.

B. 33 47 23 – Polyethylene Geomembrane Liner and Geocomposite.

C. 08 54 13 – Fiberglass Windows.

PART V: CLARIFICATIONS FROM PRE-BID MEETING AND OTHER DISCUSSIONS

1. The Owner shall pay building permit fees.

2. A Bid Bond or Cashier's Check is not required to be submitted with the Bid.

3. Depths of existing monitoring wells which require the Contractor to install a new transducer to measure depth of groundwater are:

A. MW-1 is 16 feet deep.

B. MW-2 thru MW-6 are 15 feet deep.

1. Each well has a 2-inch Diameter PVC Casing. Transducer must have an accuracy of 0.01 feet as required by SCDHEC.

4. Gulfstream Construction is the preferred contractor for the paving, grading, and drainage site work; due to their prior work on the property and relationship with the Owner. The

Owner will contract directly for this work. The Contractor shall be responsible to coordinate all related aspects of related work. Highlights of the site work scope this contractor will perform is:

- Silt Fence, Rock Check Dams, Construction Entrance, Concrete Washout Basin
- Tree Protection
- Earthwork & Rough Grading for Paving areas, Access Roads, Building Pads, Storm Water Pond & Influent Pond.
- Storm Drainage Inlets & Pipe
- Rip Rap
- Asphalt Paving & Base
- Pavement Markings & Wheel Stops
- All Weather Access Road
- Base material for Concrete Paving
- Removal of Silt Fence & Tree Protection upon completion

Site work specifically excludes:

- ✓ Concrete Paving & Sidewalks
- ✓ Pond Liner
- ✓ Utility Pipping & Structures
- ✓ Spray Field Improvements
- ✓ Landscaping, Gravel Areas & Grassing

5. M/R Systems is the preferred Scada System Integrator or System Supplier due to their prior work. The Owner will contract directly for this work. The Contractor shall be responsible to coordinate all related aspects of related work.

THOMAS & HUTTON

Mark F. Yodice

Mark F. Yodice, P.E.
Project Manager/Engineer of Record

Attachments

End of ADDENDUM NO. 1

DOCUMENT 00 41 43 - BID FORM (Revised Addendum No. 1)

PROJECT IDENTIFICATION:
Kiawah River Plantation (KRP) Wastewater Treatment Plant (WWTP)

CONTRACT IDENTIFICATION AND NUMBER:
J – 25328

THIS BID IS SUBMITTED TO:
Kiawah River Plantation Holdings, LP
and Ocean Boulevard Properties
a South Carolina Limited Partnership

C/O of Thomas & Hutton Engineering Co.
682 Johnnie Dodds Boulevard, Suite 100
Mt. Pleasant, SC 29464

1. The undersigned BIDDER proposes and agrees, if this Bid is accepted, to enter into an agreement with OWNER in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid Price and within the Bid Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.

2. BIDDER accepts all of the terms and conditions of the Advertisement or Invitation to Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 150 days after the day of Bid opening, or for such longer period of time BIDDER may agree to in writing upon request of OWNER.

3. In submitting this Bid, BIDDER represents, as more fully set forth in the Agreement, that:

   a. BIDDER has examined and carefully studied the Plans and Specifications for the work and contractual documents relative thereto, and has read all Technical Provisions, Supplementary Conditions, and General Conditions, furnished prior to the opening of Bids and can fulfill the requirements of the work to be performed.

   b. BIDDER further acknowledges hereby receipt of the following Addenda:

ADDENDUM NO.	DATE

   c. BIDDER has visited the site and become familiar with and is satisfied as to the general, local and site conditions possibly affecting cost, progress, performance and furnishing of the Work;

   d. BIDDER is familiar with and is satisfied as to all federal, state, and local Laws and Regulations possibly affecting cost, progress, performance and furnishing of the Work.

   e. BIDDER has carefully studied all reports of explorations and tests of subsurface conditions, at or contiguous to the site, and all drawings of physical conditions in or relating to existing surface or subsurface structure, at or contiguous to the site (except underground Facilities), have been identified in the Supplementary Conditions. BIDDER acknowledges such reports

and drawings are not Contract Documents and may not be complete for BIDDER's purposes.

BIDDER acknowledges OWNER and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities, at or contiguous to the site. BIDDER has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities), at or contiguous to the site or otherwise, or which relate any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including those identified in the bidding documents, associated safety precautions and programs incident thereto.

BIDDER does not consider any additional examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price and other terms and conditions of the Bidding Documents.

f. BIDDER is aware of the general nature of Work to be performed by Owner and others at the site relating to Work for which this Bid is submitted as indicated in the Bidding Documents.

g. BIDDER has correlated the information known to BIDDER, information and observations obtained from visits to the site, reports and drawings identified in the Bidding Documents and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.

h. BIDDER has given ENGINEER written notice of all conflicts, errors, ambiguities, or discrepancies BIDDER has discovered in the Bidding Documents and the written resolution thereof by ENGINEER is acceptable to BIDDER. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.

i. This bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm, or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; BIDDER has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; BIDDER has not solicited or induced any person, firm or corporation to refrain from bidding; and BIDDER has not sought by collusion to obtain for itself any advantage over any other Bidder or over OWNER.

j. Bidder has fully coordinated with the MBR supplier, Ovivo, and has included in the base bid price all work, materials, labor, equipment, and related to provide a complete and fully functional plant including the MBR system.

4. BIDDER will complete the Work in accordance with the Contract Documents. The total contract price shall include the allowances specified in Section 01 21 00 and shall include all costs related to the MBR system.

BASE BID

TOTAL BASE BID PRICE: _____

_____ (Use words)

($_____)

(Figures)

The following unit prices are established:

a. *12-inch Square Precast Concrete Piles* $_____ *per foot*
(Figures)

b. *Remove and Replace Unsuitable Material* $_____ *per cubic yard*
(Figures)

5. BIDDER agrees the Work will be substantially complete within 510 consecutive days and ready for final payment in accordance with paragraph 14.07 of the General Conditions within 540 consecutive days after the date when the Contract Times commence to run.

6. BIDDER accepts provisions of the Agreement as to liquidated damages, in the amount of $2,000.00 per day for substantial completion and $1,000.00 per day for final completion, in the event of failure to complete the Work within times specified in the Agreement.

7. The following documents are to be submitted by the two lowest bidders within 24 hours after the bid opening:

   a. Tabulation of major Subcontractors, Suppliers, and other persons and organizations required to be identified in this Bid.
   b. Schedule of Valves (formerly exhibit A) which total lump sum contract amount.

8. Communications concerning this Bid shall be addressed to:

Thomas & Hutton Engineering Co.
682 Johnnie Dodds Boulevard, Suite 100
Mt. Pleasant, SC 29464
Attn: Mark Yodice

9. Terms used in this Bid which are defined in the General Conditions or Instructions will have the meanings indicated in the General Conditions of Instructions.

SUBMITTED on _____, 2016.

_____
CONTRACTOR'S NAME

ADDRESS:

_____

_____

BY:_____

_____

State Contractor License No._____

SECTION 05 41 00

COLD-FORMED STEEL FRAMING

PART 1 – GENERAL

1.01 SUMMARY

1. This section applies to cold-formed metal trusses.

2. Relevant specification sections include 09 22 16, Non-Structural Metal Framing, applicable to interior non-loadbearing metal stud wall framing.

1.02 SUBMITTALS

A. Product Data: Truss Component Manufacturer's material certifications and descriptive literature for each item of cold-formed metal framing and each accessory specified in this section.

B. Shop Drawings: Truss fabricator's drawings and details that indicate the following:

1. special components and installations not fully detailed in product data
2. the number, types, location, and spacings of trusses and other framing members
3. details of truss loading, reactions, uplifts, support locations, material sizes and gauges, permanent truss web bracing, and splices as required for a complete installation

C. Truss Component Manufacturer's Instructions: Printed installation instructions for each item of cold-formed metal framing and each accessory specified in this section.

D. Design Data: Results of design analysis, bearing the seal and signature of a professional engineer registered in the State in which project is located.

E. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.

1.03 QUALITY ASSURANCE

A. General: For member section properties, meet requirements of AISI, Specification for the Design of Cold–Formed Steel Structural Members and Design Guide for Cold–Formed Steel Trusses.

B. Qualifications for Welding: As specified in Section 05 05 23, Welding.

C. Pre-installation Meeting: to be held on site prior to commencement of construction activities of this section to include installer(s) of products in this section, general contractor, engineer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Handle and lift shop assembled units in accordance with Truss Component Manufacturer's recommendations to prevent damage or distortion.

B. Deliver to Site in bundles marked with name of manufacturer, section type, thickness, grade of material, and length.

C. Store bundles on wood blocking, flat and off ground, to keep clean and to prevent any damage or permanent distortion. Adhere to other recommendations from Truss Component Manufacturer to prevent damage, distortion and moisture buildup.

1.05 DESIGN REQUIREMENTS

A. Design loads shall be as indicated on the drawings.

B. Design framing systems to withstand design loads without vertical deflections greater than 1/240 of the span.

C. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 degrees F.

D. Design framing systems to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.

PART 2 – PRODUCTS

2.01 GENERAL

A. Truss system, with framing components and accessories, shall provide a complete horizontal framing system, ready for deck installation, meeting specified Design Requirements.

B. Dimensions and Properties: Calculate section properties in accordance with AISI Cold–Formed Steel Design Manual.

2.02 MANUFACTURERS

A. Choose from the following:

1. Aegis Metal Framing (MiTek USA Inc.).

2. Advanced Exterior Systems.

3. TrusSteel (ITW Building Components Group).

4. Nuconsteel (A Nucor Company)

5. Raney Truss

6. East Coast Truss, Inc.

7. Other approved suppliers may be considered upon request, prior to submittal of bids and contract award.

1.03 MATERIALS

A. Truss chord and web components shall have rolled or closed edges.

B. Load Bearing Members: Mechanical properties of components shall be determined by testing conforming to ASTMA 370 - Standard Test Methods and Definitions for Mechanical Testing of Steel Products. Members shall be cold-formed to indicated sizes, profiles, and thickness of steel conforming to ASTMA 653, minimum G60 coating, and ASTM A500 as follows:

1. Chord materials - Minimum yield strength 55,000 KSI
2. Web materials - Minimum yield strength 45,000 KSI.
3. Shapes: Indicated on shop drawings.
4. Size: Indicated on shop drawings.
5. Gauge: Indicated on shop drawings.

C. Fasteners Used in Fabricating Trusses: All web to chord connections shall be made with the appropriate screw fastener as recommended by the Truss Component Manufacturer. Each screw shall bear the stamp of the Truss Component Manufacturer for ready identification. Alternative fastening methods, such as welding, are not acceptable.

D. Accessories shall be from same manufacturer as trusses.

2.04 MECHANICAL FASTENERS

A. Self–Drilling Screws:

1. Self–drilling, self–tapping screws with hexagonal washer head and corrosion–resistant finish.

2. Manufacturers and Products:

a. ITW Buildex, Itasca, IL; ICH Traxx Self–Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.

b. Hilti, Inc., Tulsa, OK; Kwik–Pro RWH Self–Drilling Screws with Kwik–Cote Treatment and Kwik–Tapper Screwdriver.

B. Powder–Driven Fasteners:

1. Knurled shank, minimum I/2–inch diameter steel washer, corrosion–resistant coating.

2. Pin diameter and length to suit deck type and flange thickness of steel support member.

3. Manufacturers and Products:

   a. ITW Buildex, Itasca, IL; Buildex BXI4 pins with yellow dichromate galvanizing and BX900 Installation Tool.

   b. Hilti, Inc., Tulsa, OK; ENP–series fasteners with electroplated zinc coating and DX–750 Installation Tool.

2.05 FABRICATION

A. Shop fabricate from cold formed steel components in accordance with shop drawings, using jigging systems to ensure consistent component placement and alignment of components, and to maintain specified tolerances as shown herein.

B. Field fabrication of trusses is strictly prohibited unless performed by authorized fabricator using the fabricator's shop assemblers and proper jigging systems. Request for this must be sent to Engineer with fabricator documentation.

C. Shop fabrication of other cold formed steel framing components into assemblies prior to erection is permitted; fabricate assemblies in accordance with shop drawings.

2.06 TOLERANCES

A. Material Tolerances: Steel for cold-formed chord components:

1. Nominal 22 ga. members: Minimum bare metal thickness: 0.0284 inch, Maximum design thickness: 0.0299 inch.
2. Nominal 20 ga. members: Minimum bare metal thickness: 0.0329 inch, Maximum design thickness: 0.0346 inch.
3. Nominal 18 ga. members: Minimum bare metal thickness: 0.0428 inch, Maximum design thickness: 0.0451 inch.
4. Nominal 16 ga. members: Minimum bare metal thickness: 0.0538 inch, Maximum design thickness: 0.0566 inch.

B. Material Tolerances: Steel for cold-formed web components

1. Nominal 20 ga. members: Minimum bare metal thickness: 0.033 inch, Maximum design thickness: 0.035 inch.
2. Nominal 18 ga. members: Minimum bare metal thickness: 0.047 inch, Maximum design thickness: 0.049 inch.
3. Nominal 16 ga. members: Minimum bare metal thickness: 0.063 inch, Maximum design thickness: 0.065 inch.

C. Materials Tolerances: Truss Assemblies: Fabricate to tolerances of maximum variation from plumb, level, or true to line as indicated below:

1. Trusses up to 30 ft long = max 1/2 in. variation from design length.
2. Trusses over 30 ft. long = max 3/4 in. variation from design length.
3. Trusses up to 5 ft. high = max 1/4 in. variation from design height.
4. Trusses over 5 ft. high = max 1/2 in. variation from design height.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Inspect all fabricated assemblies and repair any damage.

B. Examine bearing support surfaces for compliance with requirements for installation tolerances and other conditions affecting performance of metal framing systems.

C. Provide smooth level bearing surfaces.

D. Clean all member and bearing surfaces that will be in contact after assembly.

3.02 INSTALLATION

A. General:

1. Install framing systems as indicated on Drawings, complete and in accordance with manufacturer's recommendations.

2. Provide temporary bracing for support of all construction loads until framing system is installed complete with sheathing or decking.

3. Install framing in true line, plumb, level, and in proper alignment.

4. Cut ends of framing members with saw or shear to bear uniformly against abutting members. Flame cutting is not permitted.

5. All structural framing members shall be full–length without splices, unless indicated otherwise.

6. Fasten members together in accordance with AISI, Cold–Formed Steel Design Manual, Part N, Connections. Wire tying is not permitted.

B. Metal Trusses:

1. Install metal trusses in accordance with Truss Component Manufacturer's instructions and the Truss Fabricator's shop drawing submittal. Place components at spacings indicated on the Truss Fabricator's shop drawings. Install truss installation (erection) bracing. Truss installation (erection) bracing shall hold trusses straight and plumb and in safe condition until decking and permanent truss bracing has been fastened, forming a structurally sound framing system. All sub-contractors shall

employ proper construction procedures to insure adequate distribution of temporary construction loads so that the carrying capacity of any single truss or group of trusses is not exceeded.

2. Install required roof and system permanent bracing and bridging as indicated by the drawings and notes of the Architect or Engineer. See the Truss Fabricator's shop drawings for any additional bracing requirements. All truss installation (erection) bracing and permanent bracing and bridging shall be installed before the application of any loads.

3. The field removal, cutting or alteration of any truss chord, web or bracing members is not allowed without prior written approval of the Engineer and the Truss Designer.

4. Damaged chords, webs and complete trusses shall be repaired or replaced as directed and approved in writing by the Engineer and the Truss Designer prior to installation or application of the repair or replacement.

5. Install field fasteners as identified on drawings and in accordance with Manufacturer's recommendations.

6. Tolerances:

   a. Variation from Level or Specified Plane: Maximum 1/8 inch in 10 feet.

   b. Variation from Specified Position: Maximum 1/4 inch.

3.03 FIELD QUALITY CONTROL

A. An independent testing agency will be retained by Owner to inspect field connections and welds.

1. Mechanical Fasteners: Visually inspect in accordance with manufacturer's instructions, for each type of fastener.

2. Welded connections performed during fabrication shall be visually inspected.

B. Repair or replace defective welds and/or fasteners.

END OF SECTION

SECTION 06 82 00

ARCHITECTURAL FIBERGLASS COLUMN COVERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, conditions of the contract and Division 01 Specifications sections, apply to work of this section.

1.2 SUMMARY

A. Section Includes: Architectural Fiberglass Reinforced Polymer (FRP) Column Covers.

1.3 RELATED SECTIONS

A. Section 05 12 00 – Structural Steel: Support framing for architectural fiberglass column cover.

B. Section 07 92 00 – Joint sealants and field applied sealants.

1.4 DESIGN REQUIREMENTS

A. Installed architectural fiberglass column covers and fastening systems shall be designed, engineered, fabricated, and installed to conform to the state codes, local codes, and the Architect's design.

1.5 SUBMITTALS

A. Shop Drawings: Shall illustrate dimensions, adjacent construction, materials, thickness, fabrications details, required clearances, field jointing, tolerances, colors, finishes, methods of support, attachments, anchorage to substrates, integration of components, and list of part numbers that coordinate with labeled architectural column covers.

B. Submit manufacturer's current valid certification with The Certified Composites Technician (CCT) program created by the American Composites Manufacturers Association (ACMA).

C. Submit manufacturer's internal Quality Control & Assurance Procedures based upon provisions published in the "Guidelines and Recommended Practices for Fiberglass Reinforced Plastic Architectural Products" upon request.

D. Product Data: Submit manufacturer's product data and installation instructions.

E. Product Samples: Submit minimum 3-inch x 5-inch samples in specified color, texture and finish when applicable.

1.6 QUALITY ASSURANCE

A. Obtain architectural fiberglass column covers from a single source manufacturer that has the ability and resources to comply with the requirements and schedule of the project.

B. Manufacturer to comply with Quality Control & Assurance Procedures, and fabricate architectural fiberglass based upon provisions published in the "Guidelines and Recommended Practices for Fiberglass Reinforced Plastic Architectural Products".

C. Inspect each molded piece to ensure that it complies with specified requirements, including nominal dimensions.

1.7 MANUFACTURER'S QUALIFICATIONS

A. Manufacturer: Provide products manufactured by a firm specializing in the manufacture of fiberglass architectural ornamentation, in the United States with a minimum of ten (10) years' experience.

B. Manufacturer shall demonstrate current valid certification and participation in the CCT program and fabricate material based upon provisions published in the "Guidelines and Recommended Practices for Fiberglass Reinforced Plastic Architectural Products".

C. Provide a list of projects comparable in size, scope, and complexity as indicated, upon request.

D. Provide verification that architectural fiberglass column cover meets or exceeds products specified.

1.8 DELIVERY, STORAGE AND HANDLING

A. Handle, store and transport architectural fiberglass column covers according to manufacturer's recommendations and in a manner that prevents damage.

B. Protect architectural fiberglass column covers from damage by retaining shipping protection in place until installation.

C. Damage Responsibility: Except for damage caused by others, the installer is responsible for chipping, cracking, or other damage to fiberglass fabrications, after delivery to the jobsite and until installation is completed and inspected and approved by the Architect.

1.9 WARRANTY

A. Warrant architectural fiberglass column covers to be free from defect due to materials and workmanship for one year.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Architectural Fiberglass, Inc.
2. EDON Corporation.
3. Melton Classics.

2.2 PATTERNS/MOLDS

A. Custom Pattern/Mockups: Patterns and mockups shall be hand carved and/or CNC machined by skilled pattern makers with minimum of ten (10) years' experience with architectural elements. Patterns & mockups shall be available at manufacturing facility for architect's inspection and approval before molds are produced.

B. Custom Molds: Molds shall be produced with ample layers of tooling resin, tooling gel-coat, glass fibers and/or flexible rubber by skilled mold makers with minimum of ten (10) years' experience with architectural elements. Produced molds shall have rigidity and thickness to prevent distortion and deflection of molded architectural fiberglass.

2.3 MATERIALS CHARACTERISTICS

A. MOLDED EXTERIOR SURFACE: NPG-ISO polyester gel coat, 18 to 22 mils thick. Gel coat shall be sandable grade for acceptance of finish paint.

B. BARRIER COAT: Specifically formulated backup polyester surface veil 18-20 mils thick to prevent glass print through and ultimate Class A finish.

C. BACK UP LAMINATE:

1. Resin: Polyester resin shall be fire retardant, and meet Class 1 flame spread rating of 25 or less and smoke density under 450 without the use of antimony trioxide as characterized by the ASTM E-84 tunnel test at typical 1/8" glass mat laminate. General Purpose resin <u>will not</u> be permitted.
2. Filler: Functional filler to be added to resin matrix to minimize shrinkage, add stiffness, control opacity, add fire retardance, improve surface finish, minimize crazing, and control dimensional stability from weather extremes.
3. Fiberglass Reinforcement: Type "E" fiberglass, glass cloth, matt and/or random chopped glass fibers. Glass content approximately 20% to 30%.
4. Laminate Thickness: Nominal laminate shall be minimum 3/16" thickness. Additional core reinforcements and/or sandwich structure added as required for rigidity and structural integrity.

2.4 FABRICATION

A. Column cover halves shall be manufactured with sufficient butt joints to provide structural integrity and shall be manufactured to accommodate construction adhesive, and align with adjoining half section.

B. Column vertical joint shall be designed to accept polyester body filler for monolithic finish and field painting.

C. Column cover shaft half sections shall be manufactured as a single unit spanning entire height from base to top of capital.

D. Column base shall be manufactured as a separate unit for column shaft height adjustment.

AVERAGE MECHANICAL PROPERTIES:

PROPERTY	VALUE	TEST METHOD
Tensile strength	12,000 PSI	ASTM D638
Flexural strength	20,000 PSI	ASTM D790
Flexural modulus	0.9 x 10^6 PSI	ASTM D790
Compressive strength	17,000 PSI	ASTM D695
Bearing strength	9,000 PSI	ASTM D638
Thermal expansion	10 x 10^{-6} (□F)	
Specific gravity	1.5	

2.5 FINISH

A. Color as selected by Architect for field painting unless otherwise specified.

B. Surface Texture/Exposed side shall be smooth ready for light sanding and painting.

2.6 TOLERANCES

A. Part Thickness: + or – 1/8 inch.

B. Gel Coat Thickness: + or – 2.5 mils.

C. Length: + or – 1/8 inch

D. Variation from Square: 1/8 inch.

E. Hardware Location Variation: + or – ¼ inch.

2.7 IDENTIFICATION

A. Identify each column cover unit with a permanent serial number.

B. Number parts to coordinate with shop drawings.

2.8 CURING AND CLEANING

A. Cure and clean components prior to shipment and remove material which may be:

1. Toxic to plant or animal life.
2. Incompatible with adjacent building material.

2.9 ANCHORS AND FASTENERS

A. Contractor to provide anchors and fasteners and other accessories for proper installation of architectural fiberglass column covers as recommended and approved by fiberglass fabrication manufacturer.

PART 3 – EXECUTION

3.1 PRE-INSTALLATION EXAMINATION

A. Carefully observe and verify field conditions that substrates are ready for installation of architectural fiberglass column covers. Contractor shall verify on site dimensions with shop drawings and assume full responsibility for fitting the components to the structure.

B. Verify that bearing surfaces are true and level.

C. Verify that support framing has been constructed to allow accurate placement, alignment and connection of architectural column covers to structure.

D. Report discrepancies between design dimensions and field dimensions, which could adversely affect installation, to the Architect.

E. Do not proceed with installation until discrepancies are corrected, or until installation requirements are modified and approved by the Architect.

F. Beginning of installation means acceptance of existing conditions and fiberglass materials.

3.2 INSTALLATION

A. Install architectural fiberglass column covers in accordance with manufacturer's instructions and approved shop drawings.

B. Fiberglass column cover vertical joint shall be field finished and painted per manufacturer's instructions for monolithic appearance.

3.3 ALLOWABLE TOLERANCES FOR INSTALLED UNITS

A. Maximum offset from True Alignment: 1/4 inch in 20 feet.

B. Maximum Variation from True Position: 1/2 inch in 20 feet.

3.4 CLEANING

A. Clean installed architectural fiberglass column covers using cleaning methods and material approved by manufacturer.

3.5 PROTECTION OF INSTALLED FABRICATIONS

A. Comply with manufacturer's recommendations and instructions for protecting installed column covers during construction activities.

END OF SECTION

SECTION 08 54 13

FIBERGLASS WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes fixed fiberglass faced windows.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of windows with other exterior wall components. Include provisions for anchoring, flashing, weeping, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, finishes, and operating instructions for each type of window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, attachments to other Work, operational clearances, and the following:

1. Mullion details, including reinforcement and stiffeners.
2. Joinery details.
3. Flashing and drainage details.
4. Glazing details.

C. Samples for Verification: For window components required, prepared on Samples of size indicated below.

1. Main Framing Member: 12-inch- long, full-size sections of extrusions with factory-applied color finish.

D. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of window. Test results based on use of down-sized test units will not be accepted.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to window manufacturer for installation of units required for this Project.

B. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

C. Window Installation Publications: Comply with FMA/WDMA 250-10 "Standard Practice for the Installation of Non-Frontal Flange Windows with Mounting Flanges for Surface Barrier Masonry Construction for Extreme Wind / Water Conditions."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify window openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fiberglass Faced Windows:

    a. Andersen Windows Inc. – Series A Coastal Stormwatch (Basis-of-Design)
    b. Pella Corporation.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

    1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

    1. Minimum Performance Class: LC.
    2. Minimum Performance Grade: 70.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.29 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.28.

E. Sound Transmission Class (STC): Rated for not less than 34 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

F. Outside-Inside Transmission Class (OITC): Rated for not less than 31 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

G. Windborne-Debris Resistance: Capable of resisting impact from windborne debris based on testing glazed windows identical to those specified, according to ASTM E 1886 and testing information in ASTM E 1996 and requirements of authorities having jurisdiction.

2.3 FIBERGLASS WINDOWS

A. Operating Types: Provide the following operating types in locations indicated on Drawings:

    1. Fixed; non-frontal flange type with mounting flanges.

B. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide; water-repellent preservative treated.

    1. Exterior Finish: Fiberglass composite.

        a. Color: As selected by Architect from manufacturer's full range.

2. Interior Finish: Manufacturer's standard color-coated finish.

    a. Color: White.

C. Windborne-Debris-Impact-Resistant Insulating-Glass Units: ASTM E 2190 with two lites and complying with impact-resistance requirements in "Window Performance Requirements" Article.

1. Exterior Lite: ASTM C 1036, Type 1, Class 1, q3; clear; heat strengthened.
2. Interior Lite: ASTM C 1172 clear laminated glass with two plies of float glass.

    a. Float Glass: As required by performance requirements indicated.
    b. Interlayer Thickness: As required by performance requirements indicated.

3. Filling: Fill space between glass lites with argon.
4. Low-E Coating: Sputtered on second surface.

D. Exterior Trim and Casing: Where indicated on Drawings, provide fiberglass composite trim in sizes indicated.

1. Color: Match window framing.

E. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 FABRICATION

A. Fabricate windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

F. Glazing Impact-Resistant Units: Factory glaze with high performance glazing sealant as primary seal and removable interior stops. Backfill between glass edge and frame with high performance sealant. Apply high performance glazing sealant as secondary seal at glass opening perimeter

1. Color of Secondary Sealant: Match window unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; and other conditions affecting performance of work.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for installing windows, accessories, and other components; Drawings; and Shop Drawings.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Water Spray Test: Before installation of interior finishes has begun, windows designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

3.4 PROTECTION AND CLEANING

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 09 90 00

PAINTING AND PROTECTIVE COATINGS

PART 1 – GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Water Works Association (AWWA):
    a. C203, Coal–Tar Protective Coatings and Linings for Steel Water Pipelines–Enamel and Tape–Hot–Applied.
    b. C209, Cold–Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
    c. C213, Fusion–Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
    d. C214, Tape Coating Systems for the Exterior of Steel Water Pipelines.
2. Environmental Protection Agency (EPA).
3. NACE International (NACE): RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
4. NSF International (NSF): 61, Drinking Water System Components Health Effects.
5. Occupational Safety and Health Act (OSHA).
6. The Society for Protective Coatings (SSPC):
    a. P A 2, Measurement of Dry Coating Thickness with Magnetic Gages.
    b. P A 3, Guide to Safety in Paint Applications.
    c. SP 1, Solvent Cleaning.
    d. SP 2, Hand Tool Cleaning.
    e. SP 3, Power Tool Cleaning.
    f. SP 5, White Metal Blast Cleaning.
    g. SP 6, Commercial Blast Cleaning.
    h. SP 7, Joint Surface Preparation Standard Brush–Off Blast Cleaning.
    i. SP 10, Near–White Blast Cleaning.
    j. SP 11, Power Tool Cleaning to Bare Metal.

k. SP 12, Surface Preparation and Cleaning of Metals Water jetting Prior to Recoating.

l. SP 13, Surface Preparation of Concrete.

m. Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.

7. Master Painters Institute (MPI)

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCI: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. Mil: Thousandth of an inch.
6. PDS: Product Data Sheet.
7. PSDS: Paint System Data Sheet.
8. PVC: Polyvinyl Chloride.
9. SFPG: Square Feet per Gallon.
10. SFPGPC: Square Feet per Gallon per Coat.
11. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Data Sheets:

a. For each product, furnish a Product Data Sheet (PDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PDS form is appended to the end of this section.

b. For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.

c. Technical and performance information that demonstrates compliance with Specification.

d. Furnish copies of paint system submittals to the coating applicator.

e. Indiscriminate submittal of only manufacturer's literature is not acceptable.

f. Provide a cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

g. Printout of current "MPI Approved Products List" with the proposed product highlighted for those products specified in paragraph "Architectural Paint Systems and Application Schedule" herein.

2. Detailed chemical and gradation analysis for each proposed abrasive material.

3. Paint Color Schedule: List of paint colors selected (manufacturer, name and number) and corresponding locations of application.

4. Samples:

a. Reference Panel:

1) Paint & Coatings:

(a) Unless otherwise specified, before painting work is started, prepare samples as required in "Mockup" herein.

(b) Furnish additional samples as required until colors, finishes, and textures are approved.

(c) Approved samples to be the quality standard for final finishes.

B. Informational Submittals:

1. Applicator's Qualification: List of references substantiating experience.

2. Coating manufacturer's Certificate of Compliance, in accordance with Section 01 00 01, General Requirements.

3. Factory Applied Coatings: Manufacturer's certification stating factory applied coating system meets or exceeds requirements specified.

4. Manufacturer's written verification that submitted material is suitable for the intended use and is compatible with any other products applied to the same surface.

5. Manufacturer's written instructions and special details for applying each type of paint and coating.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years' experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting the emission of volatile organic compounds (VOC).

2. Perform surface preparation and painting in accordance with recommendations of the following:

a. Paint manufacturer's instructions.

b. SSPC P A 3, Guide to Safety in Paint Applications.

c. Federal, state, and local agencies having jurisdiction.

C. MPI Standards for Architectural Paint Systems:

1. Products listed in paragraph "Architectural Paint Systems and Application Schedule" shall comply with MPI Standards indicated and listed in current "MPI approved Products List".

2. Preparation and workmanship of products listed in paragraph "Architectural Paint Systems and Application Schedule" shall comply with requirements in "MPI Architectural Painting Specification Manual".

D. Mockup:

1. Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

2. Unless noted otherwise, prepare minimum 8–inch by 10–inch sample with type of paint and/or coating and application specified on similar substrate to which paint and/or coating is to be applied.

a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.

b. Doors: Provide full size samples for interior and exterior doors.

3. If preliminary color selections are not approved, additional benchmark samples of additional colors selected by Architect shall be provided by the Contractor at no added cost to Owner.

4. Final approval of color selections will be based on benchmark samples which shall serve as the quality standard for final finishes.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery:

1. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

a. Product name or title of material.
b. Product description (generic classification or binder type).
c. Manufacturer's stock number and date of manufacture.
d. Contents by volume, for pigment and vehicle constituents.
e. Thinning instructions.
f. Application instructions.
g. Color name and number.

B. Shipping:

1. Where precoated items are to be shipped to the Site, protect coating from damage. Batten coated items to prevent abrasion.
2. Protect shop painted surfaces during shipment and handling by suitable provisions including padding, blocking, and use of canvas or nylon slings.
3. Contractor shall repair damages that have occurred during transit, to the satisfaction of the Owner, or shall supply a replacement.

C. Storage:

1. Store products in a protected area that is heated or cooled to maintain temperatures within the range recommended by paint manufacturer.
2. Primed surfaces shall not be exposed to weather for more than 2 months before being top coated, or less time if recommended by coating manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures or moisture conditions outside of manufacturer's recommended maximum or minimum allowable.
2. Do not perform final abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dew point of ambient air.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Nationally recognized manufacturers of paints and protective coatings who are regularly engaged in the production of such materials for essentially identical service conditions.

B. Minimum of 5 years' verifiable experience in manufacture of specified product.

C. Each of the following manufacturers is capable of supplying most of the paint products specified in paragraph "Architectural Paint Systems and Application Schedule" herein:

1. Sherwin Williams.
2. Tnemec.
3. PPG Architectural Finishes.
4. Benjamin Moore & Co.
5. Rose Talbert Paints

D. Acceptable manufacturers of other paints and/or coatings are as specified in Section 3.

2.02 ABRASIVE MATERIALS

A. Select abrasive type and size to produce surface profile that meets coating manufacturer's recommendations for specific primer and coating system to be applied.

2.03 PAINT MATERIALS

A. General:

1. Manufacturer's highest quality products suitable for intended service.
2. Compatibility: Only compatible materials from a single manufacturer shall be used in the Work. Particular attention shall be directed to compatibility of primers and finish coats.
3. Thinners, Cleaners, Driers, and Other Additives: As recommended by coating manufacturer.

B. Products:

Product	Definition
Acrylic Latex	Single–component, finish as required.
Acrylic Latex (Flat)	Flat latex
Acrylic Sealer	Clear acrylic
Alkyd (Semigloss)	Semigloss alkyd
Alkyd Enamel	Optimum quality, gloss or semigloss finish as required, medium long oil.
Alkyd Wood Primer	Flat alkyd
Bituminous Paint	Single–component, coal–tar pitch based.
Block Filler	Primer–sealer designed for rough masonry surfaces, 100% acrylic emulsion.
Coal–Tar Epoxy	Amine, polyamide, or phenolic epoxy type 70% volume solids minimum, suitable for immersion service.
DTM Acrylic Primer	Surface tolerant, direct–to–metal water borne acrylic primer.
DTM Acrylic Finish	Surface tolerant, direct–to–metal water borne acrylic finish coat.
Elastomeric Polyurethane	100% solids, plural component, spray applied, high build, elastomeric polyurethane coating, suitable for the intended service.
Epoxy Filler/Surfacer	100% solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete and masonry. Approved for potable water contact and conforming to NSF 61, where required.
Epoxy Nonskid (Aggregated)	Polyamidoamine or amine converted epoxies aggregated; aggregate may be packaged

Product	Definition
	separately
Epoxy Primer–Ferrous Metal	Anticorrosive, converted epoxy primer containing rust–inhibitive pigments.
Epoxy Primer–Other	Epoxy primer, high–build, as recommended by coating manufacturer for specific galvanized metal, copper, or nonferrous metal alloy to be coated.
Fusion Bonded Coating	100% solids, thermosetting, fusion bonded, dry powder epoxy, suitable for the intended service.
Fusion Bonded, TFE Lube or Grease Lube	Tetrafluoroethylene, liquid coating, or open gear grease as supplied by McMaster–Carr Supply Corporation., Elmhurst, IL; RL 736 manufactured by Amrep, Inc., Marietta, GA.
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 to 8 MDFT per coat.
High Solids Polyurethane	Two–component, low VOC, aliphatic, acrylic polyurethane resin coating having a minimum of 65% volume solids; high gloss or semi gloss finish
Inorganic Zinc Primer	Solvent or water based, having 85% metallic zinc content in the dry film; follow manufacturer's recommendation for top coating.
Latex Primer Sealer	Waterborne vinyl acrylic primer/sealer for interior gypsum board and plaster. Capable of providing uniform seal and suitable for use with specified finish coats.
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Epoxy, High Solids	Polyamidoamine epoxy, 80% volume solids, minimum, suitable for immersion service
Polyurethane Enamel	Two–component, aliphatic or acrylic based polyurethane; high gloss finish
Rust–Inhibitive Primer	Single–package steel primers with anticorrosive pigment loading
Sanding Sealer	Co–polymer oil, clear, dull luster.
Silicone/Silicone Acrylic	Elevated temperature silicone or silicone/acrylic based.
Stain, Concrete	Acrylic, water repellant, penetrating stain.

Product	Definition
Stain, Wood	Satin luster, linseed oil, solid or transparent as required.
Varnish	Non–pigmented vehicle based on a variety of resins (alkyd, phenolic, urethane) in gloss, semigloss, or flat finishes, as required.
Water Base Epoxy	Two–component, polyamide epoxy emulsion, finish as required.

2.04 MIXING

A. Multiple–Component Coatings:

1. Prepare using each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple–component coatings that have been mixed beyond their pot life.
4. Furnish small quantity kits for touchup painting and for painting other small areas.
5. Mix only components specified and furnished by paint manufacturer.
6. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

B. Colors: Formulate paints with colorants free of lead, lead compounds, or other materials that might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

2.05 SHOP FINISHES

A. Shop Blast Cleaning: Reference Paragraph, Shop Coating Requirements.

B. Surface Preparation: Provide Contractor minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie–coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie–coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

2.06 ARCHITECTURAL PRODUCTS

The following is to be applied to all paint systems except where specifically noted otherwise herein and on the Drawings.

A. Exterior Metal Primer: Primer, Epoxy, Anti-Corrosive, for Metal: MPI #101

B. Exterior Wood Primer: Primer, Alkyd for Exterior Wood: MPI #5.

C. Exterior Water-Based Paint: Light Industrial Coating, Exterior, Water Based, Gloss (Gloss Level 6): MPI #164.

D. Exterior Latex Paint: Exterior Latex (Semigloss) MPI #11 (Gloss Level 5).

E. Interior Primers / Sealers: Interior Latex Primer/Sealer MPI #50.

F. Interior Metal Primers:

   a. Quick-Drying Alkyd Metal Primer MPI #76.

   b. Waterborne Galvanized-Metal Primer: MPI #134.

G. Interior Latex Paints:

   a. Interior Latex (Eggshell) MPI #52 (Gloss Level 3).

   b. Interior Latex (Semigloss): MPI #54 (Gloss Level 5).

H. Epoxy Coatings: Epoxy-Modified Latex, Interior, Gloss (Gloss Level 6) MPI #115.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide Contractor minimum 7 days' advance notice to start of field surface preparation work and coating application work.

B. Perform the Work only in presence of Contractor, unless Engineer grants prior approval to perform the Work in Contractor's absence.

C. Schedule inspection of cleaned surfaces and all coats prior to succeeding coat in advance with Contractor.

3.02 EXAMINATION

A. Factory Finished Items:

1. Schedule inspection with Contractor before repairing damaged factory-finished items delivered to Site.

2. Repair abraded or otherwise damaged areas on factory–finished items as recommended by coating manufacturer. Carefully blend repaired areas into original finish. If required to match colors, provide full finish coat in field.

B. Surface Preparation Verification: Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. The more stringent requirements shall apply.

C. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent
2. Masonry: 12 percent
3. Wood: 15 percent
4. Gypsum Board: 12 percent

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry. Commencement of coating application constitutes Contractor's acceptance of substrates and conditions.

3.03 PROTECTION OF ITEMS NOT TO BE PAINTED

A. Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere to be painted.

B. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

C. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process.

D. Mask openings in motors to prevent paint and other materials from entering.

E. Protect surfaces adjacent to or downwind of Work area from overspray.

3.04 SURFACE PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated in paragraph "Architectural Paint Systems and Application Schedule".

B. Metal Surface Preparation:

1. Where indicated, meet requirements of SSPC Specifications summarized below:

a. SP 1, Solvent Cleaning: Removal of visible oil, grease, soil, drawing and cutting compounds, and other soluble contaminants by cleaning with solvent.

b. SP 2, Hand Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using nonpower hand tools.

c. SP 3, Power Tool Cleaning: Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, using power–assisted hand tools.

d. SP 5, White Metal Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter by blast cleaning.

e. SP 6, Commercial Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 33 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations

caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

f. SP 7, Brush–Off Blast Cleaning: Removal of visible rust, oil, grease, soil, dust, loose mill scale, loose rust, and loose coatings. Tightly adherent mill scale, rust, and coating may remain on surface.

g. SP 10, Near–White Blast Cleaning: Removal of visible oil, grease, dust, dirt, mill scale, rust, coatings, oxides, corrosion products, and other foreign matter, except for random staining limited to no more than 5 percent of each unit area of surface which may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings.

h. SP 11, Power Tool Cleaning to Bare Metal: Removal of visible oil, grease, dirt, dust, mill scale, rust, paint, oxide, corrosion products, and other foreign matter using power–assisted hand tools capable of producing suitable surface profile. Slight residues of rust and paint may be left in lower portion of pits if original surface is pitted.

i. SP 12, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating: Surface preparation using high–pressure and ultrahigh–pressure water jetting to achieve specified surface cleanliness condition. Surface cleanliness conditions are defined in SSPC SP 12 and are designated WJ–I through WJ–4 for visual surface preparation definitions and SC–I through SC–3 for nonvisual surface preparation definitions.

2. The words "solvent cleaning," "hand tool cleaning," "wire brushing," and "blast cleaning," or similar words of equal intent in these Specifications or in paint manufacturer's specification refer to the applicable SSPC Specification.

3. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet or vacu–blast methods may be required. Coating manufacturers' recommendations for wet blast additives and first coat application shall apply.

4. Ductile Iron Pipe Supplied with Asphaltic Varnish Finish: Remove asphaltic varnish finish prior to performing specified surface preparation.

5. Hand tool clean areas that cannot be cleaned by power tool cleaning.

6. Round or chamfer sharp edges and grind smooth burrs, jagged edges, and surface defects.

7. Welds and Adjacent Areas:

a. Prepare such that there is:

1) No undercutting or reverse ridges on weld bead.

2) No weld spatter on or adjacent to weld or any area to be painted.

3) No sharp peaks or ridges along weld bead.

b. Grind embedded pieces of electrode or wire flush with adjacent surface of weld bead.

8. Preblast Cleaning Requirements:

a. Remove oil, grease, welding fluxes, and other surface contaminants prior to blast cleaning.

b. Cleaning Methods: Steam, open flame, hot water, or cold water with appropriate detergent additives followed with clean water rinsing.

c. Clean small isolated areas as above or solvent clean with suitable solvent and clean cloth.

9. Blast Cleaning Requirements:

a. Type of Equipment and Speed of Travel: Design to obtain specified degree of cleanliness. Minimum surface preparation is as specified herein and takes precedence over coating manufacturer's recommendations.

b. Select type and size of abrasive to produce surface profile that meets coating manufacturer's recommendations for particular primer to be used.

c. Use only dry blast cleaning methods.

d. Do not reuse abrasive, except for designed recyclable systems.

e. Meet applicable federal, state, and local air pollution and environmental control regulations for blast cleaning, confined space entry (if required), and disposition of spent aggregate and debris.

10. Post–Blast Cleaning and Other Cleaning Requirements:

a. Clean surfaces of dust and residual particles from cleaning operations by dry (no oil or water vapor) air blast cleaning or other method prior to painting. Vacuum clean enclosed areas and other areas where dust settling is a problem and wipe with a tack cloth.

b. Paint surfaces the same day they are blasted. Reblast surfaces that have started to rust before they are painted.

C. Galvanized Metal Surface Preparation:

1. Prepare in accordance with ASTM D 6386 and recommended procedures from the American Galvanizers Association (AGA).

2. Notify galvanizer that steel will be painted.

3. Newly Galvanized Metal (48 hours or less since galvanizing):

a. Grinding: removed excess zinc, remove dross particles, bumps, runs and drips by hand grinder. If process removes too much zinc, surface must be repaired in accordance with ASTM A780.
b. Ensure surface is free of oil, grease, dirt and other organic materials. If it is not, see Partially Weathered for cleaning procedure.
c. Rinse thoroughly and dry.
d. Profile by sweep blasting at a maximum pressure of 40 psi, wash primer or acrylic pre-treatment. Take care not to damage the galvanized coating.

4. Partially Weathered Metal (2 days – 12 months from galvanizing):

a. Grinding as previously defined for Newly Galvanized Metal.
b. Clean surface of organic compounds and wet storage stain using alkaline solution or solvent cleaning.
c. Rinse thoroughly and dry.
d. Profile as previously defined for Newly Galvanized Metal.

5. The pressure of cleaning or rinsing performed must not exceed 1450 psi.

6. Apply paint or coating within 12 hours of drying.

D. Nonferrous Metal Alloy Surface Preparation:

1. Remove soil, cement spatter, and other surface dirt with appropriate hand or power tools.

2. Remove oil and grease by wiping or scrubbing surface with suitable solvent, rag, and brush. Use clean solvent and clean rag for final wiping to avoid contaminating surface.

3. Obtain and follow coating manufacturer's recommendations for additional preparation that may be required.

E. Concrete Surface Preparation:

1. Do not begin until a minimum of 30 days after concrete has been placed, and longer if directed by product manufacturer.

2. Meet requirements of SSPC SP 13.

3. Adhere to manufacturer's recommendations for preparation of the concrete surface. Ensure surface is free from grease, oil, dirt, salts or other chemicals, loose materials, or other foreign matter.

4. Secure coating manufacturer's recommendations for additional preparation, if required, for excessive bug holes exposed after preparation.

5. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

F. Plastic Surface Preparation:

1. Hand sand plastic surfaces to be coated with medium grit sandpaper to provide tooth for coating system.

2. Large areas may be power sanded or brush–off blasted, provided sufficient controls are employed so surface is roughened without removing excess material.

G. Masonry Surface Preparation:

1. Complete and cure masonry construction for 14 days or more before starting surface preparation work.

2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.

3. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:

a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.

b. Brush–off blasting.

c. Water blasting.

4. Do not damage masonry mortar joints or adjacent surfaces.

5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.

6. Masonry Surfaces to be Painted: Uniform texture and free of surface imperfections that would impair intended finished appearance.

7. Masonry Surfaces to be Clear Coated: Free of discolorations and uniform in texture after cleaning.

H. Wood Surface Preparation:

1. Replace damaged wood surfaces or repair in a manner acceptable to Contractor prior to start of surface preparation.

2. Solvent clean (mineral spirits) knots and other resinous areas and coat with shellac or other knot sealer, prior to painting. Remove pitch by scraping and wipe clean with mineral spirits or turpentine prior to applying knot sealer.

3. Round sharp edges by light sanding prior to priming.

4. Filler:

   a. Synthetic–based wood putty approved by paint manufacturer for paint system.

   b. For natural finishes, color of wood putty shall match color of finished wood.

   c. Fill holes, cracks, and other surface irregularities flush with surrounding surface and sand smooth.

   d. Apply putty before or after prime coat, depending on compatibility and putty manufacturer's recommendations.

   e. Use cellulose type putty for stained wood surfaces.

   f. Ensure surfaces are clean and dry prior to painting.

I. Gypsum Board Surface Preparation: Typically, new gypsum board surfaces need no special preparation before painting.

1. Surface Finish: Dry, free of dust, dirt, powdery residue, grease, oil, or any other contaminants.

3.05 SURFACE CLEANING

A. Brush–off Blast Cleaning:

1. Equipment, procedure, and degree of cleaning shall meet requirements of SSPC SP 7.

2. Abrasive: Either wet or dry blasting sand, grit, or nutshell.

3. Select various surface preparation parameters, such as size and hardness of abrasive, nozzle size, air pressure, and nozzle distance from surface such that surface is cleaned without pitting, chipping, or other damage.

4. Verify parameter selection by blast cleaning a trial area that will not be exposed to view.

5. Engineer will review acceptable trial blast cleaned area and use area as a representative sample of surface preparation.

6. Repair or replace surface damaged by blast cleaning.

B. Solvent Cleaning:

1. Consists of removal of foreign matter such as oil, grease, soil, drawing and cutting compounds, and any other surface contaminants by using solvents, emulsions, cleaning compounds, steam cleaning, or similar materials and methods that involve a solvent or cleaning action.

2. Meet requirements of SSPC SP 1.

3.06 APPLICATION

A. General:

1. The intention of these Specifications is for new, interior and exterior masonry, concrete, and metal, surfaces to be painted, whether specifically mentioned or not, except as specified otherwise. Do not paint exterior concrete surfaces, unless specifically indicated.

2. Apply coatings and paint in accordance with these Specifications and manufacturers' printed recommendations and special details. The more stringent requirements shall apply. Allow sufficient time between coats to assure thorough drying of previously applied paint.

3. Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.

4. Coat units or surfaces to be bolted together or joined closely to structures or to one another prior to assembly or installation.

5. Water–Resistant Gypsum Board: Use only solvent type paints and coatings.

6. On pipelines, terminate coatings along pipe runs to 1 inch inside pipe penetrations.

7. Keep paint materials sealed when not in use.

8. Where more than one coat is applied within a given system, alternate colors to provide a visual reference showing required number of coats have been applied.

B. Galvanized Metal, Copper, and Nonferrous Metal Alloys:

1. Concealed galvanized, copper, and nonferrous metal alloy surfaces (behind building panels or walls) do not require painting, unless specifically indicated herein.

2. Prepare surface and apply primer in accordance with System No. 10 specification.

3. Apply intermediate and finish coats of the coating system appropriate for the exposure.

C. Porous Surfaces, Such As Concrete and Masonry:

1. Repairs shall be completed using products specified in Section 03 30 00 Cast-In-Place Concrete.
2. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects that may inhibit or prevent adequate application of coating.
3. Prime Coat: If it acceptable to the manufacturer, prime coat may be thinned to provide maximum penetration and adhesion. The reduction volume shall be determined by the manufacturer specific to the density and type of coating being applied. Reduction shall not be implemented if it voids the warranty of any product.
4. Surface Specified to Receive Water Base Coating: For most applications, surface shall be damp just prior to application of coating, but free of running water. Verify this requirement with manufacturer for specified product.

D. Film Thickness and Coverage:

1. Number of Coats:
   a. Minimum required without regard to coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.
2. Application Thickness:
   a. Do not exceed coating manufacturer's recommendations.
   b. Measure using a wet film thickness gauge to ensure proper coating thickness during application.
3. Film Thickness Measurements and Electrical Inspection of Coated Surfaces:
   a. Perform with properly calibrated instruments.
   b. Recoat and repair as necessary for compliance with Specification.
   c. Coats are subject to inspection by Contractor and coating manufacturer's representative.
4. Visually inspect concrete, masonry, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thicknesses are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to achieve complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase the hiding.

3.07 FIRE RATED ASSEMBLIES

A. Permanently identify corridor partitions, smoke stop partitions, horizontal exit partitions, exit enclosures and fire walls. Above decorative ceiling line and in concealed spaces, apply a minimum one-inch wide red line interrupted at maximum 15-ft spacing with the wording "XX HOUR FIRE AND SMOKE BARRIER -

PROTECT ALL OPENINGS" in 4-inch high letters with "XX" designating the appropriate hourly rating.

3.08 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke test procedure at any time and as often as Owner deems necessary during the period when paint is being applied.

1. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint.

B. Testing:

Testing is to be performed on the waterproof and anti-corrosion coatings applied to the interior surfaces of the Basins.

1. Thickness and Continuity Testing:

a. Measure coating thickness specified in mils with a magnetic type, dry film thickness gauge, in accordance with SSPC P A 2. Check each coat for correct millage. Do not make measurement before a minimum of 8 hours after application of coating.

b. Holiday detect coatings 20 mils thick or less, except zinc primer and galvanizing, with low voltage wet sponge electrical holiday detector in accordance with NACE RP0188.

c. Holiday detect coatings in excess of 20 mils dry with high voltage spark tester as recommended by coating manufacturer and in accordance with NACE RP0188.

d. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final tests may also be conducted by Engineer.

2. Testing Equipment:

a. Provide magnetic type dry film thickness gauge to test coating thickness specified in mils, as manufactured by Nordson Corp., Anaheim, CA, Mikrotest.

b. Provide low–voltage wet sponge electrical holiday detector to test completed coating systems, 20 mils dry film thickness or less, except zinc primer, high–build elastomeric coatings, and galvanizing, for pinholes, holidays, and discontinuities, as manufactured by Tinker and Rasor, San Gabriel, CA, Model M–I.

c. Provide high–voltage spark tester to test completed coating systems in excess of 20 mils dry film thickness. Unit as recommended by coating manufacturer.

C. Inspection: Leave staging and lighting in place until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer. Provide additional staging and lighting as requested by Engineer.

D. Unsatisfactory Application:

1. If item has an improper finish color or insufficient film thickness, clean surface and topcoat with specified paint material to obtain specified color and coverage. Obtain specific surface preparation information from coating manufacturer.
2. Evidence of runs, bridges, shiners, laps, or other imperfections is cause for rejection.
3. Repair defects in accordance with written recommendations of coating manufacturer.

E. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather the edges. Follow with primer and finish coat. Depending on extent of repair and appearance, a finish sanding and topcoat may be required.
3. Apply finish coats, including touchup and damage–repair coats in a manner that will present a uniform texture and color–matched appearance.

3.08 MANUFACTURER'S SERVICES

A. Coating manufacturer's representative shall be present at Site for the application of the waterproof and anti-corrosion coatings for the Basins as follows:

1. On first day of application of any coating system.
2. A minimum of two additional Site inspection visits, each for a minimum of 4 hours, in order to provide Manufacturer's Certificate of Proper Installation.
3. During thickness and continuity testing to verify conformance with project and manufacturer requirements.
4. As required to resolve field problems attributable to or associated with manufacturer's product.
5. To verify full cure of coating prior to coated surfaces being placed into immersion service.

3.09 CLEANUP

A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of the Work, remove staging, scaffolding, and containers from Site or destroy in a legal manner.

C. Remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.

3.10 PROTECTIVE COATINGS SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces–in accordance with the following application schedule and the environmental types defined in Section 01 00 01, General Requirements. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. System No. 2 Submerged Metal:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 5, White Metal Blast Cleaning	Prime in accordance with manufacturer's recommendations	
	Coal–Tar Epoxy –OR– High Build Epoxy	2 coats, 16 MDFT 2 coats, 16 MDFT

1. Use on the following items or areas:

   a. New metal surfaces located in submerged environment type.
   b. New metal surfaces above maximum liquid surface that are a part of submerged equipment.
   c. Submerged surfaces of metallic items, such as wall pipes, pipes, pipe sleeves, access manholes, gates, gate guides, thimbles, and structural steel that are embedded in concrete.
   d. Interior surfaces of steel piping noted in the Piping Schedule.

C. System No. 4 Galvanized Metal, Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
See Preparation section of this specification	Zinc-Rich Primer	1 coat, per mfr
	Top Coat – Acrylic Latex	1 coat, per mfr

1. Use on the following items or areas:

   a. Exposed new galvanized metal surfaces located in interior equipment/blower room
   b. Exposed galvanized metal deck: exterior and interior.
   c. Exposed galvanized structural steel, including beams and columns of monorail and porch framing.
   d. Exposed galvanized steel stair and platform framing (exterior).
   e. Galvanized steel lintels.
   f. Galvanized exterior doors and frames.

D. System No. 5 Exposed Metal, Mildly Corrosive:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near–White Blast Cleaning	Epoxy Primer – Ferrous Metal	1 coat, 2.5 MDFT
	Polyethylene Enamel	1 coat, 3 MDFT

1. Use on the following items or areas:

   a. Miscellaneous exposed new metal surfaces inside the 2nd level of the building.

   b. Interior doors and frames.

E. System No. 6 Exposed Metal Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Rust Inhibitive Primer	1 coat, 2 MDFT
	Alkalyd Enamel	2 coats, 4 MDFT

1. Use on the following items or areas:

   a. Exposed new metal surfaces including vents, exterior metal ductwork, flashing, sheet metalwork and miscellaneous architectural metal trim.

   b. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

F. System No. 8 Buried Metal General:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near White Blast Cleaning	Coal–Tar Epoxy	2 coats, 125 microns each
	Coal-Tar Primer, Coal-Tar Enamel	1 coat, per mfr 2 coats, hot applied per mfr

1. Use on the following items or areas:

   a. Buried, below grade portions of steel items, except buried stainless steel or ductile iron and the following specific surfaces:

      1) Fasteners and accessories of buried piping related items.

G. System No. 10 Nonferrous Metal Alloy Conditioning:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Nonferrous Metal Alloy Surface Preparation	Epoxy Primer–Other	As recommended by coating manufacturer Remaining coats as required for exposure

1. Use on the following items or areas:
   a. Aluminum handrail, grating, panels, and miscellaneous components both interior and exterior.
   b. After application of System No. 10, apply finish coats as required for exposure. For handrail apply per specifications herein. For other items apply per manufacturer recommendations.

H. System No. 11 Galvanized Metal Repair:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SPI) Followed by Hand Tool (SP 2), Power Tool (SP 3) or Brush off Blast (SP 7)	Organic Zinc Rich Primer	1 coat, 3 MDFT

1. Use on the following items or areas:
   a. Galvanized surfaces that are abraded, chipped or otherwise damaged.

I. System No. 19 Concrete Tank Waterproof Coating:

Surface Prep.	Paint Material	Min. Coats, Wet Thickness
As specified by the manufacturer	CIM 61TN Epoxy Primer	2 coat, 5 mil (wet) – recoat w/in 48 hrs
	CIM 1000	2 coats, 60* mil (dry)

*Apply extra thickness at corners, intersections, angles and over joints.

1. Use on the following items or areas:
   a. Walls and base slab of Chlorine Contact Basin.

J. System No. 20 Concrete Tank Anti-Corrosion Coating:

Surface Prep.	Paint Material	Min. Coats, Dry Thickness
As specified by the Manufacturer	Raven 404 System	3 coats min, 60 mil

1. Use on the following items or areas:
   a. Walls & base slab of Anoxic Basin, Pre-Aeration Basins, Splitter Box Channel, and Membrane Basins.
   b. Underside of all concrete slabs and walkways over all Basins.
   c. Coating of all exposed piping inside of all basins.

K. System No. 21 Decorative Abrasion Resistant Concrete Finish:

Surface Prep.	Paint Material	Min. Coats, Cover
Shot blast concrete as specified by manufacturer	Stontec UTF, by Stonhard Inc.	As specified by manufacturer

1. Use on the following items or areas:
    a. Floor of the Control Room, Store Room, Bathroom and Shower Room (all three on 2nd floor of the building).

L. System No. 22 Decorative Abrasion Resistant Non-Slip Concrete Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Shot blast concrete as specified by manufacturer	Stontec UTF with White Texture, by Stonhard Inc.	As specified by manufacturer

2. Use on the following items or areas:
    a. Exterior concrete slab on 2nd level at top of stairs and at covered area between monorail bay and building CMU wall.

M. System No. 23 Chemical–Resistant Non-Slip Floor and Wall Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
Shot blast concrete as specified by manufacturer	Stonchem 830, by Stonhard Inc.	As specified by manufacturer

3. Use on the following items or areas:
    a. Interior slab on grade and equipment slabs of the Equipment Room, Equipment Support Room and Chemical Room.

b. Lower 6 inches of all walls in the Equipment Room, Equipment Support Room and Chemical Room.

N. System No. 25 Exposed PVC:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Plastic and FRP Surface Preparation	Acrylic Latex Semigloss	2 coats, 320 SFPGPC

1. Use on the following items or areas:
   a. All exterior, exposed–to–view PVC and CPVC surfaces.

O. System No. 27 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
Solvent Clean (SP 1)	Prime in accordance with manufacturer's recommendations	
	Bituminous Paint	1 coat, 10 MDFT

1. Use on aluminum surfaces embedded or in contact with concrete.

P. System No. 29 Fusion Bonded Coating:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 10, Near–White Blast Cleaning	Fusion Bonded Coating 100% Solids Epoxy	1 or 2 coats, 7 MDFT

1. For steel pipe and fittings, meet all requirements of AWWA C2I3.
2. Use on the following items:
   a. Interior and exterior of valves as specified in Section 40 27 02 Process Valves and Operators.

3.11 ARCHITECTURAL PAINT SYSTEMS AND APPLICATION SCHEDULE

A. Unless otherwise shown or specified, paint surfaces in accordance with the following application schedule. In the event of discrepancies or omissions in the following, request clarification from Engineer before starting work in question.

B. System No. 102 Wood, Exterior:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Wood Surface Preparation	Alkyd Wood Primer, MPI #5	1 coat
	Latex, exterior, matching topcoat	1 coat
	Latex, exterior gloss (Gloss Level 6), MPI #119	1 coat

1. Use on the following items or areas:
   a. All exterior wood.

C. System No. 1 06 Wood, Interior, Latex System: n/a

D. System No. 109 Masonry, Semigloss:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Masonry Surface Preparation	Block Filler	1 coat, 75 SFPG
	Acrylic Latex (Semigloss)	2 coats, 240 SFPGPC

1. Use on the following items or areas:
   a. Interior CMU walls in Centrifuge Building.

E. System No. 112 Concrete, Flat:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance with Paragraph Concrete Surface Preparation	Acrylic Latex (Flat)	2 coats, 240 SFPGPC

1. Use on the following items or areas:

a. Basin exterior walls.

b. Lower wall of building on North side.

F. System No. 114 Gypsum Board, Latex System:

Surface Prep.	Paint Material	Min. Coats
In accordance with Paragraph Gypsum Board Surface preparation	Interior Latex Primer Sealer	1 coat
	Interior latex matching topcoat	1 coat
	Interior latex (eggshell)	1 coat

1. Use Latex System MPI INT 9.2A on the following items or areas:

a. Interior gypsum board in dry areas.

G. System No. 115 Gypsum Board, Epoxy-Modified Latex System:

Surface Prep.	Paint Material	Min. Coats
In accordance with Paragraph Gypsum Board Surface preparation	Skim coat of joint compound	1 coat
	Primer sealer, latex, interior	1 coat
	Epoxy-modified latex, interior, gloss (Gloss Level 6)	2 coats

1. Use Epoxy-Modified Latex System MPI INT 9.2F on the following items or areas:

a. Interior gypsum board in wet areas.

3.12 COLORS

A. Provide as designated by the Architect in Finish Schedule.

B. Proprietary identification of colors is for identification only. Selected manufacturer may supply matches.

C. Equipment Colors:

1. Equipment includes the machinery or vessel itself plus the structural supports and fasteners and attached electrical conduits.
2. Paint equipment and piping one color as selected.
3. Paint non – submerged portions of equipment the same color as the piping it serves, except as itemized below:
    a. Dangerous Parts of Equipment and Machinery: OSHA Orange.
    b. Fire Protection Equipment and Apparatus: OSHA Red.
    c. Physical hazards in normal operating area and energy lockout devices, including, but not limited to, electrical disconnects for equipment and equipment isolation valves in air and liquid lines under pressure: OSHA Yellow.

D. Pipe Identification Painting:

1. Color code non – submerged metal piping, except electrical conduit. Paint fittings and valves the same color as pipe, except equipment isolation valves.
2. Pipe Color Coding: In accordance with Piping Schedule and/or selected by the Engineer.
3. Pipe Supports (for metals that are not galvanized steel, aluminum and stainless steel): Painted light gray, as approved by Engineer.
4. PVC and CPVC pipe located inside of buildings and enclosed structures will not require painting except as noted or scheduled.

3.13 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification:

1. Paint System Data Sheet (PSDS).
2. Product Data Sheet (PDS).

END OF SECTION

PAINT PRODUCT DATA SHEET

Complete and attach manufacturer's Technical Data Sheet to this PDS for each product submitted. Provide manufacturer's recommendations for the following parameters at temperature (F)/relative humidity:

Temperature/RH	50/50	70/30	90/25
Induction Time			
Pot Life			
Shelf Life			
Drying Time			
Curing Time			
Min. Recoat Time			
Max. Recoat Time			

Provide manufacturer's recommendations for the following:

Mixing Ratio:_____

Maximum Permissible Thinning: _____

Ambient Temperature Limitations: min.:_____ max: _____

Surface Temperature Limitations: min.:_____ max: _____

Surface Profile Requirements: min.:_____ max: _____

Attach additional sheets detailing manufacturer's recommended storage requirements and holiday testing procedures.

PAINT SYSTEM DATA SHEET

Complete this PDS for each coating system, include all components of the system (surface preparation, primer, intermediate coats, and finish coats). Include all components of a given coating system on a single PDS.

Paint System Number (from Spec):		
Paint System Title (from Spec):		
Coating Supplier:		
Representative:		
Surface Preparation:		
Paint Material (Generic)	**Product Name/Number (Proprietary)**	**Min. Coats, Coverage**

INDEX TO

SECTION 33 10 00SC – WATER UTILITIES

SECTION 33 10 00SC

WATER UTILITIES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Site Piping

B. Valves

C. Fittings

D. Connect to Existing System

E. All necessary appurtenances to convey potable water from the existing system to the location shown on the plans.

1.2 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

B. Section 31 10 00 – Site Clearing

C. Section 32 92 00 – Turf and Grasses

1.3 OPTIONS

A. Where manufacturers of material or equipment are named in the specifications, Contractor may use equipment or materials of other manufacturers provided they are reviewed and accepted by Engineer as meeting specifications prior to ordering such equipment or materials.

1.4 REFERENCES (Latest Revision)

A. ASTM D 3740 – Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. ASTM E 329 – Agencies Engaged in Construction Inspection and/or Testing.

C. ANSI/AWWA C 153/A–21.53 – Ductile Iron Compact Fittings for Water Service.

D. ANSI/AWWA C 110/A21.10 – Ductile Iron and Gray Iron Fittings,

E. ANSI/AWWA C 150/A–21.50 – Thickness Design of Ductile Iron Pipe.

F. ANSI/AWWA C 151/A–21.51 – Ductile Iron Pipe, Centrifugally Cast, for Water, or other liquids.

G. ANSI/AWWA C 104/A–21.4 – Cement–Mortar Lining for Ductile Iron Pipe and Fittings for Water.

H. ASTM D 1784 – Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

I. ASTM D 2241 – Poly (Vinyl Chloride) (PVC) Pressure–Rated Pipe (SDR – Series).

J. ANSI/AWWA C 901 – Polyethylene (PE) Pressure Pipe and Tubing, 1/2 inch through 3–inches for Water Service.

K. ASTM D 2737 – Polyethylene (PE) Plastic Tubing.

L. ANSI/AWWA C 115/A21.15 – Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges.

M. ANSI/AWWA C 111/A21.11 – Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

N. ASTM D 3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

O. ANSI/AWWA C 900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inches through 12 inches, for Water Transmission and Distribution.

P. ANSI/AWWA C 500 – Metal–Seated Gate Valves for Water Supply Service.

Q. ANSI/AWWA C 509 – Resilient–Seated Gate Valves for Water Supply Service.

R. ANSI/AWWA C 502 – Dry–Barrel Fire Hydrants.

S. ANSI/AWWA C 800 – Underground Service Line Valves and Fittings.

T. ANSI/AWWA C 600 – Installation of Ductile Iron Water Mains and Their Appurtenances.

U. ANSI/AWWA C 605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

V. ASTM D 2774 – Underground Installation of Thermoplastic Pressure Piping.

W. ASTM D 6938 – In–Place Density and Water Content of Soil and Soil – Aggregate By Nuclear Methods (Shallow Depth).

X. ANSI/AWWA C 651 – Disinfecting Water Mains.

Y. ASTM D 1557 – Laboratory Compaction Characteristics of Soil Using Modified Effort.

Z. ANSI/AWWA C 504 – Rubber–Seated Butterfly Valves.

AA. ANSI B–18.2.2 – Square and Hex Bolts and Screws.

BB. ANSI B–18.2.2 – Square and Hex Nuts.

CC. ANSI/NSF Standard 61.

DD. ANSI/AWWA C200 – Steel Water Pipe – 6 inch (150 mm) and Larger.

EE. ASTM A 53 – Pipe, Steel, Black and Hot–Dipped, Zinc–Coated, Welded and Seamless.

FF. ANSI/AWWA C905 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14–inch through 48–inch (350 mm through 1,200 mm), for Water Transmission and Distribution.

GG. ANSI/AWWA C 512 – Air Release, Air/Vacuum, and Combination Valves for Waterworks Service.

HH. ANSI/AWWA C 515 – Reduced–Wall, Resilient–Seated Gate Valves for Water Supply Service.

II. ASTM A 139 – Electric–Fusion (Arc) – Welded Steel Pipe (NPS4 and Over).

1.5 QUALITY ASSURANCE

A. Materials – Contractor will furnish the Engineer and Owner a description of all material before ordering. Engineer will review the Contractor's submittals and provide in writing an acceptance or rejection of material.

B. Manufacturer – Material and equipment shall be standard products of a manufacturer who has manufactured them for a minimum of two years and who provides published data on quality and performance of the products.

C. Subcontractor – A subcontractor for any part of the work must have experience on similar work, and if required, furnish Engineer with a list of projects and Owners or Engineers who are familiar with its competence.

D. Design – If Contractor wishes to furnish devices, equipment, structures, and systems not designed by Engineer, these items shall be designed by either a Professional Engineer registered in the state of this project, or by someone Engineer accepts as qualified. If required, complete design calculations and assumptions shall be furnished to the Engineer or Owner before acceptance.

E. Testing Agencies – Soil testing shall be conducted by a testing laboratory which operates in accordance with ASTM D 3740 and E 329 latest revision and be acceptable to the Engineer prior to engagement. Mill certificates of tests on materials made by manufacturers will be accepted provided manufacturer maintains an adequate testing laboratory, makes regularly scheduled tests that are spot checked by an outside laboratory, and furnishes satisfactory certificates with name of entity making the test.

F. Hydrostatic tests on pipe shall be made by Contractor with equipment qualified by the Engineer. The Engineer or Project Representative reserves the right to accept or reject testing equipment. Hydrostatic testing shall be conducted in the presence of Engineer or Project Representative and a representative of Water Supplier.

G. All pipe, fittings, packing, jointing materials, valves, and fire hydrants shall conform to Section C of the American Water Works Association (AWWA) Standards.

H. All materials and products which contact potable water must be third party certified as meeting the specifications of ANSI/NSF Standard 61. The certifying party must be accredited by the American National Standards Institute (R.61-58.4.D. (1)).

1.6 REQUIREMENTS OF REGULATORY AGENCIES

A. Water mains shall be sterilized to meet requirements of the appropriate Health Department. Sterilization shall be in accordance with AWWA Standards C–651, latest revision.

B. Fire line sprinkler systems and dedicated fire lines shall be protected by an acceptable double check valve assembly. Water lines in high hazard categories shall be protected by an acceptable Reduced Pressure Zone (RPZ) Backflow Preventer.

C. Any pipe, solder, or flux which is used in the installation or repair of any public water system or in any plumbing in a residential or nonresidential facility which provides water, through connection to a public water system, for human consumption shall be lead free. Lead free is defined as not more than 0.2% lead with respect to solder and flux and not more than 8.0% lead with respect to pipes and pipe fittings. Leaded joints necessary for repair of cast iron pipes shall be exempt from the lead free requirement.

D. No water pipe shall pass through or come in contact with any part of a sewer manhole. Water lines may come in contact with storm sewers or catch basins if there is no practical alternative, provided ductile iron is used, no joints of water line are within the storm sewer or catch basin, and joints are located as far as possible from storm sewer or catch basin.

E. Potable water lines shall not be laid less than 25 feet horizontally from any portion of a wastewater tile field or spray field, or shall be otherwise protected by a method acceptable to DHEC.

F. Where the minimum cover of 30 inches cannot be provided, pipe shall be steel, concrete, ductile iron, or other material and method acceptable to DHEC, and, when necessary, insulated to prevent freezing.

G. Air relief valves shall be provided in accordance with sound engineering practices at high points in water mains as required. Automatic air relief valves shall not be used in situations where flooding of the manhole or chamber may occur.

H. The open end of an air relief pipe from automatic valves or from a manually operated valve shall be extended to the top of pit and provided with a screened downward facing elbow.

I. Chambers, pits, or manholes containing valves, blow–off, meters, air release valves, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer.

J. There shall be no connection between distribution systems and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the system.

K. Asbestos cement pipe shall not be used in potable water system except in the repair of existing asbestos cement lines.

L. Thermoplastic pipe shall not be used above grade.

M. Steel pipe shall not be allowed in water systems unless specified as in AWWA C200 or ASTM A53.

N. Water mains shall be installed out of contaminated areas, unless using piping materials protecting the system (i.e., Ductile Iron Pipe with chemical resistant gaskets). Route lines out of contaminated areas if possible.

O. Cross Connection Control (Backflow Prevention Devices):

1. There shall be no connection between the distribution system and any pipes, pumps, hydrants, or tanks whereby unsafe water or other contaminated materials may be discharged or drawn into the system.

2. No–by–passes shall be allowed, unless the bypass is also equipped with an equal, acceptable backflow prevention device.

3. Reduced pressure principal backflow prevention assemblies shall not be installed in any area location subject to possible flooding. This includes pits or vaults not provided with a gravity drain to the ground's surface capable of exceeding discharge rate of relief valve. Generally, if installed in a pit, drain line shall be two times the size of line entering backflow prevention device. The drain cannot empty into any type of ditch, storm drain, or sewer, which could flood water back into pit.

4. All piping up to inlet of the backflow prevention device must be suitable for potable water. The pipe must be AWWA or NSF approved. Black steel pipe cannot be used on inlet side of the device.

P. All pipe, fittings, packing, jointing materials, valves and fire hydrants shall conform to Section C of the AWWA Standards. (R.61-58.4.D. (1)).

Q. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, O-rings, and other products used for jointing pipes, setting meters or valves, or other appurtenances which will expose the material to the water. (R.61-58.4.D. (3)).

R. Lubricants which will support microbiological growth shall not be used for slip-on joints. (R.61-58.4.D. (3)).

S. The use of vegetable shortening is prohibited. (R.61-58.4.D. (3)).

T. The use of solvent-weld PVC pipe and fittings in water mains four inches and larger is prohibited.

1.7 PRODUCT DELIVERY, STORAGE & HANDLING

A. Material shall be unloaded in a manner avoiding damage and shall be stored where it will be protected and will not be hazardous to traffic. Contractor shall repair any damage caused by the storage. Material shall be examined before installation and neither damaged nor deteriorated material shall be used in the work.

1.8 SEQUENCING AND SCHEDULING

A. Contractor shall arrange work so sections of mains between valves are tested, sterilized, pavement replaced, and the section placed in service as soon as reasonable after installation.

1.9 ALTERNATIVES

A. The intention of these specifications is to produce the best system for the Owner. If Contractor suggests alternative material, equipment or procedures will improve the results at no additional cost, Engineer and Owner will examine suggestion, and if it is accepted, it may be used. The basis upon which acceptance of an alternative will be given is its value to the Owner, and not for Contractor's convenience.

1.10 GUARANTEE

A. Contractor shall guarantee the quality of materials, equipment, and workmanship for a period of 12 months after acceptance. Defects discovered during this period shall be repaired by Contractor at no cost to the Owner.

1.11 EXISTING UTILITIES

A. All known utility facilities are shown schematically on plans, and are not necessarily accurate in location as to plan or elevation. Utilities such as service lines or unknown facilities not shown on plans will not relieve the Contractor of responsibility under this requirement. "Existing Utilities Facilities" means any utility existing on the project in its original, relocated, or newly installed position. Contractor will be held responsible for the cost of repairs to damaged underground facilities; even when such facilities are not shown on plans

B. The Contractor shall call for underground utility locations before starting work. Underground utilities location service can be contacted at 811 or 1–888–721– 7877.

1.12 CONNECT NEW MAIN TO EXISTING SYSTEM

A. Contractor shall furnish necessary pipe and perform all excavation, dewatering, shoring, backfilling, etc., necessary to make the connection of a new main to existing water system. Contractor shall contact the Superintendent of Water Utility a minimum of 48 hours in advance of construction. Contractor shall be responsible for coordinating construction with the utility operator.

1.13 DAMAGE TO EXISTING WATER SYSTEM

A. Damage to any part of the existing water system by Contractor or Subcontractors, repaired by Utility Owner's forces, shall be charged to Contractor on basis of time and material, plus 30% for overhead and administration.

1.14 TESTING

A. Laboratory tests for moisture density relationship for fill materials shall be in accordance with ASTM D 1557, (Modified Proctor).

B. In place density tests in accordance with ASTM D 6938.

C. Testing laboratory shall operate in accordance with ASTM D 3740 and E 329 and be acceptable to the Engineer.

D. The testing laboratory and Project Engineer/Project Representative shall be given a minimum of 48-hour notice prior to taking any of the tests.

E. Testing shall be the responsibility of the Contractor and shall be performed at the Contractor’s expense by a commercial testing laboratory that operates in accordance with subparagraph C above.

F. Test results shall be furnished to the Engineer prior to continuing with associated or subsequent work.

1.15 UTILITY COMPANY STANDARDS

A. All construction materials and procedures shall comply with the regulatory agency standards and guidelines; St. John Water Company and SCDHEC. Where conflicts arise between those standards and these specifications, the more stringent shall apply.

PART 2 – PRODUCTS

Products and materials used in the work shall conform to the following:

2.1 GENERAL REQUIREMENTS

A. All material or products that come into contact with drinking water shall be third party certified as meeting the specifications of the American National Institute/National Sanitation Foundation Standard 61, Drinking Water System Components – Health Effects. The American National Standards Institute shall accredit the certifying party. All pipe, fittings, packing, jointing materials, valves, and fire hydrants shall conform to Section C of the AWWA Standards.

2.2 PIPE

A. Ductile Iron Pipe – Shall conform to ANSI A–21.50 (AWWA C–150) and ANSI A–21.51 (AWWA C–151). All pipe shall be Pressure Class 350 unless otherwise noted. It shall be cement lined in accordance with ANSI A–21.4 (AWWA C–104).

B. P.V.C. – All pipe shall be blue in color with factory marked homing lines. Pipe 4 inches through 12 inches shall conform to all requirements of AWWA C–900, DR 18, pressure class of 235 p.s.i. and shall have the following minimum wall thickness:

4 inches	0.267 inches
6 inches	0.383 inches
8 inches	0.503 inches
10 inches	0.617 inches
12 inches	0.733 inches

Pipe 14 inches through 18 inches in diameter shall conform to all the requirements of AWWA C 905, DR 18, pressure rating of 235 p.s.i.

Pipe with diameter less than 4 inches shall conform to all requirements of ASTM D–1784 and D–2241 (SDR 21). The pipe shall have a minimum pressure rating of 200 p.s.i. Certificates of conformance with the foregoing specifications shall be furnished with each lot of pipe supplied. All P.V.C. pipe shall bear the National Sanitation Foundation Seal of Approval.

C. Plastic Tubing – Tubing for service lines shall be:

Polyethylene Tubing: CTS PE 3408 conforming to all requirements of AWWA C–901 and ASTM D–2737 (SDR9). The tubing shall be copper tubing size and rated for a minimum working pressure of 200 p.s.i. Marking on the tubing shall include: nominal tubing pipe size; type of tubing material – PE 3408; SDR 9; pressure rating – 200 p.s.i.; ASTM D–2737; manufacturer's name and seal of the National Sanitation Foundation.

2.3 JOINTS

A. Flanged Joints – Shall conform to ANSI A–21.15 (AWWA C–115). Bolts shall conform to ANSI B–18.2.1 and nuts shall conform to ANSI B–18.2.2. Gaskets shall be rubber, either ring or full face, and shall be 1/8 inch thick. Gaskets shall conform to the dimensions recommended by AWWA C–115 latest revision.

B. Mechanical Joints – In ductile iron pipe shall conform to ANSI A–21.11 (AWWA C–111).

C. Push–On–Joints – In ductile iron pipes shall conform to ANSI A–21.11 (AWWA C–111).

D. Plastic Pipe – Joints in plastic pipe 4 inches and larger shall meet all requirements of AWWA C–900. Joints in plastic pipe 14 inches through 18 inches shall meet all requirements of AWWA C905. Joints in plastic pipe with a diameter less than 4 inches shall conform to ASTM D–3139.

E. Restrained Joints – Restrained joints for pipe, valves and fittings shall be mechanical joints with ductile iron retainer glands equivalent to "Megalug" or push–on type joints equivalent to "Lok–Ring," "TR Flex," or "Super Lock" and shall have a minimum rated working pressure of 250 p.s.i. for ductile iron pipe and 100 p.s.i. with a minimum safety factor of 2:1 for PVC pipe. The joints shall be in accordance with the applicable portions of AWWA C–111. The manufacturer of the joints shall furnish certification, witnessed by an independent laboratory, that the joints furnished have been tested without signs of leakage or failure. Restrained joints shall be capable of being deflected after assembly.

F. Natural rubber or other material which will support microbiological growth may not be used for any gaskets, o–rings, and other products used for jointing pipes, setting meters and valves or other appurtenances which will expose such material to water.

2.4 FITTINGS

A. Fittings for Ductile Iron or Plastic Pipe – Shall be ductile iron, manufactured in accordance with ANSI A–21.53 (AWWA C–153). They shall be cement lined in accordance with ANSI A–21.4 (AWWA C–104). Fittings shall be designed to accommodate the type of pipe used.

B. Fittings for Flanged Pipe – Shall be manufactured in accordance with ANSI A–21.10 (AWWA C–110), Class 125 flanges.

C. Fittings for Plastic Pipe – Less than 4 inches shall be PVC with ring-tite rubber joints conforming to ASTM D–3139.

2.5 GATE VALVES

A. Two Inches and Larger – Shall be cast iron or ductile iron body, bronze mounted, double disc or resilient wedge design, with non–rising stems, conforming to AWWA C–500, C–509, or C–515. Valves shall have a working pressure of 200 p.s.i. and be tested at 400 p.s.i.

Valves shall be furnished with "O" ring packing. Two "O" rings shall be located above the thrust collar and one "O" ring below. The thrust collar shall be permanently lubricated and have an anti–friction washer on top of the thrust collar.

Valves installed in pits or above ground shall be furnished with hand wheels. Buried valves shall be furnished with square operating nuts.

B. Smaller than Two Inches – Shall be all brass, ball valve type. The pressure rating shall be 175 p.s.i.

C. Valve Boxes – Underground valves shall be installed in acceptable valve boxes. The valve boxes shall have a suitable base which does not damage the pipe, and shaft extension sections to cover and protect the valve and permit easy access and operation. The box, cover, and any extensions needed shall be cast or ductile iron having a crushing strength of 1,500 pounds per linear foot. Valve boxes shall conform to the detail shown.

D. Valve Manholes

1. Masonry – Shall be new whole brick of good quality laid in masonry mortar or cement mortar made of one part Portland cement and two parts clean sharp sand. Every brick shall be fully bedded in mortar. Manholes shall conform to the locations and details shown on the plans.

2. Precast Concrete – Shall be reinforced concrete constructed in accordance with ASTM C 478 and the details shown on the plans "Precast Concrete Manholes." The joints shall be tongue and groove sealed with flexible gaskets or mastic sealant. Gaskets shall be O–Ring or equivalent to Type A or B "Tylox" conforming to ASTM C 443. Mastic shall be equivalent to "Ram–nek" with primer. The primer shall be applied to all contact surfaces of the manhole joint at the factory in accordance with the manufacturer's instructions.

2.6 BUTTERFLY VALVES

A. All butterfly valves shall be of the tight–closing, rubber seated type, with rubber seat positively locking in place sealing against flow from either direction. No metal–to–metal seating surfaces will be permitted. Valves shall be bubble–tight at rated

pressures with flow in either direction. Butterfly valves shall conform to ANSI/AWWA C504, Class 150B. Butterfly valves shall not be used on pipe smaller than 14 inches unless otherwise specified.

1. Valve body end connections for buried valves shall be installed using restrained joints equivalent to those manufactured by EBAA Iron, Inc.

2. Valve shafts shall be stainless steel and may consist of a one–piece unit or may be the "Stub Shaft" type. A stub shaft comprises two separate shafts inserted into the valve disc hubs. Each stub shaft shall be inserted into the valve disc hubs for a distance of at least 1 ½ shaft diameters.

3. Valve discs shall be solid ductile iron with an epoxy coating making it corrosion resistant. The thickness of the discs shall not exceed 2 ¼ times the shaft diameter.

4. Valve seats shall be natural or synthetic rubber providing 360 degrees uninterrupted seating. The resilient seat shall be adjustable or replaceable in the field without burning or grinding. The seat shall be molded over a stainless steel ring for support and secured to the disc by corrosion resistant, self-locking stainless steel screws.

5. All internal ferrous metal surfaces in the waterway shall be factory coated with a non–toxic, to–component, holiday–free, thermosetting epoxy to a nominal thickness of 4 mils.

6. All butterfly valves shall be manually operated. Operators shall be of the traveling nut, self–locking type and shall be designed to hold the valve in any intermediate position without creeping or fluttering. Operators shall be furnished with externally adjustable mechanical stop limiting devices. Valves shall have a two-inch square operating nut and shall be installed with extension stem to extend the operating nut in accordance with the project details. The operator shall be integrally mounted on the valve mounting flange and shall have a gearing totally enclosed for buried service. Maximum force for operating nut shall be 40 pounds.

B. Valve Boxes – Underground valves shall be installed in approved valve boxes. The valve boxes shall have a suitable base that does not damage the pipe, and shaft extension sections to cover and protect the valve and permit easy access and operation. The cover, box, and any extensions needed shall be cast or ductile iron having a crushing strength of 1,500 pounds per linear foot. Valve boxes shall conform to the detail shown.

C. Valve Manholes

1. Masonry – Shall be new whole brick of good quality laid in masonry mortar or cement made of one part Portland cement and two parts clean sharp sand. Every brick shall be fully bedded in mortar. Manholes shall conform to the locations and details shown on the plans.

2. Precast Concrete – Shall be reinforced concrete constructed in accordance with ASTM C 478 and the details shown on the plans "Precast Concrete Manholes." The joints shall be tongue and groove sealed with flexible gaskets or mastic sealant. Gaskets shall be O–Ring or equivalent to Type A or B "Tylox" conforming to ASTM C 443. Mastic shall be equivalent to "Ram–nek" with primer. The primer shall be applied to all contact surfaces of the manhole joint at the factory in accordance with the manufacturer's instructions.

2.7 AIR RELEASE, AIR/VACUUM AND COMBINATION AIR VALVES

A. Shall be designed for water service with a minimum working pressure of 100 p.s.i. The valve shall be constructed of a cast iron body, stainless steel or bronze trim, and stainless steel float. The inlet shall be 2 inches, 5/16 inch orifice, and a minimum venting capacity of 35 c.f.f.a.m. It shall conform to the detail shown on the drawings. Valves shall conform to AWWA C 512 and equivalent to Crispin or Valmatic.

2.8 FIRE HYDRANTS

A. General – Hydrants shall be manufacturer's current model design and construction. All units to be complete including joint assemblies. Physical characteristics and compositions of various metal used in the hydrant components shall meet the requirements as specified in AWWA C–502 latest revision. Hydrants shall be suitable for working pressure of 150 p.s.i.

B. Bonnet – Bonnet may have oil filled or dry reservoir. If oil filled, bonnet must have "O" ring packing so all operating parts are enclosed in a sealed oil bath. Oil filler plug shall be provided in bonnet to permit checking of oil level and adding oil when required. If dry type, hydrant top must have lubricating hole or nut for ease of lubrication. All parts must be removed through top of hydrant without moving entire barrel section from safety flange.

C. Nozzles and Caps – The hydrant shall have 2 ½-inch connections and 4 ½-inch steamer connection, National standard threads. Nozzles shall be bronze and have interlocking lugs to prevent blowout. Nozzle caps shall be secured to fire hydrant with non–kinking type chain with chain loop on cap ends to permit free turning of caps.

D. Seat Ring – Seat ring shall be bronze.

E. Drain Valves and Openings – Positive operating drain valves shall be provided to assure drainage of fire hydrant when the main valve is closed. Drain openings shall have bronze bushings.

F. Main Valve – Valve shall be designed to close with the pressure and remain closed. Valve shall be made from material resisting damage from rocks or other foreign matter. Valve shall have a full 5 ¼–inch opening.

G. Barrel and Safety Flanges – Hydrants shall have a safety–type vertical barrel with 3 ½-foot bury and be designed with safety flanges and/or bolts to protect the barrel and stem from damage and to eliminate flooding when hydrant is struck. Bury depth shall be cast on barrel of hydrant.

H. Operating Stop and Nut – Hydrant shall have a positive stop feature to permit opening of hydrant without over travel of stem. Operating nut shall be bronze, 1 ½-inch, point to flat, and pentagon.

I. Bolts and Nuts – Bolts, washers and nuts shall be corrosion-resistant.

J. Inlet – Bottom inlet of hydrant shall be provided with mechanical joint connection as specified and shall be 6 inch nominal diameter.

K. Direction of Opening – Hydrant shall be designed to close and open to the directions required by the utility company.

L. Coatings – All inside and outside portions of hydrant shall be coated in accordance with AWWA C–502. The exterior portion of hydrant above ground level shall be painted with two coats of best grade zinc chromate primer paint and with two coats of approved hydrant enamel. Color shall be designated by Owner and local utility company.

M. Joint Assemblies – Complete joint assemblies consisting of gland, gasket, bolts, and nut shall be furnished for mechanical joint inlets.

2.9 SERVICE CONNECTIONS

A. Taps in pipe larger than 3 inches shall be made with a tapping machine. A corporation stop shall be installed at the connection to the main. The corporation stop shall be brass manufactured in conformance with AWWA C–800. Inlet and outlet threads shall conform to AWWA C–800.

Corporation stops shall be one inch equivalent to Mueller H–15008 or B–25008 with a stainless steel stiffener. Service saddles shall have one-inch AWWA taps, equal to Ford Styles 202B or S70. Contractor shall adhere to pipe manufacturer's recommendations on maximum tap sizes for each main size.

B. Taps for services in PVC pipe three inches and smaller shall be equivalent to Romac Industries Style 306 Saddle or a PVC Tee. The connection shall be capable of withstanding internal water pressure continuously at 150 p.s.i. House service lines will be one–inch polyethylene tubing with a curb stop at the property line. The end of the service lateral at the property line shall be marked with a 2 x 4 stake, 36 inches long with the top six inches above the ground and painted blue. The depth of the pipe shall be marked on the back of the stake. Location of service line must appear on the "as–built" information and record drawings.

2.10 TAPPING SLEEVES

A. Shall be mechanical joint type sized to fit the intercepted pipe. They shall have duck–tipped end gaskets and shall be equal to Mueller H–615/715 with a tapping valve attached. The outlet end of the valve shall have a joint suitable for the type of pipe to be used in the new branch. Sleeve shall be sized to fit the intercepted pipe without leaking.

2.11 CURB STOPS

A. At the end of the service line, where the meter is to be installed, a 1 inch brass ball valve shall be installed. The unconnected end shall be closed inside I.P. thread. All ball valves shall be ¼-turn valves and the full open and closed position shall be controlled by check lugs. The pressure rating shall be 175 p.s.i. The ball valves shall be equivalent to Ford Ball Valve No. B41–444W.

2.12 BACKFLOW PREVENTER ASSEMBLY

A. Reduced Pressure – Shall consist of two independently operating check valves, one differential relief valve located between the two check valves, two resilient seat gate valves, and four properly placed resilient seated test cocks. Backflow preventer two inches and smaller shall have a bronze valve body. Backflow preventer greater than two inches shall be ductile iron or stainless steel. All internal parts in the check and relief valves shall be made of series 300 stainless steel or polymer materials suitable for potable water and rated for 175 p.s.i. working pressure. The assembly shall be constructed so all internal parts can be serviced or removed while in line. Assembly must be factory assembled and tested. Backflow preventer shall be equivalent to Febco Model 860 or Ames Model 4000 SS.

B. Double Check – Shall consist of two independently operating check valves, two resilient seat gate valves, and four properly placed resilient seated test cocks. Backflow preventer two inches and smaller shall have a bronze valve body. Backflow preventer greater than two inches shall be ductile iron or stainless steel. All internal parts in the check valves shall be made of Series 300 stainless steel or polymer materials suitable for potable water and rated for 175 p.s.i. working pressure. The assembly shall be constructed so all internal parts can be serviced or removed while in line. Assembly must be factory assembled and tested. Backflow preventer shall be equivalent to Febco Model 805 YD or Ames Model 2000 SS.

2.13 CASING

A. Casing pipe shall be steel conforming to ASTM A 139, yield point of 35,000 p.s.i., of the diameter shown on the contract drawings for each crossing. The minimum wall thickness shall be 0.25 inches.

2.14 CASING SPACERS

A. Casing spacers shall be bolt on style with a shell made in two sections of a minimum 14 gauge T–304 Stainless Steel. Connecting flanges shall be ribbed for extra strength. The shell shall be lined with a PVC liner. All nuts and bolts shall be T–304 Stainless Steel. Runners shall be made of Ultra High Molecular Weight Polymer with inherently high abrasion resistance and a low coefficient of friction. The combined height of supports and runners shall keep carrier pipe a minimum of 0.75 inches from casing pipe at all times. Casing Spacers shall be as manufactured by Cascade Waterworks Manufacturing Company, or accepted equivalent.

2.15 METAL DETECTOR TAPE

A. The tape shall consist of 0.35 mils thick solid foil core encased in a protective plastic jacket resistant to alkalis, acids, and other destructive elements found in the soil. The lamination bond shall be strong enough the layers cannot be separated by hand. Total composite thickness to be 5.0 mils. Foil core to be visible from unprinted side to ensure continuity. The tape shall have a minimum three-inch width and a tensile strength of 35 lbs. per inch.

A continuous warning message indicating "potable water" repeated every 16 inches to 36 inches shall be imprinted on the tape surface. The tape shall contain an opaque color concentrate designating the color code appropriate to the line being buried (Water Systems – Safety Precaution Blue).

2.16 TRACING WIRE

A. Tracing wire shall be # 12 gauge insulated single strand copper wire.

2.17 PRODUCT REVIEW

A. Contractor shall provide the Engineer with a complete description of all products before ordering. The Engineer will review all products before they are ordered.

PART 3 – EXECUTION

3.1 ON–SITE OBSERVATION

A. Owner's Representative or Engineer shall have the right to require any portion of work be completed in their presence. If any work is covered up after such instruction, it shall be exposed by the Contractor for observation. However, if Contractor notifies Engineer such work is scheduled, and Engineer fails to appear within 48 hours, the Contractor may proceed. All work completed and materials furnished shall be subject to review by the Engineer or Project Representative. Improper work shall be reconstructed. All materials which do not conform to requirements of specifications shall be removed from the work upon notice being received from Engineer for rejection of such materials. Engineer shall have the right to mark rejected materials to distinguish them as such.

Contractor shall give the Project Engineer or Project Representative a minimum of 48 hours' notice for all required observations or tests.

It will also be required of Contractor to keep accurate, legible records of the location of all water lines, service laterals, valves, fittings, and appurtenances. These records will be prepared in accordance with the paragraph on "Record Data" in Special Conditions. Final payment to the Contractor will be withheld until all such information is received and accepted.

3.2 INSTALLATION

A. Ductile iron pipe shall be laid in accordance with AWWA C–600; Plastic pipe shall be laid in accordance with AWWA C 605, ASTM D 2774, UNI–Bell UNI–B 3 and the pipe manufacturer's recommendations. The standards are supplemented as follows:

1. Depth of Pipe – Contractor shall perform excavation of whatever substances are encountered to a depth providing a minimum cover over top of pipe of 36 inches from the existing or proposed finished grade, unless pipe material is steel, concrete, ductile iron, or other accepted material, and if exposed, should be insulated to prevent freezing.

2. Alignment and Grade – Water mains shall be laid and maintained to lines and grades established by the plans and specifications, with fittings, valves, and hydrants at required locations unless otherwise accepted by Owner. Valve–operating stems shall be oriented in a manner to allow proper operation. Hydrants shall be installed plumb.

   a. Prior Investigation – Prior to excavation, investigation shall be made to the extent necessary to determine location of existing underground structures, utilities, and conflicts. Care shall be exercised by the Contractor during excavation to avoid damage to existing structures and utilities. Pipe manufacturer's recommendations shall be used when the water main being installed is adjacent to a facility catholically protected.

   b. Unforeseen Obstructions – When obstructions not shown on plans are encountered during progress of work and interfere so an alteration of the plans is required, Owner will alter plans, or order a deviation in line and grade, or arrange for removal, relocation, or reconstruction of obstructions.

   c. Clearance – When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the acceptance of Engineer, to provide clearance as required by federal, state, and local regulations or as deemed necessary by Engineer to prevent future damage or contamination.

3. Trench Construction – The trench shall be excavated to alignment, depth, and width specified or shown on plans and shall be in conformance with all federal, state, and local regulations for protection of workers.

4. Joint Restraint – All hydrants, bends, plugs, valves, caps and tees on two-inch pipe and larger, shall be provided with stainless steel tie rods or joint restraints equivalent to Megalugs. Additional restraint shall be as indicated on the drawings.

5. Anchorage for Hydrants – A concrete block 1 foot x 1 foot x 2 feet shall be poured between back of hydrant and undisturbed earth of the trench side without covering weep holes and bolts. Joint restraints equivalent to Megalugs manufactured by EBAA Iron may be used in lieu of concrete blocking.

6. Hydrostatic and Leakage Tests – Ductile iron pipe shall be tested in accordance with AWWA Standard C 600, Section 5.2 – Hydrostatic Testing. Allowable leakage shall not exceed the formula $L = SDP^{1/2}/148{,}000$, in which L is allowable leakage in gallons per hour; S is length of pipe in feet tested; D is nominal diameter of pipe in inches; and P is average test pressure during leakage test in pounds per square inch gauge. Test shall be conducted for at least two hours and a pressure of 150 p.s.i. shall be maintained during the test. Fire lines shall be tested at 225 p.s.i. for the same duration.

   P.V.C. pipe shall be tested in accordance with AWWA Standard C 605, Section 7.3 – Hydrostatic Testing. Allowable leakage shall not exceed formula $Q = LDP^{1/2}/148{,}000$, in which Q is allowable leakage in gallons per hour; L is length of pipe in feet tested; D is nominal diameter of the pipe in inches; and P is average test pressure during leakage test in pounds per square inch gauge. Test shall be conducted for at least two hours and a pressure of 150 p.s.i. shall be maintained during the test. Fire lines shall be tested at 225 p.s.i. for the same duration.

   Should any test of pipe laid disclose leakage greater than the above specified, Contractor shall, at its own expense, locate and repair defective joints until leakage is within specified allowance. Contractor is responsible for notifying the Engineer 48 hours (minimum) prior to applying pressure for testing. Pressure test will be witnessed by Engineer or Project Representative. All visible leaks shall be repaired regardless of the leakage amount.

7. Bedding, Backfilling, and Compaction – Continuous and uniform bedding shall be provided for all buried pipe. All trenches and excavation shall be backfilled immediately after pipes are laid therein, unless other protection of the pipe line is directed. The backfilling material shall be selected and deposited with special reference to future safety of the pipes. The material shall be completely void of rocks, stones, bricks, roots, sticks, or any other debris causing damage to pipe and tubing or preventing proper compaction of backfill. Except where special methods of bedding and

tamping are provided for, clean earth or sand shall be solidly tamped about pipe up to a level at least two feet above top of pipes, and shall be carefully deposited to uniform layers, each layer solidly tamped or rammed with proper tools to not injure or disturb the pipeline. The remainder of trench backfilling shall be carried on simultaneously on both sides of pipe in such manner preventing injurious side pressure. Material used shall be selected from excavations anywhere on site if any of the soil is suitable. Stones, other than crushed bedding, shall not come in contact with the pipe and shall not be within six inches of any pipe.

Under traffic areas, the top 24 inches of backfill material shall be compacted to a density of not less than 98% of maximum laboratory density at optimum moisture as determined by ASTM D 6938. Below the 24-inch line, and including area around pipe, density shall not be less than 95% of maximum laboratory density, at optimum moisture. In areas other than traffic areas, the backfill shall be compacted to 90% of maximum laboratory density at optimum moisture.

Whenever trenches have not been properly filled, or if settlement occurs, they shall be refilled, smoothed off, and finally made to conform to the ground surface. Backfilling shall be carefully performed, and the original surface restored to full satisfaction of Engineer immediately after installation.

Where thermoplastic (PVC) pipe is installed, Contractor shall take precautions, in accordance with ASTM D–2774, during backfilling operations, not to create excessive side pressures, or horizontal or vertical deflection of the pipe, nor impair flow capacity.

8. New Service Connections – Contractor shall tap the main and install a service connection to each vacant lot or as directed by Engineer in accordance with detail shown on plans for Water Service Connections. Plastic tubing for service lines shall be installed in a manner preventing abrupt changes or bends in any direction. Contractor shall exercise extreme caution to prevent crimping of the tubing during handling, storage, and installation. Tubing shall have an absolute positive connection to the water main to prevent leakage. Taps shall be made perpendicular to the main. A water service connection shall be marked on the curb with a "W." The mark shall be made with a branding iron on vertical face of curb and shall be a minimum of 1/4–inch in depth.

9. Detection Tape – Detection tape will be used over all pipe and tubing. The tape shall be laid 18 inches below finished grade.

10. Tracing Wire – Tracing wire will be installed on all water mains and water service laterals directly on top of the water line. The wire shall be secured to the pipe with tape or other acceptable methods at spacing of no more than 36 inches apart. Where water service laterals connect to water mains, the wire insulation shall be stripped so bare wires can and shall be jointed securely together and wrapped with a rubberized insulation tape. The

insulated wire must maintain electrical continuity. The tracing wire shall also be stubbed up into each valve box and at each fire hydrant. Stub up connections shall be stripped, joined and wrapped as previously described for water service laterals. This tracing wire system shall be checked and tested by Contractor, in the presence of Engineer or water department, prior to acceptance of water main installation. All equipment, meters, detectors, etc., needed for testing shall be furnished by the Contractor.

11. Jacking and Boring – Steel casing of diameter shown on the plans shall be jacked and bored in location indicated. Joints between sections of the steel casing shall be of a continuous weld made by a certified welder. Jacking and boring shall be in accordance with the State Department of Transportation Standard Specifications. Carrier pipe shall be installed as shown on the detail. After carrier pipe has been installed, ends of the casing shall be sealed using a rubber enclosure and stainless steel straps or brick and mortar.

    Where work involves a highway, Resident Engineer of the State Department of Transportation shall be notified three days before crossing is started. Where the work involves a railroad, installation shall conform to requirements of AREA specifications. Division Superintendent of the Railroad shall be notified 3 days prior to beginning work. Before commencing work within right–of–way of railroads or highways, Contractor shall verify the Owner has obtained required permits.

12. Lubricants – Lubricate pipe before jointing per manufacturer's recommendations using acceptable lubricants. Lubricants that will support microbiological growth shall not be used. Vegetable shortening shall not be used to lubricate joints.

13. Hydrant drains shall not be connected to or located within 10 feet of sanitary sewers. No flushing device shall be directly connected to any sewer.

14. Pipe for above water crossings shall be adequately supported and anchored, protected from damage and freezing, and accessible for repair or replacement.

15. Underwater line crossings shall have a minimum two feet of cover over the pipe. When crossing water courses greater than 15 feet in width, the following shall be provided:

    a. The pipe material and joints shall be designed appropriately.

    b. Valves shall be located on both sides of crossing so the section can be isolated for testing or repair. Valves shall be easily accessible and not subject to flooding.

c. A blow–off shall be provided on the side opposite the supply, sized in accordance with State Drinking Regulation Section R.61–58.4(D)(7). Direct blow–off away from streams, over ground.

d. Provide ductile iron pipe with mechanical joints for any lines installed in rock.

16. Installation of water mains and appurtenances shall be conducted in accordance with Section C of the AWWA Standards and/or manufacturer's recommended installation procedures. (R.61-58.4.D. (11) (a)).

17. Bedding: (R.61-58.4.D.(11)(b))

a. A continuous and uniform bedding shall be provided in the trench for all buried pipe.
b. Back-fill material shall be tamped in layers around the pipe and to a sufficient height above the pipe to adequately support and protect the pipe.
c. Stones, other than crushed bedding, shall not come in contact with the pipe and shall be within 6 inches of the pipe.

18. All water mains shall be detectable within 3 feet with electronic locating equipment. (R.61-58.4.D. (11) (g)).

19. Separation of Water Mains and Sewers: (R.61-58.4.D.(12)(a)-(f))

a. Parallel Installation – Water mains shall be laid at least 10 feet horizontally from any existing or proposed sewer. The distance shall be measured edge to edge. In cases where it is not practical to maintain a ten-foot separation, the Department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the water main closer to a sewer, provided that the water main is laid in a separate trench, or on an undisturbed earth shelf located on one side of the sewer at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.

b. Crossings – Water main crossing sewers shall be laid to provide a minimum vertical separation of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case whether the water main is either above or below the sewer line. Whenever possible, the water main shall be located above the sewer line. Where a new water main crosses a new sewer line, a full length of pipe shall be used for both the water main and sewer line and the crossing shall be arranged so that the joints of each line will be as far as possible from the point of crossing and each other. Where a new water main crosses an existing sewer line, one full length of water pipe shall be located so both joints will be as far from the sewer line as possible. Where a water main crosses under a

sewer, adequate structural support shall be provided for the sewer line to prevent damage to the water main.

c. Maximize the distances between the water main and sewer line and the joints of each.

d. Use materials which meet the requirements R.61-58.4.D (1) for the sewer line.

e. Allow enough distance to make repairs to one of the lines without damaging the other.

f. Force Mains – There shall be at least a 10-foot horizontal separation between water mains and sanitary sewer force mains. There shall be an 18-inch vertical separation at crossing as required in R.61-58.4.D (12) (a) and (b).

g. Sewer Manholes – No water pipe shall pass through or come in contact with any part of a sewer manhole. Water lines may come in contact with storm sewers or catch basins if there is no other practical alternative, provided that ductile iron is used, no joints of the water line are within the storm sewer or catch basin, and the joints are located as far as possible from the storm sewer or catch basin.

3.3 AIR RELEASE, AIR/VACUUM AND COMBINATION AIR VALVES

A. Valves shall be installed in locations as shown on the contract drawings. The Contractor shall verify high points in the water line and notify Engineer of differing conditions from the drawings.

B. Valves shall be opened during initial filling of the water main. Valves shall be closed during hydrostatic testing. Once tested and the system is accepted for operation, valves shall be opened when water lines are put on line.

3.4 CONNECTIONS OF WATER MAINS

A. Any physical connection of untested water mains with existing water mains is prohibited except when acceptable backflow prevention devices have been installed and checked by Engineer or Engineer's Representative.

1. Any new water main to be tested must be capped and restrained with retaining glands or thrust blocks to prevent blow out or leakage during the pressure testing.

2. Water for filling or flushing a new water main will be obtained through a Temporary Jumper Connection to the existing main. Appropriate taps of sufficient size must be made at the end of new system to allow air to escape during filling sequence.

3. This physical tie–in with the existing system must be physically disconnected after sufficient water for hydrostatic testing and disinfection has been obtained.

4. Once the new water system has demonstrated adequate hydrostatic testing and has been flushed and chlorinated in accordance with paragraph 3.5, the new system or main will then be subjected to bacteriological testing.

5. Permanent connection to the new system must be made with clean materials. The connection may be made with either solid or split ductile iron sleeves. Any connection with stainless steel or similar metal full circle clamps is prohibited. Once connection has been made, the new system must be flushed using water from existing system to insure adequate flow and velocity into new water system.

3.5 DISINFECTION

A. After hydrostatic and leakage tests have been completed, water pipes shall be disinfected in accordance with AWWA C 651 and Regulations of the local Health Department.

All new mains shall be thoroughly flushed then chlorinated with not less than fifty parts per million (50 ppm) of available chlorine. Chlorine gas or 70% high–test calcium hypochlorite can be used. Water from existing distribution system or other source of supply should be controlled to flow slowly into the newly laid pipeline during application of chlorine. The solution shall be retained in pipeline for not less than 24 hours and a chlorine residual of 25 ppm shall be available at this time. Then system shall be flushed with potable water and the sampling program started. Prior to sampling, the chlorine residual must be reduced to normal system residual levels or be non–detectable in those systems not chlorinating. Normal system residual should be between 0.2 and 0.8 ppm. The chlorine residual shall be measured and reported. If the membrane filter method of analysis is used for coliform analysis, non–coliform growth must also be reported. If non–coliform growth is greater than 80 colonies per 100 milliliters, the sample result is invalid and must be repeated.

A minimum of two samples from each sampling site shall be collected for total coliform analysis. The number of sites depends on amount of new construction, but must include all dead end lines, be representative of water in newly constructed mains, and shall be collected a minimum of every 1,200 linear feet. Each set of samples shall be taken at least 24 hours apart after disinfection and tested by a State approved lab and shall indicate bacteriological satisfactory water. Contractor shall submit results to the Engineer.

B. Disinfection Requirements of SCDHEC: (R.61-58.4.D.(11)(f))

1. Disinfection of all new water mains shall be in accordance with current American Water Works Association (AWWA) Standard C651 for the

disinfection of water mains. In general, one approved method referred to as "continuous feed method" is as followed.

2. Before being placed in service, all new mains shall be thoroughly flushed then chlorinated with not less than twenty-five (25) milligrams per liter of available chlorine.

3. Water from the existing distribution system or other source of supply shall be controlled so as to flow slowly into the newly laid pipeline for not less than 24 hours and then flushed thoroughly with a potable water of satisfactory bacteriological quality before starting the sampling program.

4. The Contractor or Owner shall collect a minimum of two samples from each sampling site for total coliform analysis. The number of sites depends on the amount of new construction but must include all dead-end lines, be representative of the water in the newly constructed mains, and shall be collected a minimum of every 1,200 linear feet.

5. Prior to sampling, the chlorine residual must be reduced to normal system residual levels or be non-detectable in those systems not chlorinating.

6. These samples must be collected at least 24 hours apart and must show the water line to be absent of total coliform bacteria.

7. The chlorine residual must also be measured and reported.

8. If the membrane filter method of analysis is used for the coliform analysis, non-coliform growth must also be reported.

9. If the non-coliform growth is greater than 80 colonies per 100 milliliters, the sample result is invalid and must be repeated.

10. All samples must be analyzed by a State certified laboratory.

3.6 PARTIAL ACCEPTANCE OF THE WORK

A. Owner reserves right to accept and use any portion of the work. Engineer shall have power to direct on what line Contractor shall work and the order thereof.

3.7 GRASSING

A. Grassing of areas disturbed during construction shall be in accordance with the Section 32 92 00 Turf and Grasses.

3.8 SEPARATION BETWEEN WATER AND SANITARY SEWER OR FORCE MAIN

A. Water mains shall be laid at least 10 feet horizontally from any existing or proposed sanitary sewer or force main. Deviation may be allowed for installation of the water main closer to a sanitary sewer or force main, provided water main is laid in a

separate trench, where bottom of water main is at least 18 inches above top of sanitary sewer or force main. Water mains crossing sanitary sewers or force mains shall be laid to provide a minimum vertical distance of 18 inches between the invert of water main and top of sanitary sewer or force main line; both water and sanitary sewer or force main lines must be ductile iron when laid in violation of separation requirements. At all water and sanitary sewer or force main crossings, one full length of water pipe shall be located so both joints will be as far from the sanitary sewer or force main as possible.

B. When it is impossible to obtain distances specified in Section R.61–58.4(D) (12) (a) and (b) of the State Primary Drinking Water Regulations, an alternate, SCDHEC accepted design may be allowed. The alternate design must:

1. maximize distances between the water main and sewer line and joints of each;

2. use materials which meet requirements cited in Section R.61–58.4(D)(1) of the State Primary Drinking Water Regulations for sewer line; and

3. Allow enough distance to make repairs to one of the lines without damaging other.

3.9 REMOVE AND REPLACE PAVEMENT

A. Pavement shall only be removed after prior written authorization by the Owner. Pavement removed and replaced shall be constructed in accordance with latest specifications of the State Department of Transportation. Traffic shall be maintained and controlled per State Department of Transportation regulations.

Edges of the pavement shall be cut to a neat straight line with a masonry saw. Backfill shall be compacted and tested and a concrete base course of 5,000 p.s.i. placed on compacted fill as shown in the details. The concrete base shall be placed within 24 hours after water line is installed. A temporary wearing surface may be used provided it presents a smooth surface. The final wearing surface shall be 1 ½ inches asphaltic concrete, Type C.

3.10 FIELD QUALITY CONTROL

A. Soil and density tests shall be made by a testing laboratory acceptable to Engineer. Laboratory tests of the soil shall be made in accordance with ASTM D 1557. In-place density tests shall be made in accordance with ASTM D 6938. Results of tests shall be furnished to the Engineer.

The minimum number of tests required shall be:

Backfill over pipe
In traffic areas. . . . . 1 per 100 linear feet or less for each 4 feet of depth or portion thereof.

Backfill over pipe
In non–traffic areas . . . . . 1 per 500 linear feet or less for each 4 feet of depth or portion thereof.

The minimum percent of backfill compaction, in accordance to ASTM D1557, shall be the following:

In traffic Areas. . . . . 98% of maximum laboratory density.

In non–traffic Areas . . . 90% of maximum laboratory density, unless otherwise accepted by the Engineer.

END OF SECTION

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SECTION 33 47 23 – POLYETHYLENE GEOMEMBRANE LINER AND GEOCOMPOSITE

SECTION 33 47 23

POLYETHYLENE GEOMEMBRANE LINER AND GEOCOMPOSITE

PART 1 GENERAL

1.1 SCOPE OF WORK

To furnish and install a 60-mil HDPE liner for an earthen basin (effluent lagoon) with a geocomposite ventilation system as shown on the drawings.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. D 638 Standard Test Method for Tensile Properties of Plastics
2. D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
3. D 1238 Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer
4. D 1505 Test Method for Density of Plastics by the Density–Gradient Technique
5. D 1603 Test Method for Carbon Black in Olefin Plastics
6. D 3895 Standard Test Method for Oxidative–Induction Time of Polyolefins by Differential Scanning Calorimetry
7. D 4833 Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
8. D 5199 Standard Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes
9. D 5397 Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
10. D 5596 Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
11. D 5994 Standard Test Method for Measuring Core Thickness of Textured Geomembranes
12. D 6392 Standard Test Method for Determining the Integrity of Non–reinforced Geomembrane Seams Produced Using Thermo–Fusion Methods

1.3 DEFINITIONS

A. Lot– A quantity of resin (usually the capacity of one rail car) used in the manufacture of polyethylene geomembrane rolls. The finished roll will be identified by a roll number traceable to the resin lot used.

B. Construction Quality Assurance Consultant (CONSULTANT)– Party, independent from MANUFACTURER and INSTALLER that is responsible for observing and documenting activities related to quality assurance during the lining system construction.

C. ENGINEER– The individual or firm responsible for the design and preparation of the project's Contract Drawings and Specifications.

D. Geomembrane Manufacturer (MANUFACTURER)– The party responsible for manufacturing the geomembrane rolls.

E. Geosynthetic Quality Assurance Laboratory (TESTING LABORATORY)– Party, independent from the OWNER, MANUFACTURER and INSTALLER, responsible for conducting laboratory tests on samples of geosynthetics obtained at the site or during manufacturing, usually under the direction of the OWNER.

F. INSTALLER– Party responsible for field handling, transporting, storing, deploying, seaming and testing of the geomembrane seams.

G. Panel– Unit area of a geomembrane that will be seamed in the field that is larger than 100 square feet.

H. Patch– Unit area of a geomembrane that will be seamed in the field that is less than 100 square feet.

I. Subgrade Surface– Soil layer surface which immediately underlies the geosynthetic material(s).

1.4 SUBMITTALS POST–AWARD

A. Furnish the following product data, in writing, to ENGINEER prior to installation of the geomembrane material:

1. Resin Data shall include the following:

a. Certification stating that the resin meets the specification requirements (see Section 1.9).

b. Copy of Quality Assurance/Quality Control certificates issued by MANUFACTURER and resin supplier shall be submitted.

2. Geomembrane Roll:

a. Statement certifying no reclaimed polymer is added to the resin (product run may be recycled).

b. Copy of quality assurance certificates issued by MANUFACTURER shall be furnished.

B. The INSTALLER shall furnish the following information to the ENGINEER and OWNER prior to installation:

1. Installation layout drawings:

a. Must show proposed panel layout including field seams and details
b. Must be approved prior to installing the geomembrane

1) Approved drawings will be for concept only and actual panel placement will be determined by site conditions.

2. Installer's Geosynthetic Field Installation Quality Assurance Plan

C. The INSTALLER will submit the following to the ENGINEER upon completion of installation:

1. Certificate stating the geomembrane has been installed in accordance with the Contract Documents.

2. Material and installation warranties.

3. As–built drawings showing actual geomembrane placement and seams including typical anchor trench detail.

1.5 QUALITY ASSURANCE

A. The CONTRACTOR shall engage and pay for the services of a Geosynthetic Quality Assurance Consultant and Laboratory to monitor geomembrane installation.

1.6 QUALIFICATIONS

A. MANUFACTURER:

1. Geomembrane shall be manufactured by the following:

a. Poly–Flex, Inc.
a. GSE Lining Technology, Inc.
b. Agru-America.

2. Geomembrane shall be manufactured by the following: MANUFACTURER shall have manufactured a minimum of 10,000,000 square feet of polyethylene geomembrane during the last year.

B. INSTALLER:

1. Installation shall be performed by one of the following installation companies (or approved equal):

a. DX2 Geosyntex, Inc.
b. GSE Lining Technology, Inc.
c. Poly–Flex Approved Dealer/Installers.
d. EFI Environmental Fabric, Inc.

2. INSTALLER shall have installed a minimum of 1,000,000 square feet of HDPE geomembrane during the last 3 years.

3. INSTALLER shall have worked in a similar capacity on at least 10 projects similar in complexity to the project described in the contract documents, and with at least 10,000 square feet of HDPE geomembrane installation on each project.

4. The Installation Supervisor shall have worked in a similar capacity on projects similar in size and complexity to the project described in the Contract Documents.

5. The INSTALLER shall provide a minimum of one Master Seamer for work on the project.

   a. Must have completed a minimum of 1,000,000 square feet of geomembrane seaming work using the type of seaming apparatus proposed for the use on this Project.

1.7 MATERIAL LABELING, DELIVERY, STORAGE AND HANDLING

A. Labeling – Each roll of geomembrane delivered to the site shall be labeled by the MANUFACTURER. The label will identify:

1. Manufacturer's name.
2. Product identification.
3. Thickness.
4. Length.
5. Width.
6. Roll number.

B. Delivery – Rolls of liner will be prepared to ship by appropriate means to prevent damage to the material and to facilitate off–loading.

C. Storage – The on–site storage location for geomembrane material, provided by the CONTRACTOR to protect the geomembrane from punctures, abrasions and excessive dirt and moisture for should have the following characteristics:

1. Level (no wooden pallets).
2. Smooth.
3. Dry.
4. Protected from theft and vandalism.
5. Adjacent to the area being lined.

D. Handling – Materials are to be handled so as to prevent damage.

1.8 WARRANTY

A. Material shall be warranted, on a pro–rata basis against Manufacturer's defects for a period of 20 years from the date of geomembrane installation.

B. Installation shall be warranted against defects in workmanship for a period of one year from the date of geomembrane completion.

1.9 GEOMEMBRANE

A. Material shall be smooth polyethylene geomembrane as shown on the drawings.

B. Resin:

1. Resin shall be new, first quality, compounded, and manufactured specifically for producing geomembrane.
2. Natural resin (without carbon black) shall meet the following additional minimum requirements:

Property	Test Method[1]	HDPE	LLDPE/VFPE
Density (g/cm^3)	ASTM D 1505	0.932	0.915
Melt Flow Index (g/10 min.)	ASTM D 1238 (190/2.16)	≤ 1.0	≤ 1.0
OIT (minutes)	ASTM D 3895 (1 atm at 200°C)	100[2]	100[2]

[1] GSE utilizes test equipment and procedures that enable effective and economical confirmation that the product will conform to specifications based on the noted procedures. Some test procedures have been modified for application to geosynthetics. All procedures and values are subject to change without prior notification.

[2] OIT for LLDPE/VFPE resin is performed on a representative finished product for each lot of resin rather than on the natural (without carbon black) resin.

C. Geomembrane Rolls:

1. Do not exceed a combined maximum total of one percent by weight of additives other than carbon black.

2. Geomembrane shall be free of holes, pinholes as verified by on–line electrical detection, bubbles, blisters, excessive contamination by foreign matter, and nicks and cuts on roll edges.

3. Geomembrane material is to be supplied in roll form. Each roll is to be identified with labels indicating both number, thickness, length, width and MANUFACTURER.

4. All liner sheets produced at the factory shall be inspected prior to shipment for compliance with the physical property requirements listed in Section 1.09, B, and be tested by an acceptable method of inspecting for pinholes. If pinholes are located, identified and indicated during manufacturing, these pinholes may be corrected during installation.

D. Smooth surfaced geomembrane shall meet the requirements shown in the following table(s) for the following material(s):

1. **Table 1.1 for black HDPE** shall be used for this project with oven aging and UV resistance testing in accordance with GRI GM13 and ASTM D 5885 High Pressure OIT.

2. Table 1.2 for white–surfaced HDPE.

a. The geomembrane shall be a white–surfaced, coextruded geomembrane.
b. The white surface shall be installed upwards.

3. Table 1.3 for smooth conductive HDPE:

a. The geomembrane shall have a coextruded, electrically conductive layer.
b. The conductive layer is installed downward.
c. Electrical testing shall be performed after liner installation by the INSTALLER.

4. Table 1.4 for black VFPE

5. Table 1.5 for white–surfaced VFPE:

a. The geomembrane shall be a white–surfaced, coextruded geomembrane.
b. The white surface shall be installed upwards.

E. Extrudate Rod or Bead:

1. Extrudate material shall be made from same type resin as the geomembrane.

2. Additives shall be thoroughly dispersed.

3. Materials shall be free of contamination by moisture or foreign matter.

1.10 EQUIPMENT

A. Welding equipment and accessories shall meet the following requirements:

1. Gauges showing temperatures in apparatus (extrusion welder) or wedge (wedge welder) shall be present.

2. An adequate number of welding apparati shall be available to avoid delaying work.

3. Power source capable of providing constant voltage under combined line load shall be used.

1.11 DEPLOYMENT

A. Assign each panel a simple and logical identifying code. The coding system shall be subject to approval and shall be determined at the job site.

B. Visually inspect the geomembrane during deployment for imperfections and mark faulty or suspect areas.

C. Deployment of geomembrane panels shall be performed in a manner that will comply with the following guidelines:

1. Unroll geomembrane panels using methods that will not damage geomembrane and will protect underlying surface from damage (i.e., spreader bar, protected equipment bucket).

2. Place ballast (commonly sandbags) on geomembrane which will not damage geomembrane to prevent wind uplift.

3. Personnel walking on geomembrane shall not engage in activities or wear shoes that could damage the geomembrane. Smoking will not be permitted on the geomembrane.

4. Do not allow heavy vehicular traffic directly on geomembrane. Rubber–tired ATV's and trucks are acceptable if wheel contact is less than six psi.

5. Protect geomembrane in areas of heavy traffic by placing protective cover over the geomembrane.

D. Sufficient material (slack) shall be provided to allow for thermal expansion and contraction of the material.

1.12 FIELD SEAMING

A. Seams shall meet the following requirements:

1. To the maximum extent possible, orient seams parallel to line of slope, i.e., down and not across slope.

2. Minimize number of field seams in corners, odd–shaped geometric locations and outside corners.

3. Slope seams (panels) shall extend a minimum of five feet beyond the grade break into the flat area.

4. Use a sequential seam numbering system compatible with panel numbering system that is agreeable to the CONSULTANT and INSTALLER.

5. Align seam overlaps consistent with the requirements of the welding equipment being used. A six–inch overlap is commonly suggested.

B. During Welding Operations:

1. Provide at least one Master Seamer who shall provide direct supervision over other welders as necessary.

C. Extrusion Welding:

1. Hot–air tack adjacent pieces together using procedures that do not damage geomembrane.

2. Clean geomembrane surfaces by disc grinder or equivalent.

3. Purge welding apparatus of heat–degraded extrudate before welding.

D. Hot Wedge Welding:

1. Welding apparatus shall be a self–propelled device equipped with an electronic controller which displays applicable temperatures.

2. Clean seam area of dust, mud, moisture and debris immediately ahead of the hot wedge welder.

3. Protect against moisture build–up between sheets.

E. Trial Welds:

1. Perform trial welds on geomembrane samples to verify welding equipment is operating properly.

2. Make trial welds under the same surface and environmental conditions as the production welds, i.e., in contact with subgrade and similar ambient temperature.

3. Minimum of two trial welds per day, per welding apparatus, one made prior to the start of work and one completed at mid-shift.

4. Cut four, one–inch wide by six–inch long test strips from the trial weld.

5. Quantitatively test specimens for peel adhesion, and then for bonded seam strength (shear).

6. Trial weld specimens shall pass when the results shown in Table 3 are achieved in both peel and shear test.

a. The break, when peel testing, occurs in the liner material itself, not through peel separation (FTB).

b. The break is ductile.

7. Repeat the trial weld, in its entirety, when any of the trial weld samples fail in either peel or shear.

8. No welding equipment or welder shall be allowed to perform production welds until equipment and welders have successfully completed trial weld.

F. Seaming shall not proceed when ambient air temperature or adverse weather conditions jeopardize the integrity of the liner installation. INSTALLER shall demonstrate that acceptable seaming can be performed by completing acceptable trial welds.

G. Defects and Repairs:

1. Examine all seams and non–seam areas of the geomembrane for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter.

2. Repair and non–destructively test each suspect location in both seam and non–seam areas. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.

1.13 FIELD QUALITY ASSURANCE

A. MANUFACTURER and INSTALLER shall participate in and conform to all terms and requirements of the Owner's quality assurance program. CONTRACTOR shall be responsible for assuring this participation.

B. Quality assurance requirements are as specified in this Section and in the Field Installation Quality Assurance Manual if it is included in the contract.

C. Field Testing:

1. Non–destructive testing may be carried out as the seaming progresses or at completion of all field seaming.

a. Vacuum Testing:

1) Shall be performed in accordance with ASTM D 5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.

b. Air Pressure Testing:

1) Shall be performed in accordance with ASTM D 5820, Standard Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes.

c. Other approved methods.

2. Destructive Testing (performed by CONSULTANT with assistance from INSTALLER):

a. Location and Frequency of Testing:

1) Collect destructive test samples at a frequency of one per every 1500 linear feet of seam length.

2) Test locations will be determined after seaming.

3) Exercise Method of Attributes as described by GRI GM–14 (Geosynthetics Institute, http://www.geosynthetic–institute.org) to minimize test samples taken.

b. Sampling Procedures are performed as follows:

1) INSTALLER shall cut samples at locations designated by the CONSULTANT as the seaming progresses in order to obtain field laboratory test results before the geomembrane is covered.

2) CONSULTANT will number each sample, and the location will be noted on the installation as–built.

3) Samples shall be 12 inches wide by minimal length with the seam centered lengthwise.

4) Cut a two–inch wide strip from each end of the sample for field–testing.

5) Cut the remaining sample into two parts for distribution as follows:

a) One portion for INSTALLER, 12 inches by 12 inches.

b) One portion for the third-party laboratory, 12 inches by 18 inches.

c) Additional samples may be archived if required.

6) Destructive testing shall be performed in accordance with ASTM D 6392, Standard Test Method for Determing the Integrity of Non–Reinforced Geomembrane Seams Produced Using Thermo–Fusion Methods.

7) INSTALLER shall repair all holes in the geomembrane resulting from destructive sampling.

8) Repair and test the continuity of the repair in accordance with these Specifications.

3. Failed Seam Procedures:

1) If the seam fails, INSTALLER shall follow one of two options:

a) Reconstruct the seam between any two passed-test locations.

b) Trace the weld to an intermediate location at least 10 feet minimum or to where the seam ends in both directions from the location of the failed test.

2) The next seam welded using the same welding device is required to obtain an additional sample, i.e., if one side of the seam is less than 10 feet long.

3) If sample passes, then the seam shall be reconstructed or capped between the test sample locations.

4) If any sample fails, the process shall be repeated to establish the zone in which the seam shall be reconstructed.

1.14 REPAIR PROCEDURES

A. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.

B. Repair any portion of unsatisfactory geomembrane or seam area failing a destructive or non–destructive test.

C. INSTALLER shall be responsible for repair of defective areas.

D. Agreement upon the appropriate repair method shall be decided between CONSULTANT and INSTALLER by using one of the following repair methods:

1. Patching– Used to repair large holes, tears, undispersed raw materials and contamination by foreign matter.

2. Abrading and Re–welding– Used to repair short section of a seam.

3. Spot Welding– Used to repair pinholes or other minor, localized flaws or where geomembrane thickness has been reduced.

4. Capping– Used to repair long lengths of failed seams.

5. Flap Welding– Used to extrusion weld the flap (excess outer portion) of a fusion weld in lieu of a full cap.

6. Remove the unacceptable seam and replace with new material.

E. The following procedures shall be observed when a repair method is used:

1. All geomembrane surfaces shall be clean and dry at the time of repair.

2. Surfaces of the polyethylene which are to be repaired by extrusion welds shall be lightly abraded to assure cleanliness.

3. Extend patches or caps at least six inches for extrusion welds and four inches for wedge welds beyond the edge of the defect, and around all corners of patch material.

F. Repair Verification:

1. Number and log each patch repair (performed by CONSULTANT).

2. Non–destructively test each repair using methods specified in this Specification.

1.15 FINAL FILL AND LEAKAGE TESTING

A. After seams have been tested and satisfactorily passed, the pond shall be pre–filled to design levels using non–process water for a leakage test. Contractor shall measure leakage via a pan evaporation test, measuring rainfall and evaporation rates while also recording water levels in the pond for a period of not less than 14 days. Leakage shall be less than 1/8 inch per day (3.67 x 10^{-6} cm/sec). Pre–fill water can be transferred from cell to cell after testing has been completed in each cell.

Table 1.1: Minimum Values for Smooth Black–Surfaced HDPE Geomembranes

Property	Test Method(1)	40	60
Thickness, mil (mm)	ASTM D 5199		
Minimum Average		40 (1.0)	60 (1.5)
Lowest Individual Reading		36 (0.91)	54 (1.4)
Density, g/cm^3	ASTM D 1505	0.94	0.94
Carbon Black Content, %	ASTM D 1603, Modified	2.0	2.0
Carbon Black Dispersion	ASTM D 5596	Note 2	Note 2
Tensile Properties: (each direction)	ASTM D 638 Type IV, 2 ipm		
Strength at Yield, lb./in		84	130
Strength at Break, lb./in		162 (28)	243 (43)
Elongation at Yield, %	(1.3" gauge length)	13	13
Elongation at Break, %	(2.0" gauge length)	700	700
Tear Resistance, lb (N)	ASTM D 1004	28 (124)	42 (187)
Puncture Resistance, lb (N)	ASTM D 4833	79 (352)	119 (530)
Notched Constant Tensile Load, hours	ASTM D 5397, appendix	400	400
Oxidative Induction Time, min.	ASTM D 3895	100	100

Table 3.1: Minimum Weld Values for Smooth HDPE Geomembranes

Property	Test Method(1)	40 (1.0)	60 (1.5)
Peel Strength (fusion), ppi (kN/m)	ASTM D 6392	65 (12)	98 (17)
Peel Strength (extrusion), ppi (kN/m)	ASTM D 6392	52 (9)	78 (14)
Shear Strength (fusion & ext.), ppi (kN/m)	ASTM D 6392	81 (14)	121 (21)

1.16 POLYETHYLENE EMBED CHANNELS

A. Scope – The following describes parameters for the manufacture, supply, and installation of Poly–Flex High Density Polyethylene Embed Channel (PEC). All procedures, operations, and methods shall be in strict accordance with the Engineer's specifications and drawings.

B. References – American Society for Testing and Materials.

C. Submittals:

1. The manufacturer shall maintain test records of the resins used to manufacture the PEC. This record shall be made available to the Engineer upon request.

2. The contractor shall submit shop drawings showing the exact location and installation procedures.

3. At the Engineers request sample(s) of PEC shall be submitted.

D. Manufacturer's Quality Control Testing – All resins for use in PEC must pass the Poly–Flex raw material specifications before being eligible for use. Each lot shall be sampled and tested in the Poly–Flex, Inc. laboratory. The tests shall include density, melt index, and carbon black content. All additives and concentrates must pass Poly–Flex specifications. GSE Lining Technology, Inc.

E. Product – The PEC shall be manufactured by Poly–Flex, Inc. DSE Lining Technology, Inc. or approved equal. The raw materials shall be made of polyethylene resins manufactured in the United States. Carbon black shall be added to the resin if the resin is not precompounded for ultra–violet resistance. The final product shall meet the following nominal values:

Density:	ASTM D1505	≥ 0.940 g/cc
Melt Index:	ASTM D1238–E	≤ 0.4 g/10 minutes
Carbon Black Content:	ASTM D1603	2% – 3%
Tensile Strength at Yield:	STM D638	2,500 lb/in^2
Dimensions:	As shown on the drawing	
Weight:	0.45 lb/ft	
Size:	10ft long sections	

1. Shipment and Storage – PEC shall be shipped in a manner not to be damaged by packaging or handling and shall be stored in a clean environment.

F. Installation – PEC can be nailed to wooden forms or pushed or vibrated into poured concrete. A three-inch clearance is recommended from concrete edges or corners.

1. Installation in Concrete Forms – PEC shall be installed inside the concrete forms in accordance with the shop drawings prior to pouring concrete. Place PEC in the designated locations with the surface of PEC in contact with the form. PEC shall be secured to the wooden forms by means of nails driven from the inside of PEC into the forms (see Step 1 drawing). All exposed nails shall be clipped at the surface of PEC after removal of the forms.

2. Fabrication – PEC can be prefabricated into frames and vibrated into freshly poured concrete. Small air vent holes shall be drilled in approximately three-foot intervals in the surface of PEC prior to its placement into fresh concrete.

   Butt welded connections are made by extrusion welding the back side of the 3.5-inch surface and the outside of the legs. Backup HDPE plates are

sometimes used behind the surface to be butt welded to reinforce the connection. A very flat extrusion weld bead is then placed on the 3.5-inch surface. PEC can also be butt welded similar to HDPE pipe welding techniques. The two pieces (A & B) to be welded are laid on a flat surface. Each piece is held in contact with the "welding mirror" (C) for approximately 45 seconds until a melt bead (D) forms at the mirror; the mirror is removed (E) and the pieces are pushed together (F) fusing the molten plastic. The process gives a full perimeter weld of the PEC. Care must be exercised to assure alignment of the channels after the weld. This method can also be used for miter joints.

It is necessary to prevent gaps or repair gaps caused by thermal contraction or improper placement of the PEC. The liner–to–PEC connection will not be water tight unless the PECs are properly joined at their ends. Other PEC installation details are available from Poly–Flex, Inc.

3. Seaming – All seaming shall be done in accordance with the Poly–Flex extrusion seaming procedures, as outlined in this manual, and be experienced technicians who are qualified by Poly–Flex, Inc. to seam Poly–Flex liners.

   The following steps shall be followed prior to welding Poly–Flex liners to the PEC:

   a. Remove cement paste, form oils, curing compound or other contaminants from the surface of PEC. The 3.5" wide surface shall be clean and dry. The welding surfaces of the PEC can be taped prior to its installation. The tape is removed after the concrete is hardened to expose the clean surfaces pf PEC for welding.

   b. Us a hot air gun to tack liner to PEC in a straight line in center of the PEC surface.

   c. A grinder with 80–grit disc shall be used to remove the surface contamination and oxidation from the welding surface area prior to the extrusion welding. Place the extrudate on the center line. All air vent or nail holes shall also be ground and covered with the extrudate.

   All seams shall be nondestructively tested, whenever possible, by using a vacuum box apparatus if the PEC connection is designed to be waterproof.

   Since no destructive seam testing is possible, it is very important that the seaming be done by Poly–Flex qualified technicians and/or qualified representatives of Poly–Flex dealers.

1.17 GEOCOMPOSITE GAS VENTILATION SYSTEM

A. Ventilation shall be double–sided eight-ounce geocomposite, manufactured by Poly–Flex or accepted equivalent. Ventilation Geocomposite to cover the entire

basin. Install (a minimum of 50 or the minimum recommended by the manufacturer, whichever is more stringent) air/gas vents for each basin. Vents shall be spaced in equal distance.

B. Material shall be installed as specified.

C. Non-woven needle punched geotextiles shall be thermally bonded to Poly–Flex geonets forming a geocomposite capable of providing high in–place ventilation in soil environment and under high normal loads. The geocomposite shall be inert to chemical and biological attach and are stabilized against UV degradation.

D. Double–sided geocomposite shall meet the requirements shown in the following table for the following materials:

GEOCOMPOSITE PROPERTIES		**Minimum Average Values**	
Property	Test Method	FNC200–2–6	FNC200–2–8
Transmissivity, (MD), gal/min–ft. metal plate/geocomposite/metal plate hydraulic gradient, i = 1 normal pressure = 15,000 lb/ft^2	ASTM D 4716	0.48 (1 x 10^{-4} m^2/sec)	0.19 (4 x 10^{-5} m^2/sec)
Peel Adhesion, lb/in peak load on 2" wide specimen	ASTM D413 or F904	1	1
Roll Dimensions			
1. Roll Width, ft		13.5	13.5
2. Roll Length, ft		250	200
COMPONENT PROPERTIES			
Geonet			
Thickness, mil	ASTM D 5199	200	200
Mass Per Unit Area, lb/ft^2	ASTM D 5261	0.162	0.162
Density, min., g/cc	ASTM D 1505	0.940	0.940
Carbon Black Content, min., %	ASTM D 1603	2	2
Tensile Strength, lb/in	ASTM D 1682 or 5035	45	45
Transmissivity, (MD), gal/min–ft. metal plate/net/metal plate hydraulic gradient, i = 1 normal pressure = 15,000 lb./ft^2	ASTM D 4716	4.8 (1 x 10^{-3} m^2/sec)	4.8 (1 x 10^{-3} m^2/sec)
Geotextile			
Unit Weight, oz/yd^2	ASTM D 5261	6	8
Grab Tensile, lb	ASTM D 4632	160	203
Mullen Burst, lb/in^2	ASTM D 3786	350	450
Puncture, lb	ASTM D 4833	90	130
AOS	ASTM D 4751	70 sieve	100 sieve
Flow rate, gal/min–ft^2	ASTM D 4491	110	110

E. Manufacturer's Quality Control Testing – The Drainage Net shall be tested by its manufacturer once every 50,000 square feet for listed properties, except the transmissivity, which shall be tested once every 100,000 square feet.

The geotextile shall be tested by its manufacturer once every 50,000 square feet except for apparent opening size (AOS) and permittivity, which shall be tested once every 100,000 square feet.

The geocomposite shall be tested by its manufacturer once every 100,000 square feet for the listed properties.

Any rolls not meeting the requirements of the specification shall be rejected. The manufacturer shall prepare a quality control report to be submitted to the project engineer upon request.

F. Installation:

1. The geonet and geocomposite rolls shall be wrapped in a plastic cover. The geonet and geocomposite rolls shall be shipped to the job site in a manner not to damage the rolls. The rolls shall be stored on wooden pallets or other means at elevated ground away from dirt, mud, and excessive heat.

2. Method of Placement – The subgrade shall be free of foreign and organic materials, sharp objects, or debris of any kind, which could potentially damage the geocomposite. The rolls shall be deployed using a spreader bar assembly attached to a loader bucket or by other methods approved by the project engineer. On side slopes, the rolls shall be deployed in the general direction of the maximum slope. The deployment equipment shall not damage the underlying subgrade or geosynthetics. Geocomposite shall be placed and secured in strips as shown on the project drawings. Sandbags shall be placed on leading edges of the panels to prevent wind uplift. An extra layer of drainage net or geocomposite may be required at the intersection of any two sideslopes to cover the area where the panels are staggered.

3. Field Seaming – Geonet panels shall be overlapped by a minimum of two inches. Non–black plastic ties shall be used at five-foot intervals in the direction of the roll length and in two-foot intervals across the end of the panel to tie the drainage net panels. Metallic ties shall not be allowed. On slopes, the spacing of ties across the roll end shall be six inches. The geotextile flaps of the adjacent panels shall be heat–bonded or sewn on all sides in accordance with the project specification. The geotextile flap of the upper panel shall overlap the geotextile flap of the lower panel.

4. Cover Material – The geonet and geocomposite shall be covered as soon as possible. The covering operation shall not damage the geonet or the geocomposite. The geomembrane material shall be free of foreign and organic material, sharp objects, or debris of any kind, which could potentially damage the geocomposite. No construction equipment or machinery shall operate directly on the geocomposite. The use of lightweight (i.e. generator, etc.) with low ground pressure is allowed.

5. Repairs – All panels shall be inspected for damage. Any damaged area shall be repaired by a patch of the same material extending one foot beyond the edges of the damaged area.

1.18 MEASUREMENT AND PAYMENT

A. Payment for geomembrane and geocomposite installation will be included in the contract lump sum price and as shown on Exhibit "A" – Bid Form under "Effluent Pond/Storage Piping and Piping from WWTP".

END OF SECTION

Geotechnical Engineering Report

Johns Island WWTP
Johns Island, South Carolina
February 6, 2015
Terracon Project No. EN145129

Prepared for:
Thomas & Hutton
Mount Pleasant, South Carolina

Prepared by:
Terracon Consultants, Inc.
North Charleston, South Carolina

February 6, 2015

Terracon

Thomas & Hutton
682 Johnnie Dodds Boulevard
Mount Pleasant, South Carolina 29464

Attn: Mr. Lindy Cummins
P: (843) 725-5283
E: cummins.l@thomasandhutton.com

Re: Geotechnical Engineering Report
Johns Island WWTP
Johns Island, South Carolina
Terracon Project Number: EN145129

Dear Mr. Cummins:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the Johns Island WWTP. This study was performed in general accordance with our proposal number PEN140412 dated October 28, 2014. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, slabs, and pavement for the proposed project.

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

Sincerely,
Terracon Consultants, Inc.

Ana Christina Lee, E.I.T.
Project Geotechnical Engineer

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 27816 2/6/15 BRYAN T. SHIVER

Bryan T. Shiver, P.E.
Geotechnical Department Manager
SC Registration No. 27816

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

SOUTH CAROLINA TERRACON CONSULTANTS, INC. No. 2220 CERTIFICATE OF AUTHORIZATION

TABLE OF CONTENTS

EXECUTIVE SUMMARY

This report presents the results of our geotechnical engineering services performed for the proposed Johns Island WWTP located on Mullet Hall Road in Johns Island, South Carolina. Our geotechnical scope of work for this project included fieldwork, engineering analysis, and reporting.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical considerations were identified:

- Assuming proper site preparation, the sludge dewatering equipment building may be supported on a traditional shallow foundation system sized for an allowable bearing pressure of 3,000 pounds per square foot (psf). Total estimated static settlement for traditional shallow foundations is 1 ½ inches, with differential settlement up to ½ inch per 50 feet.

- Based on our analysis, shallow foundations are not suitable for the treatment basins and attached building for the following reasons;
  - Structural loads and fill heights are variable from structure to structure.
  - Unmitigated static settlement up to 5 inches is expected with differential settlement up to 3 ½ inches.
  - Lightly loaded structures will be connected to heavily loaded structures, so differential settlement is a concern.

- Foundation support for the treatment basins and attached building should consist of deep foundations.

- Shielding consisting of steel sheeting will be necessary for deep excavation and installation of the proposed pump station. We understand these excavations will reach depths of at least 16 feet below the existing ground surface.

- Given the close proximity of groundwater to the ground surface (between 1 and 3½ feet) a dewatering program will also be necessary to provide a stable work environment during excavation and construction below the groundwater table.

- Based on the presence of potentially liquefiable soils, the 2012 International Building Code (IBC) seismic site classification for these sites is F. However, if the fundamental period of the structure(s) is less than or equal to 0.5 seconds, the site may reclassify as Class D.

- We estimate that unmitigated total liquefaction-induced settlements from the design seismic event may range up to 3 inches with differential settlement ranging from 50% to 75% of the total.

- Both the bearing depth of the pump station and the recommended pile depth for the treatment basins/attached building are located beneath significant liquefiable soils, therefore liquefaction-induced settlement of these structures is not expected to be a concern. However, the calculated liquefaction potential facilitates the need for liquefaction mitigation at the sludge dewatering equipment building. Mitigation options include earthquake drain installation or ground improvement to reduce liquefaction settlement to within tolerable limits for this building.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
JOHNS ISLAND WWTP
JOHNS ISLAND, SOUTH CAROLINA

Terracon Project No. EN145129
February 6, 2015

1.0 INTRODUCTION

Terracon has completed a geotechnical engineering report for the proposed Johns Island WWTP located on Mullet Hall Road in Johns Island, South Carolina. We explored the site with three Cone Penetration Tests (CPT) and one Seismic Cone Penetration Test (SCPT) to depths ranging from approximately 48 to 60 feet. Adjacent to the in situ tests, we conducted Hand Auger Borings (HABs) to depths of 4 feet along with five additional HABs to depths of 4 feet where the proposed lagoon will be located. Records of each field test along with site and test location plans are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design
- seismic considerations

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Proposed Improvements	Based on the "Soil Borings Location Map" provided by Thomas & Hutton, we understand that the following four main structures and lagoon are planned for the site: ■ Treatment Basins: Approx. 30' x 47' ■ 2-story Treatment Basin Building: 35' x 47' ■ 1-story Sludge Dewatering Equipment Building: 23' x 23' ■ Pump Station: 20' x 38' ■ 3,000,000 gallon lagoon

Item	Description
Structural loads	Based on information provided by Thomas & Hutton along with our experience with similar structures, the following loading conditions were used for our analysis: ■ Treatment Basins: 2,000 psf ■ 2-story Treatment Basin Building: Columns – 100 kips (assumed) Walls – 4 kips/ft (assumed) ■ 1-story Sludge Dewatering Equipment Building: Columns – 100 kips (assumed) Walls – 4 kips/ft (assumed) ■ Pump Station: 1,200 psf If final loads vary from these assumptions, further review will be necessary.
Grading	Based on the "Lagoon – Typical Cross Section" and other information provided by Thomas & Hutton, we understand that 5 feet of existing soil will be excavated for the lagoon, 4 feet of existing soil will be excavated for the treatment basins and that the pump station will be excavated at least 16 feet below grade. Grading information has not been provided for the buildings and we have assumed up to 2 feet of fill will be needed to achieve final subgrade elevations.

2.2 Site Location and Description

Item	Description
Site Location	The project site is located on Mullet Hall Road in Johns Island, South Carolina. See Appendix A, Exhibit A-1: Site Location Plan
Existing improvements	See Appendix A, Exhibit A-2: Boring Location Plan
Current ground cover	The site appears to be partially wooded and partially open farm land.
Existing topography	Relatively flat lying (assumed).

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the in situ testing, subsurface conditions within the proposed construction area can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum	Material Encountered
Stratum 1	0 to 5 inches	Topsoil: < 1" in farm area, up to 5" in wooded area
Stratum 2	20 feet	Loose to medium dense sand to silty sand with interbedded clay
Stratum 3	38 feet	Soft to very stiff clay to silty clay
Stratum 4[1]	60 feet[2]	Loose to very dense sand to silty sand with interbedded clay layers

1. This stratum was not encountered until a depth of 49 feet in CPT4.
2. Termination of deepest testing.

Conditions encountered at each test location are indicated on the individual test records. Stratification boundaries on the test records represent the approximate location of changes in soil types. In situ, the transition between materials may be gradual. Details for each of the tests can be found on records located in exhibits A-4 and A-5 located in Appendix A of this report.

3.2 Groundwater

At the time of our exploration, the water table was encountered from 1 to 3 ½ feet below the existing ground surface. Groundwater depths were determined through physical measurements within sounding boreholes and hand auger borings. A dewatering plan will be required for the pump station since excavations are expected to extend to depths approximately 16 feet below the existing ground surface. This is discussed in more detail in Section 5.3.2 Excavation Dewatering.

Rainfall events, drainage constraints, and seasonal weather patterns can vary with time and influence the level of the groundwater table. As such, the possibility of groundwater fluctuations should be considered when developing the design and construction plans for the project, especially in the wetter periods of the year. The groundwater surface should be checked prior to construction to assess its effect on site work and other construction activities.

4.0 GEOTECHNICAL SEISMIC CONSIDERATIONS

4.1 Seismic Evaluation

According to the International Building Code 2012 edition (IBC 2012), structures are required to avoid collapse during a design earthquake event. The design earthquake has a 50 year exposure period with a 2% probability of exceedance (i.e. a 2500 year design earthquake). The 2500 year design earthquake at this site has a Moment Magnitude (Mw) of 7.3 and a design Peak Ground Acceleration (PGA_M) of **0.69 g**, as determined by ASCE 7-10 for geotechnical hazards. The seismic evaluation of the site identified potentially liquefiable soils. According to the IBC (2012) and ASCE 7-10, this potential for liquefaction classifies the site as Site Class F.

ASCE 7-10 (Section 20.3.1) provides an exception to the Site Class recommendation for structure(s) with a fundamental period equal to or less than 0.5 seconds. This exception states that a site can be classified without considering liquefaction to determine spectral accelerations for structural design. If the proposed structure meets the requirements of the exception Seismic Site Class D would be applicable and the following seismic design parameters can be used for the site:

Code Used	Site Classification
2012 International Building Code (IBC)[1]	D[2,3]
Seismic Design Parameter	**Value**
F_a	1.07
F_v	1.72
F_{PGA}	1.00
S_{DS}	0.77 g
S_{D1}	0.39 g
PGA_M[4]	0.69 g

1. In general accordance with the *2012 International Building Code,* Table 1613.5.2.
2. Based upon the fundamental period exception outlined in ASCE 7-10 Section 20.3.1 and an average weighted shear wave velocity of 719 feet/sec.
3. The structural engineer should verify that this assumption is valid for the planned structure.
4. Based on procedures outlined in ASCE 7-10 Section 11.8.3 and used in geotechnical hazards analysis.

4.2 Liquefaction Potential

Due to the high seismicity of the Charleston, South Carolina area, we performed a liquefaction potential analysis for the site to evaluate the stability of the subgrade soils. Ground shaking at the foundation of structures and liquefaction of the soil under the foundation are the principle seismic hazards to be considered in design of earthquake-resistant structures. Liquefaction occurs when a rapid buildup in water pressure, caused by the ground motion, pushes sand

particles apart, resulting in a loss of strength and later densification as the water pressure dissipates. This loss of strength can cause bearing capacity failure while the densification can cause excessive settlement.

While the amount of settlement is dependent on the magnitude and distance from a seismic event, and geologic age of the soil deposit, we estimate that settlements from the design earthquake may range up to 3 inches with differential settlement ranging from 50% to 75% of the total. However, the recommended pile depths for the treatment basins and the attached building are beneath the liquefiable soils, therefore liquefaction-induced settlement of these structures is not expected. Additionally, the bearing depth of the pump station is located beneath a significant amount of liquefiable soils and based on our estimates, up to 1 inch of settlement from the design earthquake is expected. In our experience, this amount will not facilitate the need for liquefaction mitigation at the pump station.

However, the estimated liquefaction-induced settlement of 3 inches is expected for the sludge dewatering equipment building. Design under the IBC allows for buildings to sustain damage during the design earthquake event, but they must remain standing. Therefore, our liquefaction settlement estimate should be reviewed from the standpoint of risk of total collapse of the structure. While the project structural engineer should review our estimates, in our experience, this calculated liquefaction potential facilitates the need for liquefaction mitigation at the sludge dewatering equipment building.

4.3 Liquefaction Mitigation

4.3.1 General Notes

Due to the calculated liquefaction hazard at the sludge dewatering equipment building, we recommend liquefaction mitigation be under taken prior to building construction. The most economical mitigation technique in the local area is typically the installation of earthquake drains. Earthquake drains can provide stable subgrade conditions during a seismic event, and can be used in conjunction with shallow spread footings. Other potential methods for liquefaction mitigation exist that include: rammed compaction, deep foundation systems, vibro-floatation, vibro-replacement, dynamic compaction, etc. Terracon can explore these options with the owner and design team if necessary. However, our experience has shown that earthquake drains will likely be the least expensive option.

4.3.2 Earthquake Drains

Earthquake drains are prefabricated polymer tubes wrapped in filter fabric, installed vertically in the ground, that allow for dissipation of excess pore water pressures generated during an earthquake, thereby preventing or greatly reducing the settlements due to liquefaction. The filter fabric deters the migration of fines into the tubes and is an integral part of the system. The excess water is contained within the tubes and is discharged within the sands above the groundwater table.

If earthquake drains are used, we recommend that the earthquake drains be installed in an equilateral triangular pattern with a center to center spacing of 5 to 6 feet over the entire proposed structures footprint, at a minimum. The drains shall have a minimum diameter of 4 inches and extend to a depth of 40 feet below the existing ground surface. Typically the installation and drainage details for earthquake drains are provided by the contractor. If these recommendations are followed, the shallow foundation parameters for the sludge dewatering equipment building outlined in Section 5.1 can be utilized. After mitigation, we estimate the total settlement due to the design earthquake to be less than 1 inch, with differential settlements ½ of the total settlement.

The installation process of earthquake drains can affect subgrade conditions, therefore we recommend that earthquake drains be installed after the rough grading operations discussed in Section 6.2, but before fine grading. Additionally, contract documents should address grading repair after drain installation. We can provide direction when selecting a geotechnical contractor to install earthquake drains and recommend that a geotechnical engineer or their representative be present during installation.

4.3.3 Construction Vibrations

Earthquake drain installation is known to generate vibrations during the construction process. The ground vibrations, which can be a concern to any nearby existing structures, should be monitored during the installation time. An engineering technician, supervised by a registered professional engineer, can conduct vibration monitoring in conjunction with installation monitoring. In addition, we recommend that a pre-condition survey be performed of the adjacent properties to document existing cracks and other significant defects on adjacent structures.

5.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

5.1 Sludge Dewatering Equipment Building

The sludge dewatering equipment building can be supported by shallow spread footing foundation systems bearing on in situ or compacted Controlled Fill provided liquefaction mitigation as described in Section 4.3 is completed. Design recommendations for shallow foundations for this building are presented in the following paragraphs.

5.1.1 Design Recommendations

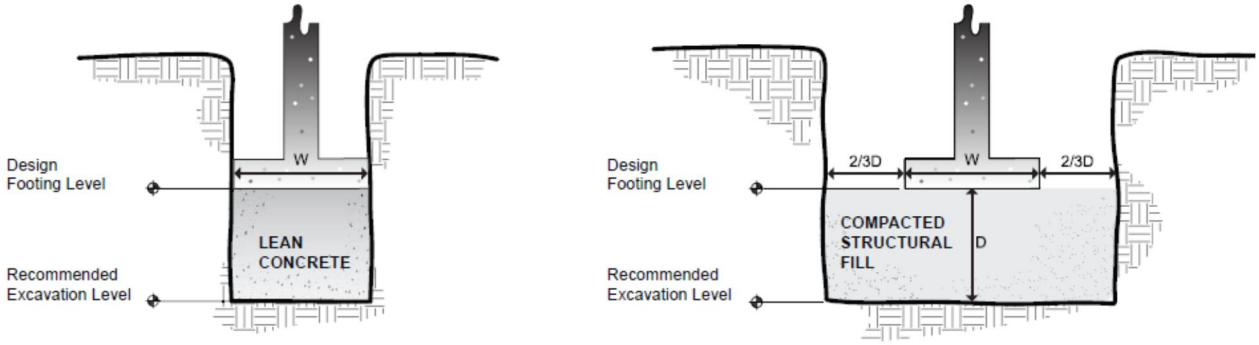
DESCRIPTION	Column	Wall
Allowable bearing pressure [1]	3,000 psf	
Minimum dimensions	24 inches	12 inches
Minimum embedment below finished grade	12 inches	12 inches
Estimated total static settlement [2]	1 ½ inches	< 1 inch
Estimated differential static settlement [2]	<1/2 inch between columns	<1/2 inch over 30 feet

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This assumes any unsuitable fill, debris or soft soils, if encountered, will be undercut and replaced with Controlled Fill. An allowable bearing pressure of 3,000 psf was assumed.
2. The settlement estimates are based on a maximum load of 100 kips for columns, 4 kips per foot for strip footings and the above allowable bearing pressure. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth and dimensions of the footings, the thickness of compacted fill, and the quality of the earthwork operations. These settlement magnitudes assume the foundation subgrade will be repaired as recommended in this report. The settlement calculations were based on maximum footing sizes of 6 ft x 6 ft for columns and 2 ft wide strip footings.

5.1.2 Shallow Foundation Construction Considerations

The base of all foundation excavations should be free of water, debris and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively dry, disturbed or saturated, the affected soil should be recompacted or removed prior to placing concrete. Place a lean concrete mud-mat over the bearing soils if the excavations must remain open over night or for an extended period of time. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

If debris or unsuitable bearing soils are encountered in footing excavations, the excavation could be extended deeper to suitable soils and the footing could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. As an alternative, the footings could also bear on properly compacted Controlled Fill extending down to the suitable soils. Overexcavation for compacted structural fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. The overexcavation should then be backfilled up to the footing base elevation with Controlled Fill material placed in lifts of 10 inches or less in loose thickness (4 inches or less if compacted with hand guided equipment) and compacted to at least 98 percent of the material's modified effort maximum dry density (ASTM D1557). The overexcavation and backfill procedure is described in the following figure.



NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

5.2 Treatment Basins and Attached Building

Based on our analysis, shallow foundations are not suitable for the treatment basins and the attached building for the following reasons:

- Structural loads, fill heights and embedment depths are variable from between the structures.
- Unmitigated static settlement up to 5 inches is expected with differential settlement up to 3 ½ inches.
- A lightly loaded structure will be connected to a heavily loaded structure, so differential settlement is a concern.

We recommend that the treatment basins and the attached building are supported by deep foundations. Deep foundations, using driven steel, augered cast-in-place or pre-stressed concrete piles, transfer building loads to deeper load-bearing stratums, eliminating static settlement issues and potential risk associated with liquefaction.

5.2.1 Design Recommendations

Deep foundations provide a reliable solution for static and liquefaction-induced settlement. We have provided recommendations for a deep foundation solution consisting of:

- Driven pre-stressed concrete (PSC) piles in 12 and 14 inch square dimensions
- Driven steel H-piles in 12 and 14 inch square dimensions
- Augered cast-in-place (ACIP) concrete piles in a 16 inch diameter dimension

The following table presents the estimated allowable axial compressive capacities bearing on the very dense sand layer encountered in SCPT2.

Pile Type	Square Dimensions	Pile Tip Depth Below Existing Grade	Allowable Axial Capacity (FS = 2.25)
PSC	12”	45 to 50 feet	70 tons
	14”		90 tons
Steel H	12”		60 tons
	14”		80 tons
ACIP	16”		90 tons

Pile elements should be installed no closer than three times the pile diameter (3D) center to center so that no reduction in axial capacity will be necessary. This value may increase once a lateral load analysis is performed to ensure that there is no reduction in lateral capacity from adjacent piles. Pre-augering for the PSC piles or the use of steel H-piles should be considered if the magnitude of ground vibrations is a concern. The capacities provided in the above table do not account for potential downdrag associated with liquefaction or consolidation-induced settlements. Capacities for additional pile types and sizes can be provided on request.

Piles should only be designed within the depths and loads shown in the above table. A factor of safety of 2.25 was used to determine the allowable capacities. This factor of safety assumes that a pile load test program utilizing a Pile Dynamic Analyzer (PDA) will be conducted to verify/modify the pile design, otherwise, a larger factor of safety will be necessary and production pile lengths may vary or number of piles needed per location may increase resulting in additional expense. Once lateral loads are known, a lateral analysis should be performed to ensure the planned tip elevation is below the minimum elevation for lateral stability and that lateral deflections will be within tolerance

The designer should factor in final finished grades of the site when determining final pile lengths. The PSC piles should conform to the guidelines specified in ACI 543R-74 Recommendations for Design, Manufacture, and Installation of Concrete Piles and PCI JR-382 Recommended Practice for Design, Manufacture, and Installation of Pre-stressed Concrete piling.

5.2.2 Deep Foundation Construction Considerations

Air, diesel, or hydraulic hammers with rated energies of approximately 25 ft-kips to 40 ft-kips should be appropriate for pile installation. Upon selection of the pile size and the contractor’s driving system, a Wave Equation Analysis of Piles (WEAP) of the hammer-pile-soil system should be conducted. The WEAP analysis will determine if the selected hammer has sufficient energy to install the selected pile size to the required depth, if the driving stresses (both compressive and tensile) during installation are within acceptable limits, and provide pile driving criteria. Upon request, Terracon can provide assistance in evaluating the selected hammer and determining the pile driving criteria.

We recommend that a minimum of two test piles be installed within the treatment basin and attached building footprint to determine final production pile lengths. The geotechnical engineer should select the test pile locations in conjunction with the structural engineer. In addition, the geotechnical engineer or their representative should be present during the installation of the test piles. Hammer restrikes should be performed on each of the test piles a minimum of seven days after installation to determine final axial capacity. This wait period will account for the time-dependent pile capacity gain characteristics of the medium dense to very dense sand layer, locally called pile "setup" or "freeze." The piles should be dynamically monitored during installation and hammer restrikes in accordance with ASTM D4945, "Standard Test Method for High-Strain Dynamic Testing of Piles." Test pile lengths should allow for a minimum of 5 feet of the pile to extend above the ground surface after installation to facilitate gage attachment for the dynamic load tests.

Vibrations caused by pile installation may be a concern for structures within 500 feet of construction. Vibrations can be reduced by pre-augering or utilizing steel H-piles, which generally create less vibrations. Based on aerial images, it appears that there may be a residential house within the vicinity of concern. If necessary, consideration should be given to performing a pre-condition survey to document the condition of the possible house and any other nearby structures prior to the beginning of pile installation, followed by vibration monitoring. An engineering technician supervised by a registered professional engineer can conduct vibration monitoring in conjunction with pile installation monitoring to ensure vibrations do not exceed project thresholds. Terracon can provide a proposal for these services upon request.

5.2.3 Lateral Earth Pressures

We understand that the treatment basins may bear up to 4 feet below the existing ground surface. If so, the concrete walls of the treatment basins will have unbalanced pressure levels on opposite sides and should be designed for earth pressures at least equal to those indicated in the following table. We recommend using "at-rest" conditions, which assumes no wall movement.

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure (psf)	Earth Pressure (psf)
At-Rest (Ko)	Controlled Fill - 0.50	60	(0.50)S	(60)H
S= Surcharge Pressure; H= Height of Wall				

Applicable conditions to the above include:

- Uniform surcharge
- In situ soil backfill weight of 120 pcf
- No safety factor included
- Heavy equipment should not operate within a distance closer than the exposed height of retaining walls to prevent additional lateral pressure

Earth pressures will be influenced by the structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained.

5.3 Pump Station

The proposed pump station may be constructed on a mat foundation with an allowable contact pressure of 1,200 psf and encompass the proposed 20' x 38' footprint of the pump station. Long-term post construction static settlements are expected to be less than 1 inch.

5.3.1 Construction Considerations

Shielding consisting of steel sheeting will be necessary for deep excavation and construction of the pump station. We understand these excavations may reach depths of 16 feet below the existing ground surface. An open cut excavation option was considered, but would not be feasible due to site area constraints and constructability issues. Open cut excavation options can be provided upon request.

Depending on the stability of the excavation bottom encountered at time of construction, it may be necessary to increase the excavation depth by 5 feet below what is necessary to construct the pump station and backfill it with free draining #57 stone or similar material. The stone will aid in dewatering using sump pumps and provide a stable working surface during construction. A nonwoven geotextile fabric with an AOS (apparent opening size) equal to a No. 100 U.S. Standard Sieve, may be placed between the stone and underlying native soils to limit the migration of fines into the stone.

Based on loading assumptions, we estimate that the weight of the pump station will resist the buoyancy (uplift) forces exerted by the groundwater. Further review should be conducted once final design plans for the pump station are available. If additional uplift resistance is needed, the designers could consider extending the perimeter of the bottom mat of the pump station beyond the edge of the vertical concrete walls to further resist the buoyant forces exerted by groundwater. The unit weight of 120 pcf and 150 pcf can be used for the soil and concrete, respectively, to calculate the vertical restraint. These values should be reduced by the unit weight of water (62.4 pcf) below the groundwater level.

The Occupational Safety and Health Administration (OSHA) requires soils within the proposed excavation be classified for shielding and safety considerations. The following estimated soil parameters may be used in conjunction with OSHA Standards 29 CFR 1926 Subpart P Appendix A for the contractor's shielding design. The contractor is solely responsible for designing and maintaining a stable excavation, and all excavations should comply with applicable local, state, and OSHA standards.

Table 1. Estimated Soil Parameters for Temporary Sheeting System Design

Stratum	Depth (ft)	Estimated Soil Properties				
		Total/Effective Unit Weight (pcf)	Friction Angle (f)	Cohesion (psf)	Earth Pressure Coeff.	
					Active (K_a)	Passive (K_p)
#1 and #2	0 to 20	120/57.6	32	n/a	0.31	3.25
#3	20 to 48	120/57.6	n/a	400	1	1
#4	48 to 49	120/57.6	32	n/a	0.31	3.25

Depending on the section modulus of sheeting selected, final loading, etc. the sheeting system may require supplemental bracing to maintain stability. If surface area is available, ground control may be accomplished with a combined slope/shoring configuration. If side slopes or open cut excavations are considered, a slope stability analysis will be necessary. The slope stability analysis should account for the potential for groundwater inflow, including steady state conditions and storm events.

The ground support system (with or without slopes) should conform to OSHA Standard 29 CFR 1926.652 – Requirements for Protective Systems. The design of the shielding system should be based on the soils within the study area and parameters provided in the previous table. The shielding system should be designed by an engineer registered in the State of South Carolina, employed by the contractor, and is familiar with this type of operation.

5.3.2 Excavation Dewatering

Groundwater will be encountered at the pump station at a depth of 3 ½ feet below the ground surface, so dewatering will be necessary to provide a stable work environment during excavation and construction below the groundwater table. The design of the excavation dewatering system should be undertaken concurrently with the shielding design. The dewatering design should be undertaken by an engineer registered in the State of South Carolina and employed by the contractor. The sheet pile installation should extend past the anticipated bottom depth of the excavation to minimize the potential for bottom heave and to limit groundwater inflow to a level that can be adequately controlled with sumps, pumps or sanded well points. The dewatering system should include provisions to limit uplift forces during construction.

5.3.3 General Excavation Notes

We expect the excavation of the pump station can be accomplished with a trackhoe and typical excavation bucket. Unless accounted for and allowed by the shielding design, soils removed from the excavation should not be placed closer than 30 feet from the edge of the excavation to prevent surcharge loading on the shielding system and to prevent spillage of spoil material back into the excavation.

OSHA standards require daily inspections of excavations, their surrounding areas, and protective systems by a geotechnical engineer or other competent person. Daily inspections are to be conducted prior to the start of work in the excavation, after each storm event or other hazard-increasing occurrence and as needed throughout the workday. These inspections search for evidence of situations that could result in possible cave-ins, indications of failure of the protective systems, or other hazardous conditions.

Safety guidelines concerning means of egress into and out of the excavation, worker protection from falling loads, and other issues as outlined in OSHA Standard 29 CFR Part 1926 should be followed at all times. Once installation of the pump station has been completed, we recommend that Controlled Fill discussed in Section 6.3 be used to backfill the pump station excavations.

6.0 ADDITIONAL GEOTECHNICAL CONSIDERATIONS

6.1 Drainage

Groundwater was encountered at shallow depths across the site (1 to 3 ½ feet), therefore control of groundwater and surface runoff will be an important aspect of site preparation. We recommend an overall site drainage plan be implemented prior to clearing operations. This plan can consist of a series of ditches tied to either sumps or possibly the existing ditches that run across the open farm area. The ditches can be constructed along the outer perimeter of the site, internal to the site, or in other areas dictated by the natural topography. If sumps or the existing ditches are utilized, they should be pumped to remove water to appropriate detention areas. It may also be prudent to construct the proposed lagoon planned for the site early in the site preparation operations. Terracon can assist in determining an appropriate drainage plan once grading plans are complete.

6.2 Earthwork

Once the site drainage plan is implemented, the building, treatment basin and parking area footprints can be stripped of trees, organic material, topsoil, roots balls, and other deleterious material. Excessively wet or dry material should either be removed or moisture conditioned and recompacted.

After stripping and grubbing, the subgrade of the building, treatment basin and parking area should be compacted with a vibratory roller then proofrolled, where possible, to aid in locating loose or soft areas. Proofrolling can be performed with a loaded tandem axle dump truck. Loose, soft, and/or wet soils that pump or rut excessive while proofrolling should be removed and replaced or compacted in-place. Due to the sandy nature of the near surface soils, in-place compaction can likely be achieved. However, removal and replacement will be determined from

proofrolling activities. Fill placement may commence after the subgrade stability has been verified by the geotechnical engineer.

6.3 Material Types

We recommend that Controlled Fill be used for site re-grading purposes and to backfill the pump station. Controlled Fill should meet the following material property requirements:

Fill Type[1]	USCS Classification	Acceptable Location for Placement
Controlled/Imported Fill	SP, SM, SP-SM, GP, GW, SW (Passing #200<12%)	All locations
Onsite Soils	SP, SM, SP-SM (Passing #200<25%)	All locations

1. Controlled Fill should consist of approved materials that are free of organic matter and debris. An adequate number of samples of proposed fill material should be submitted to the geotechnical engineer for evaluation.

The near surface onsite sandy soils, including in the treatment basin, pump station and lagoon areas, can likely be used as Controlled Fill. However, the grading contractor should provide samples of proposed fill soils prior to placement in order to ensure that the soils meet the above requirements.

6.4 Compaction Requirements

ITEM	DESCRIPTION
Fill Lift Thickness [1]	10 inches or less in loose thickness when heavy, self-propelled compaction equipment is used
	2 to 4 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used
Compaction Requirements [2]	95% of the material's maximum Modified Proctor dry density (ASTM D 1557) for structural areas.
Moisture Content – Controlled Fill [3]	Workable moisture levels

1. To limit surcharge loading against the concrete walls of the pump station, heavy compaction equipment should not be used. Placement and compaction of material directly adjacent to the pump station should be limited to hand operated equipment.
2. We recommend that Controlled 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.
3. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the Controlled Fill material pumping when proofrolled.

7.0 PAVEMENT DESIGN

7.1 Subgrade Preparation

Pavement subgrades should be carefully evaluated as the time for pavement construction approaches. The moisture content and density of the subgrade should be assessed and the subgrade proofrolled immediately prior to commencement of base course placement. The base course should also be proofrolled immediately prior to commencement of pavement placement. Any soft or yielding areas encountered during proofrolling activities should be moisture conditioned and recompacted as outlined is Section 6.4.

If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to Graded Aggregate Base Course (GABC) placement or paving. The subgrade should be in its finished form at the time of the final review. The GABC should be compacted to 100% of its Modified Proctor as determined by ASTM D1557.

7.2 Design Considerations

Traffic patterns and anticipated loading conditions were not available at the time that this report was prepared, however, we understand that the majority of traffic expected to utilize the site will be service and delivery vehicles.

Traffic loading conditions associated with the anticipated use to approach 125,000 Equivalent Single Axle Loads (ESALs) for a design life of 20 years.

If the pavement is subject to heaver traffic loading than the assumed ESALs, the thickness of pavements should be estimated using expected traffic volumes, vehicle types, and vehicle loads and should be in accordance with local, city or county ordinances. Pavement thickness can be determined using AASHTO, Asphalt Institute and/or other methods if specific wheel loads, axle configurations, frequencies, and desired pavement life are provided. Terracon can provide updated pavement design recommendations for pavements subjected to loads other than those assumed above if this information is provided.

Table 1. Recommended Pavement Thickness Summary

Traffic Area	Alternative	AC Surface Course (SCDOT Type C)	AC Intermediate Course (SCDOT Type C)	Portland Cement Concrete[1]	Graded Aggregate Base Course (SCDOT GABC)	Total Thickness
Normal Duty	AC[1]	2.0	--	--	8.0	10.0
Normal Duty	PCC[1,2]	--	--	6.0	4.0	10.0

1. AC: Asphalt Concrete; PCC: Portland Cement Concrete
2. 4,000 psi at 28 days, 4-inch maximum slump and 5 to 7% air entrained, 6-sack min. mix.

Subgrade, base and pavement construction operations and materials should meet the minimum requirements of the South Carolina Department of Transportation's (SCDOT) *Standard Specifications for Highway Construction*, 2007 edition. The Asphalt Concrete should be compacted to 92.2% to 96.0% of the theoretical maximum specific gravity of the mix, as determined by ASTM D2041. The Aggregate Base Course should be compacted to 100% of its Modified Proctor as determined by AASHTO T-180. Note, crushed concrete meeting SCDOT gradation requirements for a GABC material may be utilized for pavement base construction.

7.3 Pavement Drainage

Pavements should be sloped to provide proper drainage of surface water runoff. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded to provide drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

7.4 Pavement Maintenance

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Preventive maintenance should be planned and provided for through an on-going pavement management program to slow the rate of pavement deterioration, and to preserve the pavement integrity and ultimately pavement investment. Preventive maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

8.0 GENERAL COMMENTS

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

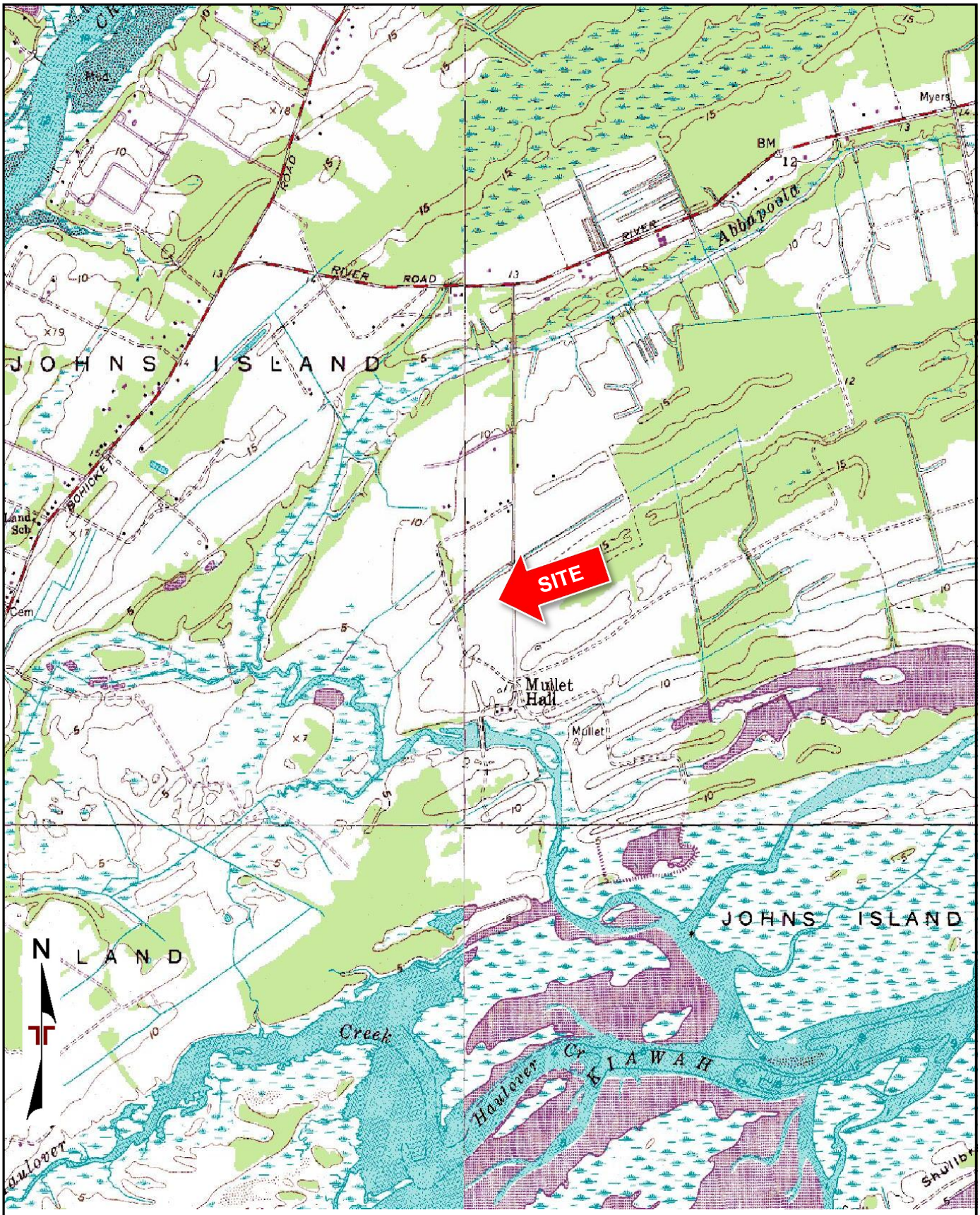
The analysis and recommendations presented in this report are based upon the data obtained from the soundings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between soundings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

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

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

APPENDIX A

Exhibit A-1 Site Location
Exhibit A-2 Exploration Plan
Exhibit A-3 Field Exploration Description
Exhibit A-4 In Situ Test Records
Exhibit A-5 Hand Auger Boring (HAB) Logs



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: WADMALAW ISLAND, SC (1/1/1971), LEGAREVILLE, SC (1/1/1971), ROCKVILLE, SC (1/1/1971) and KIAWAH ISLAND, SC (1/1/1971).

Project Manager:	ACL
Drawn by:	ACL
Checked by:	WBW
Approved by:	BTS

Project No.	EN145129
Scale:	1:24,000
File Name:	A-1
Date:	2/2/2015

Terracon
1450 5th St. West
North Charleston, SC 29405

SITE LOCATION

Johns Island WWTP
Mullet Hall Road
John's Island, SC

Exhibit

A-1

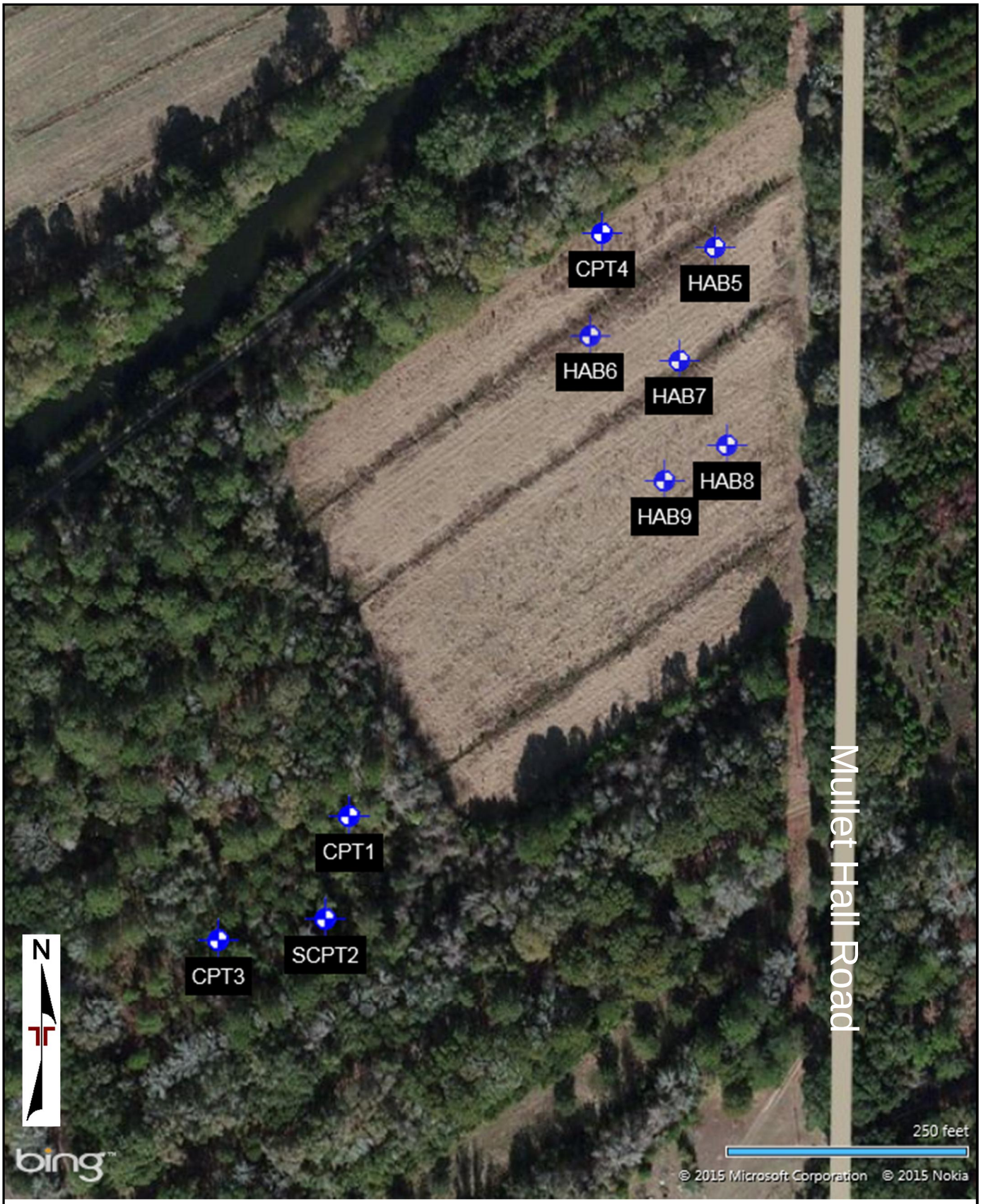


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager:	ACL
Drawn by:	ACL
Checked by:	WBW
Approved by:	BTS

Project No.	EN145129
Scale:	AS SHOWN
File Name:	A-2
Date:	2/2/2015

Terracon
1450 5th St. West
North Charleston, SC 29405

EXPLORATION PLAN

Johns Island WWTP
Mullet Hall Road
John's Island, SC

Exhibit

A-2

Field Exploration Description

The test locations were selected by Terracon personnel and located in the field utilizing a commercially available handheld Global Position System (GPS) unit. Dependent on the prevailing weather conditions at the time of boring/sounding layout and overhead power lines these units are typically considered accurate to within ±10 to 20 feet. The locations as shown in the exploration plan should be considered accurate only to the degree implied by the means and methods used to define them.

The in situ tests consisted of three Cone Penetration Tests (CPTs) to depths of 48 to 55 feet and one Seismic Cone Penetration Test (SCPT) to a depth of 60 feet. These tests were advanced with a track mounted Pagani 220-73 rig. Adjacent to each in situ test, we performed Hand Auger Borings (HABs) to depths of approximately 4 feet along with five HABs to depths of 4 feet at the proposed lagoon location.

The driller's logs were compiled and reviewed by the geotechnical engineer in order to produce the logs. The in situ tests and HAB logs are presented on Exhibits A-4 and A-5 in Appendix A. General notes and soil classification procedures for the in situ tests are presented on Exhibits B-1 and B-2 in Appendix B.

CPT LOG NO. CPT1

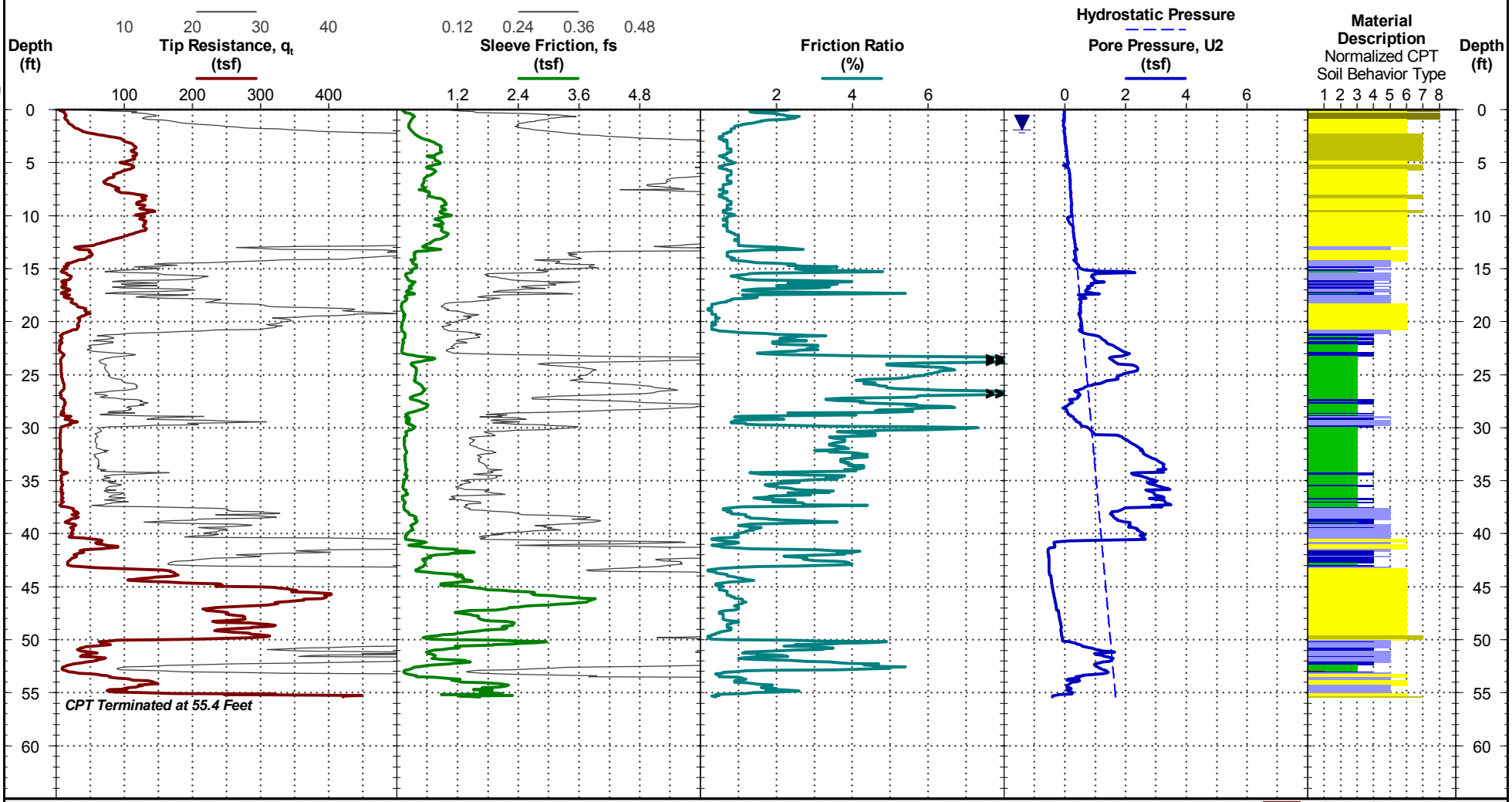
PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

TEST LOCATION: See Exhibit A-2

SITE: Johns Island, SC

Latitude: 32.63327°
Longitude: -80.12391°



See Exhibit A-3 for description of field procedures.
See Appendix B for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

▼ 1.9 ft estimated water depth
(used in normalizations and correlations; see Appendix B)

Probe no. 4526 with net area ratio of 0.83
U2 pore pressure transducer location
Manufactured by Geotech A.B.; calibrated 11/12/2014
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 1.875 in

Terracon
1450 5th Street West
North Charleston, South Carolina

CPT Started: 1/13/2015	CPT Completed: 1/13/2015
Rig: Pagani TG73-200	Operator: BR
Project No.: EN145129	Exhibit: A-4

CPT LOG NO. SCPT2

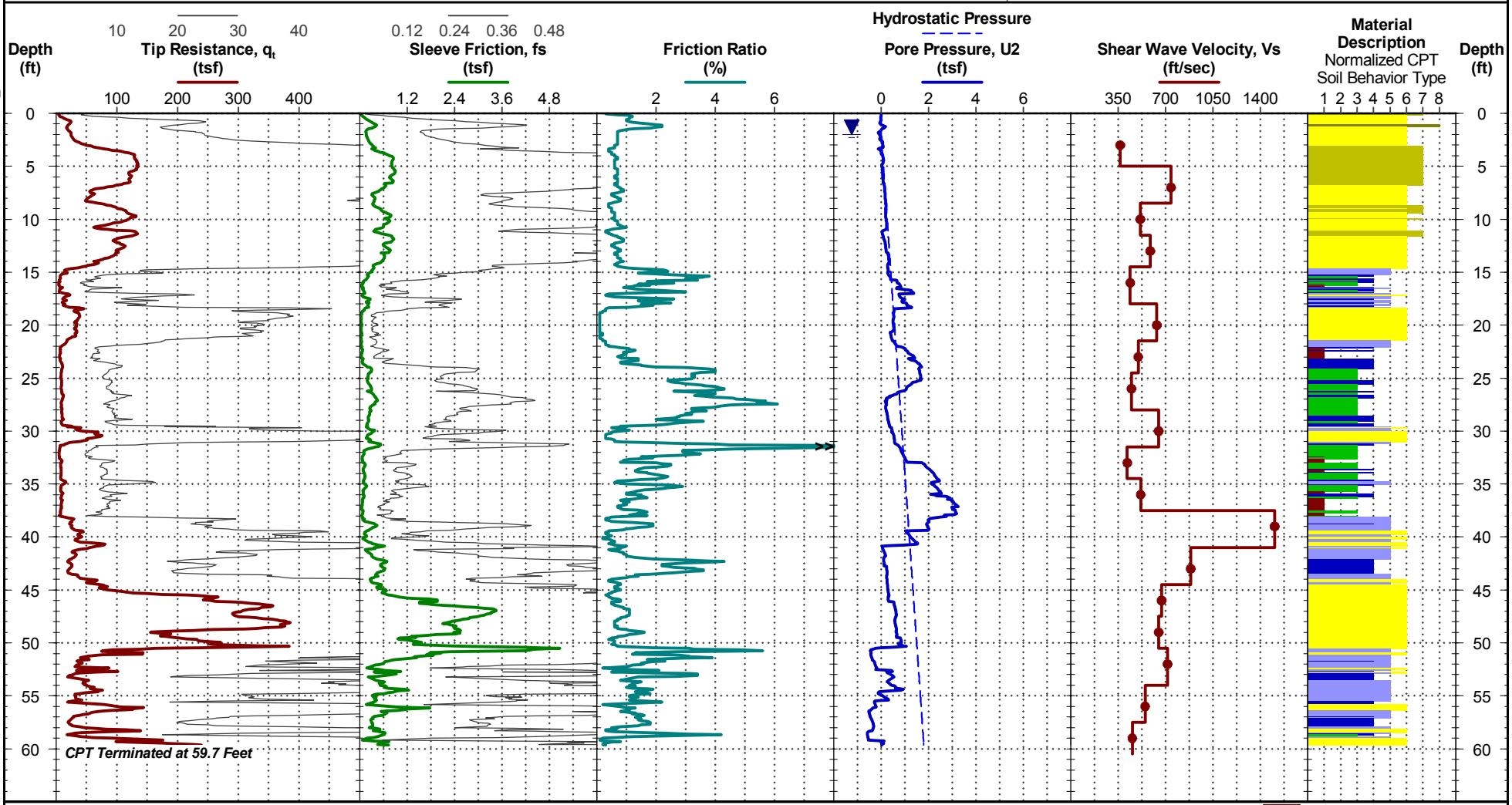
PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

TEST LOCATION: See Exhibit A-2

SITE: Johns Island, SC

Latitude: 32.63298°
Longitude: -80.12399°



See Exhibit A-3 for description of field procedures.
See Appendix B for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

▼ 2 ft measured water depth
(used in normalizations and correlations; see Appendix B)

Probe no. 4526 with net area ratio of 0.83
U2 pore pressure transducer location
Manufactured by Geotech A.B.; calibrated 11/12/2014
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 1.875 in

Terracon
1450 5th Street West
North Charleston, South Carolina

CPT Started: 1/13/2015	CPT Completed: 1/13/2015
Rig: Pagani TG73-200	Operator: BR
Project No.: EN145129	Exhibit: A-4

CPT LOG NO. CPT3

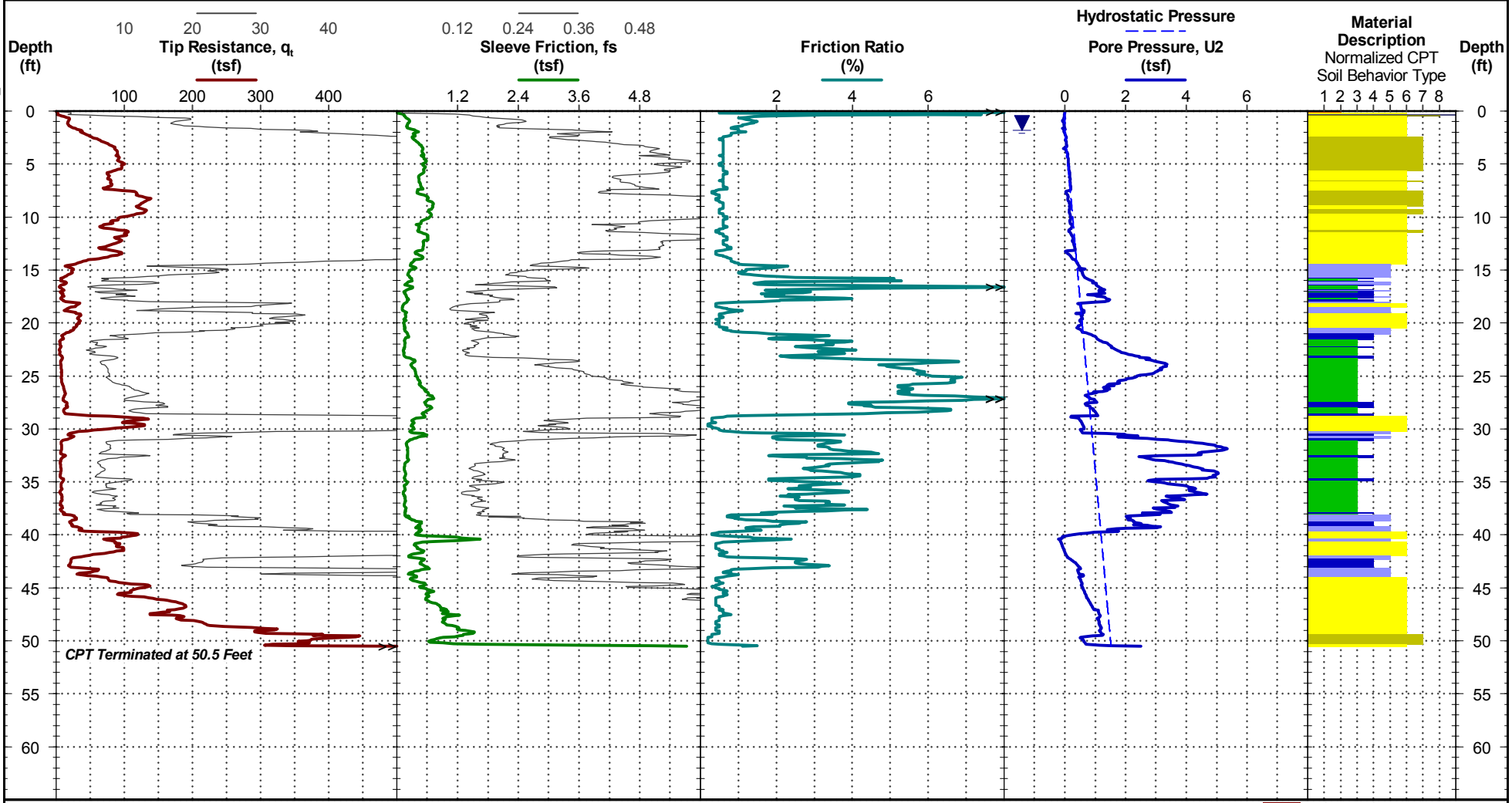
PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

TEST LOCATION: See Exhibit A-2

SITE: Johns Island, SC

Latitude: 32.63292°
Longitude: -80.12435°



See Exhibit A-3 for description of field procedures.
See Appendix B for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

▼ 1.8 ft measured water depth
(used in normalizations and correlations; see Appendix B)

Probe no. 4526 with net area ratio of 0.83
U2 pore pressure transducer location
Manufactured by Geotech A.B.; calibrated 11/12/2014
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 1.875 in

Terracon
1450 5th Street West
North Charleston, South Carolina

CPT Started: 1/13/2015	CPT Completed: 1/13/2015
Rig: Pagani TG73-200	Operator: BR
Project No.: EN145129	Exhibit: A-4

CPT LOG NO. CPT4

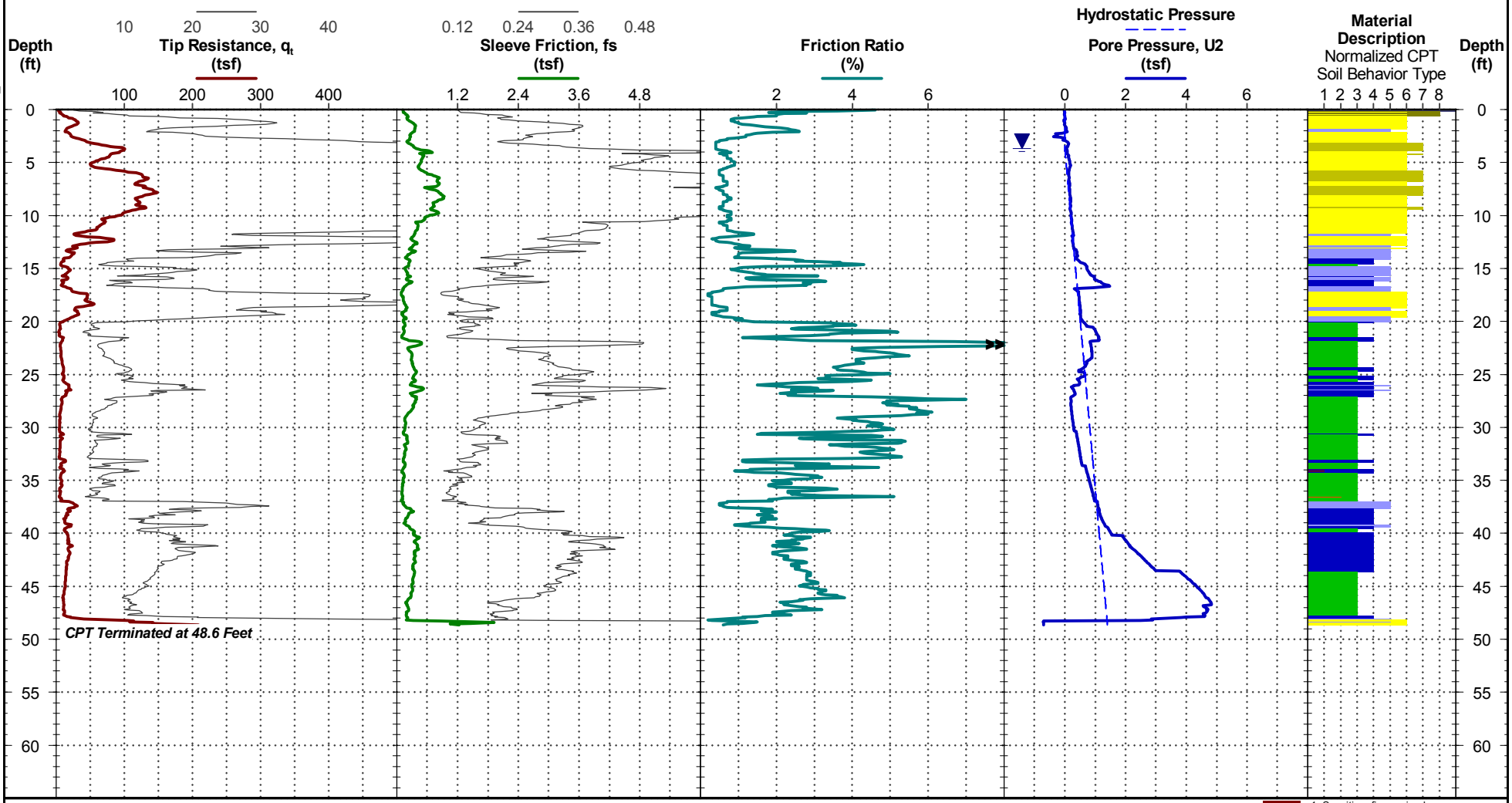
PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

TEST LOCATION: See Exhibit A-2

SITE: Johns Island, SC

Latitude: 32.63492°
Longitude: -80.12306°



See Exhibit A-3 for description of field procedures.
See Appendix B for explanation of symbols and abbreviations.

Dead weight of rig used as reaction force.
CPT sensor calibration reports available upon request.

1 Sensitive, fine grained
2 Organic soils - clay
3 Clay - silty clay to clay
4 Silt mixtures - clayey silt to silty clay
5 Sand mixtures - silty sand to sandy silt
6 Sands - clean sand to silty sand
7 Gravelly sand to dense sand
8 Very stiff sand to clayey sand
9 Very stiff fine grained

WATER LEVEL OBSERVATION

▼ 3.7 ft measured water depth
(used in normalizations and correlations; see Appendix B)

Probe no. 4526 with net area ratio of 0.83
U2 pore pressure transducer location
Manufactured by Geotech A.B.; calibrated 11/12/2014
Tip and sleeve areas of 10 cm^2 and 150 cm^2
Ring friction reducer with O.D. of 1.875 in

Terracon
1450 5th Street West
North Charleston, South Carolina

CPT Started: 1/21/2015	CPT Completed: 1/21/2015
Rig: Pagani TG73-200	Operator: BR
Project No.: EN145129	Exhibit: A-4

BORING LOG NO. HAB at CPT1

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

LOCATION See Exhibit A-2

Latitude: 32.63327° Longitude: -80.12391°

GRAPHIC LOG	DEPTH		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	0.4	**TOPSOIL**, 5" of Topsoil with roots			
	4.0	**SILTY SAND (SM)**, reddish brown to pale brown, moist to wet			
		Boring Terminated at 4 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 1.7 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015 Boring Completed: 1/13/2015

Drill Rig: NA Driller: BR

Project No.: EN145129 Exhibit: A-5

BORING LOG NO. HAB at SCPT2

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

LOCATION See Exhibit A-2

Latitude: 32.63298° Longitude: -80.12399°

GRAPHIC LOG	DEPTH		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	0.3	**TOPSOIL**, 4" of Topsoil with roots			
	4.0	**SILTY SAND (SM)**, dark gray and dark brown to pale brown, moist to wet		▽	
		Boring Terminated at 4 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 2.0 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015 | Boring Completed: 1/13/2015

Drill Rig: NA | Driller: BR

Project No.: EN145129 | Exhibit: A-5

BORING LOG NO. HAB at CPT3

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.63292° Longitude: -80.12435° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	TOPSOIL, 5" of Topsoil with roots 0.4			
	SILTY SAND (SM), reddish brown to pale brown, moist to wet, with cemented sand from 10" to 15" 4.0		▽	
	Boring Terminated at 4 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 1.8 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015	Boring Completed: 1/13/2015
Drill Rig: NA	Driller: BR
Project No.: EN145129	Exhibit: A-5

BORING LOG NO. HAB at CPT4

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.63492° Longitude: -80.12306° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	SILTY SAND (SM), dark brown to pale brown, moist to wet		▽	
	4.0 ***Boring Terminated at 4 Feet***			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 3.7 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/21/2015	Boring Completed: 1/21/2015
Drill Rig: NA	Driller: BR
Project No.: EN145129	Exhibit: A-5

BORING LOG NO. HAB5

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.63488° Longitude: -80.12268° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	SILTY SAND (SM), dark brown to pale brown, moist to wet		▽	
	4.0 ***Boring Terminated at 4 Feet***			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 2.8 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015	Boring Completed: 1/13/2015
Drill Rig: NA	Driller: BR
Project No.: EN145129	Exhibit: A-5

BORING LOG NO. HAB6

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.63463° Longitude: -80.1231° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	SILTY SAND (SM), pale brown to brown, moist to wet		▽	
	4.0 ***Boring Terminated at 4 Feet***			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 1.1 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015 | Boring Completed: 1/13/2015

Drill Rig: NA | Driller: BR

Project No.: EN145129 | Exhibit: A-5

BORING LOG NO. HAB7

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

LOCATION See Exhibit A-2

Latitude: 32.63456° Longitude: -80.1228°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	SILTY SAND (SM), dark brown to pale brown, moist to wet		▽	
	4.0			
	Boring Terminated at 4 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 1.8 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015 | Boring Completed: 1/13/2015

Drill Rig: NA | Driller: BR

Project No.: EN145129 | Exhibit: A-5

BORING LOG NO. HAB8

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

GRAPHIC LOG	LOCATION See Exhibit A-2 Latitude: 32.63432° Longitude: -80.12264° DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	SILTY SAND (SM), dark brown to reddish brown and pale brown, moist to wet		▽	
	4.0 ***Boring Terminated at 4 Feet***			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 2.2 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015 | Boring Completed: 1/13/2015

Drill Rig: NA | Driller: BR

Project No.: EN145129 | Exhibit: A-5

BORING LOG NO. HAB9

PROJECT: Johns Island WWTP

CLIENT: Thomas & Hutton
Mount Pleasant

SITE:
Johns Island, SC

LOCATION See Exhibit A-2

Latitude: 32.63422° Longitude: -80.12285°

GRAPHIC LOG	DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE
	SILTY SAND (SM), dark brown to reddish brown and pale brown, moist to wet		▽	
	4.0			
	Boring Terminated at 4 Feet			

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
Manual Hand Auger

Abandonment Method:
Boring backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.

See Appendix B for description of laboratory procedures and additional data (if any).

Notes:

WATER LEVEL OBSERVATIONS

▽ *Groundwater encountered at 2.0 feet*

Terracon
1450 5th Street West
North Charleston, South Carolina

Boring Started: 1/13/2015 Boring Completed: 1/13/2015

Drill Rig: NA Driller: BR

Project No.: EN145129 Exhibit: A-5

APPENDIX B

Exhibit B-1 General Notes
Exhibit B-2 Unified Soil Classification System

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING


Auger


Split Spoon


Shelby Tube


Macro Core


Ring Sampler


Rock Core


Grab Sample


No Recovery

WATER LEVEL


Water Initially Encountered


Water Level After a Specified Period of Time


Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

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

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, tsf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 0.25	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	0.25 to 0.50	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	0.50 to 1.00	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	1.00 to 2.00	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	2.00 to 4.00	15 - 30	19 - 42
			Hard	> 4.00	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

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

GRAIN SIZE TERMINOLOGY

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

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

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

CPT GENERAL NOTES

DESCRIPTION OF MEASUREMENTS AND CALIBRATIONS

To be reported per ASTM D5778:

Uncorrected Tip Resistance, q_c
Measured force acting on the cone divided by the cone's projected area

Corrected Tip Resistance, q_t
Cone resistance corrected for porewater and net area ratio effects
$q_t = q_c + U2(1 - a)$

Where a is the net area ratio, a lab calibration of the cone typically between 0.70 and 0.85

Pore Pressure, U1/U2
Pore pressure generated during penetration
U1 - sensor on the face of the cone
U2 - sensor on the shoulder (more common)

Sleeve Friction, fs
Frictional force acting on the sleeve divided by its surface area

Normalized Friction Ratio, FR
The ratio as a percentage of fs to q_t, accounting for overburden pressure

To be reported per ASTM D7400, if collected:

Shear Wave Velocity, Vs
Measured in a Seismic CPT and provides direct measure of soil stiffness

DESCRIPTION OF GEOTECHNICAL CORRELATIONS

Normalized Tip Resistance, Q_t
$Q_t = (q_t - \sigma_{v0})/\sigma'_{v0}$

Over Consolidation Ratio, OCR
$OCR\ (1) = 0.25(Q_t)^{1.25}$
$OCR\ (2) = 0.33(Q_t)$

Undrained Shear Strength, Su
$Su = Q_t \times \sigma'_{v0}/N_{kt}$
N_{kt} is a geographical factor (shown on Su plot)

Sensitivy, St
$St = (q_t - \sigma_{v0}/N_{kt}) \times (1/fs)$

Effective Friction Angle, ϕ'
$\phi'\ (1) = \tan^{-1}(0.373[\log(q_t/\sigma'_{v0}) + 0.29])$
$\phi'\ (2) = 17.6 + 11[\log(Q_t)]$

Unit Weight
$UW = (0.27[\log(FR)]+0.36[\log(q_t/atm)]+1.236) \times UW_{water}$
σ_{v0} is taken as the incremental sum of the unit weights

Small Strain Shear Modulus, G_0
$G_0\ (1) = \rho Vs^2$
$G_0\ (2) = 0.015 \times 10^{(0.55Ic + 1.68)}(q_t - \sigma_{v0})$

Soil Behavior Type Index, Ic
$Ic = [(3.47 - \log(Q_t))^2 + (\log(FR) + 1.22)^2]^{0.5}$

SPT N_{60}
$N_{60} = (q_t/atm) / 10^{(1.1268 - 0.2817Ic)}$

Elastic Modulus, Es (assumes $q/q_{ultimate} \sim 0.3$, i.e. FS = 3)
$Es\ (1) = 2.6\Psi G_0$ where $\Psi = 0.56 - 0.33\log Q_{t,clean\ sand}$
$Es\ (2) = G_0$
$Es\ (3) = 0.015 \times 10^{(0.55Ic + 1.68)}(q_t - \sigma_{v0})$
$Es\ (4) = 2.5q_t$

Constrained Modulus, M
$M = \alpha_M(q_t - \sigma_{v0})$
For Ic > 2.2 (fine-grained soils)
$\alpha_M = Q_t$ with maximum of 14
For Ic < 2.2 (coarse-grained soils)
$\alpha_M = 0.0188 \times 10^{(0.55Ic + 1.68)}$

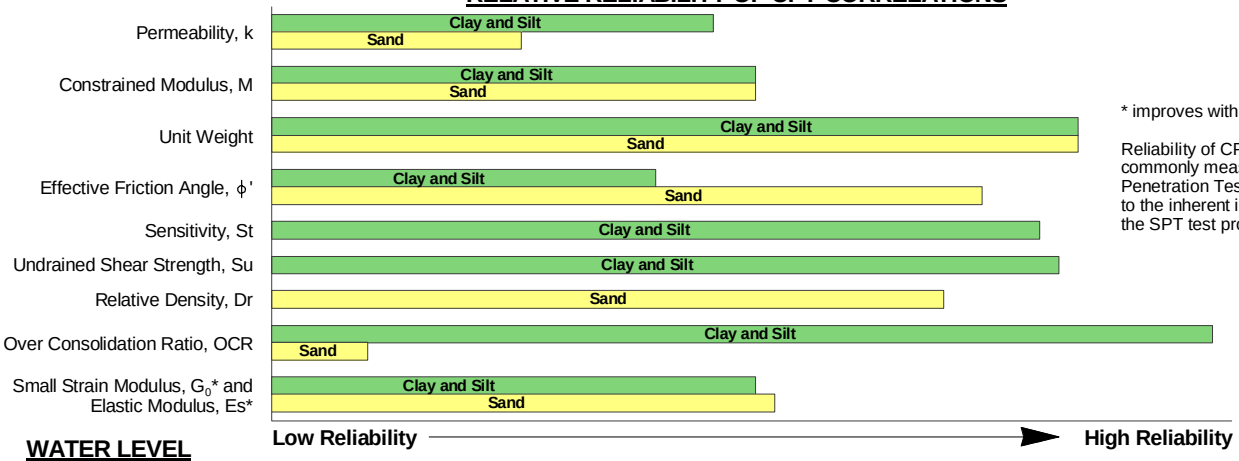
Hydraulic Conductivity, k
For $1.0 < Ic < 3.27$ $k = 10^{(0.952 - 3.04Ic)}$
For $3.27 < Ic < 4.0$ $k = 10^{(-4.52 - 1.37Ic)}$

Relative Density, Dr
$Dr = (Q_t / 350)^{0.5} \times 100$

REPORTED PARAMETERS

CPT logs as provided, at a minimum, report the data as required by ASTM D5778 and ASTM D7400 (if applicable). This minimum data include tip resistance, sleeve resistance, and porewater pressure. Other correlated parameters may also be provided. These other correlated parameters are interpretations of the measured data based upon published and reliable references, but they do not necessarily represent the actual values that would be derived from direct testing to determine the various parameters. The following chart illustrates estimates of reliability associated with correlated parameters based upon the literature referenced below.

RELATIVE RELIABILITY OF CPT CORRELATIONS



* improves with seismic Vs measurements

Reliability of CPT-predicted N_{60} values as commonly measured by the Standard Penetration Test (SPT) is not provided due to the inherent inaccuracy associated with the SPT test procedure.

WATER LEVEL

The groundwater level at the CPT location is used to normalize the measurements for vertical overburden pressures and as a result influences the normalized soil behavior type classification and correlated soil parameters. The water level may either be "measured" or "estimated:"

Measured - Depth to water directly measured in the field

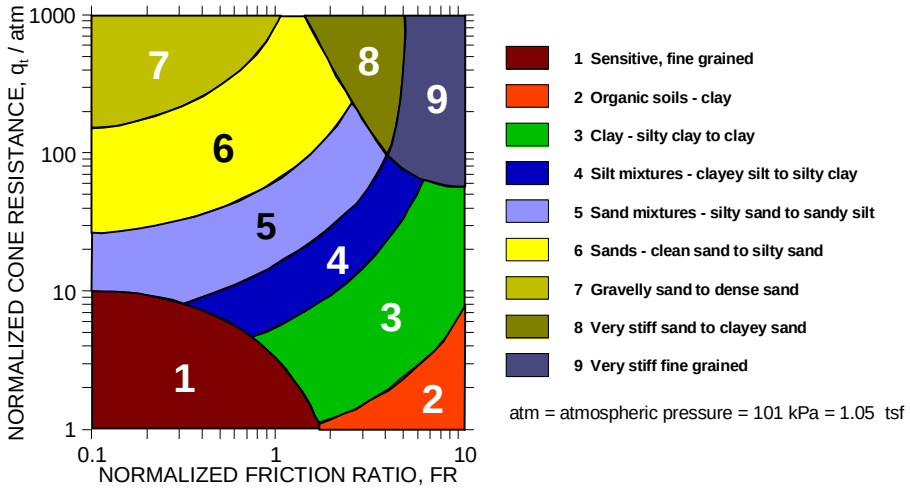
Estimated - Depth to water interpolated by the practitioner using pore pressure measurements in coarse grained soils and known site conditions

While groundwater levels displayed as "measured" more accurately represent site conditions at the time of testing than those "estimated," in either case the groundwater should be further defined prior to construction as groundwater level variations will occur over time.

CONE PENETRATION SOIL BEHAVIOR TYPE

The estimated stratigraphic profiles included in the CPT logs are based on relationships between corrected tip resistance (q_t), friction resistance (fs), and porewater pressure (U2). The normalized friction ratio (FR) is used to classify the soil behavior type.

Typically, silts and clays have high FR values and generate large excess penetration porewater pressures; sands have lower FRs and do not generate excess penetration porewater pressures. Negative pore pressure measurements are indicative of fissured fine-grained material. The adjacent graph (Robertson et al.) presents the soil behavior type correlation used for the logs. This normalized SBT chart, generally considered the most reliable, does not use pore pressure to determine SBT due to its lack of repeatability in onshore CPTs.



atm = atmospheric pressure = 101 kPa = 1.05 tsf

REFERENCES

Kulhawy, F.H., Mayne, P.W., (1997). "Manual on Estimating Soil Properties for Foundation Design," Electric Power Research Institute, Palo Alto, CA.

Mayne, P.W., (2013). "Geotechnical Site Exploration in the Year 2013," Georgia Institue of Technology, Atlanta, GA.

Robertson, P.K., Cabal, K.L. (2012). "Guide to Cone Penetration Testing for Geotechnical Engineering," Signal Hill, CA.

Schmertmann, J.H., (1970). "Static Cone to Compute Static Settlement over Sand," *Journal of the Soil Mechanics and Foundations Division*, 96(SM3), 1011-1043.

Terracon

UNIFIED SOIL CLASSIFICATION SYSTEM

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

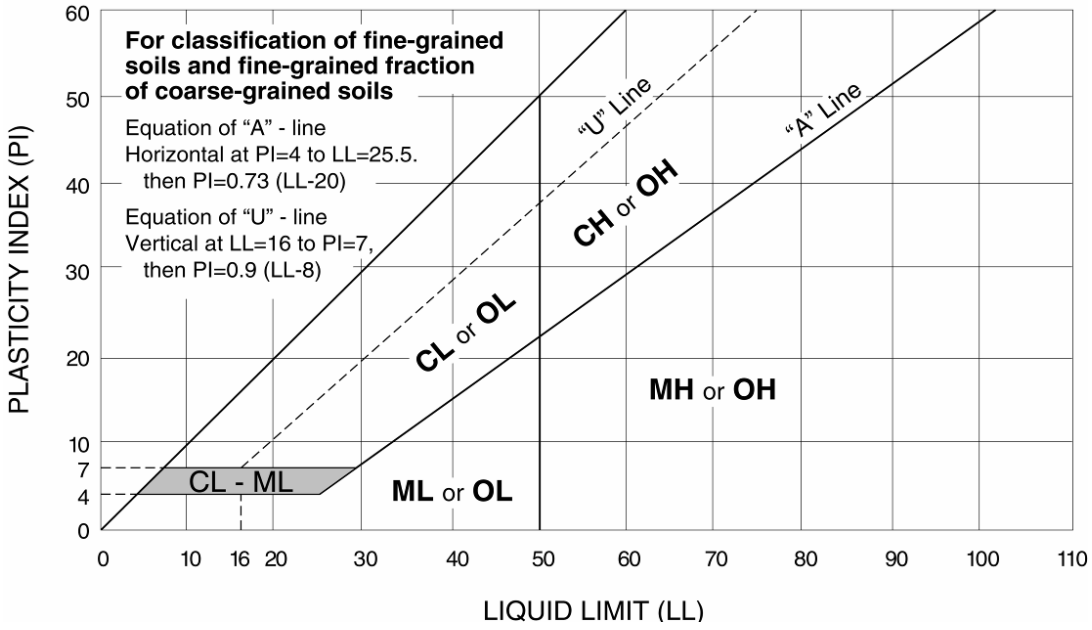
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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.



WASTEWATER TREATMENT PLANT (WWTP)

FOR

KIAWAH RIVER PLANTATION

CHARLESTON COUNTY, SOUTH CAROLINA

PREPARED FOR:

KIAWAH RIVER PLANTATION HOLDINGS, LP
OCEAN BOULEVARD PROPERTIES
A SOUTH CAROLINA LIMITED PARTNERSHIP

DECEMBER 18, 2015
ISSUED FOR BID JANUARY 29, 2016
TM# 212-00-00-001

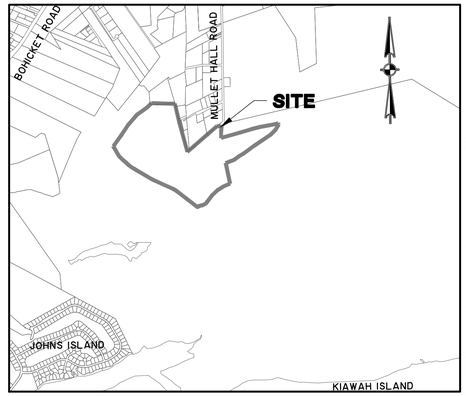
J-25328.0000
PREPARED BY:

THOMAS & HUTTON
Engineering | Surveying | Planning | GIS | Consulting

Savannah, GA | Brunswick, GA | Charleston, SC | Myrtle Beach, SC | Columbia, SC

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 13293 Seal MARK F. YONCE

SOUTH CAROLINA THOMAS & HUTTON ENGINEERING CO. No. C00285 CERTIFICATE OF AUTHORIZATION



VICINITY MAP
SCALE: 1" = 2000'

KIAWAH RIVER PLANTATION WWTP
J-25328.0000
12/18/15

REVISION HISTORY

REV. NO.	REVISION	BY	DATE
2	BID ADDENDUM #1 COMMENTS	MFY	3/7/16

SUBMITTAL HISTORY

SUBMITTED TO	DATE
ISSUED FOR BID	1/29/16
ISSUED TO AGENCY FOR PERMITTING	9/16/15

811 Know what's below. Call before you dig.

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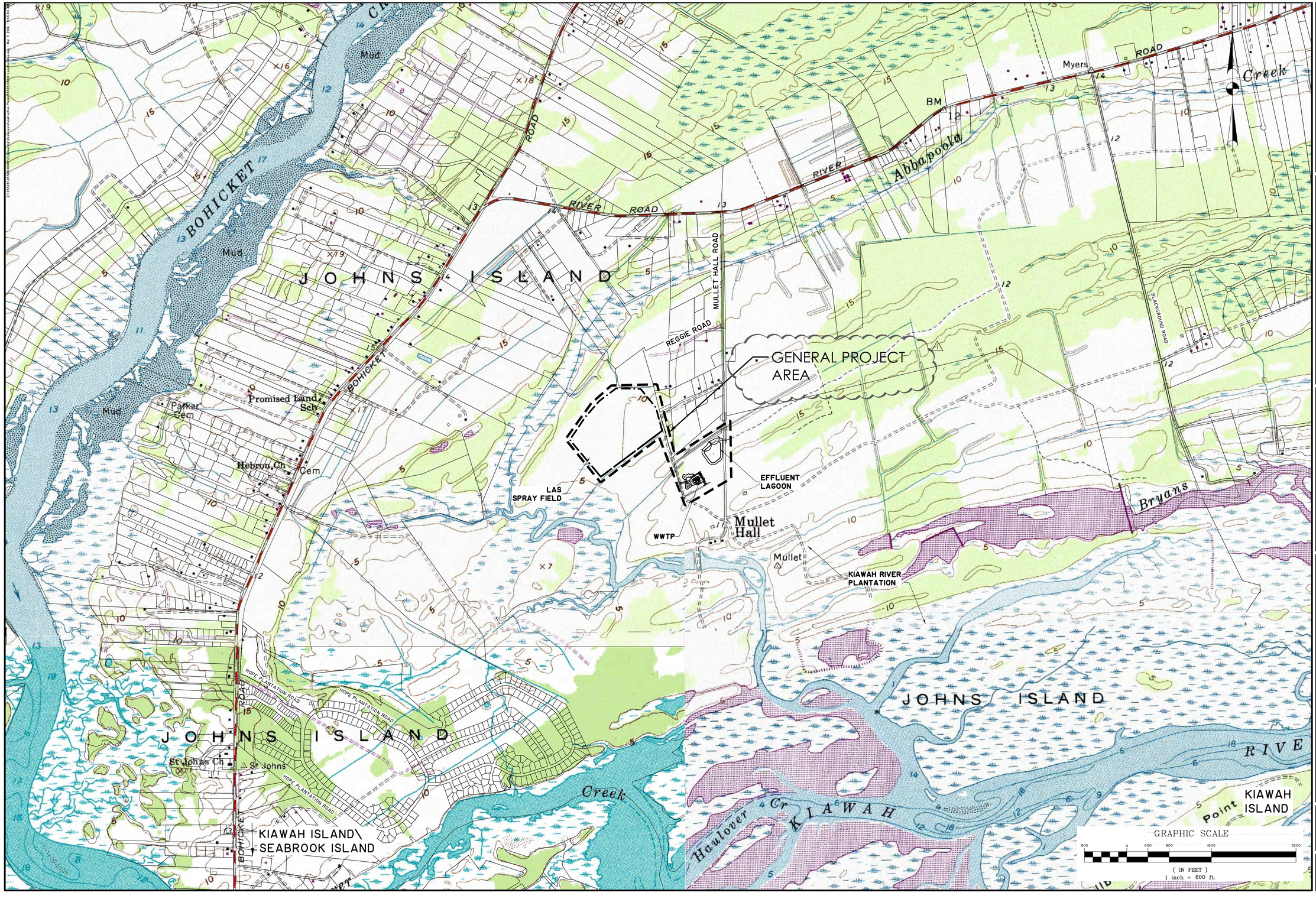

SOUTH CAROLINA
THOMAS & HUTTON ENGINEERING
No. C00265
REGISTERED
SOUTH CAROLINA
PROFESSIONAL ENGINEER
No. 19293
REGISTERED
MARK F. YOUNG

NO.	REVISIONS	BY	DATE
1	BID ADDENDUM #1 COMMENTS	MFY	3/7/16

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KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

LOCATION MAP

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	AS NOTED

01-G-01

SCHEDULE OF DRAWINGS

SHEET NO.	DESCRIPTION	BY
	01 - GENERAL	
01-G-00	COVER SHEET	T&H
01-G-01	LOCATION MAP	T&H
01-G-02	INDEX OF DRAWINGS	T&H
01-G-03	GENERAL CIVIL NOTES	T&H
01-G-04	GENERAL CIVIL NOTES	T&H
01-G-05	GENERAL CIVIL NOTES & LEGENDS	T&H
01-G-06	OVERALL PROCESS FLOW DIAGRAM	T&H
01-G-07	HYDRAULIC PROFILE	T&H
01-V-01	SURVEY CONTROL SHEET	T&H
01-S-01	STRUCTURAL NOTES & DETAILS	T&H
01-S-02	STRUCTURAL DETAILS	T&H
01-S-03	STRUCTURAL DETAILS	T&H
01-S-04	STRUCTURAL DETAILS	T&H
01-M-01	HVAC SCHEDULE, DETAILS AND SPECS	CHATM
01-P-01	PLUMBING NOTES, FIXTURES AND DETAILS	CHATM
	02 - WATER MAIN LINE	
02-C-01	WATER MAIN - SHEET INDEX	T&H
02-C-02	WATER MAIN - PLAN AND PROFILE	T&H
02-C-03	WATER MAIN - PLAN AND PROFILE	T&H
02-C-04	WATER MAIN - PLAN AND PROFILE	T&H
02-C-05	WATER MAIN - PLAN AND PROFILE	T&H
02-C-06	WATER MAIN - PLAN AND PROFILE	T&H
02-C-07	WATER MAIN - PLAN AND PROFILE	T&H
02-C-08	WATER MAIN - DETAILS	T&H
02-C-09	WATER MAIN - DETAILS	T&H
	05 - OVERALL SITE	
05-C-01	EXISTING SITE CONDITIONS	T&H
05-C-02	OVERALL SITE PLAN	T&H
05-C-03	WWTP & EFFLUENT LAGOON SITE PLAN	T&H
05-C-04	LAS SITE PLAN (PHASE 1)	T&H
05-C-05	EROSION & SEDIMENT CONTROL - INITIAL PHASE	T&H
05-C-05A	EROSION & SEDIMENT CONTROL - FINAL PHASE	T&H
05-C-06	SWPPP - NOTES	T&H
05-C-07	SWPPP - CHARTS	T&H
05-C-08	SWPPP - DETAILS	T&H
05-C-09	SWPPP - DETAILS	T&H
05-C-10	SITE PIPING PLAN - OVERALL SITE	T&H
05-C-11	CIVIL DETAILS	T&H
05-C-12	CIVIL DETAILS	T&H
05-C-13	CIVIL DETAILS	T&H
05-C-14	CIVIL DETAILS	T&H
2 05-E-01	~~ELECTRICAL PLAN - OVERALL SITE~~	~~CH~~
05-L-01	LANDSCAPE PLAN	T&H
05-L-02	LANDSCAPE DETAILS & NOTES	T&H
05-L-03	LANDSCAPE SPECIFICATION	T&H
05-L-04	GRASSING SPECIFICATION	T&H
	06- WWTP SITE	
06-C-01	SITE LAYOUT PLAN	T&H
06-C-01A	TREE PROTECTION AND REMOVAL PLAN - WWTP	
06-C-02	PIPING PLAN - WWTP	T&H
06-C-03	PAVING, GRADING & DRAINAGE PLAN - WWTP	T&H
	07- TREATED EFFLUENT LAGOON	
07-C-01	PAVING, GRADING AND DRAINAGE PLAN - EFFLUENT LAGOON	T&H
07-C-02	PIPING PLAN - EFFLUENT LAGOON	T&H
07-C-03	DETAILS AND SECTIONS - EFFLUENT LAGOON	T&H
07-C-04	DETAILS AND SECTIONS - EFFLUENT LAGOON	T&H
	08 - SPRAYFIELD IRRIGATION PUMP STATION	
08-C-01	EFFLUENT PUMP STATION - PLAN AND SECTION	T&H
08-C-02	EFFLUENT PUMP STATION - SECTION AND DETAILS	T&H
2 08-E-01	~~EFFLUENT ELECTRICAL PLAN AND DETAILS~~	~~CHATM~~

SCHEDULE OF DRAWINGS

SHEET NO.	DESCRIPTION	BY
	09 - LAND APPLICATION SPRAYFIELD (LAS)	
09-C-01	STAKING PLAN - LAS	T&H
09-C-02	SITE PIPING PLAN - LAS	T&H
09-C-03	DETAILS AND SECTIONS - LAS	T&H
09-C-04	DETAILS AND SECTIONS - LAS	T&H
09-C-05	INDIVIDUAL SPRINKLER COORDINATES AND NOZZLE SIZE	T&H
09-C-06	INDIVIDUAL SPRINKLER COORDINATES AND NOZZLE SIZE	T&H
	10 - INFLUENT SCREEN S- WWTP	
10-S-01	STRUCTURAL PLANS	T&H
10-S-02	SECTION & DETAILS	T&H
10-D-01	PIPING PLANS	T&H
10-D-02	PIPING SECTIONS	T&H
	15 - PLANT DRAIN PUMP STATION (WWTP)	
15-D-01	PIPING PLAN & SECTIONS	T&H
	30 - ODOROUS AIR TREATMENT	
30-D-01	GENERAL ARRANGEMENT	T&H
	35 - ANOXIC/AEROBIC/MBR/ARCH/MP	
35-A-01	LIFE SAFETY ANALYSIS	
35-A-02	LIFE SAFETY ANALYSIS	SWTAIL
35-A-03	LOWER FLOOR PLAN	SWTAIL
35-A-04	UPPER FLOOR PLAN	SWTAIL
35-A-05	ROOF PLAN	SWTAIL
35-A-06	SCHEDULES	SWTAIL
35-A-07	DETAILS & SCHEDULES	SWTAIL
35-A-08	REFLECTED CEILING PLAN	SWTAIL
35-A-09	NORTH ELEVATION	SWTAIL
35-A-10	WEST ELEVATION	SWTAIL
35-A-11	SOUTH ELEVATION	SWTAIL
35-A-12	EAST ELEVATION	SWTAIL
35-A-13	BUILDING SECTION	SWTAIL
35-A-14	BUILDING SECTION	SWTAIL
35-A-15	WALL SECTIONS	SWTAIL
35-A-16	WALL SECTIONS	SWTAIL
35-A-17	DETAILS	SWTAIL
35-A-18	DETAILS	SWTAIL
35-A-19	DETAILS & SCHEDULES	SWTAIL
35-S-01	FOUNDATION PLAN	T&H
35-S-02	LOWER PLAN	T&H
35-S-03	2ND FLOOR FRAMING PLAN	T&H
35-S-04	UPPER LEVEL OVERVIEW	T&H
35-S-05	ROOF FRAMING PLAN	T&H
35-S-06	BASINS & BUILDING SECTION	T&H
35-S-07	SECTIONS & DETAILS	T&H
35-S-08	SECTIONS & DETAILS	T&H
35-S-09	BUILDING DETAILS	T&H
35-S-10	BUILDING DETAILS	T&H
35-M-01	HVAC LOWER LEVEL PLAN AND DETAILS	CHATM
35-M-01	HVAC UPPER LEVEL PLAN AND DETAILS	CHATM
35-P-01	PLUMBING PLAN LOWER LEVEL	CHATM
35-P-02	PLUMBING PLAN UPPER LEVEL	CHATM
35-D-01	TREATMENT BASINS - LOWER LEVEL - PLAN	T&H
35-D-02	TREATMENT BASINS - UPPER LEVEL - PLAN	T&H
	36- CHLORINE CONTACT CHAMBER	
36-S-01	PLAN VIEW	T&H
36-S-02	SECTIONS & DETAILS	T&H
36-D-01	PIPING PLAN & SECTIONS	T&H
	40 - SLUDGE DEWATERING (CENTRIFUGE)	
40-A-01	LIFE SAFETY ANALYSIS	SWTAIL
40-A-02	BUILDING PLAN & ROOF PLAN	SWTAIL
40-A-03	BUILDING ELEVATIONS	SWTAIL
40-A-04	SCHEDULES	SWTAIL
40-S-01	SLAB PLAN	T&H
40-S-02	ROOF PLAN	T&H
40-S-03	SECTIONS	T&H
40-M-01	HVAC PLAN	CHATM
40-P-01	PLUMBING PLAN	CHATM
40-D-01	PIPING PLAN	T&H
40-D-02	MISCELLANEOUS DETAILS	T&H

SCHEDULE OF DRAWINGS

SHEET NO.	DESCRIPTION	BY
	45 - OPERATION BUILDING	
45-D-01	CHEMICAL ROOM - PROCESS PIPING	T&H
45-D-02	CHEMICAL ROOM - MISCELLANEOUS DETAILS	T&H
45-D-03	LOWER LEVEL - PLAN	T&H
	50 - ELECTRICAL	
50-E-01	LEGEND, ABBREVIATIONS & GENERAL NOTES	CHATM
50-E-02	ELECTRICAL DETAILS & FIXTURE SCHEDULE	CHATM
50-E-03	ELECTRICAL DETAILS	CHATM
50-E-04	OVERALL PROJECT PLAN - ELECTRICAL	CHATM
50-E-05	TREATMENT PLANT SITE - ELECTRICAL	CHATM
50-E-06	TREATMENT PLANT SITE - PHOTOMETRY	CHATM
50-E-07	WWTP BUILDING - GROUND FLOOR - POWER	CHATM
50-E-08	WWTP BUILDING - UPPER FLOOR - POWER	CHATM
50-E-09	WWTP BUILDING - GROUND FLOOR - LIGHTING	CHATM
00-E-10	WWTP BUILDING - UPPER FLOOR - LIGHTING	CHATM
50-E-11	CENTRIFUGE BUILDING - LIGHTING & POWER	CHATM
50-E-12	ONE-LINE DIAGRAM	CHATM
50-E-13	EFFLUENT PUMP STATION PLAN - ELECTRICAL	CHATM
50-E-14	SPRAYFIELD PLAN - ELECTRICAL	CHATM
50-E-15	MCC ELEVATIONS	CHATM
50-E-16	ONE-LINE DIAGRAM AND SCHEDULES	CHATM
50-E-17	MCC ELEVATIONS AND SCHEDULES	CHATM
50-E-18	OVIVO FIELD INSTRUMENT CONNECTIONS	CHATM
50-E-19	IN-PLANT SCADA FIELD INSTRUMENT CONN.	CHATM
50-E-20	IN-PLANT SCADA RISER DIAGRAM	CHATM

SCHEDULE OF DRAWINGS

SHEET NO.	DESCRIPTION	BY
60-I-01	PROCESS & INSTRUMENTATION DIAGRAM	T&H
	60 - INSTRUMENTATION AND CONTROL BY OVIVO	
I-1.00	COVER SHEET	OVIVO
I-1.01	EQUALIZATION BASIN	OVIVO
I-1.02	EQUALIZATION PUMPS	OVIVO
I-1.03	FINE SCREENS	OVIVO
I-1.04	ANOXIC BASIN	OVIVO
I-1.05	PRE-AERATION BASIN 01	OVIVO
I-1.06	PRE-AERATION/MEMBRANE THICKENING BASIN 02	OVIVO
I-1.07	FEED CHANNEL	OVIVO
I-1.08	MEMBRANE BIOREACTOR BASIN 01	OVIVO
I-1.09	MEMBRANE BIOREACTOR BASIN 02	OVIVO
I-1.10	RAS WET WELL	OVIVO
I-1.11	PERMEATE PUMPS	OVIVO
I-1.12	MBT PERMEATE PUMP	OVIVO
I-1.13	PRE-AERATION BLOWERS	OVIVO
I-1.14	MBR/ PRE-AIR BLOWERS	OVIVO
I-1.15	CHEMICAL CLEANING	OVIVO
I-1.16	CHEMICAL ADDITION	OVIVO
I-1.17	EMERGENCY STANDBY GENERATOR	OVIVO
I-1.18	ODOR CONTROL SYSTEM #2	OVIVO
I-1.19	CODES LEGEND	OVIVO
I-1.20	SYMBOLS LEGEND	OVIVO
1	MBR PLANT LAYOUT - PERSPECTIVE VIEW	OVIVO
2	MBR PLANT LAYOUT - PLAN	OVIVO
3	MBR PLANT LAYOUT - SECTIONS	OVIVO
4	MBR PLANT LAYOUT - SECTION	OVIVO
5	MBR PLANT LAYOUT - SECTION	OVIVO
6	MBR PLANT LAYOUT - SECTIONS	OVIVO

THE DRAWING NUMBERS FOR THIS PROJECT FOLLOW THE FOLLOWING GUIDELINE:

XX - N - ##

- XX — FACILITY NUMBER (2 DIGITS)
- N — DISCIPLINE DESIGNATOR
- ## — SEQUENTIAL NUMBERING (2 DIGITS)

FACILITY NUMBER	DISCIPLINE DESIGNATOR	SEQUENTIAL NUMBERING
01 - GENERAL	C CIVIL	01
02 - WATER SUPPLY LINE	A ARCHITECTURAL	02
05 - OVERALL SITE	S STRUCTURAL	03
06 - WASTEWATER TREATMENT PLANT SITE	E ELECTRICAL	ETC.
07 - TREATED EFFLUENT LAGOON	G GENERAL	
08 - SPRAYFIELD IRRIGATION PUMP STA.	D PROCESS MECHANICAL	
09 - LAND APPLICATION SYSTEM (LAS)	M MECHANICAL HVAC	
10 - PRIMARY INFLUENT SCREEN (WWTP)	P PLUMBING	
15 - PLANT DRAIN PUMP STATION (WWTP)	R INSTRUMENTATION & CONTROL	
30 - ODOROUS AIR TREATMENT	L LANDSCAPE	
35 - ANOXIC/AEROBIC/MBR/ARCH/MP	Y YARD PIPING	
36 - CHLORINE CONTACT CHAMBER	V SURVEYING	
40 - SLUDGE DEWATERING	I INSTRUMENTATION	
45 - OPERATION BUILDING/TREATMENT PROCESS		
50 - ELECTRICAL		
60 - INSTRUMENTATION & CONTROL		

PROJECT INFORMATION

OWNER:
KIAWAH RIVER PLANTATION HOLDINGS, LP AND OCEAN BOULEVARD PROPERTIES LIMITED PARTERSHIP
211 KING STREET, SUITE 300
CHARLESTON, SC 29401
(843) 722-2615

SITE/STRUCTURAL:
THOMAS & HUTTON
682 JOHNNIE DODDS BLVD.
SUITE 100
MT. PLEASANT SC, 29464
(843) 849-0200

ARCHITECTURAL:
SWALLOWTAIL ARCHITECTURE, LLC
814 N. CEDAR STREET
SUMMERVILLE SC, 29483
(843) 885-9400

MEP ENGINEERING:
CHATHAM ENGINEERING
109 PARK OF COMMERCE DRIVE
SAVANNAH, GA 31405
912-238-2400

WATER:
ST. JOHN'S WATER COMPANY
3362 MAYBANK HWY
JOHN'S ISLAND, SC 29455
(843) 768-0641

POWER:
BERKELEY ELECTRIC
ST. JOHNS DISTRICT
3351 MAYBANK HIGHWAY
P.O. BOX 1285
ST. JOHNS, SC 29455
(843)559-2458

TELEPHONE:
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975 SAVANNAH HWY, SUITE 301
CHARLESTON, SC 29407
(843)556-7611

SOUTH CAROLINA — THOMAS & HUTTON ENGINEERING — No. C00285 — CERTIFICATE OF AUTHORITY

SOUTH CAROLINA — REGISTERED PROFESSIONAL ENGINEER — No. 18293 — MARK F. YORK

NO.	BY	DATE
2	MFY	3/7/16
1	MFY	12/2/15

BID ADDENDUM #1 COMMENTS
GENERAL REVISIONS
REVISIONS

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KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

INDEX OF DRAWINGS

JOB NO:	J-25328.0000
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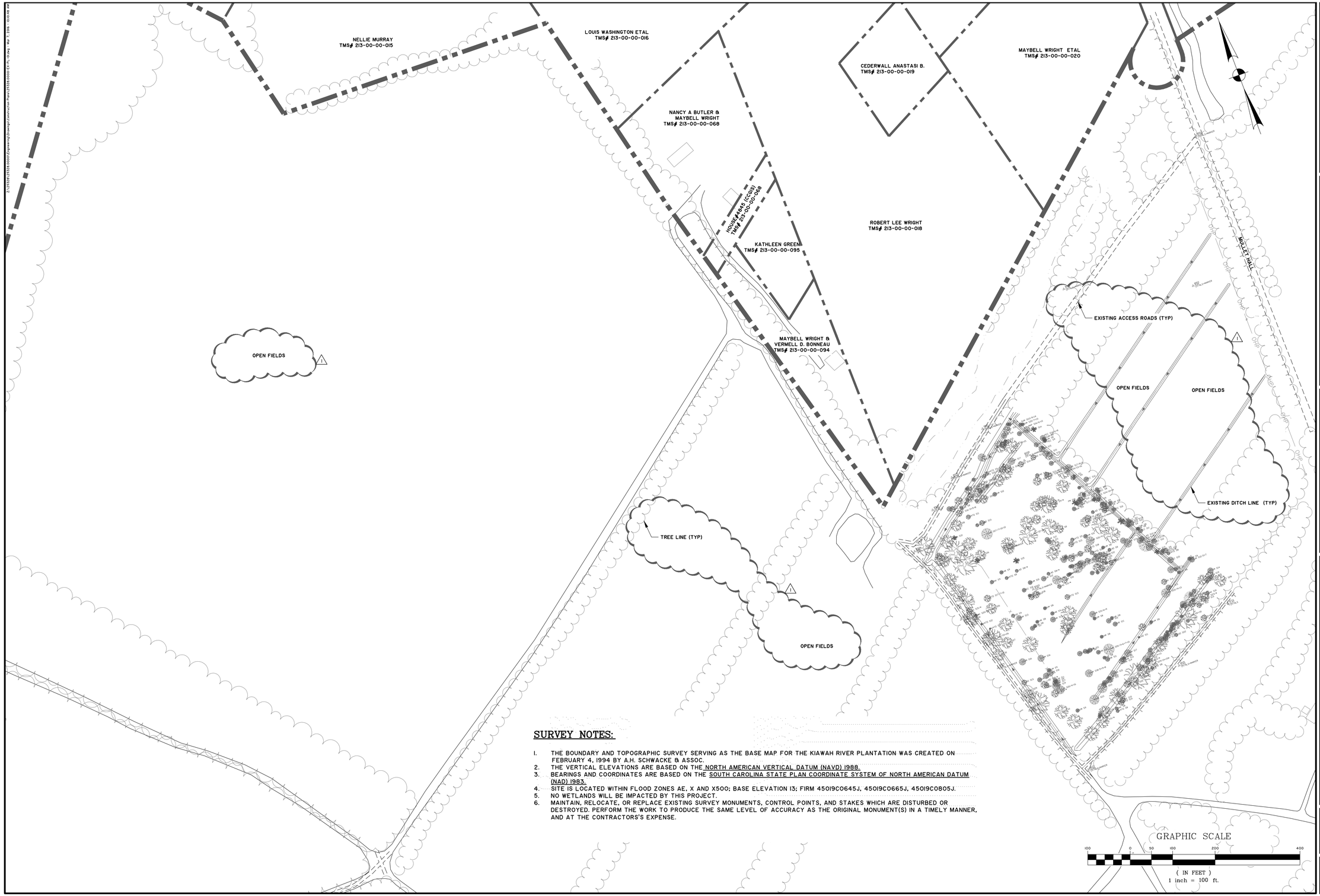
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	NTS

01-G-02



SURVEY NOTES:

1. THE BOUNDARY AND TOPOGRAPHIC SURVEY SERVING AS THE BASE MAP FOR THE KIAWAH RIVER PLANTATION WAS CREATED ON FEBRUARY 4, 1994 BY A.H. SCHWACKE & ASSOC.
2. THE VERTICAL ELEVATIONS ARE BASED ON THE NORTH AMERICAN VERTICAL DATUM (NAVD) 1988.
3. BEARINGS AND COORDINATES ARE BASED ON THE SOUTH CAROLINA STATE PLAN COORDINATE SYSTEM OF NORTH AMERICAN DATUM (NAD) 1983.
4. SITE IS LOCATED WITHIN FLOOD ZONES AE, X AND X500; BASE ELEVATION 13; FIRM 45019C0645J, 45019C0665J, 45019C0805J.
5. NO WETLANDS WILL BE IMPACTED BY THIS PROJECT.
6. MAINTAIN, RELOCATE, OR REPLACE EXISTING SURVEY MONUMENTS, CONTROL POINTS, AND STAKES WHICH ARE DISTURBED OR DESTROYED. PERFORM THE WORK TO PRODUCE THE SAME LEVEL OF ACCURACY AS THE ORIGINAL MONUMENT(S) IN A TIMELY MANNER, AND AT THE CONTRACTORS'S EXPENSE.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)
1 inch = 100 ft.

SOUTH CAROLINA
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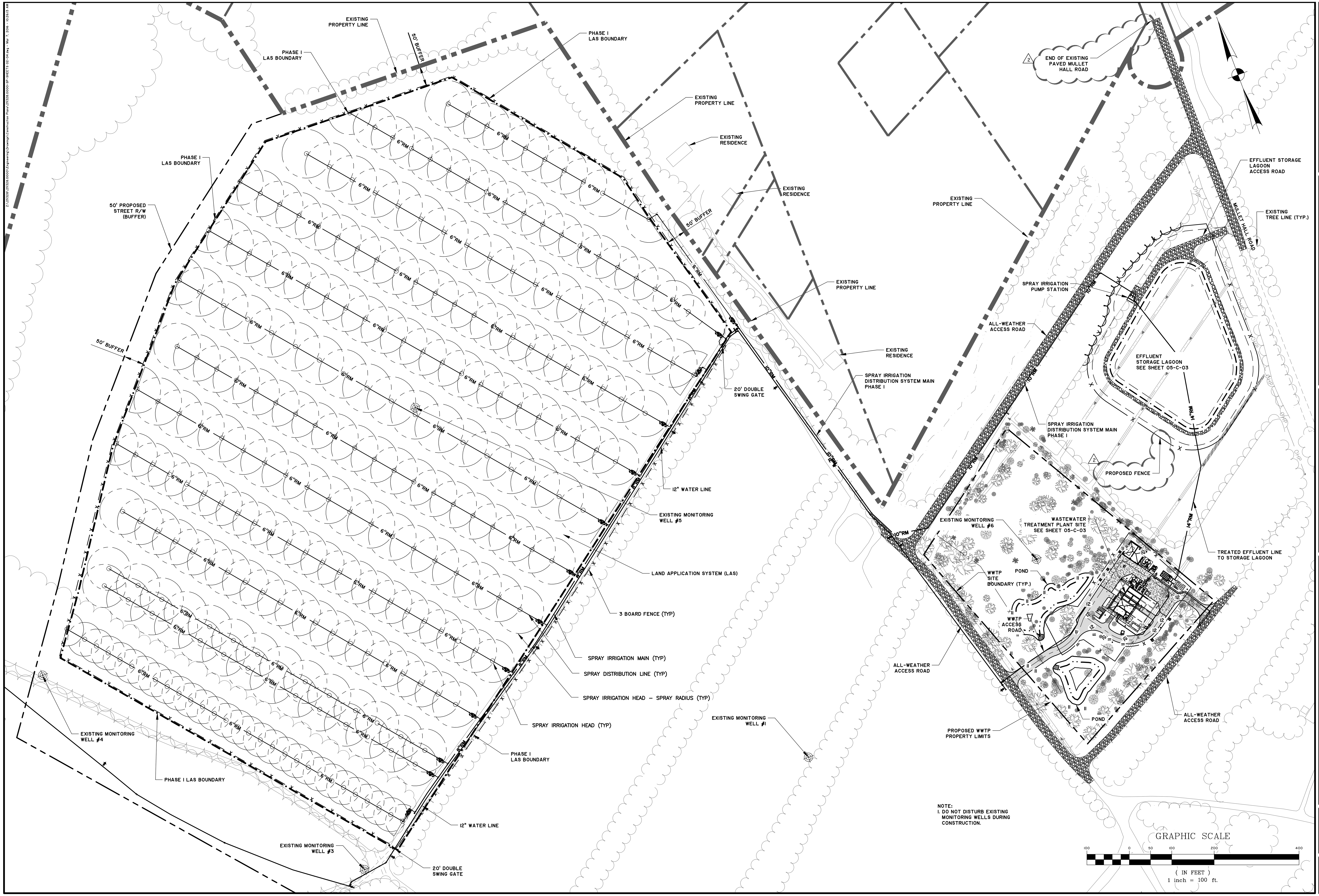
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

EXISTING SITE CONDITIONS

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1" = 100'

05-C-01


EXISTING PROPERTY LINE
PHASE I LAS BOUNDARY
50' BUFFER
50' PROPOSED STREET R/W (BUFFER)
EXISTING RESIDENCE
END OF EXISTING PAVED MULLET HALL ROAD
EFFLUENT STORAGE LAGOON ACCESS ROAD
EXISTING TREE LINE (TYP.)
MULLET HALL ROAD
SPRAY IRRIGATION PUMP STATION
ALL-WEATHER ACCESS ROAD
EFFLUENT STORAGE LAGOON SEE SHEET 05-C-03
SPRAY IRRIGATION DISTRIBUTION SYSTEM MAIN PHASE I
20' DOUBLE SWING GATE
PROPOSED FENCE
12" WATER LINE
EXISTING MONITORING WELL #5
EXISTING MONITORING WELL #6
WASTEWATER TREATMENT PLANT SITE SEE SHEET 05-C-03
TREATED EFFLUENT LINE TO STORAGE LAGOON
POND
WWTP SITE BOUNDARY (TYP.)
WWTP ACCESS ROAD
LAND APPLICATION SYSTEM (LAS)
3 BOARD FENCE (TYP)
SPRAY IRRIGATION MAIN (TYP)
SPRAY DISTRIBUTION LINE (TYP)
SPRAY IRRIGATION HEAD – SPRAY RADIUS (TYP)
SPRAY IRRIGATION HEAD (TYP)
EXISTING MONITORING WELL #1
PROPOSED WWTP PROPERTY LIMITS
EXISTING MONITORING WELL #4
PHASE I LAS BOUNDARY
EXISTING MONITORING WELL #3
6"RM
10"RM
14"RM

NOTE:
1. DO NOT DISTURB EXISTING MONITORING WELLS DURING CONSTRUCTION.

GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

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KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

OVERALL SITE PLAN

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1" = 100'

05-C-02

MATCH LINE - SEE SHEET NO. 05-C-04

PROPERTY LINE

EXTEND GRAVEL SURFACE TO END OF EXISTING PAVED ROAD

PROPOSED 20' WIDE ALL-WEATHER ACCESS ROAD

PROPOSED SPRAY IRRIGATION DISTRIBUTION MAIN

TREE LINE

SPRAY IRRIGATON PUMP STATION

MAINTAIN 50' (MIN) UNDISTURBED WOODS

TOE OF SLOPE

PROPOSED EFFLUENT STORAGE LAGOON ALL-WEATHER ACCESS ROAD

12" WATER LINE

WWTP SITE BOUNDARY

EXISTING MONITORING WELL #6

EXISTING DRAINAGE DITCH

180 LF 30" RCP (INTERIOR COATED) OR 30" C905 @ 0.5%

18' DOUBLE LEAF SWING GATE

CLEAN OUT EXISTING DITCH (TYP)

TOP OF SLOPE

BOTTOM SLOPE OF POND EL = 10.0'

INTAKE/OUTLET STRUCTURE SEE 2/07-C-04 TOP 9.0'

PROPOSED 20' WIDE ALL-WEATHER ACCESS ROAD

POND

TOP OF SLOPE

TOP OF WATER EL = 15.1'

MILLET HALL ROAD

TAPER GRAVEL ROAD TO MATCH EXISTING ROAD WIDTH OVER 50' DISTANCE

TOE OF SLOPE

PROPOSED FENCE

TOP OF DIKE EL = 18.0'

20' WIDE ACCESS ROAD

EXISTING TREE LINE (TYP.)

PROPOSED WWTP PROPERTY LIMITS

EXISTING DRAINAGE DITCH

20' SLIDE GATE

CENTRIFUGE BUILDING

FILL EXISTING DITCH (HATCHED AREA)

ODOROUS AIR TREATMENT

PLANT DRAIN PUMP STATION

TREATED EFFLUENT FORCE MAIN

ODOROUS AIR TREATMENT

POND

CHLORINE CONTACT CHAMBER

SECURITY FENCE (TYP.)

WASTEWATER TREATMENT FACILITY

18' SLIDE GATE

PROPOSED 18' WIDE ALL-WEATHER ACCESS ROAD

NOTE:
1. DO NOT DISTURB EXISTING MONITORING WELLS DURING CONSTRUCTION.

GRAPHIC SCALE

60 0 30 60 120 240

(IN FEET)
1 inch = 60 ft.

SOUTH CAROLINA PROFESSIONAL ENGINEER — THOMAS & HUTTON ENGINEERING CO. No. C00285 — CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA PROFESSIONAL ENGINEER — No. 13293 — REGISTERED — MARK F. YORK

NO.	REVISIONS	BY	DATE
2	BID ADDENDUM #1 COMMENTS	MFY	3/7/16
1	GENERAL REVISIONS	MFY	12/2/15

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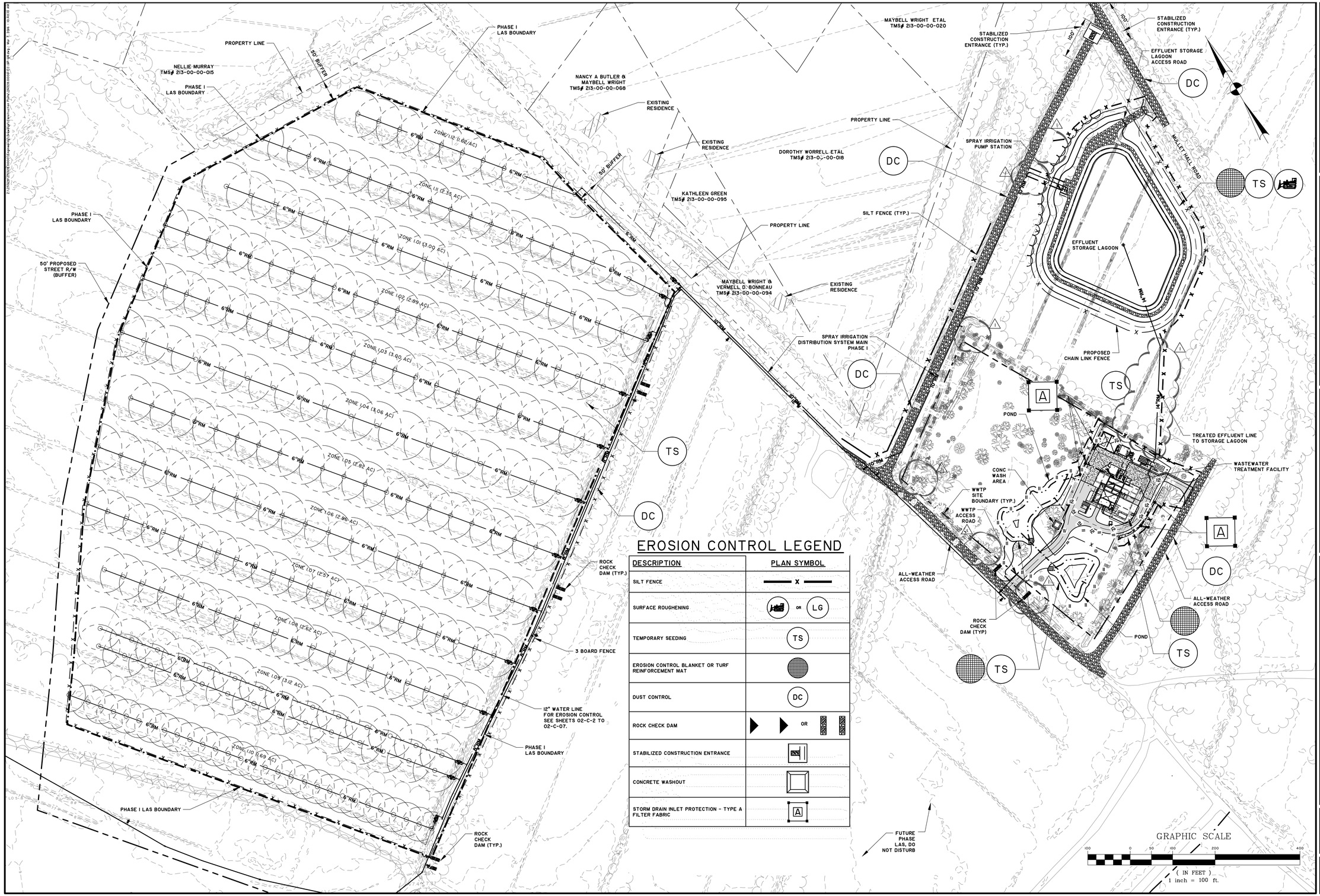
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

WWTP & EFFLUENT LAGOON SITE PLAN

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1"=60'

05-C-03



EROSION CONTROL LEGEND

DESCRIPTION	PLAN SYMBOL
SILT FENCE	x
SURFACE ROUGHENING	OR LG
TEMPORARY SEEDING	TS
EROSION CONTROL BLANKET OR TURF REINFORCEMENT MAT	
DUST CONTROL	DC
ROCK CHECK DAM	OR
STABILIZED CONSTRUCTION ENTRANCE	
CONCRETE WASHOUT	
STORM DRAIN INLET PROTECTION - TYPE A FILTER FABRIC	A

GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

SOUTH CAROLINA — THOMAS & HUTTON ENGINEERING No. C00285 — CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA — REGISTERED PROFESSIONAL ENGINEER No. 13293 — MARK F. YORK

NO.	REVISIONS	BY	DATE
1	BID ADDENDUM #1 COMMENTS	MFY	3/7/16

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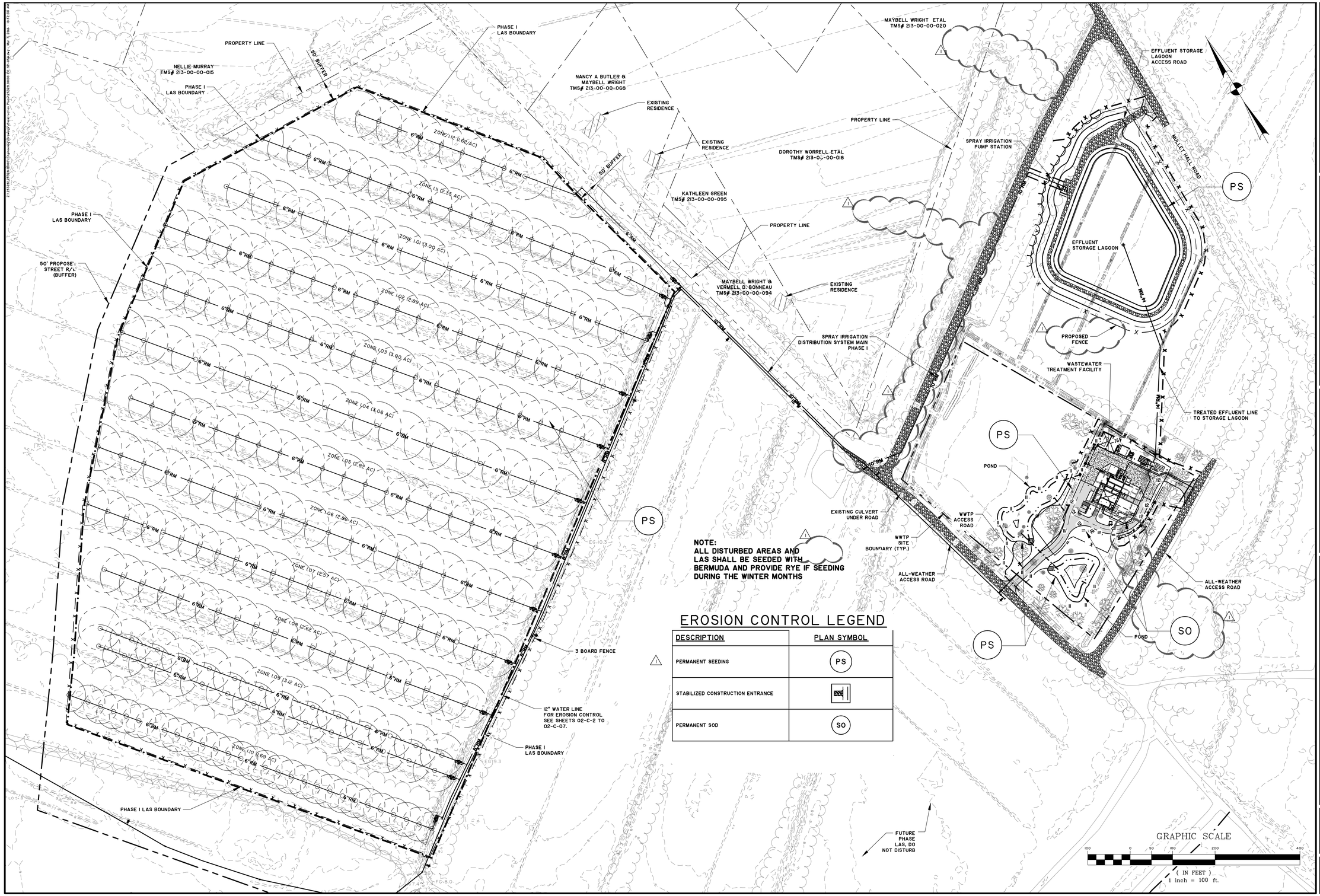
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

EROSION & SEDIMENT CONTROL PLAN - INITIAL PHASE

JOB NO:	J-25328.0000
DATE:	7/31/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1"=100'

05-C-05



NOTE:
ALL DISTURBED AREAS AND LAS SHALL BE SEEDED WITH BERMUDA AND PROVIDE RYE IF SEEDING DURING THE WINTER MONTHS

EROSION CONTROL LEGEND

DESCRIPTION	PLAN SYMBOL
PERMANENT SEEDING	PS
STABILIZED CONSTRUCTION ENTRANCE	
PERMANENT SOD	SO

GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

SOUTH CAROLINA — THOMAS & HUTTON ENGINEERING — No. C00285 — CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA — REGISTERED PROFESSIONAL ENGINEER — No. 13293 — MARK F. YORK

NO.	REVISIONS	BY	DATE
1	BID ADDENDUM #1 COMMENTS	MFY	3/7/16

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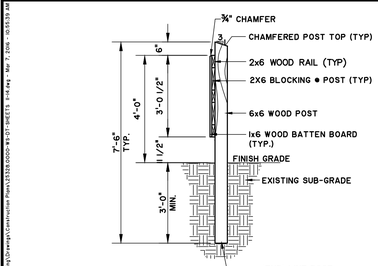
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

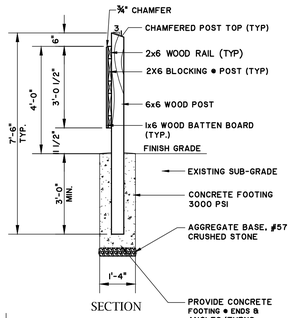
EROSION & SEDIMENT CONTROL PLAN - FINAL PHASE

JOB NO:	J-25328.0000
DATE:	7/31/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1"=100'

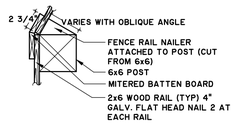
05-C-05A



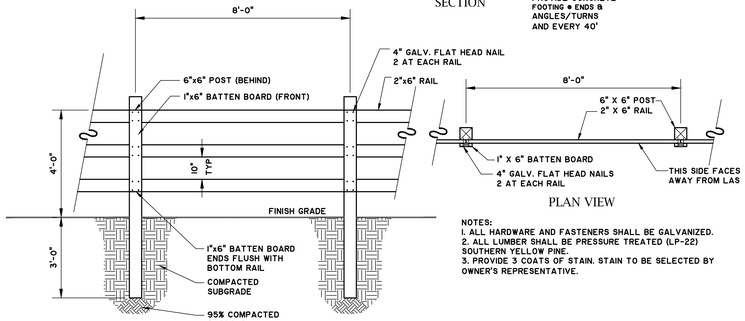
SECTION



SECTION



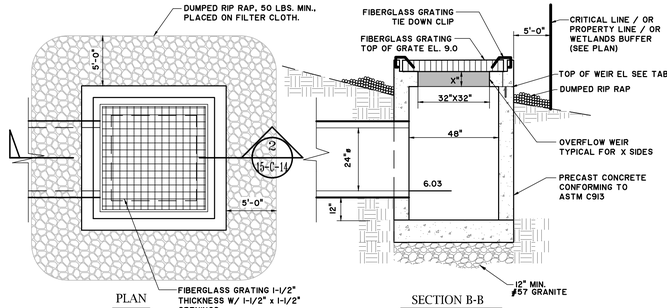
OBLIQUE FENCE DETAIL (N.T.S.)



PLAN VIEW

NOTES:
1. ALL HARDWARE AND FASTENERS SHALL BE GALVANIZED.
2. ALL LUMBER SHALL BE PRESSURE TREATED (LP-22) SOUTHERN YELLOW PINE.
3. PROVIDE 3 COATS OF STAIN. STAIN TO BE SELECTED BY OWNER'S REPRESENTATIVE.

1 THREE BOARD FENCE DETAIL
05-C-14 SCALE: N.T.S.

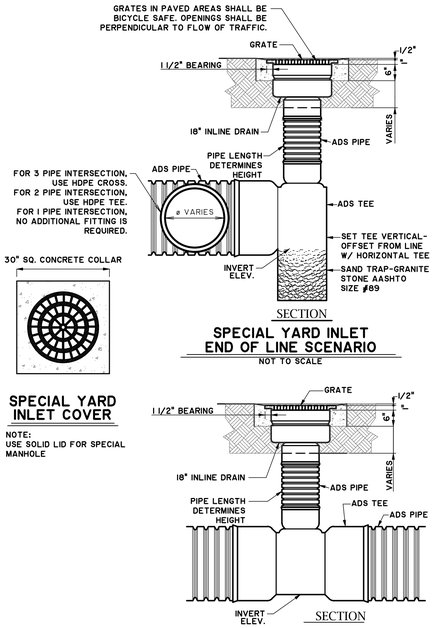


NOTES:
1. STRUCTURE, GRATE, & FRAME SHALL BE APPROVED BY ENGINEER PRIOR TO ORDERING.

WEIR TABLE

VERT WEIR 1 = EL 7.5'
SPAN = 24"
RISE = 6"
VERT WEIR 2 = EL 8.0'
SPAN = 48"
RISE = 12"

2 BUBBLER SYSTEM
05-C-14 NOT TO SCALE

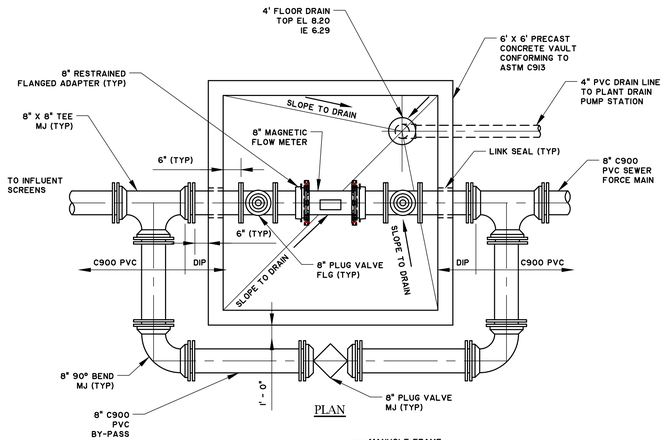


SPECIAL YARD INLET COVER

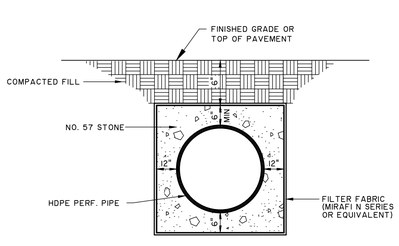
NOTE:
USE SOLID LID FOR SPECIAL MANHOLE

SPECIAL YARD INLET END OF LINE SCENARIO
NOT TO SCALE

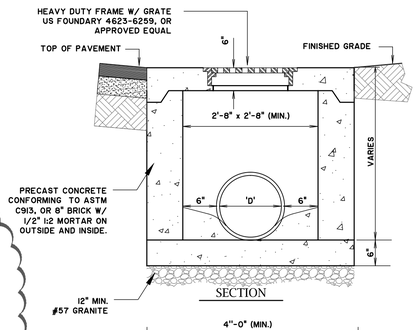
3 SPECIAL YARD INLET DETAIL
05-C-14 NOT TO SCALE

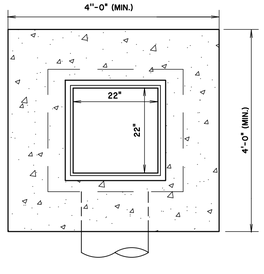


6 FLOW METER AND CONCRETE VAULT DETAIL
05-C-14 1/2"=1'-0"

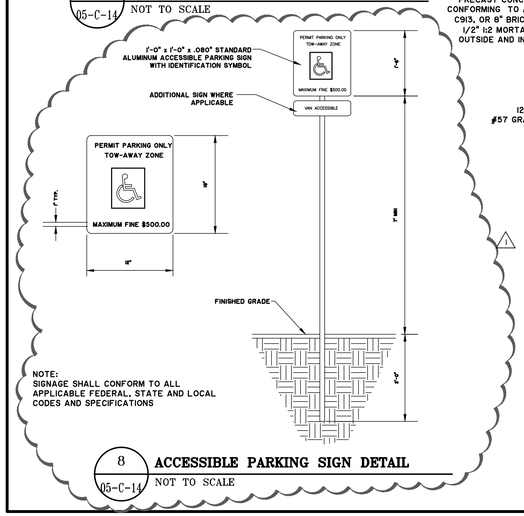


4 PERFORATED PIPE DETAIL
05-C-14 NOT TO SCALE

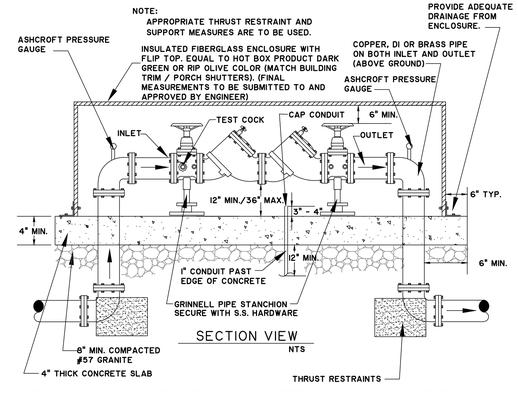




5 STANDARD INLET - GRATE TYPE
05-C-14 NOT TO SCALE



8 ACCESSIBLE PARKING SIGN DETAIL
05-C-14 NOT TO SCALE



NOTES:
1. ASSEMBLY EQUIVALENT TO BEECO-HERSEY, FEBCO, OR WATTS. ALL REDUCED PRESSURE DEVICES MUST BE INSTALLED ABOVE GROUND.
2. BOX MUST BE SIZED TO ALLOW ADEQUATE ROOM FOR TESTING AND MAINTENANCE. TYPICALLY THIS DIMENSION SHOULD BE A MIN. OF 12" ALL AROUND, (SIDES AND BOTTOM).
3. CONTRACTOR SHALL SUBMIT "TO SCALE" SHOP DRAWINGS OF PROPOSED INSTALLATION TO ENGINEER FOR APPROVAL PRIOR TO ORDERING ANY MATERIAL
4. A CERTIFIED TESTER SHALL TEST ASSEMBLY ACCORDING TO SCDHEC AND LOCAL REQUIREMENTS. SUBMIT RESULTS TO ENGINEER.
5. INSTALL ACCORDING TO MANUFACTURES RECOMMENDATIONS.
6. ALL ASSEMBLIES MUST BE ON SCDHEC LIST OF APPROVED BACKFLOW PREVENTION ASSEMBLIES FOR SC.

7 BACKFLOW PREVENTER
05-C-14 NOT TO SCALE

SOUTH CAROLINA PROFESSIONAL ENGINEER THOMAS & HUTTON ENGINEERING No. C00285 CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 13293 REGISTERED MAINE F. YORK

NO.	REVISIONS	BY	DATE
1	BID ADDENDUM #1 COMMENTS	MFY	3/7/16

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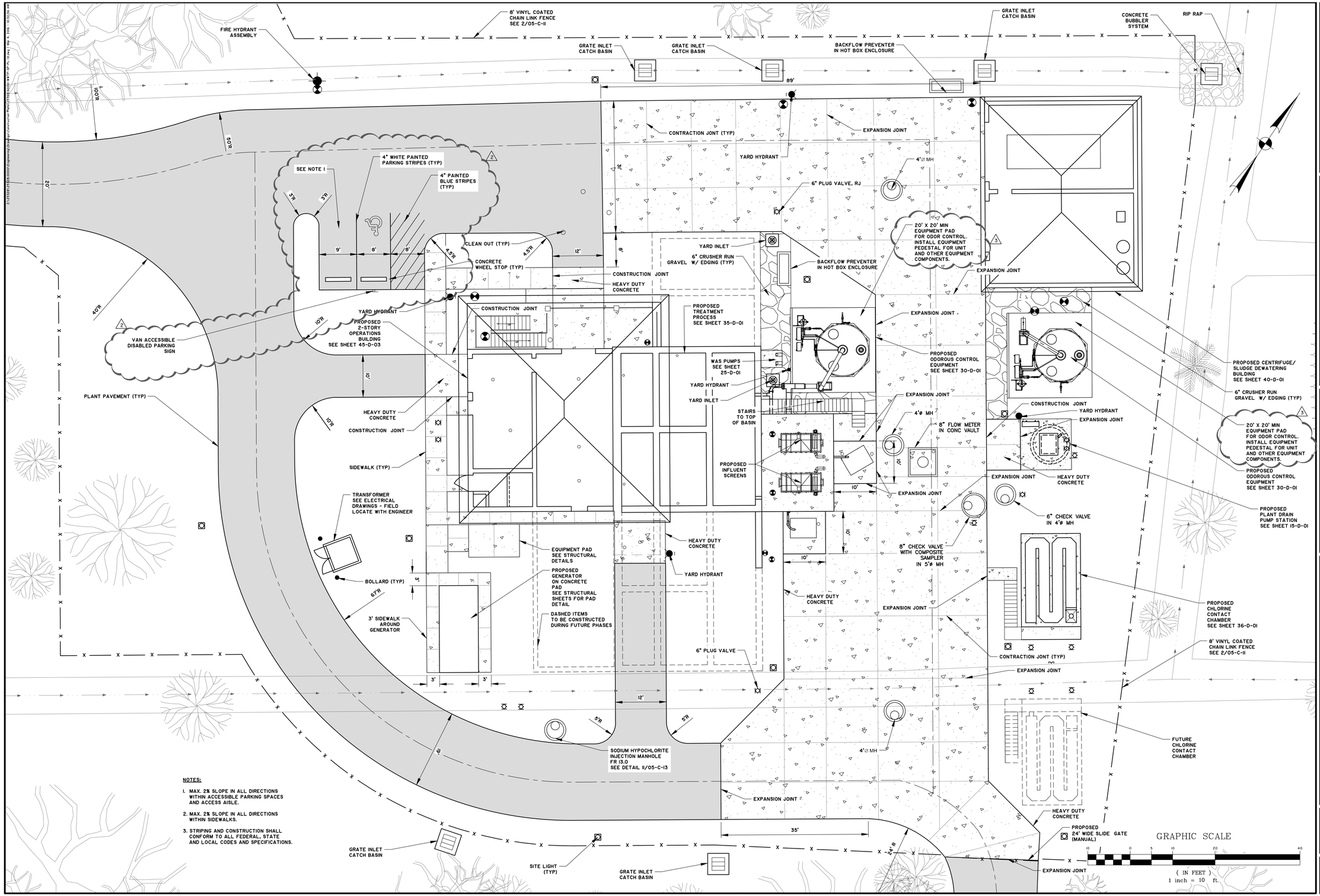
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

CIVIL DETAILS

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	AS NOTED

05-C-14



NOTES:

1. MAX. 2% SLOPE IN ALL DIRECTIONS WITHIN ACCESSIBLE PARKING SPACES AND ACCESS AISLE.
2. MAX. 2% SLOPE IN ALL DIRECTIONS WITHIN SIDEWALKS.
3. STRIPING AND CONSTRUCTION SHALL CONFORM TO ALL FEDERAL, STATE AND LOCAL CODES AND SPECIFICATIONS.

GRAPHIC SCALE

(IN FEET)
1 inch = 10 ft.

SOUTH CAROLINA PROFESSIONAL ENGINEER — THOMAS & HUTTON ENGINEERING No. C00285 — CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER — No. 13293 — MARK F. YORK

NO.	REVISIONS	BY	DATE
3	BID ADDENDUM #1 COMMENTS	MFY	3/7/16
2	CHARLESTON COUNTY COMMENTS	MFY	2/15/16
1	GENERAL REVISIONS	MFY	12/22/15

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KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

SITE LAYOUT - WWTP

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1" = 10'

06-C-01

EXISTING TREE SYMBOLS	
ABBREVIATION	DESCRIPTION
CHR	CHERRY
GUM	GUM
LAO	LAUREL OAK
LO	LIVE OAK
MAG	MAGNOLIA
OAK	MISC. OAK
PEC	PECAN
PM	PALM/PALMETTO
WATO	WATER OAK

TREE REMOVAL SCHEDULE		
TYPE	TRUNK DIAMETER	DIAMETER TOTAL INCHES
CHR	(3)8", 9", 11", 12", 16", 18", 20"	110
GUM	(7)8", 10", 11", (2)13", (2)14", 15", 16", 17", 18", 19", 22", 34"	272
LAO	9", 11", 15", 10"	45
LO	12"	12
OAK	12", 14", (2)18"	62
WATO	13"	13
PEC	13"	13
TOTAL		527

LEGEND

ABBREVIATION/SYMBOL	DESCRIPTION
	TREE PROTECTION
X	TREE TO BE REMOVED
⊗	DISEASED TREE

GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 22285 THOMAS & HUTTON ENGINEERING CERTIFICATE OF AUTHORIZATION No. C00285

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 13293 MARK F. YOUNG

NO.	REVISIONS	BY	DATE
2	BID ADDENDUM #1 COMMENTS	MFY	3/7/16
1	CHARLESTON COUNTY COMMENTS	MFY	2/15/16

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KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

TREE PROTECTION AND REMOVAL PLAN - WWTP

JOB NO:	J-25326.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	MFY
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1" = 20'

06-C-01A

MATCH LINE – SEE SHEET NO. 06-C-03

8" 45° BEND, RJ
8" 45° BEND, RJ
8" C900 PVC
8"W
FIRE HYDRANT ASSEMBLY
8" X 6" REDUCER, RJ
6" X 4" TAPPED TEE, RJ
6" C900 PVC
6"W
40 LF 24" CLASS III RCP @ 0.6%
30 LF 24" CLASS III RCP @0.6%
50 LF 24" CLASS III RCP @ 0.6%
GRATE INLET CATCH BASIN FR 13.5 IE IN 5.72
CONCRETE BUBBLER SYSTEM IE 6.03
RIP RAP
52 LF 24" CLASS III RCP @ 0.6%
YARD HYDRANT
4" X 3" REDUCER, RJ
3" 90° BEND, RJ
4" C900 PVC
4"W
3" GATE VALVE, RJ
GRATE INLET CATCH BASIN FR 12.7 IE IN 5.24 IE OUT 5.24
GRATE INLET CATCH BASIN FR 13.0 IE IN 5.42 IN IN 10.30 (S) IE OUT 5.42
6" X 4" REDUCER, RJ
BACKFLOW PREVENTER IN HOT BOX ENCLOSURE
6" X 4" TAPPED TEE, RJ
3" GATE VALVE, RJ
3" PVC WL
3"W
3' M.C.
CLEAN OUT IE 4.75
6" WYE IE 4.70
40 LF 12" CLASS IV RCP @ 0.5%
6" SDR 26 PVC
4'Ø MH FR 13.90 IE IN 4.00 IE OUT 3.80
3' M.C.
3" PVC WL
3"W
3'
CLEAN OUT IE 4.85
6" SDR 26 PVC
6" WYE IE 4.80
6" WYE IE 7.15
6" PLUG VALVE, RJ
6" SDR 26 PVC
12" X 6" WYE IE 3.77
3" FM
3" SCHED 80 PVC
3" FM
3" FM
8" 45° BEND
8" SDR 26 PVC
CONNECT TO 12" SUCTION LINE WITH 12" X 4" TEE
2" GATE VALVE, RJ
YARD HYDRANT
CLEAN OUT IE 7.55
6" WYE IE 7.50
6" 45° BEND (TYP)
YARD INLET FR 13.40 IE IN 11.00 IE OUT 10.50
33 LF 6" HDPE @ 1.96% SEE NOTE 1
CENTRIFUGE INFLUENT
BACKFLOW PREVENTER IN HOT BOX ENCLOSURE
2" SCHED 80 PVC
12" SDR 26 PVC @ 0.4%
6" DIP @ 1.03%
3' M.C.
4" WYE
3' M.C.
3" GATE VALVE, RJ
PROPOSED 2-STORY OPERATIONS BUILDING SEE SHEET 45-D-03
CLEAN OUT
3" SCHED 80 PVC
3" FM
PROPOSED TREATMENT PROCESS SEE SHEET 35-D-01
3" PVC WL
3" DIP
12" X 4" WYE W/ 4" PLUG TAPPED FOR 2" NPT IE 3.70
2" PVC WL
0.5'
4" 90° BEND
TOP OF 4" LINE 1'-0" CLEARANCE BELOW BOTTOM OF SLAB
4" 45° BEND (TYP)
6" X 4" WYE
3" BV
WAS PUMPS SEE SHEET 25-D-01
PROPOSED ODOROUS CONTROL EQUIPMENT SEE SHEET 30-D-01
4" SCHEDULE 80 PVC ODOR CONTROL LINE
PROPOSED CENTRIFUGE/ SLUDGE DEWATERING BUILDING SEE SHEET 40-D-01
YARD HYDRANT
YARD INLET FR 12.80 IE 11.15
STAIRS TO TOP OF BASIN
4'ø MH FR 13.10 IE IN 3.56 (N) IE IN 4.25 (S) IE IN 4.45 (W) IE OUT 3.56
4" FD TOP 13.0 IE 11.03
4" FD IE 6.29
2" SCHED 80 PVC
4" X 2" WYE IE 6.21
4" 45° BEND
10" C900 PVC (TYP)
10" 45° BEND, RJ (TYP)
14" X 10" REDUCER, RJ
14" 45° BEND, RJ
14" X 10" WYE, RJ
10" PLUG VALVE, RJ (TYP)
4" SDR 26 PVC
4" SDR 26 PVC @ 0.4%
PROPOSED INFLUENT SCREENS
8" C900 PVC INFLUENT
8" 45° BENDS, RJ
IE 3.41
IE 6.19
6" 45° BEND, RJ
6" SDR 26 PVC
PROPOSED ODOROUS CONTROL EQUIPMENT SEE SHEET 30-D-01
6" WYE IE 8.35
8" FLOW METER IN CONC VAULT TOP EL 12.87
8" X 6" WYE, RJ
6" 45° BENDS, RJ
PROPOSED PLANT DRAIN PUMP STATION SEE SHEET 15-D-01
1" SCHED 80 PVC SODIUM HYPOCHLORITE SOLUTION LINE
6" PLUG IE 8.35
6" PLUG IE 8.35
2" PVC WL
10" SDR 26 PVC
12" X 10" WYE ? IE 4.32
2" SCHED 80 PVC DRAIN
6" PLUG VALVE, RJ
8" CHECK VALVE WITH COMPOSITE SAMPLER IN 5'ø MH FR 12.50
6" CHECK VALVE IN 4'ø MH FR 12.50 SEE DETAIL 13/05-C-13
6" PLUG IE 5.50
6" CLEAN OUT IE 8.40
6" FD TOP EL 13.40 IE 8.40
YARD HYDRANT
10" 45° BEND
TOP 13.00 IE 11.50
6" PLUG VALVE, RJ
PROPOSED CHLORINE CONTACT CHAMBER SEE SHEET 36-D-01
PROPOSED GENERATOR SEE ELECTRICAL DRAWINGS
2" GATE VALVE
3" GATE VALVE W/ PLUG
10" FD TOP 13.00 IE 11.53
14" C900 PVC
12" SDR 26 PVC @ 0.4%
8" C905 PVC INFLUENT
DASHED ITEMS TO BE CONSTRUCTED DURING FUTURE PHASES
10" PLUGS, RJ
10" PLUG VALVE, RJ (TYP)
14" 45° BEND, RJ
6" PLUG VALVE
12" X 6" WYE IE 4.47
14" 45° BEND, RJ
14" C900 PVC
14" C900 PVC TO EFFLUENT POND
6" PLUG IE 4.82
10" 45° BEND, RJ (TYP)
14" X 10" WYE, RJ (TYP)
6" 45° BEND
6" SDR 26 PVC
6" PLUG IE 4.90
6" SDR 26 PVC
14" C900 PVC
4'ø MH FR 12.10 IE 4.50
14" 45° BEND, RJ
FUTURE CHLORINE CONTACT CHAMBER
SODIUM HYPOCHLORITE INJECTION MANHOLE FR 13.0 SEE DETAIL 11/05-C-13
IE 8.10
63 LF 12" RCP CLASS III @ 0.4%
SITE LIGHT (TYP)
8" 45° BEND, RJ
8" 45° BEND, RJ
GRATE INLET CATCH BASIN FR 10.70 IIE 8.35
65 LF 12" RCP CLASS III @ 0.4%
GRATE INLET CATCH BASIN FR 10.70 IIE 8.61
MATCH LINE – SEE SHEET NO. 06-C-03

NOTES:

1. PROVIDE PERFORATED 6" HDPE WRAPPED IN A FILTER SOCK AND BEDDED IN #57 STONE (GRANITE) 2' WIDE BY A MIN OF 1.5' DEEP. COMPLETELY WRAP TRENCH (MIRAFI 140N OR EQUIVALENT.
2. ALL CLEANOUTS AND MANHOLE COVERS SHALL BE WATERTIGHT.
3. PIPES UNDER STRUCTURES SHALL BE DIP UNLESS OTHERWISE NOTED AND SHALL BE ENCASED IN CONCRETE.

GRAPHIC SCALE
10 0 5 10 20 40
(IN FEET)
1 inch = 10 ft.

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 03293 MARK F. YORK

SOUTH CAROLINA PROFESSIONAL ENGINEER No. C00285 THOMAS & HUTTON ENGINEERING CERTIFICATE OF AUTHORIZATION

NO.	REVISIONS	BY	DATE
2	BID ADDENDUM #1 COMMENTS	MFY	3/7/16
1	GENERAL REVISIONS	MFY	12/2/15

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KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA
KIAWAH RIVER PLANTATION WWTP
PIPING PLAN - WWTP

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1" = 10'

06-C-02

EXISTING DIRT ROAD
OUTFALL GRASSED AREA
72 LF 24" CLASS IV RCP ● 0.2% IE 6.51
8" PLUG TIE TO WATER SUPPLY LINE
30'R
EL 9.80
TURF REINFORCEMENT MAT
EL 9.50
TP 11.20
TP 11.50
TP 10.70
8" C900 PVC WATER LINE
20' SLIDE GATE
200' R
PROPOSED ACCESS DRIVE
IE 6.65
TP 10.85
TP 11.50
121 LF 24" RCP CLASS III ● 0.17%
IE 4.00
STORM WATER DETENTION POND TOP EL 10.0
BOT EL 0.0
POND 1
WSE 7.0
IE 4.50
36 LF 15" RCP CLASS IIII ● 9.72%
IE 8.00
6' BLACK VINYL COATED FENCE
PROPOSED TRANSFORMER
IE 8.1
FG 13.20
TP 11.65
63 LF 12" CLASS III RCP ● 0.4%
GRATE INLET CATCH BASIN FR 10.70 IE 8.35
65 LF 12" CLASS III RCP ● 0.4%
GRATE INLET CATCH BASIN FR 10.70 IE 8.61
HP 11.00
30' R
PROPOSED 18' WIDE ALL WEATHER ACCESS ROAD
POND 2
STORM WATER DETENTION POND TOP EL 10.0
BOT EL 0.0
IE 3.8
WSE 7.5
IE 5.5
IE 5.0
IE 9.5
40 LF 12" HDPE ● 10.0%
30 LF 24" CLASS III RCP ● 0.6%
50LF 24" CLASS III RCP ● 0.6%
52 LF 24" CLASS III RCP ● 0.6%
40 LF 24" CLASS III RCP ● 0.6%
GRATE INLET CATCH BASIN FR 13.00 IE 5.42 IE 10.3 (S)
GRATE INLET CATCH BASIN FR 13.70 IE IN 5.24 IE OUT 5.24
GRATE INLET CATCH BASIN FR 13.50 IE 5.72
CONCRETE BUBBLER SYSTEM IE 6.03 SEE DETAIL II/05-C-II
RIP RAP AT DISCHARGE OF BUBBLER SYSTEM
MATCH LINE – SEE SHEET NO. 06-C-02
MATCH LINE SEE SHEET NO. 06-C-02
TP 12.30
TP 12.75
TP 12.80
TP 12.34
TP 12.00
TP 12.85
TP 11.95
TP 13.82
TP 13.95
TP 13.74
TP 13.70
TP 13.60
TP 13.50
TP 12.10
TP 12.50
TP 11.40
TP 11.77
TP 11.35
TP 11.25
TP 12.25
TP 12.45
TP 12.21
TC 13.35
TC 13.95
TC 13.98
TC 13.90
TC 13.78
TC 13.60
TC 13.40
TC 13.80
TC 13.62
TC 13.70
TC 13.25
TC 13.10
TC 13.00
TC 12.87
TC 13.04
TC 12.88
TC 12.70
TC 12.33
TC 12.22
TC 12.00
FG 13.10
FG 12.3
FG 13.3
FG 13.1
FG 14.0
FG 12.43
FG 12.0
FR 13.90
FR 13.40
FR 13.10
FR 12.50
FR 12.10
FFE 14.00
40 LF 12" CLASS IV RCP ● 0.5%
33 LF 6" HDPE ● 1.96%
YARD INLET CATCH BASIN FR 13.40 IE 11.00 (IN) IE 10.50 (OUT)
YARD INLET CATCH BASIN FR 13.00 IE 11.15
PROPOSED GENERATOR
8" C900 PVC INFLUENT
PROPOSED 24' SLIDE GATE (MANUAL)
CONTRACTOR SHALL SET EQUIPMENT PAD ON SLAB WITH 1% SLOPE TO DRAIN AND A MIN OF 4" ABOVIE PAD
8"FM
8" PLUG, RJ
TAPER FROM EXISTING ROAD WIDTH TO 18'

GRAPHIC SCALE
20 0 10 20 40 80
(IN FEET)
1 inch = 20 ft.

STRUCTURE LEGEND

MARK	DESCRIPTION
1	PROPOSED CENTRIFUGE/SLUDGE DEWATERING BUILDING
2	PROPOSED ODOROUS CONTROL EQUIPMENT
3	PROPOSED ODOROUS CONTROL EQUIPMENT
4	PROPOSED PLANT DRAIN PUMP STATION
5	PROPOSED CHLORINE CONTACT CHAMBER
6	FUTURE CHLORINE CONTACT CHAMBER
7	PROPOSED INFLUENT SCREENS
8	PROPOSED TREATMENT PROCESS
9	PROPOSED 2-STORY OPERATIONS BUILDING
10	PROPOSED 8" FLOW METER IN CONCRETE VAULT

SOUTH CAROLINA PROFESSIONAL ENGINEER No. 13293 REGISTERED MARK F. YONCE

SOUTH CAROLINA THOMAS & HUTTON ENGINEERING No. COA285 CERTIFICATE OF AUTHORIZATION

NO.	REVISIONS	BY	DATE
2	BID ADDENDUM #1 COMMENTS	MFY	3/7/16
1	GENERAL REVISIONS	MFY	12/2/15

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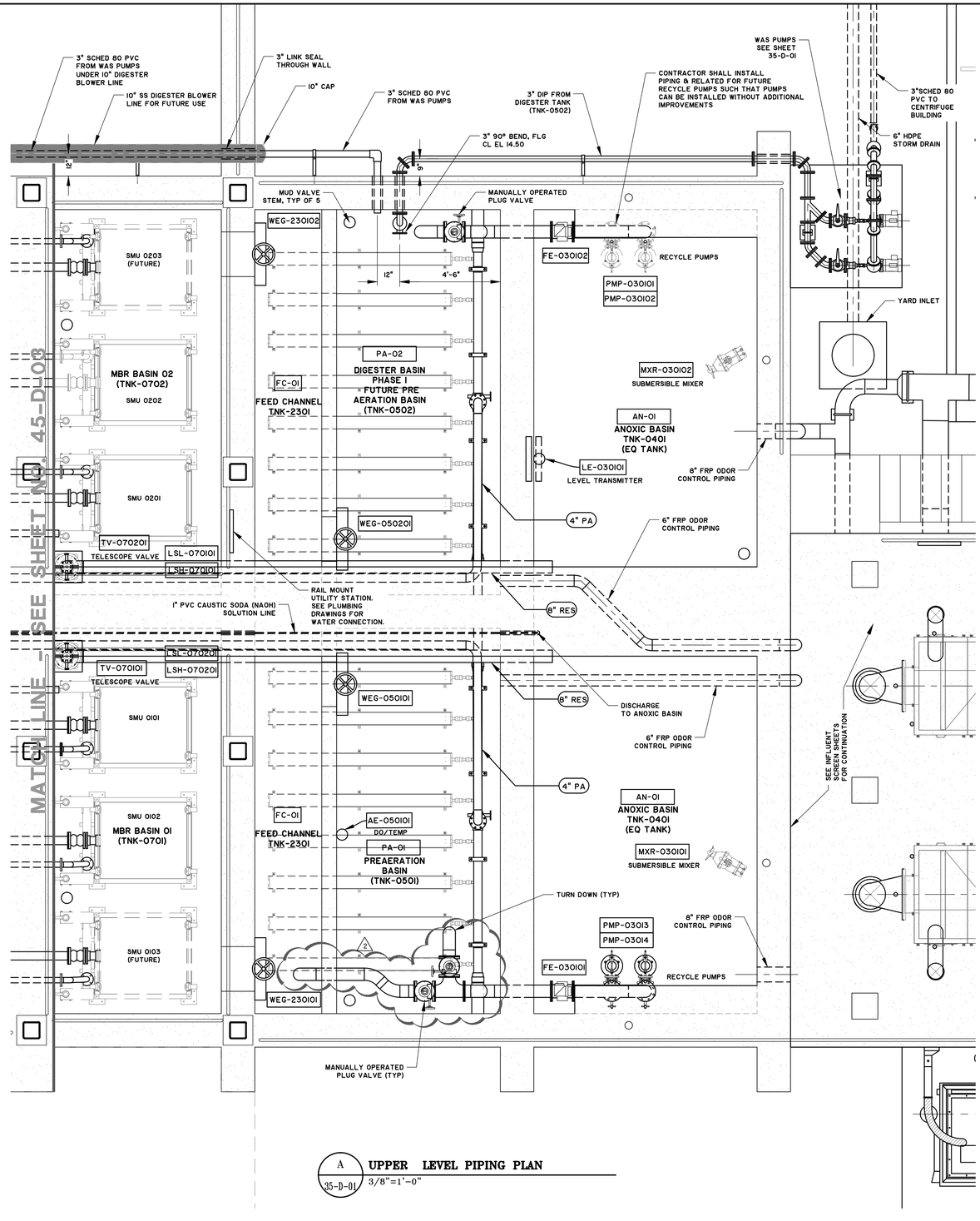
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

PAVING GRADING & DRAINAGE PLAN - WWTP

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	KEN
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	1" = 20'

06-C-03



A / 35-D-01 **UPPER LEVEL PIPING PLAN**
3/8"=1'-0"

NOTES:

1. CONTRACTOR SHALL COORDINATE LOCATIONS OF LEVEL SWITCHES IN MBR BASINS 01 AND 02 WITH OVIVO.
2. CONTRACTOR SHALL COORDINATE RAILINGS AND GATE PENETRATIONS IN GRATING/COVERS FOR THE SLIDE GATES.
3. CONTRACTOR SHALL SEAL OPENINGS AROUND SLIDE GATES AND OTHER OPENINGS WITH ALUMINUM PLATES.
4. CONTRACTOR SHALL PROVIDE SUPPORTS AND BRACING TO SUPPORT EQUIPMENT.

SOUTH CAROLINA — THOMAS & HUTTON ENGINEERING CO. No. C00285 — CERTIFICATE OF AUTHORITY

SOUTH CAROLINA — REGISTERED PROFESSIONAL ENGINEER — No. 13293 — MARK F. YORK

NO.	REVISIONS	BY	DATE
2	BID ADDENDUM #1 COMMENTS	MFY	3/7/16
1	GENERAL REVISIONS	MFY	12/2/15

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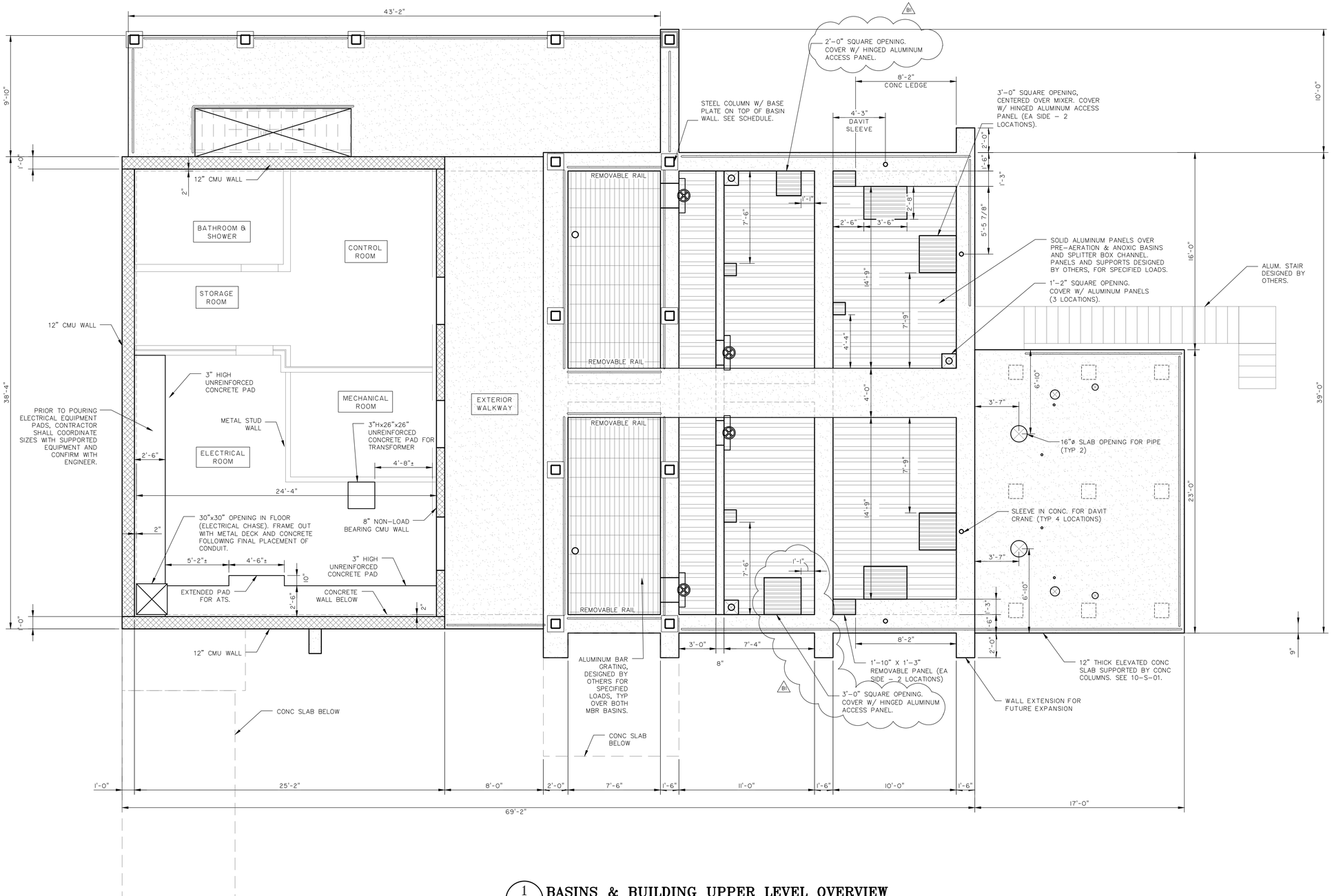
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA

KIAWAH RIVER PLANTATION WWTP

TREATMENT BASINS UPPER LEVEL - PLAN

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	MFY
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	3/8"=1'-0"

35-D-02



1 BASINS & BUILDING UPPER LEVEL OVERVIEW

35-S-04 SCALE: 1/4" = 1'-0"

SOUTH CAROLINA PROFESSIONAL ENGINEER — THOMAS A. HUTTON — No. 24727 — LICENSED

SOUTH CAROLINA — NOLTE ASSOCIATES — THOMAS & HUTTON ENGINEERING Co. — No. C00285 — CERTIFICATE OF AUTHORIZATION

NO.	REVISIONS	BY	DATE
BI	BID ADDENDUM 1	JAH	3/3/16

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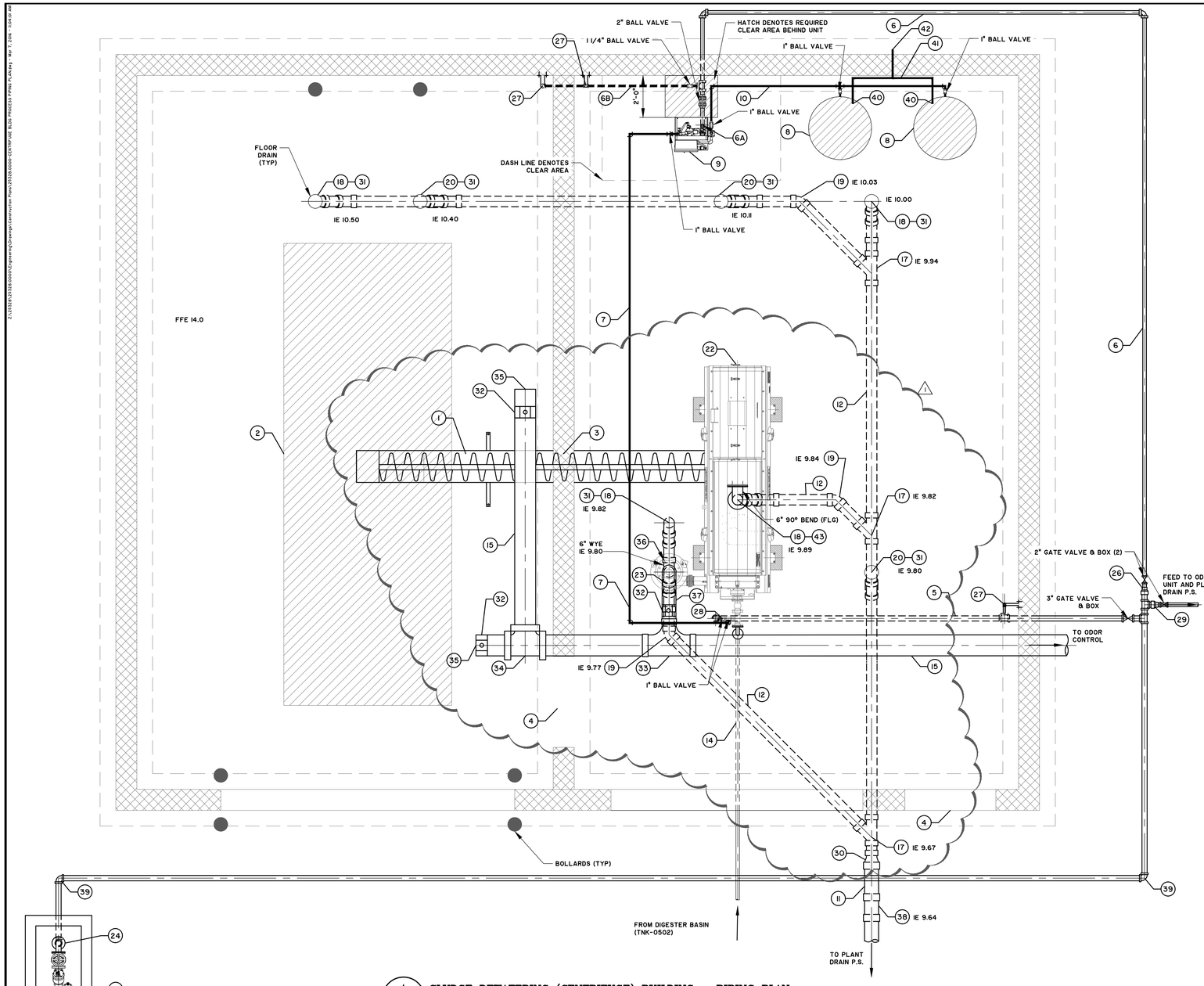
CHARLESTON COUNTY, SOUTH CAROLINA

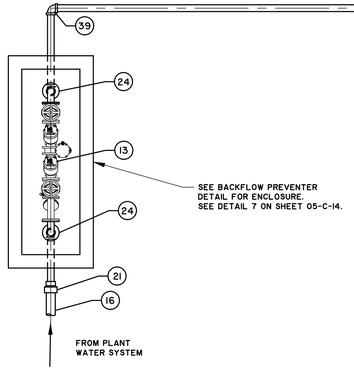
KIAWAH RIVER PLANTATION WWTP

BASINS & BLDG UPPER LEVEL OVERVIEW

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	JAH/SHG
DESIGNED:	JAH/EAC
REVIEWED:	JAH/SHG
APPROVED:	MFY
SCALE:	AS NOTED

35-S-04





A
40-D-01
SLUDGE DEWATERING (CENTRIFUGE) BUILDING – PIPING PLAN
3/8"=1'-0"

NOTES:

1. FOR EXTERIOR BUILDING DOORS SEE ARCHITECTURAL SHEETS.
2. SLOPE FLOOR SLAB TO FLOOR DRAINS.
3. ALL FLOORS SHALL HAVE PROTECTIVE COATING (ANTI-SLIP).
4. ALL VENTS TO BE OUTSIDE OF BUILDING AND ALL WALL PENETRATIONS SHALL BE SEALED AIR AND WATER TIGHT.
5. ALL PIPING TO BE SCHEDULE 80 PVC UNLESS OTHERWISE NOTED
6. ALL PIPING AND EQUIPMENT SHALL BE ATTACHED TO WALLS AND OTHER STRUCTURES USING FIBERGLASS REINFORCEMENT PLASTIC (FRP) HANGERS AND SUPPORTS. BRACKETS SHALL CONFORM TO AND FIT DIRECTLY AROUND THE OUTSIDE DIAMETER OF PIPE BEING SUPPORTED. NO CARBONS STEEL SHALL BE USED.
7. SPACING OF PIPE SUPPORTS AND BRACKETS SHALL BE A MINIMUM OF 4 FEET ABD MAXIMUM OF 8 FEET.
8. ADDITIONAL HANGERS AND SUPPORTS SHALL BE INSTALLED AS NEEDED SO THERE ARE NO MOVEMENTS OR VISIBLE SAGGING BETWEEN SUPPORTS.
9. SUBMIT PROPOSED HANGERS AND SUPPORTS TO ENGINEER PRIOR TO INSTALLATION.
10. PROVIDE AND INSTALL NEOPRENE GASKETED OR PAD BETWEEN ALL SURFACES.
11. ALL PIPE TO BE COLOR CODED WITH PROPER LABELING OF FLUID AND FLOW DIRECTION.
12. COAT ALL FLOORS WITH ANTI-SLIP COATING AND RECOMMENDED EPOXY PAINTS. USE EPOXY PAINT COATINGS ON WALLS ALSO.

PIPING AND EQUIPMENT LEGEND

NUMBER	DESCRIPTION	QUANTITY
1	12-INCH (MIN) DISTRIBUTION SHAFTLESS SCREW CONVEYOR - U TROUGH WITH COVER - DOUBLE FORMED FLANGE. INSTALL A MIN 48-INCHES ABOVE WALL OF WASTE BIN. (STAINLESS STEEL 304) CONTRACTOR SHALL VERIFY CLEARANCE REQUIRED TO REMOVE WASTE BIN	1
2	20 OR 12 CUBIC YARD WASTE BIN	1
3	CUT OR PROVIDE WALL OPENING TO CLEAR SCREW CONVEYOR BY 6" ALL THE WAY AROUND. INSTALL RUBBER BOOT AROUND OPENING. HEIGHT TO BE DETERMINED BY EQUIPMENT SELECTED.	1
4	FIBERGLAS DOOR (4' X 8') AND FRAME (TAN) WITH 24" X 24" FIBERGLASS WINDOW KIT W/ S.S. HARDWARE	1
5	3-INCH WATER SUPPLY LINE. CONNECT TO CENTRIFUGE ● 1" NPT WASHWATER CONNNECTION (75 GPM● 40 PSI)	1
6	2-INCH WATER SUPPLY (PVC) TO POLYMER SYSTEM (20 GPM ● 40 PSI)	1
6A	REDUCE AND CONNECT TO 1-INCH FNPT DILUTION WATER INLET. PROVIDE 1" BALL VALVE	1
6B	1 1/4-INCH WATER SUPPLY (PVC) TO HOSE BIBBS	1
7	1-INCH POLYMER FEED LINE (LINE OVERHEAD) - HANG FROM CEILING	1
8	POLYMER DRUMS	2
9	POLYMER FEED SYSTEM - SKID MOUNTED	1
10	1-INCH POLYMER INLET	1
11	8-INCH C-900 DRAIN LINE ● 1.0%	-
12	6-INCH C-900 DRAIN LINE ● 1.0%	-
13	3-INCH REDUCED PRESSURE ASSEMBLY (WATTS SERIES 909RPDA OR EQUIVALENT) IWITH INSULATED FIBERGLASS ENCLOSURE (HOT BOX MODEL # HB3NS OR EQUIVALENT) INSTALLED ON 5-INCH THICK CONCRETE PAD	1
14	3-INCH PVC CENTRIFUGE FEED INLET - REDUCE TO 2-INCH AT CONNECTION TO CENTRIFUGE	1
15	12-INCH FRP VENT LINE - HANG FROM CEILING	1
16	4-INCH PVC POTABLE WATER SUPPLY LINE	1
17	6-INCH WYE	3
18	(2) 6-INCH 45° BENDS AT END OF LINE	3
19	6-INCH 45° BEND	3
20	6-INCH WYE AND 45° BEND AT IN-LINE FLOOR DRAINS	4
21	4-INCH X 3-INCH REDUCER	1
22	CENTRIFUGE D4 SERIES BY ANDRITZ	1
23	6-INCH C-900 UP AND TRANSITION CONNECTION TO 5-INCH FLANGE FOR EFFLUENT OUTLET	1
24	3-INCH 90° BEND - RESTRAINED	2
25	3-INCH TEE	1
26	REDUCE TO 2-INCH PVC LINE PAST TEE	1
27	INSTALL WATER HOSE BIBB (WITH VACUUM BREAKERS) - SEE DETAIL 5/05-C-13	3
28	INSTALL SHUT OFF VALVE WITH FLEXIBLE (REINFORCED) PIPE/TUBING AT CONNECTION TO CENTRIFUGE	1
29	3-INCH X 2-INCH REDUCER	1
30	8-INCH X 6-INCH REDUCER COUPLING	1
31	FLOOR DRAIN WITH TRAP PRIMER	6
32	DAMPER	3
33	12-INCH X 8-INCH TEE	1
34	12-INCH X 12-INCH TEE	1
35	OPEN INTAKE GRILL	2
36	FLEXIBLE CONNECTION AT UNIT	1
37	8-INCH FRP UNIT LINE - HANG FROM CEILING	1
38	22 1/2° BEND TURNED DOWN - DIRECT AND CONNECT TO GRAVITY LINE	1
39	3-INCH 90° BEND	2
40	VENT CONNECTION - 1 1/4 INCH MIN	2
41	1 1/2 INCH PVC VENT	1
42	VENT TO EXTERIOR (1 FOOT BELOW CEILING)	1
43	6" 90° BEND WITH FLG X PVC ADAPTER CONNECTED TO FLANGE OF SCREW CONVEYOR DRAIN	1

SOUTH CAROLINA — THOMAS B HUTTON ENGINEERING No. C00285 — CERTIFICATE OF AUTHORIZATION

SOUTH CAROLINA — REGISTERED PROFESSIONAL ENGINEER — No. 13293 — MARK F. YORK

NO.	REVISIONS	BY	DATE
1	BID ADDENDUM #1 COMMENTS	MFY	3/7/16

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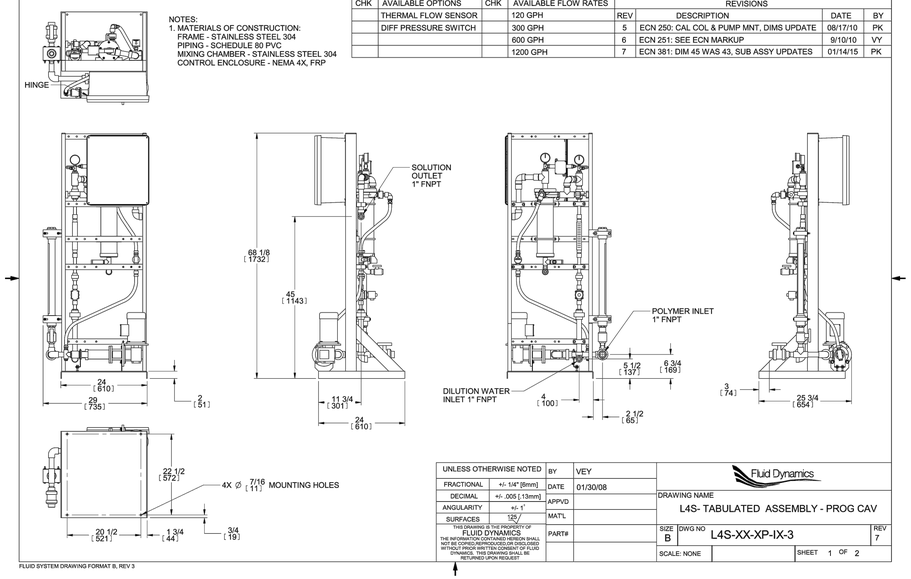
KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA
KIAWAH RIVER PLANTATION WWTP
SLUDGE DEWATERING (CENTRIFUGE) - PIPING PLAN

JOB NO:	J-25328.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	MFY
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	3/8"=1'-0"

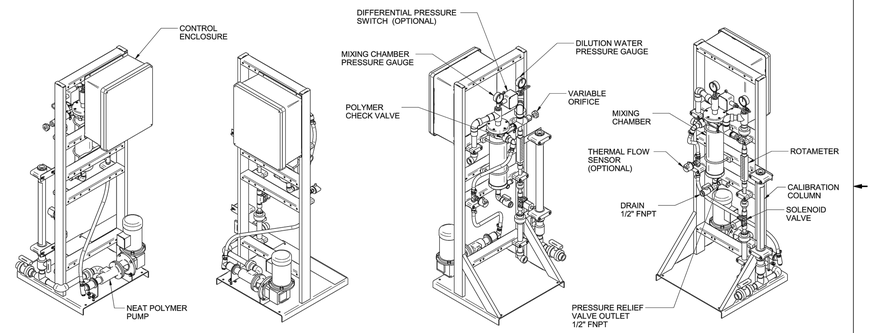
40-D-01



CHK	AVAILABLE OPTIONS	CHK	AVAILABLE FLOW RATES	REV	DESCRIPTION	DATE	BY
	THERMAL FLOW SENSOR		120 GPH	5	ECN 250: CAL COL & PUMP MNT, DIMS UPDATE	08/17/10	PK
	DIFF PRESSURE SWITCH		300 GPH	6	ECN 251: SEE ECN MARKUP	9/10/10	VY
			600 GPH	7	ECN 381: DIM 45 WAS 43, SUB ASSY UPDATES	01/14/15	PK
			1200 GPH				

UNLESS OTHERWISE NOTED	BY	VEY	Fluid Dynamics
FRACTIONAL +/- 1/4" [6mm]	DATE	01/30/08	
DECIMAL +/- .005 [.13mm]	APP'D		DRAWING NAME
ANGULARITY +/- 1°	MAT'L		L4S- TABULATED ASSEMBLY - PROG CAV
SURFACES 125/	PART#		SIZE B DWG NO L4S-XX-XP-IX-3 REV 7
THIS DRAWING IS THE PROPERTY OF FLUID DYNAMICS. THE INFORMATION CONTAINED HEREIN SHALL NOT BE COPIED, REPRODUCED OR DISCLOSED WITHOUT PRIOR WRITTEN CONSENT OF FLUID DYNAMICS. THIS DRAWING SHALL BE RETURNED UPON REQUEST.			SCALE: NONE SHEET 1 OF 2

FLUID SYSTEM DRAWING FORMAT B, REV 3



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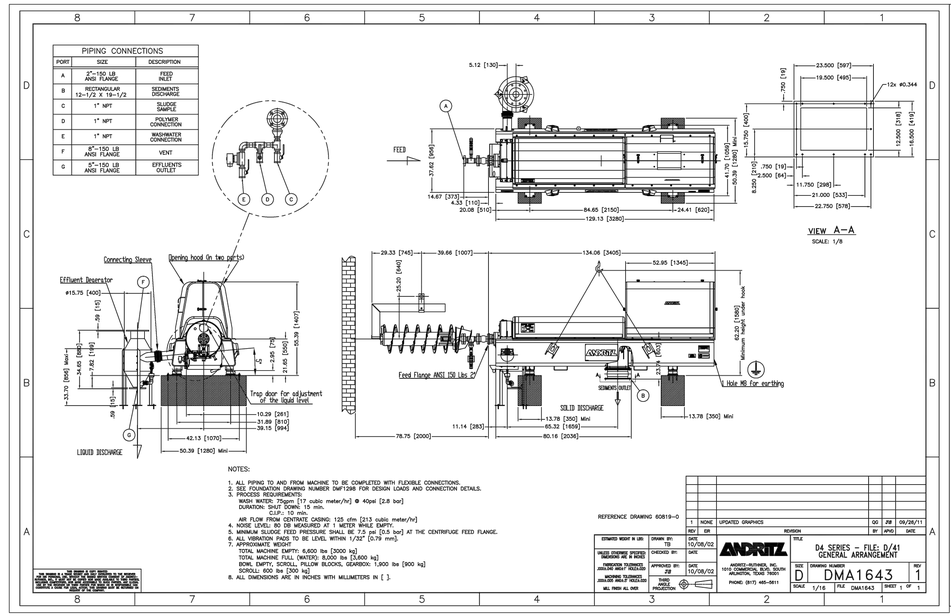
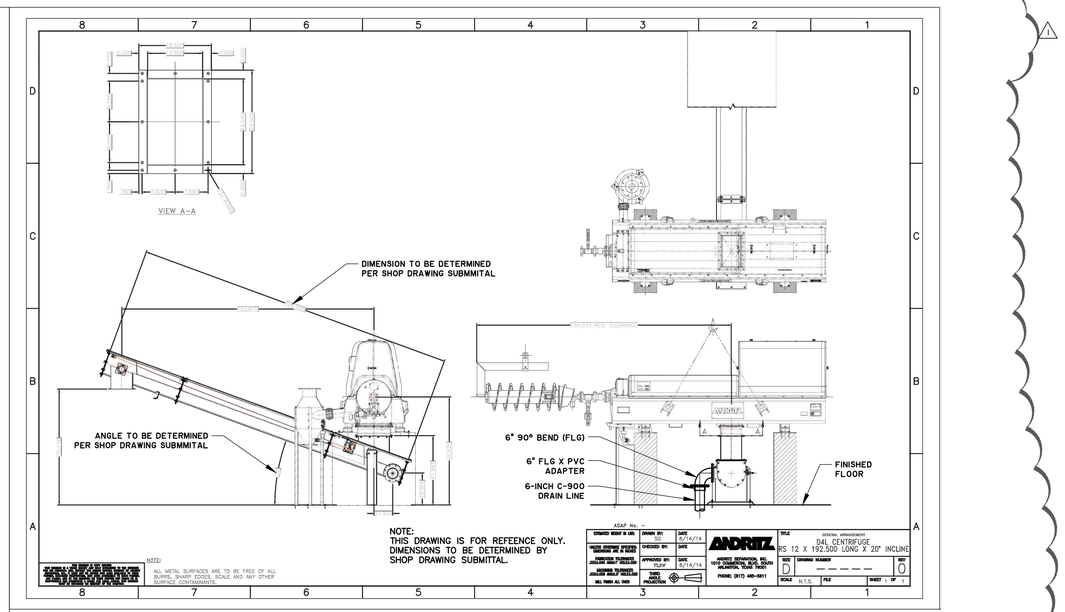
FLUID SYSTEM DRAWING FORMAT B, REV 3





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1	BID ADDENDUM #1 COMMENTS	MFY	3/7/16

KIAWAH RIVER PLANTATION
CHARLESTON COUNTY, SOUTH CAROLINA
KIAWAH RIVER PLANTATION WWTP
SLUDGE DEWATERING (CENTRIFUGE) - MISCELLANEOUS DETAILS

JOB NO:	J-25326.0000
DATE:	12/18/15
DRAWN:	DNF
DESIGNED:	MFY
REVIEWED:	MFY
APPROVED:	MFY
SCALE:	AS NOTED

40-D-02

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION THOMAS & HUTTON ENGINEERING No. C00285

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 19293 MARK F. YORK