

**LEE/HENDRY COUNTY
REGIONAL SOLID WASTE DISPOSAL FACILITY
CELL 2A CLASS III LANDFILL**

**BIDDING AND CONSTRUCTION
CONTRACT DOCUMENTS AND
TECHNICAL SPECIFICATIONS**

Project No. 12345-026-01

Owner:

LEE COUNTY SOLID WASTE DEPARTMENT
10500 Buckingham Road
Fort Myers, Florida 33905

Engineer:

JONES EDMUNDS & ASSOCIATES, INC.
13545 Progress Boulevard, Suite 100
Alachua, Florida 32615

July 2024

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FOR CELL 2A**

**LEE/HENDRY COUNTY
REGIONAL SOLID WASTE DISPOSAL FACILITY
CELL 2A CLASS III LANDFILL
TECHNICAL SPECIFICATIONS
CERTIFICATION PAGES**

**Digitally signed by Tobin McKnight
Date: 2024.07.03 12:40:25-04'00'**

TOBIN S. MCKNIGHT, FLORIDA PROFESSIONAL ENGINEER
LICENSE NO. 69187

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY
TOBIN S. MCKNIGHT, PE, ON THE DATE INDICATED HERE.

PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND
SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC
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JONES EDMUNDS
13545 PROGRESS BOULEVARD, SUITE 100
ALACHUA, FLORIDA 32615
E.O.R.: TOBIN S. MCKNIGHT, III, PE, NO. 69187

THE ABOVE NAMED PROFESSIONAL ENGINEER SHALL BE RESPONSIBLE FOR
THE FOLLOWING DIVISIONS IN ACCORDANCE WITH RULE 61G15-23.004, FAC:
DIVISIONS 0, 1, 2, 9, 11, AND 15.

**LEE/HENDRY COUNTY
REGIONAL SOLID WASTE DISPOSAL FACILITY
CELL 2A CLASS III LANDFILL
TECHNICAL SPECIFICATIONS
CERTIFICATION PAGES**

Michael Clark Digitally signed by Michael
Clark
Date: 2024.07.03 12:28:34
-04'00'

MICHAEL L. CLARK, FLORIDA PROFESSIONAL ENGINEER
LICENSE NO. 48898

THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY
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JONES EDMUNDS
3910 S. WASHINGTON AVENUE, SUITE 210
TITUSVILLE, FLORIDA 32780
E.O.R.: MICHAEL L. CLARK, PE, NO. 48898

THE ABOVE NAMED PROFESSIONAL ENGINEER SHALL BE RESPONSIBLE FOR
THE FOLLOWING DIVISION IN ACCORDANCE WITH RULE 61G15-23.004, FAC:
DIVISIONS 13 AND 16.

DIVISION 1

GENERAL REQUIREMENTS

SECTION 01000
PROJECT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

- A. Owner – The term “Owner” when used in the Technical Specifications refers to the entity with whom the Contractor has entered into the Agreement for this project and for whom the Work is to be performed. The term “Owner” also encompasses representatives of the Owner including the Engineer.

1.02 SCOPE OF WORK

- A. The Work to be done consists of the furnishing of all labor, materials, and equipment and the performance of all Work included in this Contract. The summary of the Work is presented in Section 01100, Summary of Work.
- B. Work Included
1. The Contractor shall furnish all labor, superintendence, materials, plant power, light, heat, fuel, water, tools, appliances, equipment, supplies, and means of construction necessary for proper performance and completion of the Work. The Contractor shall obtain and pay for all necessary local building permits. The Contractor shall perform and complete the Work in the manner best calculated to promote rapid construction consistent with safety of life and property and to the satisfaction of the Owner and in strict accordance with the Contract Documents. The Contractor shall clean up the Work and maintain it during and after construction, until accepted, and shall do all Work and pay all costs incidental thereto. The Contractor shall repair or restore all structures and property that may be damaged or disturbed during performance of the Work.
 2. The cost of incidental work described in these Project Requirements for which there are no specific Contract Items shall be considered as part of the general cost of doing the Work and shall be included in the prices for the various Contract Items. No additional payment will be made therefor.
 3. The Contractor shall provide and maintain such modern plant, tools, and equipment as may be necessary, in the opinion of the Owner, to perform in a satisfactory and acceptable manner all the Work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his workmanship, materials, and equipment, prior approval of the Owner notwithstanding.

C. Public Utility Installations and Structures

1. Public utility installations and structures shall be understood to include all poles, tracks, pipes, wires, conduits, vaults, manholes, and all other appurtenances and facilities pertaining thereto whether owned or controlled by the Owner, other governmental bodies, or privately owned by individuals, firms, or corporations used to serve the public with transportation, traffic control, gas, electricity, telephone, sewerage, drainage, water, or other public or private property which may be affected by the Work shall be deemed included hereunder.
 - a. The Contract Documents contain data relative to existing public utility installations and structures above and below the ground surface. These data are not guaranteed as to their completeness or accuracy and it is the responsibility of the Contractor to make his own investigations to inform himself fully of the character, condition, and extent of all such installations and structures as may be encountered and as may affect the construction operations.
 - b. The Contractor shall protect all public utility installations and structures from damage during the Work. Access across any buried public utility installation or structure shall be made to avoid any damage to these facilities. All required protective devices and construction shall be provided by the Contractor at his expense. All existing public utilities damaged by the Contractor shall be repaired by the Contractor, at his expense. No separate payment shall be made for such protection or repairs to public utility installations or structures.
 - c. Public utility installations or structures owned or controlled by the Owner or other governmental body which are shown on the Drawings to be removed, relocated, replaced, or rebuilt by the Contractor shall be considered as a part of the general cost of doing the Work and shall be included in the prices bid for the various Contract Items. No separate payment shall be made therefor.
 - d. Where public utility installations or structures owned or controlled by the Owner or other governmental body are encountered during the Work and are not indicated on the Drawings or in the Specifications, and when, in the opinion of the Owner, removal, relocation, replacement, or rebuilding is necessary to complete the Work under this Contract, such Work shall be accomplished by the utility having jurisdiction, or such Work may be ordered, in writing by the Owner, for the Contractor to accomplish. If such work is accomplished by the utility having jurisdiction it will be carried out expeditiously, and the Contractor shall give full cooperation to

permit the utility to complete the removal, relocation, replacement, or rebuilding as required. If such work is accomplished by the Contractor, it will be paid for as extra work as provided in the Agreement.

- e. At all times in performance of the Work the Contractor shall employ acceptable methods and exercise reasonable care and skill so as to avoid unnecessary delay, injury, damage, or destruction of public utility installations and structures and shall at all times in the performance of the Work avoid unnecessary interference with or interruption of public utility services and cooperate fully with the owners thereof to that end.
- f. The Contractor shall give written notice to the Owner and other governmental utility departments and other owners of public utilities of the location of his proposed construction operations at least 48 hours in advance of breaking ground in any area or on any unit of the Work.
- g. The maintenance, repair, removal, relocation, or rebuilding of public utility installations and structures, when accomplished by the Contractor as herein provided, shall be done by methods approved by the owners of such utilities.

1.03 WORK SEQUENCE

- A. The Contractor shall sequence work to accommodate the operations of the facility and construction at the facility. Specifically, the Contractor shall:
 - 1. Order materials and equipment with long lead times within 14 days of receiving an approved submittal. Materials and equipment include geosynthetics and mechanical equipment.
 - 2. The Contractor shall coordinate deliveries of materials and equipment with the Owner to minimally impact facility operations and traffic.
 - 3. The Contractor shall perform a preconstruction topographic survey of the limits of construction and the proposed borrow area. The survey shall be performed by a Florida-licensed Professional Surveyor and Mapper and shall be signed and sealed.
 - 4. Dewatering (also refer to Section 02240, Dewatering):
 - a. The Dewatering Plan development and approval shall be the top priority on receiving the Notice to Proceed to allow for the Engineer's review and approval.
 - b. Submit the Dewatering Plan within 30 days of Notice to Proceed.

5. Stormwater Diversion Berm:
 - a. The Contractor shall construct the stormwater diversion berm in accordance with the Drawings and Specifications including all earthwork and geomembrane installation before beginning bottom-liner installation within Cell 2A.
6. Follow the Excavation and Fill Plan submitted in accordance with Section 02301, Earthwork for Landfill Construction, Article 1.02.A.1, to minimize double-handling and import of soil.
7. Cover the geosynthetic clay liner (GCL) with geomembrane as the GCL installation proceeds.
8. Complete protective soil installation within the limits of the areas being dewatered before dewatering is ceased and the dewatering system is decommissioned.

1.04 DRAWINGS AND PROJECT MANUAL

- A. Drawings: When obtaining data and information from the Drawings, figures shall be used in preference to scaled dimensions and large-scale drawings in preference to small-scale drawings.
- B. Supplementary Drawings
 1. When, in the opinion of the Owner, it becomes necessary to explain more fully the Work to be done or to illustrate the Work further or to show any changes that may be required, the Owner will prepare drawings known as Supplementary Drawings, with specifications pertaining to such Drawings, and the Contractor will be furnished one complete set of reproducible black-line prints (22 inches by 34 inches) and one reproducible copy of the specifications, or alternatively may be provided electronic files in PDF format, at the Contractor's option.
 2. The Supplementary Drawings shall be binding upon the Contractor with the same force as the Contract Drawings. Where such Supplementary Drawings require either less or more than the estimated quantities of Work, credit to the Owner or compensation therefor to the Contractor shall be subject to the terms of the Agreement.

C. Contractor to Check Drawings and Data

1. The Contractor shall verify all dimensions, quantities, and details shown on the Drawings, Supplementary Drawings, Schedules, Specifications, or other data received from the Owner, and shall notify the Owner of all errors, omissions, conflicts, and discrepancies found therein. Failure to discover or correct errors, conflicts, or discrepancies shall not relieve the Contractor of full responsibility for unsatisfactory work, faulty construction, or improper operation resulting therefrom, nor from rectifying such conditions at his own expense. He will not be allowed to take advantage of any errors or omissions, as full instructions will be furnished by the Owner should such errors or omissions be discovered.
2. All schedules are given for the convenience of the Owner and the Contractor and are not guaranteed to be complete. The Contractor shall assume all responsibility for making estimates of the size, kind, and quantity of materials and equipment included in the Work to be done under the Contract.

D. Specifications: The Technical Specifications each consist of three parts: General, Products, and Execution. The General part of a Specification contains General Requirements that govern the Work. The Products and Execution parts modify and supplement the General Requirements by detailed requirements for the Work and shall always govern whenever there appears to be a conflict.

E. Intent

1. All Work called for in the Specifications applicable to this Contract, but not shown on the Drawings in their present form, or vice versa, shall be of like effect as if shown or mentioned in both. Work not specified in either the Drawings or in the Specifications but involved in carrying out their intent or in the complete and proper execution of the Work is required and shall be performed by the Contractor as though it were specifically delineated or described.
2. The apparent silence of the Specifications as to any detail or the apparent omission from them of a detailed description concerning any work to be done and materials to be furnished shall be regarded as meaning that only the best general practice is to prevail and that only material and workmanship of the best quality is to be used. The interpretation of these Specifications shall be made upon that basis.

1.05 MATERIALS AND EQUIPMENT

A. Manufacturer

1. All transactions with the manufacturers or subcontractors shall be through the Contractor unless the Contractor shall request and at the Owner's option that the manufacturer or subcontractor deal directly with the Owner. Any such transactions shall not in any way release the Contractor from his full responsibility under this Contract.
2. Any two or more pieces of material or equipment of the same kind, type, or classification, and being used for identical types of service, shall be made by the same manufacturer.

B. Delivery

1. The Contractor shall deliver materials in ample quantities to ensure the most speedy and uninterrupted progress of the Work to complete the Work within the allotted time.
2. The Contractor shall also coordinate deliveries to avoid delay in or impediment of the progress of the work of any related Contractor.

C. Tools and Accessories

1. Unless otherwise stated in the Contract Documents, the Contractor shall furnish each type, kind, or size of equipment one complete set of suitably marked high-grade special tools and appliances that may be needed to adjust, operate, maintain, or repair the equipment. Such tools and appliances shall be furnished in approved painted-steel cases, properly labeled, and equipped with good-grade cylinder locks and duplicate keys.
2. Spare parts shall be furnished as specified herein and as recommended by the manufacturer necessary for the operation of the equipment, not including materials required for routine maintenance.
3. Each piece of equipment shall be provided with a substantial nameplate, securely fastened in place, and clearly inscribed with the manufacturer's name, year of manufacture, serial number, weight, and principal rate data.

D. Service of Manufacturer's Engineer

1. The Contract Prices for equipment shall include the cost of furnishing a competent and experienced engineer or superintendent who shall represent the manufacturer and shall help the Contractor, when required, install, adjust, test, and place in operation the equipment in conformity with the Contract Documents.

2. After the equipment is placed in permanent operation by the Contractor, the manufacturer's engineer or superintendent shall make all adjustments and tests required by the Owner to prove that the equipment is in proper and satisfactory operating condition and shall instruct such personnel as may be designated by the Owner in the proper operation and maintenance of such equipment.

1.06 INSPECTION AND TESTING

A. General

1. For tests specified to be made by the Contractor, the testing personnel shall make the necessary inspections and tests, and the reports thereof shall be in such form as will facilitate checking to determine compliance with the Contract Documents. Reports shall be submitted and authoritative certification thereof must be furnished to the Owner as a prerequisite for the acceptance of any material or equipment.
2. If, in the making of any test of any material or equipment, the Owner ascertains that the material or equipment does not comply with the Contract Documents, the Contractor will be notified thereof and he will be directed to refrain from delivering said material or equipment, or to remove it promptly from the site or from the Work and replace it with acceptable material without cost to the Owner.
3. Tests of electrical and mechanical equipment and appliances shall be conducted in accordance with the recognized test codes of the ANSI, ASME, or the IEEE, except as may otherwise be stated herein.
4. The Contractor shall be fully responsible for the proper operation of equipment during testing and instruction periods and shall neither have nor make any claim for damage that may occur to the equipment before the time when the Owner formally takes over the operation thereof.

B. Costs

1. The Contractor shall provide all inspection and testing of materials furnished under this Contract, unless otherwise expressly specified.
2. The Contractor shall bear the cost of shop and field tests of equipment and of certain other tests specifically called for in the Contract Documents, and such costs shall be deemed to be included in the Contract Price.
3. The Owner may test materials and equipment submitted by the Contractor as the equivalent to those specifically named in the Contract for compliance. The Contractor shall reimburse the Owner for the expenditures incurred in making such tests of materials and equipment that are rejected for non-compliance.

C. Certificate of Manufacture

1. The Contractor shall furnish the Owner with authoritative evidence in the form of a certificate of manufacture that the materials to be used in the Work have been manufactured and tested in conformity with the Contract Documents.
2. These certificates shall be notarized and shall include copies of the results of physical tests and chemical analyses, where necessary, that have been made directly on the product or on similar products of the manufacturer.

D. Shop Tests

1. Each piece of equipment for which pressure, duty, capacity, rating, efficiency, performance, function, or special requirements are specified shall be tested in the shop of the maker in a manner that shall conclusively prove that its characteristics comply fully with the requirements of the Contract Documents.
2. Manufacturer's actual test data and interpreted results thereof, accompanied by a certificate of authenticity sworn to by a responsible official of the manufacturing company and/or independent laboratory, shall be submitted to the Owner for approval.
3. The Contractor shall bear the cost of shop tests and of furnishing manufacturer's preliminary and shop test data of operating equipment.

E. Start-up Tests

1. As soon as conditions permit, the Contractor shall furnish all labor, materials, and instruments and shall make start-up tests of equipment.
2. If the start-up tests disclose any equipment furnished under this Contract that does not comply with the requirements of the Contract Documents, the Contractor shall, before demonstration tests, make all changes, adjustments, and replacements required. The furnishing Contractor shall assist in the start-up tests as applicable.

F. Demonstration Tests

1. Before the Contractor's request for a Substantial Completion inspection, all equipment and piping installed under this Contract shall be subjected to demonstration tests as specified or required to prove compliance with the Contract Documents.
2. The Contractor shall furnish labor, fuel, energy, water, and all other materials, equipment, and instruments necessary for all demonstration tests at no additional cost to the Owner. The Contractor shall assist in the demonstration tests as applicable.

1.07 LINES AND GRADES

A. Grade

1. All Work under this Contract shall be constructed in accordance with the lines and grades shown on the Drawings or as given by the Owner. The full responsibility for keeping alignment and grade shall rest upon the Contractor.
2. The Contractor will establish benchmarks and coordination points using Surveys, where provided in the Contract Drawings. Where not provided in the Contract Drawings, the benchmarks and coordination points will be established by the Contractor at no additional cost to the Owner. Reference marks for lines and grades as the Work progresses will be located by the Contractor to cause as little inconvenience to the prosecution of the Work as possible. The Contractor shall place excavation and other materials so as to cause no inconvenience in the use of the reference marks provided. He shall remove any obstructions he places contrary to this provision.

B. Surveys

1. At his own expense, the Contractor shall furnish and maintain stakes and other such materials.
2. The Contractor shall check such reference marks by such means as he may deem necessary and, before using them, shall call the Owner's attention to any inaccuracies.
3. At his own expense, the Contractor shall establish all working or construction lines and grades as required from the reference marks set by the Contractor and shall be solely responsible for the accuracy of these lines and grades. He shall, however, be subject to check and review by the Owner.

C. Safeguarding Marks

1. The Contractor shall safeguard all points, stakes, grade marks, monuments, and benchmarks made or established on the Work; bear the cost of re-establishing them if disturbed; and bear the entire expense of rectifying Work improperly installed due to not maintaining or protecting or removing without authorization such established points, stakes, and marks.
2. The Contractor shall safeguard all existing and known property corners, monuments, and marks adjacent to but not related to the Work and shall bear the cost of re-establishing them if they are disturbed or destroyed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01100 SUMMARY OF WORK

PART 1 GENERAL

1.01 SCOPE OF WORK

Unless otherwise expressly provided in the Contract Documents, the Work must be performed in accordance with best modern practice, with materials and workmanship of the highest quality to the satisfaction of the Engineer.

- A. The Project title is Lee/Hendry County Regional Solid Waste Disposal Facility Cell 2A Class III Landfill.
- B. The principal Work of this Project is the following:
 - 1. To install an approximately 9.5-acre single-liner system for the Class III Cell 2A Construction project, including ancillary work associated with the cell construction. The Contractor shall be responsible for providing all materials, equipment, and labor for performing all work necessary and as required by the Contract Documents. The principal features of the project include performing earthwork; installing a geosynthetic bottom-liner system consisting of geomembrane, geosynthetic clay liner (GCL), geocomposite, drainage cover soil, and leachate collection and removal system; dewatering; installing a groundwater monitoring well; excavating borrow for landfill construction and operations, and performing ancillary work associated with the landfill cell.
- C. The Specification divisions and Drawings are an integrated part of the Contract Documents and, as such, will not stand alone if used independently as individual sections, divisions, or drawing sheets. The Drawings and Specifications establish minimum standards of quality for this project. They do not purport to cover all details entering into the design and construction of materials and equipment.
- D. The Project is in Lee County, Florida, at the Lee/Hendry County Regional Solid Waste Disposal Facility. The Contractor shall be aware of the nature of the activities at a landfill that may restrict access to the portions of the site due to general landfill operations and may require certain health and safety measures during construction. The Contractor shall coordinate with the Engineer to determine when certain areas of the site may be unavailable for work.

- E. The Contractor shall not interfere with landfill operations. If any construction activity requires closing any paved on-site roads, the Contractor shall set up a detour and coordinate scheduling with the landfill Operations Manager. Signs and traffic control personnel shall be provided by the Contractor.

1.02 REFERENCE STANDARDS

Reference standards and recommended practices referred to herein shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Association of State Highway and Transportation Officials (AASHTO) Formerly (AASHO)
- B. American Concrete Institute (ACI)
- C. American Institute of Steel Construction (AISC)
- D. American Iron and Steel Institute (AISI)
- E. American National Standards Institute (ANSI)
- F. American Standards Association (ASA)
- G. American Society of Mechanical Engineers (ASME)
- H. American Society for Testing and Materials (ASTM)
- I. American Water Works Association (AWWA)
- J. American Welding Society (AWS)
- K. Anti-Friction Bearing Manufacturer's Association (AFBMA)
- L. Building Officials and Code Administrators International, Inc. (BOCA)
- M. Construction Specifications Institute (CSI)
- N. Federal Specification (FS)
- O. Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, 2024-25 Edition (Standard Specifications)
- P. FDOT Roadway and Traffic Design Standards, 2023-24 Edition (FDOT Index)
- Q. Geosynthetics Institute (GSI)
- R. National Bureau of Standards (NBS)
- S. National Electrical Manufacturer's Association (NEMA)
- T. National Fire Protection Association (NFPA)
- U. Portland Cement Association (PCA)
- V. Occupational Safety and Health Act (Public Law 91-596), U.S. Department of Labor (OSHA)
- W. Steel Structures Painting Council (SSPC)
- X. Southern Standard Building Code (SSBC)
- Y. Underwriters' Laboratories, Inc. (UL)
- Z. United States of America Standards Institute (USASI)
- AA. Regulations of Florida Industrial Commission Regarding Safety
- BB. All local, state, county, or municipal building codes requirements of the Owner's Insurance

1.03 GENERAL REQUIREMENTS

- A. Unless otherwise specified on the Construction Drawings or Specifications, all work and the quality of materials shall conform to the referenced sections of the Florida Department of Transportation (FDOT) *Standard Specifications for Road and Bridge Construction, Supplementary Specifications, and Roadway and Traffic Design Standards*. The Contractor shall retain on the job site copies of these standard FDOT documents. The basis of payment shall conform to Section 01200, Measurement and Payment, of the General Requirements.

1.04 WORKING HOURS

- A. Normal landfill hours are 7:00 am to 4:00 pm, Monday through Friday, and 7:00 am to 12:00 pm on Saturdays.
- B. Allowable work times shall be Monday through Friday from 7:00 am to 4:00 pm, and Saturdays from 7:00 am to 12:00 pm. Work under this contract shall not be prosecuted on Sundays or the following holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day, except in time of emergency, and then only under written permission from the Engineer who shall be the sole judge as to the urgency of the situation.
 - 1. Construction personnel may access the site through the front gate 30 minutes before allowable work times and must exit the site through the front gate within 30 minutes of the end of the allowable work times.
 - 2. The Contractor's Project Manager, Superintendent, Engineer, and up to three assistant personnel working under their direct supervision will be granted access to the site outside these hours at the Engineer's discretion to inspect/maintain erosion control measures, dewatering pumps, and other essential equipment; perform essential maintenance activities; fuel equipment; and stage construction materials when necessary to limit impacts to site operations. Clarifications to permitted activities, access times, and access procedures should be requested for approval by the Contractor during bidding if specific details are essential to the Contractor's schedule or bid price.
 - 3. If the Contractor wishes to work outside the allowable work times, Sundays, or holidays, they shall reimburse the Owner for additional Field Representative and County staff costs in accordance with Article 1.05 of this Section. Requests for work outside these hours shall be submitted to the Engineer in writing 7 days in advance of the desired work period and granting of extended hours are at the Engineer's discretion.

1.05 REIMBURSEMENT FEES

- A. The following rates shall be applied as the Owner's reimbursement of the Engineer's fee to be paid by the Contractor for all Contractor back charges by the Owner.

1.	Senior Field Representative (Construction):	\$125
2.	Senior Construction Administrator:	\$175
3.	Senior Engineer (Project Manager):	\$255
4.	Senior Administrative Assistant:	\$110

1.06 OWNER OCCUPANCY AND LANDFILL OPERATIONS

- A. The Contractor shall cooperate with the Owner and Engineer during construction operations to minimize conflicts with Owner work and facilitate Owner usage. The Contractor shall perform the Work so as to not interfere with the Owner's operations, maintenance, environmental monitoring, and other Owner activities at the site.
- B. Contractor Staging Area: The Contractor staging area shall be as indicated in the Bid Documents. The Contractor shall record pre-construction photographs of this area and shall be required to restore this area to its pre-construction condition. Ponded water shall not be allowed in this area.

1.07 SITE CONDITIONS

- A. The Contractor shall field verify the location of existing features before beginning construction.
- B. The Contractor shall enforce safety procedures to minimize hazards to workers, the public, and the environment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01200
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers methods of measurement and payment for items of work under this Contract.
- B. The total Contract Price shall cover all work required by the Contract Documents. All cost in connection with the proper and successful completion of the work including furnishing all materials, equipment, and tools and performing all necessary labor and supervision to fully complete the work shall be included in the unit price and lump-sum Bid prices. All work not specifically set forth as a pay item in the Bid Form or Bid Schedule shall be considered a subsidiary/ancillary obligation of the Contractor, and all costs in connection with these subsidiary/ancillary obligations shall be included in the Bid(s) to provide a complete and functional Project.

1.02 EXCAVATION, TRENCHING, AND CLEARING

- A. Except where otherwise specified, the unit price or lump-sum price bid for each item of work which involves excavation, trenching, clearing, grubbing, or disposal of cleared and grubbed materials shall include all costs for such work. No direct payment shall be made for clearing, grubbing, disposal of cleared or grubbed materials, excavation, trenching, disposal of surplus excavated material, handling water (and groundwater), and purchasing and hauling of required fill material. All excavation and trenching shall be unclassified as to materials which may be encountered; in addition, trenches shall be unclassified as to depth, unless otherwise stated.

1.03 LUMP SUM

- A. For lump-sum items, payments shall be made to the Contractor in accordance with an accepted Progress Schedule of Values on the basis of actual work completed and accepted by the Owner at the final completion of the Project.

1.04 UNIT PRICE

- A. For unit price items, payment shall be made based on the actual amount of work accepted by the Engineer and for the actual amount of materials in place at the final completion of the Project, as confirmed by the final measurements.

- B. After the work is completed and before final payment is made, the Engineer will make final measurements, with all required assistance from the Contractor, to determine the quantities of various items of work accepted as the basis for the final unit price payment.

1.05 PAYMENT FOR INCREASED OR DECREASED QUANTITIES

- A. When alterations in the quantities of unit price work not requiring a Change Order(s), as herein provided for, are ordered and performed, the Contractor shall accept payment in full at the Contract unit price multiplied by the actual quantities of work constructed and accepted by the Engineer at the completion of the project.
- B. The actual percentage of each lump-sum bid item completed by the Contractor and accepted by the Engineer at the final completion of the Project will be paid to the Contractor.

1.06 DELETED ITEMS

- A. The Engineer may at any time order deletions or revisions in the work. This action shall in no way invalidate the Contract and no financial allowance or compensating payment for anticipated profit, overhead, etc., will be made for items so eliminated in making final payment to the Contractor.

1.07 PARTIAL PAYMENTS

- A. Partial payments shall be made monthly as the work progresses. Partial payment shall be made subject to the provisions of the General Conditions and Supplemental Information.

1.08 PAYMENT FOR STORED MATERIAL DELIVERED TO THE PROJECT

- A. When requested by the Contractor and at the discretion of the Owner and Engineer, payment may be made for all or part of the value of acceptable materials and equipment to be incorporated into bid items, which have not been used, and which have been delivered to the construction site or placed in storage places acceptable to the Engineer. The Contractor shall provide receipts for all stored material items requested for reimbursement which clearly identify the stored material item, where it is to be constructed, the unit cost of the item, as well as the total cost of the delivered item(s), the quantity of the item, the brand name of the item, and the supplier. Note that there are additional documentation requirements and storage requirements within the Contract Documents that must also be met before the Contractor can be reimbursed for these stored materials.

- B. No payment shall be made for fuels, supplies, installation or connection hardware, lumber, false work, or other similar materials or on temporary structures or other work (items) of any kind which are not a permanent part of the Contract. Items having a value of less than \$2,500 shall not be compensated for as a stored material item.

1.09 FINAL PAYMENT

- A. If requested by the Engineer, the Contractor shall field verify all quantities in dispute by using visual observation, taped measurements, or other methods designated by the Engineer. The field verification shall be made in the presence of the Engineer and agreed to by both the Engineer and the Contractor. The Engineer will prepare a final adjusting Change Order that will adjust the final quantities of the project Bid Schedule to reflect the actual work accepted by the Engineer and for which the Contractor will be compensated.

1.10 SCHEDULE OF VALUES

- A. A schedule of values for the lump-sum bid items and some of the unit-price bid items as required by the Engineer shall be submitted and accepted before the Notice to Proceed. The schedule of values shall be based on the prices bid in the Bid Schedule(s). Prices bid in the Bid Schedule(s) cannot be changed in the schedule of values; they can only be broken down into more detail so that the Engineer can more accurately review and approve the Contractor's pay application for the completed work.

1.11 MISCELLANEOUS CONSTRUCTION ITEMS

- A. The Contractor shall take all precautions necessary to protect existing utilities, roads, and miscellaneous items from damage during construction.
- B. The Contractor shall repair, relocate, or replace existing utilities, roadways, and miscellaneous items to pre-construction conditions. The repair of asphalt roads includes but is not limited to supplying, hauling, and placing stabilized subgrade, asphalt, limerock, traffic signs, and roadway markings.
- C. All repairs, relocations, and replacements necessary are considered incidental to the work and will be at the Contractor's cost, with no cost to the Owner.
- D. The lump-sum bid items for all pipe items shall constitute full compensation for furnishing, laying, jointing, and testing of pipe; dewatering; excavation and backfill; and cleanup.

PART 2 PAY ITEM DESCRIPTIONS

2.01 BID

The descriptions provided in the following Paragraphs are to be used by the Bidder in preparing the Bid Schedule(s). They generally indicate how the major workscope items and their respective costs are to be separated into the line items listed in the Bid Schedule(s). These descriptions are not fully representative nor all-inclusive of the work required to complete the project in accordance with the Contract Documents. It is the Bidder's responsibility to include all required costs within the most appropriate line item(s).

GENERAL

Item 1. Mobilization and Demobilization

- a. This item includes all costs for construction preparatory operations including but not limited to moving personnel and equipment to and from the site, field offices, sanitary facilities, project administration and management, insurance, bonds, Owner and Engineer indemnification, temporary utilities, permits related to construction, and all other similar activities and facilities necessary for executing this project.
- b. This item also includes all costs for establishing, maintaining, and monitoring a complete and comprehensive site health and safety program during the execution of the Contract that complies with all local, state, and federal safety guidelines and laws.
- c. This item shall not exceed 5% of the total Contract Amount.
- d. This item is lump sum.
- e. The Contractor will be paid 40% of this item on completing mobilization and 10% on demobilization; the remainder will be paid on a prorated basis equally over the remaining scheduled construction duration.

Item 2. Environmental Protection

- a. This item includes but is not limited to:
 - i. All costs for providing and implementing a comprehensive environmental protection program for the project site and areas affected by the construction whether or not it is specifically delineated in the Drawings and stated in the Specifications.
 - ii. Providing all labor, equipment, and materials necessary to prevent environmental damage to the soil, water, and air in conformance with all local, state, and federal laws.

- iii. Examples include controlling stormwater, erodible soils, noise, dust, pollutants, trash, waste, pumping discharge, and any other substance or activity that may adversely impact the environment.
- iv. Performing and obtaining required permits identified by the Contractor, monitoring, maintaining, and restoring the site.
- b. This item is lump sum.
- c. The Contractor will be paid 30% of this item upon Environmental Protection and Dewatering Plan(s) approval, establishing environmental protection as determined by the Engineer, and submitting the Florida Department of Environmental Protection (FDEP) National Pollutant Discharge Elimination System (NPDES) Construction General Permit Notice of Intent, and the remainder will be paid on a prorated basis equally over the remaining construction duration.

Item 3. Construction Surveying and Record Drawings

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to perform construction surveying and provide Record Surveys and Record Drawings.
 - ii. Establishing vertical control and horizontal control, staking out and re-staking construction, and performing record surveying throughout the construction duration.
 - iii. Updating the electronic copy of the Record Drawings, identifying items that were revised during the project, and providing electronic (.pdf and .dwg) and paper copies.
 - iv. Providing all required surveys signed and sealed by a Florida-licensed professional engineer or professional surveyor and mapper, in electronic (.pdf and .dwg) and paper formats.
 - v. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. A maximum of 60% of this item will be paid on a prorated basis equally over the construction duration. Once the Record Drawings and Record Surveys have been determined to be complete by the Engineer in accordance with the requirements of the Specifications, the entire lump sum will be paid to the Contractor.

Item 4. Clearing, Grubbing, Stripping, and Demolition

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to clear, grub, and strip the limits of clearing, grubbing, and stripping.
 - ii. Clearing vegetation, grubbing soil, stripping topsoil, stripping mulch, and loading, hauling, and unloading material at a location designated by the Engineer.

- iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to demolish existing site infrastructure and roadways within the project limits.
 - ii. Demolishing, excavating, loading, hauling, stockpiling, and disposing.
 - iii. Performing all related work as shown on the Drawings, stated in the Specifications, and as can be reasonably determined based on the scope and nature of the proposed construction work.
 - iv. Earthwork required for site demolition shall be considered incidental to the work, and payment for this earthwork shall not be made under any other pay item.
- c. This item is lump sum.
- d. Partial payments will be paid based on the percentage of clearing, grubbing, stripping, and demolition completed and accepted as determined by the Engineer.

Item 5. Stormwater Management System

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to construct the stormwater management system.
 - ii. Furnishing and installing drainage structures, drainage pipe, mitered end sections, concrete ditch pavement, and riprap with bedding stone and filter fabric.
 - iii. Excavating, installing, and compacting backfill for drainage improvements and furnishing and installing all appurtenances, fittings, and fasteners to complete the work.
 - iv. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. Partial payments will be paid based on materials stored and the percentage of work completed and accepted as determined by the Engineer.

Item 6. Dewatering

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to permit, design, construct, implement, maintain, and operate a dewatering system and surface-water management system in accordance with applicable site permits.
 - ii. Developing dewatering and effluent disposal plans and surface-water management plans, constructing the systems, operating and maintaining the systems, and preventing surface-water discharge from other locations onto the project site.

- iii. Field monitoring and testing of the dewatering discharge/effluent related to permit and regulatory requirements as needed.
- iv. All piping, fittings, pumps, connections, and associated infrastructure required to pump the dewatering effluent to the leachate storage tank for disposal by the Owner.
- v. Producing required documentation and performing all related work as shown on the Drawings and as stated in the Specifications.
- b. This item is lump sum.
- c. The Contractor will be paid 60% of this item on installing and starting up an approved dewatering system, surface-water management system, and dewatering effluent requiring an off-site disposal system and 10% on removing dewatering equipment including abandoning associated components and removing the temporary portions of the surface-water management system as determined by the Engineer. The remainder will be paid on a prorated basis equally over the duration of construction.

Item 7. Stormwater Diversion Berm

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services associated with constructing the stormwater diversion berm.
 - ii. Excavating from the project subgrade; loading, hauling, placing, compacting, grading, testing, reworking, maintaining, and protecting the completed earthwork; correcting wind and stormwater impacts; installing geomembrane; and assisting with manufacturers quality assurance (MQA) and construction quality assurance (CQA) testing and retesting.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of completed, tested, and approved stormwater diversion berm as determined by the Engineer.

Item 8. Earthwork – Excavate to Backfill

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services associated with excavating the project subgrade and backfilling with material excavated from the project subgrade and the onsite borrow area to construct the project subgrade, including preparing the subgrade for installing the geosynthetic clay liner (GCL) and geomembrane, all aspects of the bottom-liner systems and stormwater systems, and all earthwork not included under other pay items as presented in the Contract Documents or as directed by the Engineer.
 - ii. Excavating, loading, hauling, unloading, and stockpiling, compacting, grading, quality-control (QC) testing, reworking and retesting, maintaining,

- and protecting the completed earthwork; correcting wind and stormwater impacts; and assisting with MQA and CQA testing and retesting.
- iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of area of project work completed, tested, and approved as determined by the Engineer.

Item 9. Earthwork – Borrow to Stockpile

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services related to earthwork necessary to excavate from the Borrow Area and stockpile the excavated material in the Stockpile Area.
 - ii. Mobilizing, excavating, loading, hauling, unloading, spreading, stockpiling, grading, QC testing, reworking and retesting, maintaining, and protecting the completed earthwork; seeding and sodding; and correcting wind and stormwater impacts.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and as stated in the Specifications.
- b. Measurement and Payment will be on a unit-price basis for the actual quantity (cubic yards [CY]) of borrow material excavated and stockpiled.
- c. The quantity of material for payment shall be determined based on the difference between the Contractor's preconstruction and post-construction surveys of the Stockpile Area that shall be paid under this item.
- d. All excavation and stockpiling of borrow material shall be completed within 90 days of issuance of the project Notice to Proceed.

Item 10. GCL-Protective Geomembrane

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to furnish and install the GCL-protective geomembrane.
 - ii. Procuring, testing, transporting, unloading, storing, handling, and installing the GCL-protective geomembrane.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of area of the GCL-protective geomembrane completed, tested, and approved for the overlying GCL placement as determined by the Engineer.
- d. The quantity of GCL-protective geomembrane required for testing, overlapping, tying-in, anchoring, and waste shall be incidental to this work.

Item 11. Geosynthetic Clay Liner

- a. This item includes but is not limited to:
 - i. All labor, equipment, incidental materials, and services necessary to furnish and install the GCL.
 - ii. Procuring, testing, transporting, unloading, storing, handling, and installing the GCL.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
 - iv. Installing the GCL for the berm penetration flap.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of the area of the GCL completed, tested, and approved for overlying geomembrane placement as determined by the Engineer.

Item 12. Geomembrane

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to furnish and install the geomembrane.
 - ii. Procuring, testing, transporting, unloading, storing, handling, and uncovering existing geomembrane at tie-in locations, tying-in to the existing cell geomembrane, and installing the geomembrane.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
 - iv. Installing the geomembrane for the berm penetration flap.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of area of the geomembrane completed, tested, and approved for overlying the geocomposite placement as determined by the Engineer.
- d. The quantity of geomembrane required for testing, overlapping, tying-in, anchoring, and waste shall be incidental to this work.

Item 13. Geocomposite

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to furnish and install the geocomposite.
 - ii. Procuring, testing, transporting, unloading, storing, handling, and installing the geocomposite.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.

- c. Partial payments will be paid based on the percentage of area of the geocomposite completed, tested, and approved for overlying the drainage soil layer placement as determined by the Engineer.
- d. The quantity of geocomposite required for testing, overlapping, tying-in, anchoring, and waste shall be incidental to this work.

Item 14. Anchor Trench

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to construct the landfill anchor trench and supply and install the edge-of-liner markers.
 - ii. Excavating, loading, hauling, placing, compacting, grading, QC testing, reworking and retesting, maintaining, and protecting the completed earthwork; correcting wind and stormwater impacts; and assisting with MQA and CQA testing and retesting.
 - iii. Procuring, testing, transporting, unloading, storing, handling, and installing the anchor trench materials.
 - iv. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
 - v. Installing the anchor trenches for the for the berm penetration flap.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of the anchor trench completed, tested, and approved as determined by the Engineer.
- d. The quantity of materials required for testing, overlapping, and waste shall be incidental to this work.

Item 15. Leachate Collection Trench

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to construct the leachate collection trench.
 - ii. Procuring, testing, transporting, installing, and inspecting the separation geotextile, cushioning geotextile, trench gravel, perforated high-density polyethylene (HDPE) pipe, solid-walled HDPE pipe, clean-outs, and boots.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
 - iv. Installing the geotextile, gravel, and pipe for the berm penetration flap.
- b. This item is lump sum.
- c. Partial payments will be paid based on the linear feet of trench completed, tested, and approved as determined by the Engineer.

Item 16. Drainage Soil

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services associated with supplying and installing drainage soil for the drainage soil layer from the Contractor's source.
 - ii. Excavating from the Contractor's source, loading, hauling, unloading, placing, installing, compacting, grading, QC testing, reworking and retesting, maintaining, and protecting the completed earthwork; correcting wind and stormwater impacts; and assisting with MQA and CQA testing and retesting.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of area of the drainage soil layer completed, tested, and approved as determined by the Engineer.

Item 17. Leachate Pump Station

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services associated with the leachate pump stations, sumps, and side-slope riser systems.
 - ii. Supplying, loading, transporting, unloading, fabricating, excavating, backfilling, and testing the leachate pump stations, leachate collection sump, side-slope riser systems, concrete slabs and subgrade, asphalt paving with stabilized subgrade and limerock base, bollards, piping, fittings, control panels, riser pipes, gravel sumps, and appurtenances.
 - iii. Procuring, testing, transporting, installing, and inspecting the separation geotextile, cushioning geotextile, trench gravel, perforated HDPE pipe, solid-walled HDPE pipe, clean-outs, and boots.
 - iv. Furnishing and installing the leachate collection sump including gravel, riser pipes, and geomembrane rub sheet; leachate-removal pumping systems, controls, and associated work; pumps; discharge line; pull cable; connecting to the blind flange adaptor; control panel; junction boxes; power transfer switch; providing electrical power to the control panel; electrical services; installing conduit, valves, meters, level sensors, and piping; and testing, startup, and training.
- b. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications including Operation and Maintenance manuals and providing training. This item is lump sum.
- c. Partial payments for this item will be paid based on the percentage of completed and approved work as determined by the Engineer.
- d. The maximum amount paid will be 80% of the lump-sum price until the pump stations are demonstrated to be fully functional, Record Documents are approved,

startup is completed, and all work for this item is accepted as determined by the Engineer.

Item 18. Leachate Force Main

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to supply, install, and construct the leachate force main.
 - ii. Excavating, backfilling, road crossings, pipe testing, and providing and installing all piping, fittings, valves, and appurtenances.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. Partial payments for this item will be paid based on the percentage completed and approved as determined by the Engineer.

Item 19. Unpaved Site Roads

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services necessary to construct stabilized subgrade, limerock base, and paved surface where applicable for the unpaved site roads.
 - ii. Excavating from the Contractor's source, loading, hauling, installing, grading, and testing.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
 - iv. This item includes the ramp to the leachate pump station and the cell access ramp.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of completed and approved as determined by the Engineer.

Item 20. Groundwater Monitoring Well

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services required to furnish and install the groundwater monitoring well.
 - ii. Supplying, installing, constructing, and developing the monitoring wells, drilling, surveying, permitting, and providing concrete pads, bollards, and signage.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.

- c. The Contractor will be paid 100% of this item on installing, developing, and completing the groundwater monitoring wells and gas probes as determined by the Engineer.

Item 21. Sod

- a. This item includes but is not limited to:
 - i. All labor, equipment, materials, and services required to furnish and install sod on all disturbed areas.
 - ii. Preparing topsoil (excluding the drainage soil) and fertilizing, watering, and mowing until established.
 - iii. Producing required documentation and performing all related work as shown on the Drawings and stated in the Specifications.
- b. This item is lump sum.
- c. Partial payments will be paid based on the percentage of work completed and accepted as determined by the Engineer.

END OF SECTION

SECTION 01290 SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. To the Engineer, a proposed Schedule of Values allocated to the various portions of the Work, in accordance with Section 01000, Project Requirements, and Section 01200, Measurement and Payment.
- B. Upon request of the Engineer, supporting data, which will substantiate the values' correctness.
- C. The accepted Schedule of Values shall be used only as the basis for the Contractor's Applications for Payment.
- D. An update and resubmittal of the Schedule of Values when Change Orders affect the listing or when the actual performance of the Work involves necessary changes of substance to values previously listed and approved.
- E. Schedule of Values
 - 1. Submit typed schedule on forms provided by the Engineer. The Contractor's standard form or electronic media printout will be considered.
 - 2. Submit Schedule of Values in duplicate within 10 days after the date of Owner-Contractor Agreement.
 - 3. Format – Use the schedule of prices in the Bid Proposal. Show the cost breakdown for each lump-sum item. The lump-sum breakdown shall, at a minimum, use the Table of Contents of this manual outline. Identify each line item with the number and title of the major Specification Section. Identify site mobilization and demobilization, bonds and insurance, Record Drawings, photographs, and operations and maintenance manuals, etc.
 - 4. For unit cost allowances, identify quantities taken from the Contract Documents multiplied by the unit cost to achieve the total for the item.

5. Include within each line item a direct proportional amount of the Contractor's overhead and profit.
6. Revise the schedule to list approved Change Orders with each Application for Payment.

1.02 CASH ALLOWANCES

- A. Costs Included in Allowances—The cost of the product to the Contractor or subcontractor, less applicable trade discounts and including applicable taxes.
- B. Costs Not Included in the Allowance, but Included in the Contract Price—Product handling at the site, including unloading, uncrating, and storage; protection of products from elements and from damage and labor for installation and finishing.
- C. Contractor Responsibilities:
 1. Execute purchase agreement with designated supplier.
 2. Arrange for and process shop drawings, product data, and samples.
Arrange for delivery.
 3. Promptly inspect products upon delivery for completeness, damage, and defects.
- D. Differences between allowance amounts and actual costs will be adjusted by Change Order before final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01310
CONSTRUCTION COORDINATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall coordinate Work with that of other construction projects as needed.
- B. Before starting Work and from time to time as the Work progresses, the Contractor and each subcontractor shall examine the work and materials installed by others as it applies to its own work and shall notify the Engineer immediately in writing if any conditions exist which will prevent satisfactory results in the installation of the system. Should the Contractor or subcontractor start work without such notification, it shall be construed as an acceptance of all claims or questions as to the suitability of the work of others to receive its Work. The Contractor shall remove and/or replace, at its own expense, all work under this Contract that may have to be removed on account of such defects or omissions.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The Contractor shall ensure that all drawing, product data, and samples comply with Contract Documents and field dimensions and clearances.
- B. The Contractor shall submit requests for interpretation of Contract Documents in a timely fashion to ensure there are no disruptions with the Work as scheduled. Obtain instructions through the Engineer to resolve all queries.
- C. Process requests for substitutions and Change Orders through the Engineer.
- D. Deliver close-out submittals to the Engineer.

1.03 WORK SEQUENCE

- A. The Contractor shall submit a preliminary Progress Schedule in accordance with the General Conditions to the Engineer. After review, the Contractor shall revise and resubmit the Progress Schedule to comply with requested revisions.

1.04 CONSTRUCTION MOBILIZATION

The Contractor shall do the following:

- A. Cooperate with the Engineer in allocating mobilization areas on site for field offices and sheds, access, traffic, and parking facilities. During construction, the Contractor shall coordinate the use of the site and facilities through the Engineer.
- B. Comply with the Engineer's procedures for intra-project communications: submittals, reports and records, schedules, coordination drawings, recommendations, and resolution of ambiguities/conflicts.
- C. Comply with the Engineer's instructions for use of temporary utilities and construction facilities.
- D. Coordinate field engineering and layout work under instructions of the Engineer.
- E. Coordinate scheduling, submittals, and work of the various sections of Contract Documents to ensure the efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed later.
- F. Coordinate the sequence of Work to accommodate the Owner occupancy as specified in the Contract Documents.
- G. Hold Pre-Construction Conferences specified in the General Conditions with personnel and subcontractors to ensure coordination of Work in addition to regular Progress Meetings. The Engineer shall be informed of such meetings and shall be allowed to attend.
- H. Coordinate the Work of various sections having interdependent responsibilities for installing equipment, connecting equipment, and placing such equipment in service.
- I. Coordinate the use of project space and the sequence of installing civil, mechanical, structural, instrumentation, systems, and electrical work. Follow practicable routings for pipes and conduits with due allowance for available physical space. Use space efficiently to maximize accessibility for other installations, maintenance, and repairs.
- J. Coordinate Work at existing facilities to minimize disruption of the Owner's operations.

- K. Assemble and coordinate close-out submittals specified in Section 01770, Project Closeout.

1.05 COORDINATION DRAWINGS

- A. The Contractor shall provide information required by the Engineer for preparing coordination drawings.
- B. The Contractor shall review drawings before submitting them to the Engineer.

1.06 CLOSE-OUT PROCEDURES

The Contractor shall do the following:

- A. Notify the Engineer when Work is considered ready for Substantial Completion.
- B. Comply with the Engineer's instructions to correct items of Work listed in executed Certificates of Substantial Completion.
- C. Notify the Engineer when Work has reached Final Completion.
- D. Comply with the Engineer's instructions for completing items of Work found incomplete in the Engineer's final inspection.
- E. Comply with Section 01770, Project Closeout.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. All vehicles on the property or easement must be operational.

3.02 UTILITIES

- A. The Contractor shall coordinate the activities of all utility companies with equipment in the construction area with the Contractor's and Subcontractor's Work.

END OF SECTION

SECTION 01325
CONSTRUCTION PHOTOS AND VIDEOS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall have digital photos and videos made of the Work from views and at such times as directed by the Owner. The photos and videos shall represent a visual history of the Project, from Contract Award through Contract Completion.
- B. The requirements of this Section constitute a minimum requirement, but the Owner may request additional photos or videos at their discretion for complete documentation of the work performed.
- C. The Contractor shall also use additional digital photography as necessary to record and facilitate resolution of on-site issues through the transmission of photos by email or other electronic submittal forum from the site to the Owner's offices.

1.02 SUBMITTALS

- A. Aerial Photos and Video Plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 DIGITAL PHOTO REQUIREMENTS

- A. Digital photos shall be in color. Provide one copy of each digital photo via electronic submittal to the Owner.
- B. Provide photos taken of each of the major items during construction.
- C. View and Quantities Required: A minimum of 30 photos per month clearly showing project status and key elements of construction.
- D. Deliver digital photos to the Owner with every pay request.
- E. Photos shall be from locations to illustrate the condition of construction and the state of progress adequately.

- F. The Contractor shall provide before, during, and after photos of the project site. The photos shall cover aboveground and belowground conditions and improvements before, during, and after construction. Include photos of all equipment, slabs, precast structures, piping, valves, fittings, utility crossings, new connection points, directional drills and tie-together arrangements, electrical equipment, generators, driveways, stormwater systems, paving, fencing, site restoration, and any other work listed in Section 01200, Measurement and Payment.
- G. All photos shall be submitted electronically in ascending date order to show the Work as it progresses.

3.02 DIGITAL VIDEO RECORDING REQUIREMENTS

- A. The Contractor shall provide to the Owner color digital video of each major facility and structures and facilities adjacent to the construction before construction starts, during construction, and when construction has been completed. Videos shall include the entire site and areas of adjacent properties within 100 feet of the limit of the Work. Special effort shall be made to show the existing improvements and features affected by the work.

3.03 AERIAL PHOTOS

- A. The Contractor shall obtain digital, true-color, aerial photos and aerial videos using aerial drones or other approved means of the entire project site before construction begins, monthly during construction, and at final completion showing the entire completed construction project.
- B. The Contractor is required to secure all permits and approvals from authorities having jurisdiction before any aerial or drone flights and shall have licensed pilots/drone pilots performing the flights in accordance with applicable regulations.
- C. From each flight, provide a minimum of four aerial digital photos of the project area.

3.04 PHOTO AND VIDEO INFORMATION

- A. Each digital photo and video file shall be digitally tagged with the following data or the file name shall be referenced from a log that contains the following information for each photo and video:
 - 1. Digital photo or video digital file name/number.
 - 2. Project name.
 - 3. Contract number.

4. Name of Contractor.
 5. Date photo or video was taken.
 6. Photographer name.
 7. Description of location, view, and construction items the photo displays.
- B. All photos and videos shall be clear, unobstructed, sharply focused, and free of distortion.

END OF SECTION

SECTION 01330
SUBMITTALS AND ACCEPTANCE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall submit documentation that describes the Work to be performed under the Contract as required in this Section. This documentation will be for the Engineer's review and use. The documentation furnished by the Contractor must enable the Engineer to verify the Contractor's performance and compliance with Contract requirements. The documentation shall cover all services and deliverables required and secured by the Contract Documents.

1.02 SUBMITTALS

- A. General—The Contractor shall submit the following:
1. Project documentation: For the Engineer's internal use and shall include all information that will be essential for the facility's operations, maintenance, training, and repair of equipment and facilities supplied by the Contractor. The Contractor shall submit all documentation necessary to ascertain compliance with technical/contractual provisions.
 2. Shop drawings: Drawings, schedules, diagrams, warrants, and other data prepared specifically for this Contract by the Contractor or through the Contractor by way of subcontractor, manufacturer, supplier, distributor, or other lower-tier contractor to illustrate a portion of the Work.
 3. Product data: Preprinted materials such as illustrations, standard schedules, performance charts, instructions, brochures, diagrams, manufacturer's descriptive literature, catalog data, and other data to illustrate a portion of the Work, but not prepared exclusively for this Contract.
 4. Samples: Physical examples of products, materials, or workmanship that are physically identical to portions of the Work, illustrating portions of work, or establishing standards for evaluating appearance of finished work or both.
 5. Installation Lists: All manufacturers or equipment suppliers who propose to furnish equipment or products shall submit an installation list to the Owner with the required Shop Drawings. The installation list shall include all installations where identical equipment has been installed and has been operating for at least 1 year.
 6. Administrative submittals: Data presented for reviews and acceptance to ensure that administrative requirements of the project are adequately met

but not to ensure directly that work is in accordance with the design concept and in compliance with Contract Documents.

B. Coordination

1. Submittals and schedules shall be checked and coordinated with the Work of all trades involved before they are submitted and shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawings or schedules submitted without this stamp of approval shall be returned to the Contractor for resubmission.

C. Start of Work

1. Within 30 calendar days after the notice to proceed for the project, the Contractor shall submit to the Engineer a Contract Data Requirements List that defines all data to be submitted under this Contract. Included in this list shall be the names of all proposed manufacturers furnishing specified items to the extent known. Review of this list by the Engineer shall in no way relieve the Contractor from providing materials, equipment, systems, and structures fully in accordance with the Specifications.

D. General Requirements

1. The Contractor shall prepare, assemble, and submit all documents as described herein. The Contractor shall submit certification that the documents prepared conform to the Contract requirements and will result in a complete and operable project. The Engineer shall review the Contractor's documents for conformance to the Contract requirements and may comment on the documents.
2. The Contractor shall approve and certify all project documents. The Contractor's failure to certify the documents or failure to provide documents that demonstrate conformance to the Contract requirements are grounds for rejection. The Contractor shall be responsible for and bear all costs for proceeding with any part of the Work that fails to meet the Contract requirements.
3. Submittal of documents for the Engineer's review shall in no way relieve the Contractor of full responsibility for providing a complete, safe, reliable, operating, and coordinated Work (system/equipment/facilities) that comply with these Contract documents.

E. Requests for Substitution

1. All requests for substitution shall clearly and specifically indicate any and all differences or omissions between the products specified as basis of

design and the product proposed for substitution. Data shall include but not be limited to differences as follows for both the specified and substituted products:

- a. Principle of operation.
- b. Materials of construction or finishes.
- c. Thickness or gauge of materials.
- d. Weight of item.
- e. Deleted features or items.
- f. Added features or items.
- g. Changes in other work caused by the substitution.
- h. If the substitution contains differences or omissions not specifically called to the attention of the Engineer, the Engineer reserves the right to require equal or similar features to be added to the substituted product at the Contractor's expense.

F. Submittal Requirements and Procedures

1. Drawing Formats and Requirements

- a. Drawings—All Drawings and Shop Drawings shall be prepared in 11-x-17-inch or larger format and shall have a blank area of 3 x 4 inches in the lower right hand corner above the title block. Each Drawing shall indicate the following information in the title block:
 - (1) Title and Drawing Number.
 - (2) Date of Drawing or Revision.
 - (3) Name of Facility.
 - (4) Name of Contractor or subcontractor.
 - (5) Drawing contents and locations.
 - (6) Specification Section and Subsection Numbers.
- b. All drawings shall be submitted via electronic transmittal in PDF format or other formats as may be required by the Owner for review.

2. Product Data

- a. Requirements—Product data shall include all catalog cuts, performance surveys, test reports, equipment lists, material lists, diagrams, pictures, and descriptive material. All product data shall be submitted in either 8.5-x-11-inch or 11-x-17-inch size formats. The submittal information shall show the standard and optional

product features, as well as all performance data and specifications. The manufacturer's recommendation for special tools shall be supplied.

- b. All product data shall be submitted via electronic transmittal in PDF format or other formats as may be required by the Owner for review.

3. Samples—The Contractor shall furnish samples required by the Contract Documents, for review by the Engineer. Samples shall be delivered to the Engineer as specified or directed.

- a. All samples shall be of sufficient size and quantity to illustrate clearly the functional characteristics of the product, with integrally related parts and attachment devices. The samples shall show the full range of color, texture, and pattern.
- b. The Contractor shall submit a minimum of four samples of items submitted. All samples shall be marked with required submittal information, as specified below.

4. Submittal Information Requirements

- a. When used in the Contract Documents, the term "Submittal Information" shall be considered to mean the following information at a minimum:
 - (1) Contract Name.
 - (2) Contract Number.
 - (3) Location within the Facility.
 - (4) Date Submitted.
 - (5) Specification Section and Subsection Numbers.
- b. Drawings—The Contractor shall mark submittal information on all Drawings in the left half of the 3-x-4-inch block as described above.
- c. Product Data and Manufacturer's Literature—The Contractor shall mark all product data and manufacturer's literature with submittal information and note which item is being furnished. The Contractor shall mark the option and supplies to be furnished with the item. Do not submit the manufacturer's general catalog: submit only items being installed or delivered. When manuals are being submitted, the Contractor shall mark submittal information on both the cover and title page. If manuals being submitted contain more

than just one item, each item must be marked and only Contract name and number are to be marked on the cover and title page.

5. Training, Operation and Maintenance Manuals

- a. The Contractor shall submit to the Engineer for review and acceptance of manufacturer's installation, operations, lubrication, maintenance, and training manuals for all equipment installed or delivered under this Contract. All manuals shall have submittal information marked on the front cover, title page, and three places inside the manual. If the manual being submitted is for different components, mark the front cover and title page only. Each component section must be marked with the Specification Section and subsection numbers.
- b. Operations and Maintenance Manual shall conform to requirements defined in Section 01830, Operations and Maintenance Manuals.

G. Required Submittals

1. Structural Submittals

- a. This Section specifies general procedural requirements for contractual submittals for the following structural schedules, product data, samples, and manufacturer's certificates.
 - (1) Product Data—The Contractor shall provide product data for all structural items, options, and other data and provide supplemental manufacturer's standard data for information unique to the Work and installation. The submittals shall reflect all items delivered or installed under this Contract.
 - (2) Samples—The Contractor shall provide all samples required under this Specification including color charts and product samples.
 - (3) Material, equipment, and installation and demolition Specifications.

2. Mechanical and Electrical System Submittals

- a. This Section specifies general procedural requirements for mechanical schedules, performance data, control diagrams, and other submittal data.

- b. The Contractor shall submit the following:
- (1) Performance Data.
 - (2) Finished Data—Complete surface preparation and finished data for all mechanical and electrical unit/subsystems shall be provided, including a complete list of cleaning instructions.
 - (3) Factory Testing—Detailed description of factory testing procedures, reporting procedures and criteria for test passing or failing shall be provided for all mechanical and electrical units/subsystems. Testing shall comply with the General Requirements and Technical Requirements Sections.
 - (4) Site (Field) Testing and Acceptance—Detailed description of site testing and acceptance tests including descriptions of procedures, testing equipment, reporting procedures, and criteria for passing or failing tests shall be provided for all mechanical and electrical units/subsystems. Testing shall comply with General Requirements and Technical Requirements.
 - (5) Factory Test Report—After fabrication and testing, the Contractor shall submit the results of tests. No shipment of any mechanical and electrical unit/subsystem shall be allowed without the written certification from the Contractor that the equipment conforms to the Contract requirements.
 - (6) Site Test and Acceptance Report—Site test and acceptance reports shall be submitted to the Engineer.
 - (7) Operations and Maintenance Manuals—The Contractor shall furnish manuals for all mechanical and electrical equipment specified under this Contract. Each manual shall include the following at a minimum:
 - (a) Description of equipment.
 - (b) Record shop drawing.
 - (c) Operation and maintenance instructions.
 - (d) Part lists.
 - (e) Equipment ratings.

- (f) Valve list.
- (g) Lubrication and other maintenance instructions.

H. Submittal Review

1. The Engineer's review of the Contractor's documents shall not relieve the Contractor of the responsibility for meeting all of the requirements of the Contract nor of the responsibility for correcting the documents furnished. The Contractor shall have no claim for additional cost or extension in time because of delays due to revisions of the documents that may be necessary for ensuring compliance with the Contract.
2. The Engineer will review a submittal or re-submittal once, after which the cost of review shall be borne by the Contractor. The cost of Engineering review shall be equal to the Engineer's full cost.
3. No partial submittals will be reviewed. A submittal or re-submittal not complete will be returned to the Contractor for completing and re-submittal.
4. Documents submitted by the Contractor for approval by the Engineer will be returned bearing a project-specific stamp bearing the dated signature of the reviewer and one of four boxes checked:
 - a. NO EXCEPTIONS NOTED—This indicates that the submittal appears to comply with the requirements of the performance specifications and that the Work may proceed.
 - b. MAKE CORRECTIONS NOTED—This indicates that the reviewer has added a minor correction to the submission and that the Work (modified in accordance with the correction comment) may proceed. The Contractor shall accept the responsibility of the modified document and resulting Work with no additional compensation.
 - c. AMEND AND RESUBMIT—This indicates that the submittal will require Contractor modifications based on the reviewer's comments that accompanied the returned submittal. The Contractor will be cautioned that work may not proceed under this review status.
 - d. REJECTED—This indicates that the submittal is not in conformance with the requirements of the performance Specifications and cannot be modified to gain compliance. A new submittal will be required in the instance of a "reject" status and the Contractor will be cautioned that work may not proceed under this condition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUBMITTAL PROCEDURES

- A. Before submitting documents for the Engineer's review, the Contractor shall review the documentation for conformance to the Contract requirements. Submittals shall be complete and comprise a logical division of the Contract Work.
- B. All documentation submitted by the Contractor to the Engineer shall be accompanied by a letter of transmittal and shall be submitted in a sequence that allows the Engineer to have all of the information necessary for checking and accepting a particular document at the time of submittal.
- C. Each document shall be identified by a document number, Contract number, Contract name, location, Specification Section, subsection numbers, and submittal date. Where a manual/drawing is revised to reflect a change in design or a change for any other reason, each such revision shall be shown by a revision number, date, and subject in a revision block. Indication of official approval by the Contractor's Project Manager shall also be included. To permit rapid location of the revision, additional notation shall be made in the manual opposite the line or area where the change was made and identified by the corresponding revision number.

3.02 DOCUMENTATION CONTROL AND SUBMITTAL SEQUENCING

- A. The Contract Data Requirements List shall be updated and resubmitted to the Engineer monthly throughout the duration of the Contract. This list shall identify the Contractor's submittal number, proposed and actual submittal date, Contract Specification Section Number, Paragraph, Item of the Work, and type of document.
- B. The Contractor shall work with the Engineer to provide a regulated flow of submittals that allows the Engineer to review the submittals in the defined time frame without undue delays. Monthly the Contractor shall provide the Engineer a schedule of the approximate quantities and delivery dates for all submittals due for the next 120 days.

3.03 FINAL RECORD DRAWINGS

- A. The Contractor shall submit the Final Record Drawing Package to the Owner for review at Substantial Completion. The Contractor shall be provided with CADD files of the Contract Drawings in AutoCAD, version specified by the Owner. Final Record Drawings shall be prepared in AutoCAD with the same version used for the Contract Drawings and shall be provided electronically in AutoCAD. The Contractor may request to use a different version, but it must be approved by the Owner.

- B. Final Record Drawings shall also be provided in hardcopy format, three copies, printed at the full size of the original Contract Drawings.
- C. Record Drawings shall be in accordance with Section 01785, Record Documents.

3.04 REQUIREMENTS FOR SUBMITTAL

- A. Additional documents, drawings, interface data, and other pertinent project submittal data are listed in specific sections of this Contract.

3.05 RECORD PRINTS

- A. The Contractor shall submit one set of all record prints before final completion. The record print or project records shall include submittals, catalog cuts, drawings, calculations, test reports, manufacturer's data, maintenance manuals, installation instructions, and operating manuals. All "record prints" shall be delivered to the Engineer in three-ring binders with dividers and shall be placed in order by Specification Section.

END OF SECTION

SECTION 01350
ENVIRONMENTAL PROTECTION PROCEDURES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work covered by this Section consists of furnishing all labor, materials, and equipment and performing all work required for the prevention of environmental pollution in conformance with applicable laws and regulations during and as the result of construction operations under this Contract. In this Section *environmental pollution* is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utility of the environment for aesthetic and/or recreational purposes.
- B. The control of environmental pollution requires considering air, water, and land and involves managing noise and solid waste as well as other pollutants.
- C. The Contractor shall schedule and conduct all work in a manner that will minimize the erosion of soils in the area of the Work. The Contractor shall provide erosion-control measures such as diversion channels, sedimentation or filtration systems, berms, staked silt fence, seeding, mulching or other special surface treatments that are required to prevent silting and muddying of streams, rivers, impoundments, lakes, etc. All erosion-control measures shall be in place in an area before any construction activity in that area. Specific requirements for erosion and sedimentation controls are specified in Section 02370, Erosion and Sedimentation Control.
- D. This Section is intended to ensure that construction is achieved with a minimum of disturbance to the existing ecological balance between a water resource and its surroundings. These are general guidelines. It is the Contractor's responsibility to determine the specific construction techniques to meet these guidelines.
- E. All phases of sedimentation and erosion control shall comply with and be subject to the laws of the State of Florida and the Project Environmental Resource Permit.

1.02 SUBMITTALS

- A. The Contractor shall prepare a Stormwater Pollution and Prevention Plan (SWPPP) and a sedimentation and erosion-control drawing meeting the Florida Department of Environmental Protection (FDEP) and South Florida Water

Management District (SFWMD) requirements. The drawing shall clearly indicate the construction entrance, delivery and storage area, in-stream turbidity controls and proposed locations for soil stockpiles. The Contractor shall furnish two copies to the Engineer and two copies to the Owner.

- B. The Contractor shall provide the Engineer with two copies of documentation that the Contractor filed with FDEP a “NOTICE OF INTENT TO USE GENERIC PERMIT FOR STORMWATER DISCHARGE FROM LARGE AND SMALL CONSTRUCTION ACTIVITIES” in accordance with Rule 62-621.300(4), FAC.
- C. The Contractor shall submit two copies of approved Spill Prevention Control and Countermeasures (SPCC) plans to the Owner and the Engineer.
- D. If the Contractor proposes to construct temporary roads or embankments and excavations for work areas, the Contractor shall submit the following to the Owner for approval at least 10 days before the scheduled start of such temporary work:
 - 1. A layout of all temporary roads, excavations, embankments, and drainage to be constructed within the work area.
 - 2. Details of temporary road construction.
 - 3. Drawings and cross-sections of proposed embankments and their foundations, including a description of proposed materials.
 - 4. Drawings showing the proposed restoration of the area. The proposed removal of any trees and shrubs must be indicated. The Contractor is responsible for obtaining necessary tree clearing permits with the local municipalities.
 - 5. Locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged.
 - 6. The drawings shall provide for the obliteration of construction scars as such and shall provide for a natural appearing and functioning final condition of the area.
 - 7. Modification of the Contractor’s approved drawings shall be made only with the written approval of the Owner. No unauthorized road construction, excavation, or embankment construction including disposal areas will be permitted.
 - 8. The Contractor shall mark/flag the proposed temporary work in the field for review by the Owner prior to beginning such work.

1.03 WORK SEQUENCE

- A. Before beginning the Work, the Contractor shall meet with the Owner to establish agreed-upon compliance with these provisions and administration of the environmental pollution control program.

- B. The Contractor shall remove temporary environmental control features when approved by the Engineer and incorporate permanent control features into the project at the earliest practicable time.

1.04 REFERENCE STANDARDS

- A. Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.
- B. The Contractor shall comply with all applicable Federal, State, and local laws and regulations concerning environmental pollution control and abatement.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EROSION CONTROL

- A. The Contractor shall provide positive means of erosion control such as shallow ditches around construction to carry off surface water. Erosion-control measures, such as temporary vegetation, siltation basins, mulch check dams, mulching, jute netting, and other equivalent techniques shall be used as appropriate. Surface water shall be prevented from flowing into excavated areas. At the completion of the Work, erosion and sedimentation controls shall be removed and the ground surface restored to its original condition.

3.02 PROTECTION OF STREAMS AND SURFACE WATERS

- A. Care shall be taken to prevent or reduce to a minimum any damage to any stream or surface water from pollution by debris, sediment, or other material or from the manipulation of equipment and/or materials in or near such streams. Water that has been used for washing or processing or that contains oils or sediments that will reduce the quality of the water in the stream shall not be directly returned to the stream. Such waters shall be diverted through a settling basin or filter before being directed into streams or surface waters.
- B. All preventative measures shall be taken to avoid spillage of petroleum products and other pollutants. In the event of any spillage, prompt remedial action shall be taken in accordance with a contingency action plan approved by FDEP. The Contractor shall submit two copies of approved contingency plans to the Engineer.

3.03 PROTECTION OF LAND RESOURCES

- A. After completion of construction, the Contractor shall restore land resources within the project boundaries and outside the limits of permanent work to a condition that will appear to be natural and not detract from the appearance of the project. All construction activities shall be confined to areas shown on the Drawings.
- B. The Contractor shall not deface, injure, or destroy trees or shrubs nor remove or cut them without prior approval. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage unless specifically authorized by the Engineer. Where such special emergency use is permitted, the Contractor shall first wrap the trunk with a sufficient thickness of burlap or rags over which softwood cleats shall be tied before any rope, cable, or wire is placed. The Contractor shall in any event be responsible for any damage resulting from such use.
- C. The Contractor shall protect trees that may possibly be defaced, bruised, injured, or otherwise damaged by the construction equipment, dumping, or other operations by placing boards, planks, or poles around them. Monuments and markers shall be protected similarly.
- D. Any trees or other landscape features scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to their original condition. The Owner will decide the method of restoration to be used and whether damaged trees shall be treated and healed or removed and disposed of.
 - 1. All scars made on trees by equipment, construction operations, or by the removal of limbs larger than 1 inch in diameter shall be coated as soon as possible with an approved tree wound dressing. All trimming or pruning shall be performed in an approved manner by experienced workmen with saws or pruning shears. Tree trimming with axes will not be permitted.
 - 2. Climbing ropes shall be used where necessary for safety. Trees that are to remain, either within or outside established clearing limits, that are subsequently damaged by the Contractor and, in the opinion of the Owner, are beyond saving shall be immediately removed and replaced.
- E. The Contractor's storage and other construction buildings required temporarily in the performance of the work shall be located in cleared portions of the job site or areas to be cleared as shown on the Drawings and approved by the Owner and shall not be within wetlands or floodplains. Preserving the landscape shall be required in the selection of all sites and in the construction of buildings. Drawings showing storage facilities shall be submitted for the Owner's approval.

- F. The Contractor shall remove all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess waste materials, or any other vestiges of construction as directed by the Engineer. Excavating, filling, and plowing of roadways are expected to be required to restore the area to near natural conditions which will permit the growth of vegetation the roadway areas. The disturbed areas shall be prepared and seeded as approved by the Owner.
- G. All debris and excess material will be disposed of outside wetland or floodplain areas in an environmentally sound manner.

3.04 PROTECTION OF AIR QUALITY

- A. Burning—Burning will not be permitted at the project site for the disposal of refuse and debris.
- B. Dust Control—The Contractor shall maintain all excavations, embankment, stockpiles, access roads, waste areas, borrow areas, and all other work areas within or outside the project boundaries free from dust which could cause the standards for air pollution to be exceeded and which would cause a hazard or nuisance to others.
- C. An approved method of stabilization consisting of sprinkling or other similar methods will be permitted to control dust. The use of petroleum products is prohibited. The use of chlorides is prohibited.
- D. To be approved, sprinkling must be repeated at such intervals as to keep all parts of the disturbed area at least damp at all times, and the Contractor shall have sufficient competent equipment on the job to accomplish this. Dust control shall be performed as the Work proceeds and whenever a dust nuisance or hazard occurs, as determined by the Owner.

3.05 NOISE CONTROL

- A. The Contractor shall make every effort to minimize noises caused by the construction operations. Equipment shall be equipped with silencers or mufflers designed to operate with the least possible noise in compliance with Federal and State regulations.

3.06 MAINTENANCE OF POLLUTION-CONTROL FACILITIES DURING CONSTRUCTION

- A. During the life of this Contract, the Contractor shall maintain all facilities constructed for pollution control as long as the operations creating the particular pollutant are being carried out or until the material concerned has become stabilized to the extent that pollution is no longer being created.

3.07 PERMIT COMPLIANCE REQUIREMENTS

- A. The Contractor shall comply with all conditions of permits and crossing agreements obtained by the Owner or required to be obtained by the Contractor, including but not limited to:
 - 1. FDEP.
 - 2. SFWMD.

END OF SECTION

SECTION 01400 QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

A. General

1. This Section defines the minimum requirements for the Quality Assurance (QA) Program to be provided by the Contractor. The deliverable documents are defined along with the method of execution of the QA Program.
2. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve the Contractor of responsibility for compliance with the Contract Document requirements.
3. Specified tests, inspections, and related actions do not limit the Contractor's Quality Control (QC) procedures that facilitate compliance with the Contract Documents.

B. Definitions

1. QA Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with Contract requirements.
2. QC Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with the Contract requirements.

C. Payment

1. Separate payment will not be made for providing and maintaining an effective QA and QC Program, and all costs associated with such a program shall be included in the applicable unit prices, lump-sum prices, or allowances contained in the Contract Price Breakdown.

1.02 WORK SEQUENCE

- ##### A.
- Where reference is made to a particular standard, the revision in effect at the time of Bid opening shall apply except where a specific date is established.

- B. For products or workmanship specified by association, trades, or other consensus standard, the Contractor shall comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable code.
- C. If specified reference standards conflict with the Contract Documents, the Contractor shall request clarification from the Engineer before proceeding.

1.03 QUALITY ASSURANCE

- A. The Contractor shall install all materials and equipment in a neat and first-class workman-like manner.
- B. The Contractor shall replace all existing paving, stabilized earth, curbs, driveways, sidewalks, fences, signs, and other improvements with the same type of material that was removed during construction or as directed by the Engineer without an increase in the Contract Price or Contract Time.
- C. The Engineer shall recommend to the Owner the removal and replacement of any items that, in the Engineer's opinion, do not present an orderly and reasonably neat or workman-like appearance, provided such an orderly installation can be made using customary trade methods. The removal and replacement shall be done when directed in writing by the Engineer at the Contractor's expense and without additional expense to the Owner.

1.04 TOLERANCES

- A. Monitor tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. If manufacturers' tolerances conflict with the Contract Documents, request clarification from the Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.05 FIELD SAMPLES

- A. The Contractor shall furnish field samples at the site as required by individual Specifications Sections for review.
- B. Acceptable samples represent a quality level for the Work.

- C. Where a field sample is specified in individual sections to be removed, the Contractor shall clear the area after the field sample has been accepted by the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor is responsible for QC and shall establish and maintain an effective QC system in compliance with the Contract Documents. The QC system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract requirements. The system shall cover all Work and shall be keyed to the proposed design and construction sequence. The Project QC Officer shall be responsible for the quality of work on the Project and is subject to removal by the Engineer for non-compliance with quality requirements specified in the Contract. The Project QC Officer in this context shall mean the individual with responsibility for the overall management of the Project quality.

3.02 QUALITY CONTROL PLAN

- A. General: Not later than 30 calendar days after receipt of Notice to Proceed, the Contractor shall furnish for review by the Engineer the QC Plan proposed to implement the requirements of the Contract. The Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. The Engineer will consider an interim plan for the first 30 calendar days of operation.
- B. Content of the QC Plan: The QC Plan shall include, at a minimum, the following to cover all on-site and off-site construction operations, including work by subcontractors, fabricators, suppliers, and purchasing agents:
 - 1. A description of the QC organization including a chart showing lines of authority for all aspects of the Work specified. The staff shall include a QC Officer who shall report to the Project Manager or executive.
 - 2. The name, qualifications (in résumé format), duties, responsibilities, and authorities of each person assigned a QC function.
 - 3. A copy of the letter to the Quality Control Officer signed by an authorized official of the Contractor that describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the Quality Control Officer, including authority to stop work which is not in compliance with the Contract.

4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, off-site fabricators, suppliers, and purchasing agents.
 5. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures will verify that identified deficiencies have been corrected.
 6. Reporting procedures, including proposed reporting formats.
- C. Acceptance of the Plan: Acceptance of the Contractor's QC Plan is required before the start of Work. Acceptance is conditional and will be predicated on satisfactory performance during the Work. The Engineer reserves the right to require the Contractor to make changes in its QC Plan and operations, including removing personnel as necessary to obtain the quality specified.
- D. Notification of Changes: After acceptance of the QC Plan, the Contractor shall notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

3.03 SUBMITTALS

- A. Submittals shall be made as specified in Section 01330, Submittals and Acceptance. The QC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements.

3.04 TESTS

- A. Testing Services
1. All tests to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to the Owner. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped, and fully qualified to perform the tests in accordance with the specified standards.
 2. Testing services provided by the Owner are for the sole benefit of the Owner; however, test results shall be available to the Contractor. Testing necessary to satisfy the Contractor's internal QC procedures shall be the sole responsibility of the Contractor.
 3. When necessary, the Contractor shall interrupt its Work for Owner sampling and testing. The Contractor shall have no claim for increase in Contract Price or Contract Time due to such interruption. The Contractor shall cooperate in these testing activities as needed.
 4. Testing, including sampling, will be performed by the testing firm's laboratory personnel in the general manner indicated in the Specifications.

- B. Transmittal of Test Reports: Written reports of tests and engineering data furnished by the Contractor for the Engineer's review shall be submitted as specified for Shop Drawings.
- C. Manufacturer's Field Services
 - 1. The manufacturer's field services will be specified in the respective equipment sections.
 - 2. An experienced, competent, and authorized representative of the manufacturer of each item of equipment for which field services are indicated shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed into operation. The manufacturer's representative shall revisit the site as often as necessary until any and all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of the Engineer.
 - 3. Each manufacturer's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchor bolts, has been operated under full load conditions, and has operated satisfactorily.

3.05 COMPLETION INSPECTION

- A. Final Completion Punch List: Near the completion of all Work, the QC Officer shall inspect the Work and develop a "punch list" of items that do not conform to the approved Drawings and Specifications. Such a list of deficiencies shall be included in the QC documentation and shall include the estimated date by which the deficiencies shall be corrected. The QC Officer or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Engineer that the Facility is ready for the Engineer's final inspection.
- B. Final Inspection and Acceptance: The Contractor's QC Officer and the Engineer will be in attendance at this inspection. Additional Engineer personnel may also be in attendance. The Final Acceptance inspection will be formally scheduled by the Engineer when all punch list deficiencies have been corrected. Notice shall be given to the Engineer at least 14 days before the final inspection and must include the Contractor's assurance that all punch list items will be complete and acceptable by the date scheduled for the final inspection. Failure of the Contractor to have all Contract Work acceptably complete for this inspection will be cause for noncertification of final payment by the Engineer.

3.06 NOTIFICATION OF NONCOMPLIANCE

- A. The Engineer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor, shall be deemed sufficient for the purpose of notification. The Contractor shall reply to the Notice of Noncompliance with specific steps being taken to return to compliance and any corrective actions necessary to correct defective Work. If the Contractor fails or refuses to comply promptly, the Engineer may issue an order stopping all or part of the Work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

3.07 REPAIR AND PROTECTION

- A. On completion of testing, inspection, sampling, and similar services, the Contractor shall repair damaged construction and restore substrates and finishes.
- B. The Contractor shall protect all construction exposed by or for QC service activities.
- C. Repair and protection are the Contractor's responsibilities, regardless of the assignment of responsibility for QC services.

END OF SECTION

SECTION 01450
TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall engage the services of a soil and geosynthetics laboratory to perform construction quality control (CQC) testing including but not limited to soil density and moisture content, concrete compressive strength, and geosynthetic conformance. Testing necessary to satisfy the Contractor's quality control procedures shall be the sole responsibility of the Contractor in accordance with Section 01400, Quality Requirements.
- B. The Engineer may request sampling and testing in addition to that performed by the Contractor. Failed tests will be back-charged to the Contractor at the time of final payment. All soil and concrete testing shall be coordinated with the Engineer and the laboratory and scheduled by the Contractor. The Owner may select an independent laboratory for Owner-paid testing.
 - 1. The Contractor shall cooperate with the Engineer and the laboratory to facilitate the execution of required services.
 - 2. The Engineer shall approve the selection of the testing laboratory.
 - 3. Employment of a testing laboratory shall in no way relieve the Contractor of the obligation to perform work in accordance with the requirements of the Contract Documents.
 - 4. Testing services may be required by the Engineer for the sole benefit of the Owner and to verify the quality of the work. Owner test results shall be available to the Contractor upon request. If deficient work is discovered, the Contractor shall remedy defective work. The Contractor may retest the defective work discovered by Owner testing.

1.02 RELATED WORK

- A. Conditions of the Contract: Inspections and testing required by laws, ordinances, rules, regulations, orders, or approvals of public authorities.
- B. Respective Sections:
 - 1. Certification of products.
 - 2. Laboratory tests required and standards for testing.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Submit to the Engineer for review a list and schedule of all tests to be conducted.
- C. Describe test procedures along with the duration of tests.
- D. After each inspection and test, the Laboratory shall promptly submit two copies of the laboratory report to the Engineer, one copy to the Contractor, and one copy to the Owner.
- E. Include the following:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of field testing technician or inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and Specifications Section.
 - 6. Location in the Project.
 - 7. Type of inspection or test.
 - 8. Date of test.
 - 9. Results of test.
 - 10. Conformance with Contract Documents.
- F. When requested by the Engineer, provide interpretation of test results.

1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - 2. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.05 QUALITY ASSURANCE

- A. The Laboratory is not authorized to do any of the following:
1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Approve or accept any portion of the Work.
 3. Perform any duties of the Engineer of Record or the Engineer.
- B. The Contractor shall be responsible for the following:
1. Cooperating with laboratory personnel, providing access to work and to manufacturer's operations.
 2. Securing and delivering to the laboratory adequate quantities of representative samples of materials proposed to be used and that require testing.
 3. Providing to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes that require control by the testing laboratory.
 4. Furnishing incidental labor and facilities:
 - a. To provide access to Work to be tested.
 - b. To obtain and handle samples at the project site or at the source of the product to be tested.
 - c. To facilitate inspections and tests.
 - d. To store and cure test samples.
 5. Notifying the Engineer and laboratory sufficiently in advance of operations to allow the laboratory time to assign personnel and schedule tests.
 6. Employing and paying for the services of the same or a separate, equally qualified independent testing laboratory to perform additional inspections, sampling, and testing required for the Equipment Supplier or Contractor's (as applicable) convenience.
- C. Materials and equipment used in the performance of Work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. Standard requirements for quality and workmanship are indicated in the Contract Documents. The Engineer may require the equipment supplier or Contractor (as applicable) to provide statements or certificates from the manufacturers and fabricators that the materials and equipment provided by them are manufactured

or fabricated in full accordance with the standard specifications for quality and workmanship indicated in the Contract Documents. All costs of this testing and providing statements and certificates shall be a subsidiary obligation of the Contractor, and no extra charge to the Owner shall be allowed on account of such testing and certification.

- D. If the test and any subsequent retest results indicate that the materials or equipment fail to meet the requirements of the Contract Documents, the equipment supplier or Contractor (as applicable) shall pay for the laboratory costs.

1.06 QUALIFICATIONS

- A. Laboratory: Licensed to operate in Florida.
- B. Laboratory Staff: Maintain a full-time Florida-registered Professional Engineer on staff to review the services performed under this project.
- C. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards (NBS) or accepted values of natural physical constants.
- D. Provide qualified personnel at the site. Cooperate with the Engineer and Contractor in performing services.
- E. Perform specified inspection, sampling, and testing of products in accordance with specified standards.
- F. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- G. Promptly notify the Engineer and Contractor of observed irregularities or non-conformance of Work or Products.
- H. Perform additional inspections and tests required by Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 RESPONSIBILITY

- A. This Section specifies the minimum requirements for temporary facilities, utilities, and controls required to provide an adequate and safe work site at every stage during construction of the Project. The Contractor is solely responsible for the requirements set forth in this Section.

1.02 ONSITE TEMPORARY

- A. Except as otherwise indicated, the Contractor may, at his option, furnish stand-alone utility plants to provide needed services in lieu of connected services from available public utilities, provided such stand-alone plant facilities comply with all governing regulations. Before availability of temporary utility services, the Contractor will provide trucked-in/trucked-out containerized or unitized services for start-up of construction operations at the site.

1.03 COSTS

- A. Except as otherwise indicated, the costs of providing and using temporary utility services are included in the contract sum.

1.04 TEMPORARY FACILITIES

- A. The types of utility services required for temporary use at the project site include the following (other specific services may be required for specific construction methods of operations):
 - 1. Electrical Power Service.
 - 2. Water Service (potable for certain uses).
 - 3. Sanitary.
 - 4. Storm Sewer or Open Drainage/Run-off Control.
 - 5. Gas (fuel) Service.
 - 6. Telephone Service.

1.05 TEMPORARY ELECTRICITY

- A. The Contractor shall make the necessary applications and arrangements and pay all fees and charges for electrical energy for power and light necessary for proper

completion of the Work and during its entire progress up to time of final acceptance by the Owner. The Contractor shall provide and pay for all temporary switches, connections, and meters.

1.06 TEMPORARY WATER

- A. The Contractor shall make all necessary application and arrangements and pay all fees and charges for water necessary for the proper completion of the Project up to the time of final acceptance. The Contractor shall provide and pay for any temporary piping and connections.

1.07 TEMPORARY SANITARY FACILITIES

- A. The Contractor shall provide adequate sanitary facilities for the use of those employed on the Work. Such facilities shall be made available when the first employees arrive on the site of the Work, shall be properly secluded from public observation, and shall be constructed and maintained during the progress of the Work in suitable numbers and at such points and in such manner as may be required or approved.

1.08 CLEANLINESS OF FACILITIES

- A. The Contractor shall maintain the sanitary facilities in a satisfactory and sanitary condition at all times and shall enforce their use. He shall rigorously prohibit the committing of nuisances on the site of the Work, on the lands of the Owner, or on adjacent property.

1.09 TERMINATION AND REMOVAL

- A. At the time the need for a temporary utility service has ended or has been replaced by use of permanent services, or no later than the time of final completion, the Contractor shall promptly remove the installation unless requested by the Engineer to retain it for a longer period. Any work that may have been delayed or affected by the installation and use of the temporary utility, including repairs to construction and grades and restoration and cleaning of exposed surfaces, shall be completed at this time. The Contractor shall replace any work damaged beyond acceptable restoration.

1.10 NOISE CONTROL

- A. The Contractor shall provide adequate protection against objectionable noise levels caused by the operation of construction equipment.

1.11 DUST CONTROL

- A. The Contractor shall provide for adequate protection against raising objectionable dust clouds caused by moving construction equipment, high winds, or any other cause.

1.12 WATER CONTROL

- A. The Contractor shall provide for satisfactory disposal of surplus water and shall submit a plan to the Engineer for review before initiating and implementing the plan. Approval shall be obtained from the proper authorities before the use of public or private lands or facilities for such disposal.

1.13 POLLUTION CONTROL

- A. The Contractor shall provide for adequate protection against polluting any public or private lands, lakes, ponds, rivers, streams, creeks, and other such areas by the disposal of surplus material in the form of solids, liquids, gases, or from any other cause.

1.14 ADVERSE IMPACT

- A. The Contractor shall evaluate and assess the impact of any adverse effects on the natural environment that may result from construction operations and shall operate to minimize pollution of air, ground, or surface waters vegetation, and afford the neighboring community the maximum protection during and up to completion of the construction project.

1.15 STREAMS, LAKES, AND OTHER BODIES OF WATER

- A. The Contractor shall take sufficient precautions to prevent pollution of streams, lakes, and reservoirs with fuels, oils, bitumens, calcium chloride, or other harmful materials. He shall conduct and schedule his operations to avoid or otherwise prevent pollution of siltation of streams, lakes, and reservoirs and to avoid interference with the movements of migratory fish.

1.16 CHEMICALS

- A. All chemicals used during project construction or furnished for project operation, whether herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in strict conformance with instructions.

1.17 EROSION CONTROL

- A. The Contractor shall not expose by construction operations a larger area of erosive land at any one time than the minimum necessary for efficient construction operations, and the duration of exposure of the uncompleted construction to the elements shall be as short as practicable. Erosion-control features shall be constructed concurrently with other work and at the earliest practicable time.

1.18 STORAGE FACILITIES

- A. All products, materials, and equipment shall be stored in accordance with the manufacturer's instructions, with seals and labels intact and legible. Products subject to damage by the elements shall be stored in weathertight enclosures. Temperature and humidity shall be maintained within the ranges required by the manufacturer's instructions. Fabricated products shall be stored above the ground on blocking or skids. Products that are subject to deterioration shall be covered with impervious coatings with adequate ventilation to avoid condensation. Loose granular materials shall be stored in a well-drained area on solid surfaces to prevent mixing with foreign matter. Any products that will come in contact with water shall be stored off the ground to prevent contamination.

1.19 INSPECTION

- A. Storage shall be arranged in such a manner to provide easy access for inspection. Periodic inspections shall be made of all stored products to ensure that they are maintained under specified conditions and free from damage or deterioration.

1.20 TEMPORARY PROTECTION

- A. After installation, the Contractor shall provide substantial coverings as necessary to installed products to protect them from damage from traffic and subsequent construction operations. Coverings shall be removed when no longer needed.

1.21 ADJACENT TO WORK

- A. The Contractor shall protect from damage all property along the line of the Work or in the vicinity of or in any way affected by the Work, the removal or destruction of which is not called for by the Drawings. Wherever such property is damaged due to the activities of the Contractor, it shall be immediately restored to its original condition by the Contractor at no cost to the Owner.

1.22 REMEDY BY OWNER

- A. In case of failure on the part of the Contractor to restore such property or make good such damage or injury, the Owner may, after 48 hours' notice to the Contractor, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary and the cost of such repairs, rebuilding, or restoration will be deducted from any monies due or which may become due to the Contractor under this Contract.

1.23 PROTECTION FROM DAMAGE

- A. The Contractor shall be responsible for protecting property in the areas in the vicinity of the Project and for protecting his equipment, supplies, materials, and work against any damage resulting from the elements, such as flooding, rainstorm, wind damage, or other such damage, and shall be responsible for damage resulting from the same. The Contractor shall provide adequate drainage facilities, tie-downs, or other protection throughout the contract period for the protection of his, the Owner's, and other properties from such damage.

1.24 TRAFFIC REGULATION

- A. Signs, marking barricades, and procedures shall conform to the requirements of the Florida Department of Transportation Manual on Traffic Controls and Safe Practices for Street and Highway Construction, Maintenance, and Utility Operations.

1.25 SIGNAGE

- A. The Contractor shall provide and maintain adequate barricades around open excavations.

1.26 REMOVAL OF SIGNAGE

- A. On completion of the Work, the Contractor shall remove all debris, excess materials, barricades, and temporary work, leaving walkways and roads clear of obstructions.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01520
FIELD OFFICES

PART 1 GENERAL

- A. Within 2 weeks after starting work, the Contractor shall provide a minimum of one field office trailer including space for use of the Owner and Owner's representatives. The Contractor shall maintain the field office until the completion of the work to be done under this Contract.
1. The field office shall be a minimum 8 feet by 28 feet. The Owner's space within the field office shall be a minimum of 8 feet by 8 feet, unless otherwise approved by Owner.
 2. Installation of the field office shall meet all local codes and ordinances. At a minimum, the Contractor shall install the structure on a level, well-drained area and secure it against wind in accordance with applicable requirements of the Florida Building Code and ASCE-7.
 3. The field office shall be provided with structurally sound and safe steps and landings for each door. The doors shall have secure locks.
 4. The field office shall be designated as a "No Smoking Area."
 5. The windows shall be arranged for cross ventilation with screens.
 6. The Contractor shall provide air conditioning and heating systems with thermostat control.
 7. The Contractor shall provide electric power for the duration of the Project.
 8. On completion of the Project, the Contractor shall remove the field office and all such temporary facilities from the site at a time discussed and agreed to with the Owner. The Contractor shall remove foundations and debris, remove any temporary pavement, compacted ground, or base materials (such as limerock or stabilized soils created by the Contractor for construction parking or storage), grade the site to required elevations, sod all disturbed areas, and clean and remove all trash and debris. Ensure the soil permeability for stormwater drainage is equivalent to preconstruction conditions or as required by the Contract Documents.
- B. In general, at a minimum the Contractor shall provide the following:
1. Electric lights (50-foot candles at desktop height) and power supply outlets (minimum of four).
 2. High-speed Internet access with a Wi-Fi router for wireless access and a Wi-Fi password made available to the Owner.
 3. Complete toilet facilities within the field office acceptable to the Owner that meet all local and State health codes and regulations including appropriate restroom signage.

4. Fire extinguisher (Halon type, minimum 4-pound capacity).
5. Water coolers, bottled water, and paper cups for the duration of the Project.
6. Table for viewing the Project Drawings.
7. Office furnishings, as described in Article 1.05 below.
8. File cabinets, storage, bookcases, as described in Article 1.05 below.
9. Standard office supplies.
10. Miscellaneous field supplies, as described in Article 1.05 below.
11. Weekly janitorial services.

1.02 REFERENCE STANDARDS

- A. Comply with all federal, state, and local codes including the National Electric Code, OSHA, FLOSHA, Florida Building Code, and ASCE-7.
- B. Comply with all General Industrial standards and regulations, including but not limited to AWWA, ANSI, NEMA, IEEE, ASHRAE, UL, etc.

1.03 SPECIFIC REQUIREMENTS

Unless otherwise noted, the quantity shall be sufficient for the duration of the Project.

- A. Office Furnishings/Equipment: The following furnishings and equipment shall be delivered and placed subject to Owner approval:
 1. Owner's Space: One office desk and chair with two guest chairs. Chairs shall be adjustable height and on rollers with arm rests.
 2. Chairs in common space: Eight desk-type chairs, adjustable heights, on rollers, with armrests.
 3. Drawing Table: One plywood or standard drawing tables, 3 feet by 6 feet, with all required appurtenances.
 4. Printer/Copier: One color copier capable of copying, scanning, and printing pages up to and including 11-inch-x-17-inch paper size. All warranties, maintenance, and servicing for the duration of the Work. Sufficient appropriate ink/toner cartridges and paper for the Owner or the Owner's Representatives to print thirty 11-inch-x-17-inch or sixty 8-1/2-inch-x-11-inch color prints per week for the duration of the Work in addition to the Contractor's printing needs.
 5. One each: 4.0-cubic-foot or larger refrigerator, microwave, coffee machine, and toaster oven.
 6. Other furnishings, storage, or equipment deemed necessary by the Contractor.

B. Miscellaneous Field Supplies

1. One minimum/maximum digital thermometer with batteries for the duration of the Work.
2. Broom, dustpan, and brush.
3. One rain gauge.
4. One 36-inch-x-72-inch table and eight folding chairs.
5. Large wastebasket.
6. Wall clock.

1.04 ELECTRICITY, LIGHTING

- A. The Contractor shall obtain and pay for utilities including electrical facilities and water and sanitary facilities. Connections to existing facilities will not be allowed unless properly metered and protected.

1.05 SANITARY FACILITIES

- A. The Contractor shall provide suitable and adequate toilet facilities for all employees, subject to the approval of the Owner as to the type, size, and location.
- B. The facilities shall be maintained in a sanitary condition, frequently cleaned and disinfected, and promptly removed from the site when directed by the Owner.

1.06 FIRST AID

- A. The Contractor shall provide a completely equipped first-aid kit that shall be maintained in a clean and orderly condition in the field office.
- B. Telephone numbers for summoning aid from the Police Department, Fire Department, physicians, ambulances, inhalator, and rescue squads from outside sources shall be conspicuously posted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01600 MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SCOPE OF WORK

This Section includes the minimum requirements for the furnished materials and equipment for this project. The more stringent requirements in the Technical Specification sections shall take precedence over these requirements for any conflicts.

- A. Materials and equipment furnished by the Contractor shall be new and shall not have been in service at any other installation unless otherwise approved. They shall conform to applicable specifications approved in writing by the Engineer.
- B. Manufactured and fabricated products shall be designed, fabricated, and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gauges so as to be interchangeable.
- C. Quantities of items that are identical shall be by the same manufacturer, regardless of the Design Package breakdown.
- D. Equipment sizes, capacities, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.
- E. Materials and equipment shall not be used for any purpose other than that for which they are designed or specified.
- F. Where materials are specifically shown or specified to be reused in the Work, special care shall be used in removing, handling, storing, and reinstalling.
- G. Material and equipment incorporated into the Work:
 - 1. Shall conform to applicable specifications and standards.
 - 2. Shall comply with size, make, type, and quality specified or as specifically approved in writing by the Engineer.
 - 3. Manufactured and fabricated products:
 - a. Rotating machinery shall be designed and fabricated to provide satisfactory operation without excessive wear and without

excessive maintenance during its operating life. Rotating parts shall be statically and dynamically balanced and shall operate without excessive vibration.

1.02 ACCEPTANCE OF MATERIAL AND EQUIPMENT

- A. Only new materials and equipment shall be incorporated in the Work unless otherwise specified to be reused. All materials and equipment furnished by the Contractor shall be subject to the inspection and acceptance of the Engineer. No material shall be delivered to the site that does not meet the Contract Specifications.
- B. The Contractor shall submit data and samples sufficiently early to permit consideration and acceptance before materials are necessary for incorporating in the work. Any delay of acceptance resulting from the Contractor's failure to submit samples or data promptly shall not be used as a basis of claim against the Owner.
- C. The materials and equipment used in the Work shall correspond to the approved samples or other data.
- D. If requested, the Contractor shall be required to submit to the Engineer ample evidence that each and every part of the materials, machinery, and equipment to be furnished is of a reliable make and of a type that has been in successful operation within the continental United States. No equipment will be considered unless the manufacturer has designed and manufactured equipment of a comparable type and size for at least 3 years. The Engineer will not allow any experimental or untried type of material or machinery to be installed.
- E. The equipment specified shall be carefully designed and installed to ensure that it adequately performs all required functions within the specified degree of precision. Each unit shall operate with each of the other parts of the equipment to provide a completely integrated system that shall operate to the satisfaction of the Engineer.
- F. All equipment, machinery, parts, and assemblies of equipment, machinery, or parts entering into the Work shall be tested as specified. Unless waived in writing by the Engineer, all field and operating tests shall be made in the presence of the Engineer or the Engineer's authorized representative. When such a waiver is issued, the Contractor or manufacturer shall furnish sworn statements in duplicate of the tests conducted and the results of the tests to the Engineer.

1.03 MANUFACTURER'S INSTRUCTIONS FOR INSTALLATION

- A. The equipment installation details shall suit the existing and furnished equipment and are subject to acceptance by the Engineer.
- B. Any changes or revisions made necessary by the type and dimensions of the equipment furnished shall be made at the expense of the Contractor who shall furnish detailed drawings showing such changes or revision for the acceptance of the Engineer.
- C. The installation of all work shall comply with the manufacturer's printed instructions. The Contractor shall obtain and distribute copies of such instructions to parties involved in the installation, including six copies to the Engineer for distribution. One complete set of instructions shall be maintained at the job site during installation and until the Project is complete.
- D. All products and equipment shall be handled, installed, connected, cleaned, conditioned, and adjusted in accordance with the manufacturer's instructions and specified requirements. Should job conditions or specified requirements conflict with the manufacturer's instructions, such conflicts shall be called to the Engineer's attention for resolution and revised instructions.
- E. The Contractor shall perform work according to the manufacturer's instructions and not omit any preparatory step or installation procedure unless the instructions are specifically modified or the step or procedure exempted by the Contract Documents.

1.04 INSTALLATION OF EQUIPMENT

- A. The cost of the Work shall include the cost of competent manufacturers' representatives of all equipment to supervise the installation, adjustment, and testing of the equipment as required elsewhere in the specifications and to instruct the Owner's operating personnel on operation and maintenance.
- B. A certificate from the manufacturer stating that the installation of the equipment is satisfactory, that the unit has been satisfactorily tested, is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication, and care of the unit shall be submitted before Substantial Completion. The Manufacturer's Certificate of Compliance and Equipment Manufacturer's Certificate of Installation Testing and Instruction are included in Section 11000, General Equipment Requirements.
- C. The Contractor shall furnish the service of competent manufacturers' representatives for Contractor furnished equipment when evident malfunction or

over-heating makes such services necessary or as determined by the Engineer. All such equipment shall be installed by skilled mechanics and in accordance with the instructions of the manufacturer.

- D. Special care shall be taken to ensure proper alignment of all equipment with particular reference to mechanical equipment such as pumps. These units shall be carefully aligned on their foundations by qualified millwrights after their sole or base plates have been shimmed to true alignment at the anchor bolts. The anchor bolts shall be set in place and the nuts tightened against the shims. After the manufacturer has approved the foundation alignments, the bedplates or wing feet of the equipment shall be securely bolted in place. The alignment of equipment shall be further checked after securing to the foundations. After all alignments are confirmed, the sole or base plates shall be finally grouted in place. The Contractor shall be responsible for the exact alignment of equipment with associated piping, and under no circumstances will "pipe springing" be allowed. Special installation requirements in the Technical Specifications shall take precedence over the requirements of this Section.
- E. The Contractor shall furnish all wedges, shims, filling pieces, keys, packing, grout, or other materials necessary to properly align, level, and secure an apparatus in place. All parts intended to be plumb or level must be proven exactly so. Any grinding necessary to bring parts to proper alignment after erection shall be done at the expense of the Contractor.
- F. The Contractor shall furnish the necessary materials and construct suitable concrete foundations or pads for all equipment installed by the Contractor, even though such foundations or pads may not be indicated on the Drawings. The tops of foundations shall be at such elevations as will permit grouting.
- G. In setting pumps the Contractor shall make an allowance of at least 1 inch for grout under the equipment bases. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and as inconspicuous as possible in the completed work. Unless otherwise permitted, all grout shall be a suitable non-shrinking grout.
 - 1. Grout shall be mixed and placed in accordance with the recommendations of the manufacturer. Where practicable, the grout shall be placed through the grout holes in the base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.
 - 2. Where such procedure is impracticable, the method of placing grout shall be as permitted. After the grout has hardened sufficiently, all forms, hoppers, and excess grout shall be removed, and all exposed grout

surfaces shall be patched in an approved manner and, if necessary, as required by the Engineer, and given burlap-rubbed finish.

1.05 SPECIAL TOOLS

- A. Manufacturers of equipment and machinery shall furnish two sets of any special tools (including grease guns or other lubricating devices) required for normal adjustment, operations and maintenance, and disassembly, together with instructions for their use. The Contractor shall preserve and deliver to the Engineer these tools and instructions in good order before completing the Contract. Tools shall be high-grade, smooth, forged, alloy tool steel. Grease guns shall be lever-type.
- B. Special tools are considered to be those tools that because of their limited use are not normally available but that are necessary for the particular equipment.
- C. Special tools shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such special tools until completion of the work, at which time they shall be delivered to the Engineer.

1.06 LUBRICATION SYSTEM

- A. The minimum design criteria for lubricating moving parts of the equipment shall include 1 week of continuous operation during which no lubricants shall be added to the system.
- B. The system shall be designed to receive lubricants whether in operation or shut down and shall not leak or waste lubricants under either condition. The manufacturer's recommendations of grade and quality and a supply of the lubricants so recommended in quantities sufficient to conduct start-up and testing operations shall be furnished with the equipment. The Contractor shall provide a 1-year supply of each required lubricant.

1.07 TESTS AND TEST REPORTS

- A. When used in the Contract Documents, "Factory/Fabricating Shop Performance, Evaluation, Certification, and/or Acceptance Tests and Test Reports" shall be considered to mean the corresponding manufacturer's, fabricator's, and/or other builder's official test and tests reports. Included in these test reports shall be appropriate substantiating documentation/data ascertaining the correct and complete manufacture, fabrication, and "shop performance" (to the greatest extent normally practicable) of the particular material, equipment, system, and/or facilities proposed for eventual delivery. These are subdivided into three significant tests and test report types: 1) Certification Tests and Test Reports,

2) Factory Tests and Test Reports, and 3) Shop Performance/Evaluation Tests and Test Reports. Minimal requirements are described below.

B. Certification Tests and Test Reports

1. Standard specifications, code references, etc. for minimum quality and workmanship levels are indicated in the Contract Documents and Construction Documents. Statements, certificates, and other substantiating reporting data, called "Certification Test Reports" in this Section, of tests conducted on previously manufactured materials or equipment identical to that proposed for use shall be compiled by the Contractor.
2. At a minimum, all Certification Test Reports shall contain an official analysis of sufficient material composition or show evidence of meeting or exceeding the specified material standard(s) referenced, e.g., ASTM, ASME, or other designations. All reports shall also indicate from whom the material was/will be purchased.
3. The Contractor shall pay all costs of certification tests and test reports.

C. Factory Tests and Test Reports

1. Additional tests and reports performed on material or equipment by the manufacturer or fabricator to ascertain quality or workmanship are referred to here as "Factory Tests and Test Reports."
2. Before the delivery of any Factory Test Report, the Contractor shall first submit for review and approval a detailed description of the proposed testing, including reporting procedure and criteria. Such descriptions shall also be delivered to the Engineer for review as part of the first submission of the technical submittal.
3. Materials and equipment used in the performance of the Work under this Contract are subject to inspection and testing at the point of manufacture or fabrication. If Work to be accomplished away from the construction site is to be inspected on behalf of the Owner during its fabrication or manufacture, the Contractor shall give prior notice to the Engineer of the place and time where such fabrication or manufacture is to be done. Such notice shall be in writing and delivered to the Engineer not less than 30 days before the Work is to be done so that the necessary arrangements for the particular factory inspection tests can be made.
4. Upon completion of the factory inspection tests and immediately following manufacture or fabrication, the Contractor shall compile a complete Factory Test Report following the approved format above. All such reports shall be delivered to the Engineer for review as part of the technical submittal corresponding to such tested material or equipment.

D. Shop Performance/Evaluation Tests and Test Reports

1. Material and equipment used in the performance of the Work of this Contract are also subject to evaluation and testing after the complete full-scale assembly into major equipment and/or systems. Shop Performance/Evaluation Tests, i.e., tests of simulated startup, steady-state, variable loading, and other normal operating conditions, for such assembled equipment/systems shall be accomplished in strict accordance with the standard testing practices specified or otherwise accepted by the Engineer.
2. Before the delivery of any Shop Performance/Evaluation Test Report, the Contractor shall submit for review a detailed description of the proposed performance/evaluation tests, including anticipated reporting procedures, data reduction, and criteria used. Where appropriate, such descriptions shall also be delivered to the Engineer for review as part of a first or subsequent submission of the technical submittal.
3. Should such performance/evaluation tests be accomplished away from the construction site, the Contractor shall give prior notice to the Engineer of the places and times where such tests will be accomplished. Such prior notice shall be in writing and delivered not less than 30 days before such events so that necessary arrangements for the particular tests can be made.
4. The requirements above pertaining to Factory Tests and Test Reports shall be incorporated for shop Performance/Evaluation Tests and Test Reports. Unless factory tests are coincident with shop performance tests and vice versa for the same material or equipment, a minimum of 15 days shall be scheduled between such multiple equipment tests where extended travel is required.

E. Cost of Performance Shop Tests

1. The Contractor shall conduct shop performance full-scale tests at its expense on all equipment as specified. Each piece of equipment shall be tested completely assembled and the shop tests performed by the equipment manufacturer until successful tests are achieved.
2. If the performance tests are conducted outside the continental United States, the Contractor shall pay all transportation expenses incurred by the Owner's representatives in witnessing the tests at no additional cost to the Owner.

1.08 FIELD TESTING

- A. Field testing shall be conducted when called for in the Technical Specification Sections and on all completed systems in general. The Contractor shall provide services of a factory-authorized service representative to perform, approve, and certify the field testing specified in this Section. Field testing shall generally

consist of performing the pre-startup and startup tests as specified in the Division 11 Specifications and the final mechanical performance test specified in Section 11000, General Equipment Requirements. The Contract Documents may require the Contractor to perform factory testing on equipment items before the Engineer approves their use for this project. The Contractor shall refer to the Division 11 Specifications regarding equipment shop testing requirements.

- B. After completing the installation, the Contractor shall test the system in the presence of the Engineer and under actual operating conditions. Tests shall be performed according to the manufacturer's recommendations.
- C. The Contractor shall include with its bid the services of the equipment manufacturer's field service technician for a period necessary to complete the Work to the satisfaction of the Engineer.
- D. This service shall be for the purposes of checkout, initial start-up, certification, and instruction of facilities personnel.
- E. A written report covering the technician's findings and installation approval shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

1.09 ACCEPTANCE OF INSTALLATION

- A. The Engineer may accept an equipment system installation as ready for Substantial Completion when:
 - 1. The Engineer has accepted all factory tests and all other component testing.
 - 2. The Engineer has accepted all performance shop tests.
 - 3. All components of the system are installed and tested, including without limitation hydrostatic tests, leak tests, continuity tests, insulation resistance tests, phase rotation tests, bump tests, stroke testing, calibration, adjustment for proper operation, and all other component tests as appropriate.
 - 4. Field start-up activities have been completed and approved by the Engineer.
 - 5. The appropriate certificates have been submitted.
 - 6. All equipment has met the performance requirements.
 - 7. The Engineer has accepted integrated system tests and adjustments performed by the Contractor to demonstrate that the system as a whole functions reliably and meets the performance requirements, in manual and automatic modes, without failure, fault, or defect of any component or of the system as a whole.

8. The Engineer has accepted integrated facilities tests performed by the Contractor to demonstrate that the entire Construction functions together reliably as an integrated facility and meets the performance requirements, in manual and automatic modes, without failure, fault, or defect of any component.
9. The Engineer has accepted facility performance tests that demonstrate that the design criteria and performance criteria are met.
10. The Engineer has accepted the O&M Manuals.
11. All required Owner personnel have been trained.
12. All other Contract requirements for Substantial Completion have been satisfied.

1.10 ELECTRICAL EQUIPMENT ENCLOSURES

- A. All items of electrical equipment that are furnished with process, or other equipment shall conform to the requirements specified under Section 16401, Low-Voltage Electrical Work—General Requirements. Enclosures for electrical equipment, such as switches and starters, shall conform to the requirements specified under Section 16401, Low-Voltage Electrical Work—General Requirements.

1.11 EQUIPMENT DRIVE GUARDS

- A. Screens, guards, or cages shall be provided for all exposed rotating or moving parts in accordance with accepted practices of applicable governmental agencies. Unless specified otherwise in the technical sections, guards shall be constructed of galvanized sheet steel or galvanized woven wires or expanded metal set in a frame of galvanized steel members. Guards shall be secured in position by steel braces or straps that will permit easy removal for servicing the equipment.

1.12 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous-impregnated felt, heavy -bituminous coatings, nonmetallic separators or washers, or other acceptable materials.

1.13 SLEEVES

- A. Unless otherwise indicated on the Drawings or specified, openings for the passage of pipes through floors and walls shall be formed of sleeves of standard-weight, galvanized-steel pipe. Each sleeve shall be of ample diameter to pass the pipe and its insulation, if any, and to permit such expansion as may occur. Sleeves shall be

of sufficient length to be flush at the walls and the bottom of the slabs and to project 2 inches above the finished floor surface. Threaded nipples shall not be used as sleeves.

1.14 SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. The Contractor shall arrange for a qualified service representative from each company manufacturing or supplying certain equipment as listed in this Section (or in the respective Technical Specification sections) to perform the duties described in this Section.
- B. After the listed equipment has been installed and the equipment is presumably ready for operation but before it is operated by others, the representative shall inspect, operate, test, and adjust the equipment. The inspection shall include but not be limited to the following points as applicable:
 - 1. Soundness (without cracked, abraded, or otherwise damaged parts).
 - 2. Completeness in all details, as specified.
 - 3. Correctness of setting, alignment, and relative arrangement of various parts.
 - 4. Adequacy and correctness of packing, sealing, and lubricants.
- C. The operation, testing, and adjustment shall be as required to prove that the equipment is left in proper condition for satisfactory operation under the conditions specified.
- D. On completion of his or her work, the manufacturer's or supplier's representative shall submit in triplicate to the Engineer a complete, signed report of the result of the inspection, operation, adjustments, and tests. The report shall include detailed descriptions of the points inspected, tests and adjustment made, quantitative results obtained if such are specified, and suggestions for precautions to be taken to ensure proper maintenance. The report also shall include a certificate that the equipment conforms to the requirements of the Contract and is ready for permanent operation and that nothing in the installation will render the manufacturer's warranty null and void.
- E. After the Engineer has reviewed the reports from the manufacturer's representatives, the Contractor shall make arrangements to have the manufacturer's representatives present when the field acceptance tests are made in addition to training of the Owner's operation personnel.

F. The Contractor, at a minimum, shall arrange for the service of qualified service representatives from the companies manufacturing or supplying the following equipment and as required in the Technical Specifications:

1. Pumping Equipment.
2. Instrumentation and Control Systems.
3. Flow Meters.
4. Fiber Optic Communication System.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01650
DELIVERY, STORAGE, AND HANDLING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the general requirements for the delivery, handling, storage, and protection of all items required in the construction of the Work. Specific requirements, if any, are specified with the related item.

1.02 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in this Section for storing and protecting the items.
- B. The Contractor shall do the following:
 - 1. Materials and equipment shall be loaded and unloaded by methods affording adequate protection against damage. Every precaution shall be taken to prevent injury to the material or equipment during transportation and handling. Suitable power equipment shall be used and the material or equipment shall be under control at all times. Under no condition shall the material or equipment be dropped, bumped, or dragged. When a crane is used, a suitable hook or lift sling shall be used. The crane shall be so placed that all lifting is done in a vertical plane. Materials or equipment skid loaded, palletized, or handled on skidways shall not be skidded or rolled against material or equipment already unloaded.
 - 2. Material and equipment shall be delivered to the job site by means that will adequately support it and not subject it to undue stresses. Material and equipment damaged or injured in the process of transportation unloading or handling shall be rejected and immediately removed from the site.
 - 3. The Contractor shall coordinate the delivery of all materials, including those furnished by the Owner. The Contractor shall be responsible for the proper transport, handling, and storing of all materials, and materials shall be protected to ensure their expected performance. Delivery schedules shall be coordinated by the Contractor, in advance, so that the Work will be done in a timely manner.

4. The Contractor shall coordinate deliveries of products with construction schedules to avoid conflict with work and conditions at the site. The Contractor shall also do the following:
 - a. Deliver products in undamaged condition, in the manufacturer's original containers or packaging, with identifying labels intact and legible.
 - b. Immediately on delivery, inspect shipments to ensure compliance with requirements of the Contract Documents and approved submittals and to ensure that the products are properly protected and undamaged.
5. The Contractor shall provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.
6. All materials and equipment shall be stored on-site in complete compliance with the manufacturer's recommendations.
7. Store products subject to damage by the elements in weather-tight enclosures.
8. Maintain temperature and humidity within the ranges required by the manufacturer's instructions.
9. Store fabricated products above the ground, on blocking or skids to prevent soiling or staining. Cover products that are subject to deterioration with impervious sheet coverings, and provide adequate ventilation to avoid condensation.
10. All materials and equipment to be incorporated in the Work shall be handled and stored by the Contractor before, during, and after shipment in a manner that will prevent warping, twisting, bending, breaking, chipping, rusting, and any injury, theft, or damage of any kind to the material or equipment.
11. All materials which, in the opinion of the Owner, have become so damaged as to be unfit for the use intended or specified shall be promptly removed from the site of the Work, and the Contractor shall receive no compensation for the damaged material or its removal.
12. The Contractor shall arrange storage in a manner to provide easy access for inspection and make periodic inspections of stored products to ensure that products are maintained under specified conditions, free from damage or deterioration.

13. The Contractor shall provide substantial coverings as necessary to protect installed products from traffic damage and subsequent construction operations and shall remove these coverings when they are no longer needed.
14. Should the Contractor fail to take proper action on storage and handling of equipment supplied under this Contract, within 7 days after written notice to do so has been given, the Owner retains the right to correct all deficiencies noted in the previously transmitted written notice and deduct the cost associated with these corrections from the Contractor's Contract. These costs may include expenditures for labor, equipment use, administrative, clerical, engineering, and any other costs associated with making the necessary corrections.
15. Schedule delivery to reduce long-term onsite storage before installation and/or operation. Under no circumstances shall equipment be delivered to the site more than 1 month before installation without written authorization from the Owner.
16. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged, or sensitive to deterioration.
17. Deliver products to the site in the manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting, and installing.
18. Unload and place all items delivered to the site in a manner which will not hamper normal construction operation nor that of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
19. Provide necessary equipment and personnel to unload all items delivered to the site.
20. The Contractor shall store and protect products in accordance with the manufacturer's instructions, with seals and labels intact and legible. Follow storage instructions, review them with the Owner, and keep a written record of this. Arrange storage to permit access for inspection.
21. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

22. Store cement and lime under a roof and off the ground and keep it completely dry at all times. All structural, miscellaneous, and reinforcing steel shall be stored off the ground or otherwise to prevent accumulations of dirt or grease and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping, or cracking. Handle and store brick, block, and similar masonry products in a manner to keep breaking, cracking, and spilling to a minimum.
23. Store all mechanical and electrical equipment and instruments subject to corrosive damage by the atmosphere if stored outdoors (even though covered by canvas) in a weathertight building to prevent damage. The building may be a temporary structure on the site or elsewhere, but it must be satisfactory to the Owner. The building shall be provided with adequate ventilation to prevent condensation. The Contractor shall ensure that temperature and humidity are maintained within the range required by the manufacturer.
- a. All equipment shall be stored fully lubricated with oil, grease, and other lubricants unless otherwise instructed by the manufacturer.
 - b. Moving parts shall be rotated a minimum of once weekly to ensure proper lubrication and to avoid metal-to-metal "welding." Upon installation of the equipment, the Contractor shall start the equipment, at least at half load, once weekly for an adequate period to ensure that the equipment does not deteriorate from lack of use.
 - c. Lubricants shall be changed when installation is complete and as frequently as required thereafter during the period between installation and acceptance. The Contractor shall put new lubricants into the equipment at the time of acceptance.
 - d. Before accepting equipment that has been stored for some time, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested, and accepted in a minimum time period. As such, the manufacturer will guarantee the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01720
FIELD ENGINEERING

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall do the following:

- A. Provide and pay for the following field engineering services required for the Project:
 - 1. Survey work required in the execution of the Project.
 - 2. Civil, structural, or other professional engineering services specified or required to execute the Contractor's construction methods.
- B. Retain the services of a Florida-registered land surveyor to do the following:
 - 1. Identify existing control points and property line corner stakes as required.
 - 2. Verify all existing structure locations and all proposed structure corner locations, and equipment locations within the Project site.
 - 3. Maintain an accurate location of all buried piping 4 inches in diameter and larger.

1.02 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. The Contractor shall submit to the Engineer the name and address of the registered land surveyor or professional engineer.
- C. On request of the Engineer, the Contractor shall submit documentation to verify the accuracy of field engineering work.
- D. The Contractor shall submit a certificate signed by a registered land surveyor certifying that elevations and locations of improvements are in conformance or non-conformance with Contract Documents.
- E. At the end of the Project and before final payment, submit the certified drawings listed below with the Surveyor's title block (signed and sealed by the registered

land surveyor) of the items listed below. These drawings shall be included with and made a part of the project record documents.

1. Certified site survey at 1-inch = 50-foot scale on sheets 24 inches by 36 inches, indicating the paved areas, and location of all aboveground structures for the project site.
2. Certified drawing showing the location, lines, and grades of all lines and other buried facilities (i.e., valves, tanks, vaults, etc.) installed as a result of the work. This shall be at the same scale as the Engineer's yard piping drawing and submitted on reproducible tracing paper.
3. Certified drawings showing elevations of all flow control points such as weirs, and elevations of all existing and new structures.
4. Certified drawings showing elevations of the subgrade layer and the top of protective cover soil layer.
5. Certified drawings showing the invert elevations at-50 foot intervals along the length for all leachate collection piping.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. All work shall be performed in accordance with the Minimum Technical Standards set forth by the Board of Professional Surveyors and Mappers.

1.04 QUALITY ASSURANCE

- A. Existing basic horizontal and vertical control points for the project are those designated on Drawings.
- B. Locate and protect control points before starting site work and preserve all permanent reference points during construction:
 1. Make no changes or relocations without prior written notice to the Engineer.
 2. Report to the Engineer when any reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
 3. Require the surveyor to correctly replace project control points that may be lost or destroyed.
 4. Establish replacements based on original survey control.

1.05 QUALIFICATIONS

- A. Registered land surveyor of the discipline required for the specific service on the project, currently licensed in Florida.

1.06 SYSTEM DESCRIPTION

- A. The Contractor shall establish a minimum of two permanent benchmarks on the site, referenced to data established by survey control points:
 - 1. Record locations, with horizontal and vertical data, on Record Documents.
- B. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:
 - 1. Site improvements:
 - a. Stakes for grading, fill, and topsoil placement.
 - b. Utility slopes and invert elevations.
 - 2. Building (pump station) foundations, and floor levels.
 - 3. Controlling lines and levels required for mechanical and electrical trades.
- C. From time to time, verify layouts by the same methods.
- D. Maintain a complete and accurate log of all control and survey work as the work progresses.
- E. As a condition for approval of monthly progress payment requests, update the project record drawings monthly based on the work performed during the month ending at the pay request. The Contractor shall coordinate this monthly with the Engineer on the site as part of the pay request.
- F. Maintain an accurate record of piping changes, revisions, and modifications.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01740
FINAL CLEANING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall execute cleaning during progress of the Work and at the completion of the Work as required by General Conditions.

1.02 ENVIRONMENTAL CONCERNS

- A. Cleaning and disposal operations shall comply with codes, ordinances, regulations, and anti-pollution laws.

PART 2 PRODUCTS

2.01 CLEANING MATERIALS

The Contractor shall do the following:

- A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
- B. Use only those cleaning materials and methods recommended by the manufacturer of the surface material to be cleaned.
- C. Use cleaning materials only on surfaces recommended by the cleaning material manufacturer.

PART 3 EXECUTION

3.01 PERIODIC CLEANING

The Contractor shall do the following:

- A. Execute periodic cleaning to keep the work, the site, and adjacent properties free from accumulations of waste materials, rubbish, and windblown debris.
- B. Provide onsite containers for the collection of waste materials, debris, and rubbish.

- C. Remove waste materials, debris, and rubbish from the site periodically and dispose of at legal areas away from the site.

3.02 DUST CONTROL

The Contractor shall do the following:

- A. Clean interior spaces before the start of finish painting and continue cleaning on an as-needed basis until painting is finished.
- B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly coated surfaces.

3.03 FINAL CLEANING

The Contractor shall do the following:

- A. Employ skilled workers for final cleaning.
- B. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from interior and exterior surfaces exposed to view.
- C. Broom clean exterior paved surfaces; rake clean other surfaces of the grounds.
- D. Before final completion or Owner occupancy, inspect interior and exterior surfaces exposed to view and all work areas to verify that the entire Work is clean.

END OF SECTION

SECTION 01755
EQUIPMENT TESTING AND STARTUP

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall provide a competent field services technician of the manufacturers of all equipment furnished under Divisions 11, Equipment, 13, Special Construction, 15, Mechanical, and 16, Electrical, to supervise installation, adjustment, initial operation and testing, performance testing, final acceptance testing, and startup of the equipment.
- B. The Contractor shall perform specified equipment field performance tests, final acceptance tests, and startup services.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Submit name, address, and résumé of proposed field services technicians at least 30 days in advance of the need for such services.
- B. Submit for review detailed testing procedures for shop tests, field performance tests, and final acceptance tests as specified in the various equipment specification sections. Test procedures shall be submitted at least 30 days in advance of the proposed test dates and shall include at least the following information:
 - 1. Name of equipment to be tested, including reference to specification section number and title.
 - 2. Testing schedule of proposed dates and times for testing.
 - 3. Summary of power, lighting, chemical, water, sludge, gas, etc., needs and identification of who will provide them.
 - 4. An outline of specific assignments of the responsibilities of the Contractor and manufacturers' factory representatives or field service personnel.
 - 5. Detailed description of step-by-step testing requirements, with reference to appropriate standardized testing procedures and laboratory analyses by established technical organizations (e.g., ASTM, WPCF Standard Methods).
 - 6. Samples of forms to be used to collect and record test data and to present tabulated test results.

- C. Submit copies of test reports upon completion of specified shop, performance, and acceptance tests. Test reports shall incorporate the information provided in the test procedures submittals, modified to reflect the actual conducting of the tests and the following additional information:
 - 1. Copies of all test data sheets and results of lab analyses.
 - 2. Summary comparison of specified test and performance requirements vs. actual test results.
 - 3. Should actual test results fail to meet specified test and performance requirements, a description of actions to be taken before re-testing the equipment.
- D. Submit copies of the manufacturer's field service technician's report summarizing the results of the initial inspection, operation, adjustment, and pre-tests. The report shall include detailed descriptions and tabulations of the points inspected, tests and adjustments made, quantitative results obtained, suggestions for precautions to be taken to ensure proper maintenance, and the equipment supplier's Certificate of Installation in the format specified in this Section.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Water Works Association (AWWA)
 - 1. AWWA C653—Disinfection of Water Treatment Plants.
- B. American Society for Testing and Materials (ASTM)
- C. Water Pollution Control Federation (WPCF)
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.04 QUALITY ASSURANCE

- A. Field service technicians shall be competent and experienced in the proper installation, adjustment, operation, testing, and startup of the equipment and systems being installed.

- B. Manufacturers' sales and marketing personnel will not be accepted as field service technicians.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PRELIMINARY REQUIREMENTS

- A. After the equipment has been installed and the equipment is presumably ready for operation but before it is operated by others, the manufacturer's field service technician shall inspect, operate, test, and adjust the equipment. The inspection shall include at least the following points where applicable:
 - 1. Soundness (without cracks or otherwise damaged parts).
 - 2. Completeness in all details, as specified and required.
 - 3. Correctness of setting, alignment, and relative arrangement of various parts.
 - 4. Adequacy and correctness of packing, sealing, and lubricants.
- B. The operation, testing, and adjustment shall be as required to prove that the equipment has been left in proper condition for satisfactory operation under the conditions specified.
- C. Upon completion of this work, the manufacturer's field service technician shall submit a signed report of the results of his/her inspection, operation, adjustments, and tests.

3.02 WITNESS REQUIREMENTS

- A. Shop tests or factory tests may be witnessed by the Owner and/or the Owner's representatives, as required by the various equipment specifications.
- B. Field performance and acceptance tests shall be performed in the presence of the Owner, the Owner's designated personnel, and/or the Owner's representatives.

END OF SECTION

SECTION 01770
PROJECT CLOSEOUT

PART 1 GENERAL

1.01 SUBSTANTIAL COMPLETION

- A. When the Contractor considers that the Work or designated portion of the Work is Substantially Complete, the Contractor shall submit written notice to the Engineer with a list of items to be completed or corrected.
- B. If the Engineer's review finds that the Work is not Substantially Complete, the Engineer will promptly notify the Contractor in writing, listing observed deficiencies.
- C. The Contractor shall remedy deficiencies and send a second written notice of Substantial Completion.
- D. When the Engineer finds the Work is Substantially Complete, the Engineer will prepare a Certificate of Substantial Completion.

1.02 FINAL COMPLETION

- A. When the Contractor considers that the Work or designated period of the Work is complete, the Contractor shall submit written certification to the Engineer indicating the following:
 - 1. The Contract Documents have been reviewed.
 - 2. The Work has been reviewed for compliance with the Contract Documents.
 - 3. The Work has been completed in accordance with the Contract Documents and deficiencies listed with Certificates of Substantial Completion have been corrected.
 - 4. The Work is complete and ready for final inspection.
 - 5. All required shop drawings, catalog cuts, operations and maintenance manuals, instruction manuals, test reports, samples, and all other submittals have been submitted and reviewed by the Engineer.
 - 6. All deliverables have been delivered or placed as accepted by the Engineer.
- B. If the Engineer's review reveals that the Work is incomplete, the Engineer will promptly notify the Contractor in writing listing observed deficiencies.

- C. The Contractor shall remedy deficiencies and send a second Certification of Final Completion.
- D. When the Engineer finds that the Work is complete, the Engineer will consider closeout submittals.

1.03 ADDITIONAL REVIEW FEES

- A. If the status of Completion of Work requires more than two reviews of the Work by the Engineer due to failure of the Work to comply with the Contractor's claims on the first and second reviews, the Owner will deduct from the final payment to the Contractor the amount of the Engineer's compensation for additional review services.

1.04 CLOSEOUT SUBMITTALS

- A. Evidence of Compliance with Requirements of Governing Authorities:
 - 1. All required Certificates of Government Inspections.
- B. Operation and Maintenance Manuals: Under the provisions of Section 01830, Operations and Maintenance Manuals.
- C. Record Documents: Under the provisions of Section 01785, Record Documents.
- D. Evidence of Payment and Release of Liens: In accordance with the Conditions of the Contract.
- E. Consent of Surety to Final Payment.

1.05 STATEMENT OF ADJUSTMENT OF ACCOUNTS

- A. Submit a final statement reflecting adjustments to the total Contract Price, indicating the following:
 - 1. Original total Contract Price.
 - 2. Previous change orders.
 - 3. Changes under allowances.
 - 4. Changes under unit prices.
 - 5. Deductions for uncorrected Work.
 - 6. Penalties and bonuses.
 - 7. Deductions for liquidated damages.
 - 8. Deductions for Engineer's additional review fees.
 - 9. Other adjustments to the total Contract Price.

10. Total Contract Price as adjusted.
11. Previous payments.
12. Sum remaining due.

- B. On the Owner's review and approval, the Engineer will issue a final Change Order reflecting approved adjustments to the total Contract Price not previously made by change orders.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Submit application for final payment in accordance with the provisions of the Conditions of the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01780
WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall do the following:

- A. Compile specified warranties.
- B. Compile specified bonds (if required by the Contract Documents).
- C. Co-execute submittals when so specified.
- D. Review submittals to verify compliance with Contract Documents.
- E. Submit submittals to the Engineer for review.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Assemble warranties and bonds executed by each of the respective manufacturers, suppliers, and subcontractors.
- B. Number of original signed copies required: two each.
- C. Table of Contents: Neatly typed, in sequence of the Specifications. Provide completion information for each item as follows:
 - 1. Product or work item.
 - 2. Firm, address, telephone and fax numbers, and name and email of principal.
 - 3. Scope.
 - 4. Date of beginning of warranty, bond, or service and maintenance contract.
 - 5. Duration of warranty, bond, or service and maintenance contract.
 - 6. Provide information for Owner's personnel:
 - a. Proper procedure in case of failure.
 - b. Instances that might affect the validity of warranty or bond.

- 7. Contractor, with address, telephone and fax numbers, and the name and email of responsible principal.
- D. Submittal of warranties and bonds shall be included in submittals for review and before Final Completion with actual dates included.
- E. The Contractor's obligation to correct defective or nonconforming Work shall run for a minimum of 1 year (or such longer period may otherwise be specified in the Contract Documents) beginning from the date Substantial Completion is achieved.

1.03 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and this Section.
- B. All mechanical and electrical equipment together with devices of whatever nature and all components that are furnished and/or installed by the Contractor shall be guaranteed.
- C. The guarantee shall be against the manufacturing and/or design inadequacies, materials, and workmanship not in conformity, improper assembly, hidden damage, failure of devices and/or components, excessive leakage, or other circumstances that would cause the equipment to fail under normal design and/or specific operating conditions for a minimum of 1 year (or such longer period may otherwise be specified in the Contract Documents) beginning from the date Substantial Completion is achieved.
- D. The Contractor shall replace and install each piece of equipment, device, or component that shall fail within the term specified above of the guarantee with reasonable promptness without increase in the Contract Price. If the Contractor fails to provide timely repairs as specified in this Section, the Owner shall issue a claim against the Contractor's Bond. In some instances, if approved by the Owner, the Contractor may be allowed to repair the equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01785
RECORD DOCUMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section details the minimum requirements for the Contractor for maintenance and recording of Record Documents.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The Contractor shall store documents and samples in the Contractor's field office apart from documents used for construction and shall do the following:
 - 1. Provide files and racks for storage of documents.
 - 2. Provide cabinet or secure storage space for storage of samples.
- B. The Contractor shall institute a computerized record control program.
- C. The Contractor shall make documents and samples available at all times for inspection by the Engineer.
- D. At Contract closeout, the Contractor shall transmit Record Documents and samples with cover letter to the Engineer, listing the following:
 - 1. Date.
 - 2. Project title and number.
 - 3. Contractor's name and addresses.
 - 4. Number and title of each Record Document.
 - 5. Signature of Contractor or its authorized representative.
 - 6. Contract Section and Subsection numbers.
 - 7. Location.
- E. Before assembling and submitting records, the Contractor shall review for completeness the records maintained by its subcontractors.
- F. Tracings of all Construction Documents and Shop Drawings made by the Contractor, subcontractors, and suppliers of materials or equipment shall be corrected to show the Work as actually completed or installed.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 PROJECT RECORD

- A. The Contractor shall label and file Record Documents and samples in accordance with the corresponding Specification Section number. Each document shall be labeled "PROJECT RECORD" in neat, large, printed letters. Record Documents shall be maintained in a clean, dry, and legible condition. Record documents shall not be used for construction purposes.

3.02 RECORDING

The Contractor shall record construction information as follows:

- A. Record and update daily Record information from field notes on a set of opaque drawings and to the satisfaction of the Engineer.
- B. Provide felt tip marking pens, maintaining separate colors for each major system, for recording information.
- C. Record information concurrently (daily) with construction progress. Work shall not be concealed until required information is recorded.
- D. Mark Record Drawings to reflect the following:
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances referenced to permanent surface improvements.
 - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of construction.
 - 3. Field changes of dimension and detail.
 - 4. Changes made by modifications.
 - 5. Details not on original Construction Drawings.
- E. CAD Requirements for Record Drawings: The Contractor shall provide the Engineer with a complete set of Record Drawings in the latest version of AutoCAD format upon completion of the Work. No additional compensation will be allowed for the Contractor to provide the Record Drawings. The Contractor shall use the AutoCAD drawings furnished by the Engineer for this purpose. Record Drawings must be submitted in the AutoCAD format of the contract drawings. No other CAD software or format will be accepted. It is Contractor's

sole responsibility to ensure that the Record Drawings conform to the following CAD requirements:

1. Drawings shall be submitted to the Engineer on CD-ROM. Each CD shall be clearly labeled with the appropriate project number, client name, date, and file names included on each CD. If files are compressed, a description of the compression software must be included along with a copy of the appropriate uncompressing software.
2. Layer filters shall be included for views or drawings on layout tabs.
3. All changes to drawings must be done in accordance with the appropriate scale of the drawing revised and shall be delineated by placing a "cloud" around the areas revised and adding a revision triangle indicating the appropriate revision number.
4. Each drawing must have the revision block completed to indicate the revision number, date, and initials of the person revising the drawing. The description of the revision must say "Record Drawing." This procedure must be followed for every drawing even when no changes are made to the drawing.
5. All revisions to drawings must be put on separate layers with the layer names prefixed Record followed by the appropriate existing layer name. The colors and line types of the appropriate existing layers shall be adhered to when creating new layers.
6. All entities shall be drawn with properties (i.e., line types and colors) BYLAYER. This also applies to all Civil 3D styles and objects. Civil 3D styles set to color by entity are not to be used.
7. Text shall be placed on a text only layer and will be 0.1 inch in height with a width factor of 0.9. The font for all text styles shall be ROMANS. Wipeouts are not to be used.
8. The LTSCALE variable shall be set to the viewport scale and all line types shall remain at an entity scale of 1.
9. When mixed scales are to be used (i.e., different horizontal and vertical scales), please contact the Jones Edmunds representative for input.
10. Contours shall be placed on a separate layer of their own. Contour labels shall be smaller than the rest of the text on the drawing (0.1 minimum). The contour interval shall be 1 foot. "Tick marks" designating depression contours, if used, shall be placed on a separate layer.
11. There shall be no disjointed lines or polylines. To the extent possible, lines and polylines shall be continuous. Splines are not to be used.
12. A short description of the survey shall be provided in writing. The description shall include coordinate base (horizontal and vertical datum), benchmark information, North rotation, etc.
13. Civil 3D spot elevations shall use only the Civil 3D Points command in their own layer. Spot elevations as Surface Labels are not to be used.

14. Drawings shall be provided in AutoCAD 2018 DWG (if base or plain and ONLY if exported to AutoCAD) format or Autodesk Civil 3D 2018 on compact disc, FTP, or via email.
 15. The Contractor shall supply one full set of Record Drawings on reproducible black line prints and five full sets of opaque copies.
- F. The Contractor shall have the Florida-licensed Professional Surveyor and Mapper submit signed-and-sealed record surveys of completed work or various required stages thereof and certify the Record Drawings as being correct and complete. Record surveys shall include but are not limited to:
1. Preconstruction Survey – Survey of site project site conditions prior to beginning work.
 2. As-Built Liner Subgrade Survey – Survey of site subgrade following earthwork prior to geomembrane installation.
 3. Groundwater monitoring wells (including top of casing).
 4. Top of landfill leak-detection gravel including trench and sump gravel.
 5. Top of landfill leachate-collection gravel including trench and sump gravel.
 6. Leachate collection pipe including leak detection and leachate collection sump piping.
 7. Pump stations and access drives.
 8. Stormwater improvements.
 9. Anchor trench.
 10. Installed drainage soil.
 11. Edge-of-liner markers.
 12. Concrete structures.
 13. Leachate force main.
 14. Transducers and pumps.

END OF SECTION

SECTION 01800
HEALTH AND SAFETY PLAN

PART 1 GENERAL

1.01 GENERAL

- A. No smoking will be allowed on the active disposal areas, in the work area, or in the construction field offices or confined spaces. Areas for smoking will be designated as immediately outside the construction field offices or as otherwise allowed by the Owner.
- B. Actions that potentially endanger workers should be stopped immediately and brought to the Owner and Engineer's attention. Health and Safety is the responsibility of the Contractor.
- C. The Contractor is hereby made aware by the Owner and Engineer that the Construction Site is adjacent to and above active landfill cells, and that landfill gas may migrate onto the Construction Site. The Contractor shall take proven means to protect personnel and facilities from related hazards, including explosion, asphyxiation, and poisoning due to the presence of landfill gases.
- D. Animals and plants may be present that could affect the health and safety of the Contractor.

1.02 SITE-SPECIFIC HEALTH AND SAFETY PLAN

- A. The Contractor shall prepare a written site-specific Health and Safety Plan (Plan) for use by the Contractor and Subcontractor's site workers. This plan must be prepared to meet the 29 CFR 1910.120 OSHA regulations and shall include as a minimum, the following:
 - 1. Organizational Structure: To include general supervision, Health and Safety officer, lines of authority, and responsibility and communication. The Health and Safety Officer shall be a worker who will be present at all times during site construction, in addition to his/her other site duties.
 - 2. Comprehensive Work Plan: To include the work tasks and objectives, resources needed, and training requirements for workers (health and safety, machine operations license, etc.). This shall also include a section on safety procedures to be followed for excavation.
 - 3. Health and Safety: To include identification of possible site hazards, training levels for each category of site workers, personal protective

equipment and medical surveillance needed, site control measures, and confined space entry procedures.

4. Emergency Response Plans: To include all emergency telephone numbers, a highlighted map showing the quickest route to the nearest emergency care facility and directions to the facility.
5. Air Monitoring Procedures: To include frequency and type of air monitoring of exposed refuse and site worker areas, calibration of air monitoring equipment and action levels of air contaminants for site worker protection. All equipment calibration and field gas measurements shall be recorded with the date and time of sample and the sampler's name. Sampling shall be done by a Contractor worker trained in the use of gas sampling equipment. These trained workers shall be designated in the Contractor's Plan.
6. A signature page for all site workers covered by the Plan (Contractor and Subcontractor site workers).

1.03 SUBMITTAL

- A. The Contractor shall submit copies of the site-specific Plan to the Engineer at the pre-construction meeting. The Engineer will review the plan for information purposes only. It is the Contractor's responsibility to prepare and implement a Plan appropriate for the work to be conducted at the landfill.

1.04 SITE OPERATIONS

- A. The Plan will be kept on site in a known and easily accessible spot during all site operating hours. All site workers will be notified of the location of the Plan.
- B. The Contractor shall have a Health and Safety Officer, with requisite qualifications and experience, on site during all activities.
- C. A Safety Meeting will be held by the Contractor and attended by all Contractor site workers before starting construction. The Contractor shall notify the Engineer before the meeting to provide the Engineer the opportunity to attend the meeting. At this safety meeting, the Plan will be reviewed with the site workers, and all site workers will sign the Plan indicating that they have been apprised of the Plan's contents. New site workers must review the Plan with the Contractor's Health and Safety Officer before beginning work on site and must sign that they have been apprised of the Plan's contents.
- D. Site operations will take place in conditions of adequate light only.
- E. All heat or torch welding or joining with solvents should take place in areas away from exposed refuse when possible. When work must take place in an excavation,

appropriate ventilation measures shall be taken, as addressed in the Contractor's plan.

- F. Start-up and shutdown of engines will not be done in areas of excavated refuse.
- G. *A Compilation of Landfill Gas Field Practices and Procedures*, Solid Waste Association of North America (SWANA), March 1992, shall be reviewed by the Contractor for further safety information and requirements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01820 TRAINING

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall do the following:

- A. Instruct and train the Owner's personnel in the operation and maintenance of the equipment and systems supplied and/or installed under this Contract.
- B. Incorporate operation and maintenance data and training services furnished by the suppliers into the training program such as shop drawings, equipment manuals, and start-up engineering and training assistance.
- C. Ensure that system suppliers provide a qualified training instructor to help the Contractor train the Owner's employees in the proper operation and maintenance of all equipment and systems.
- D. Prepare instructors and training materials required for complete factory, field, classroom, and hands-on training.
- E. Furnish training videos and manuals during the training program.
- F. Include in the total Contract Price the cost for training equipment; preparing training manuals; performing field, factory, and hands-on training; and coordinating and incorporating training service provided by suppliers and all other activities required to provide a comprehensive training program of sufficient length, as determined by the Owner and Engineer.

1.02 WORK SEQUENCE

- A. The field training programs shall be conducted in accordance with the approved schedule.
- B. Individuals requiring training shall be trained in small groups during Mondays through Fridays. The Contractor will normally provide training during the 8-hour dayshift.
- C. The hands-on training shall be conducted with a maximum of 10 students per instructor.

- D. The Contractor shall coordinate and submit a training schedule to the Engineer 30 days before the first training event.

1.03 QUALITY ASSURANCE

- A. Preparation of training materials and instructions to be provided shall be performed by personnel:
 - 1. Trained and experienced in operation and maintenance of equipment and systems installed under this Contract.
 - 2. Familiar with the training requirements of the Owner.
- B. The Contractor shall furnish résumés, including three outside references, for each instructor to be used in the training program.
- C. The Engineer may review the résumés. Based on the review of the résumés and contacts with references, the Engineer shall approve, request additional information, or reject proposed instructors for the training program. If a proposed instructor is rejected, the Contractor shall submit the résumé and references of another candidate within a reasonable time.

1.04 TRAINING PLAN

- A. At the completion of the Work, the Contractor shall provide a competent and experienced person thoroughly familiar with the Work for not less than 1 day to instruct permanent operating personnel in the operation of equipment and control systems.
- B. At least 30 days before training, the Contractor shall submit to the Engineer a detailed training plan including the following:
 - 1. Title and objectives.
 - 2. Training schedule.
 - 3. Prerequisite training and experience of attendees.
 - 4. Recommended types of attendees (e.g., managers, engineers, operators, maintenance staff).
 - 5. Course description and outline of course content.
 - 6. Duration.
 - 7. Location (e.g., training center or site).
 - 8. Format (e.g., lecture, self-study, demonstration, hands-on).
 - 9. Instruction materials and equipment requirements.

1.05 FORM OF TRAINING MANUALS

- A. The Contractor shall prepare training packages in the form of an instruction manual for use by the Owner's personnel. At least 30 days before the training, the Contractor shall submit the training packages to the Engineer for acceptance.
- B. Format
 - 1. Size: 8-1/2 x 11 inches.
 - 2. Paper: 20-pound minimum, white, for typed pages.
 - 3. Text: Manufacturer's printed data or neatly word processed including the following:
 - a. Table of contents.
 - b. Learning objectives.
 - c. General operations, theory, and specific equipment information.
 - 4. Drawings:
 - a. Provide reinforced punched binder tab, bind in with text.
 - b. Reduce larger drawings and fold to size of text pages, not larger than 11 x 17 inches.
 - 5. Cover: Identify each volume with the following:
 - a. Title of Project.
 - b. Identity of separate structure or system as applicable.
 - c. Identity of general subject matter covered in the manual.
 - d. Locations.
- C. Binders
 - 1. Commercial quality three-post binders with durable and cleanable plastic covers.
 - 2. Maximum post width shall be 3 inches.
 - 3. When multiple binders are used, correlate the information into related consistent groupings.

1.06 VIDEOTAPED TRAINING MATERIAL

The Contractor shall do the following:

- A. Produce or provide video training material subject to approval of the Engineer.
- B. Furnish four copies of each videotape in DVD format in plastic case with title, the Owner's name, and time on a label in a clear plastic sleeve.
- C. Bear all costs associated with production and provision of the DVDs.

1.07 INSTRUCTIONS

- A. At the completion of Work, the Contractor shall provide a competent and experienced person thoroughly familiar with the Work for a period of time as directed by the Owner and Engineer to instruct permanent operating personnel in the operation of equipment and control systems.
- B. The Contractor shall furnish four complete sets of operating instructions applying to each piece of equipment installed in conjunction with this Contract.
- C. An "As-Installed" diagram of all control wiring and operating instructions shall be mounted in a watertight pocket on the inside door of the control panel of each unit.
- D. Unless otherwise specified, the Contractor shall provide engraved metal, plastic tags, or instructions on any valve, switch, control, pipe, or other piece of equipment which is not self-evident as to its function or mode of operation. This includes, but is not limited to, all exposed piping and all switches. This shall particularly apply to operations that must be manually sequenced.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01830
OPERATIONS AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SCOPE OF WORK

The Contractor shall do the following:

- A. Compile product data and related information appropriate for the Owner's maintenance and operation of products furnished under the Contract.
 - 1. Prepare operating and maintenance data as specified in this Section and as referenced in other pertinent Sections of the Specifications. The data presented in the O&M Manuals shall be specifically related to this Contract and application.
 - 2. Incorporate maintenance and operation data furnished by the Owner, if any.
- B. Furnish all labor, equipment, materials, and all other items to supply and deliver to the Owner O&M Manuals for the Work in accordance with the requirements of this Section.
- C. Provide O&M Manuals for all equipment, including instrumentation, electrical, and process control system equipment and software for the entire proposed Facility.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Manuals which, in general, shall have two levels: a facilities-wide systems level and an individual-component level.
 - 1. The facilities-wide systems level shall do the following:
 - a. Describe the facilities-wide systems, including diagrams.
 - b. Explain start-up, shutdown, normal operations, and malfunctions of the facilities-wide systems.
 - c. Tabulate a lubrication schedule for the facilities-wide systems.

- d. Describe preventive maintenance checking procedures for the facilities-wide systems.
 - e. Include a cross-reference to all individual component manuals.
- 2. The individual-component level shall contain the following:
 - a. Storage requirements.
 - b. Installation instructions.
 - c. Alignment instructions and tolerances.
 - d. Operating instructions.
 - e. Troubleshooting instructions.
 - f. Lubrication requirements.
 - g. Maintenance instructions.
 - h. Parts list.
 - i. Recommended spare parts list and how to obtain same.

B. Format:

- 1. Electronic file format: PDF.
- 2. Size: 8 1/2-x-11-inch format for narrative and figures. Larger standard sizes are acceptable for drawings.
- 3. Text: Manufacturer's printed data or neatly word-processed.
- 4. Provide a new page for each separate product or each piece of operation equipment.
 - a. Provide a word-processed description of the product and major component parts of equipment.
 - b. Provide indexed tabs.
- 5. Cover: Identify each volume with the typed title, "OPERATION AND MAINTENANCE INSTRUCTIONS," listing the following:
 - a. Title of Project.
 - b. Identity of separate structure as applicable.
 - c. Identity of general subject matter covered in the manual.
- 6. All word processing must be done using the latest version of Microsoft Word.
- 7. Arrange the data into related consistent groupings and cover all with a table of contents and index with page numbering of all sheets.

- C. The Contractor shall submit the following:
1. Equipment Manuals—O&M Instruction Manual for each piece of equipment shall be submitted to the Owner with delivery of the equipment.
 2. Systems O&M Manuals—Systems O&M Manuals, indexed and submitted to the Owner no later than 14 days before the Facility's start-up. Systems O&M Manuals will be complete except for field results and refinements added as result of demonstrations.
 3. Final O&M Manuals—Final Equipment and Systems O&M Manuals, indexed and submitted to the Owner before the Substantial Completion under this Contract.
 4. The cost of these Manuals shall be included in the total Contract Price.
- D. Any modifications required after final O&M submission shall be made to the manuals by issuance of complete replacement O&M manuals. Addenda with pages for insertion into manuals previously provided are not allowed. The updated manuals shall be accompanied by a written description of the changes made to the manual.

1.03 QUALITY ASSURANCE

- A. Data shall be prepared by personnel:
1. Trained and experienced in maintaining and operating the described products.
 2. Familiar with requirements of this Section.
 3. Skilled as a technical writer to the extent required to communicate essential data.
 4. Skilled as a person competent to prepare required drawings.

1.04 CONTENTS, EACH VOLUME

- A. Neatly word-processed table of contents for each volume, arranged in systematic order, to include the following:
1. Contractor, name of responsible principal, address, fax number, and telephone number.
 2. A list of each product required to be included, indexed to content of the volume.

3. A list with each product, name, address, fax number, and telephone number of the following:
 - a. Subcontractor or installer.
 - b. A list of each product to be included, indexed to content of the volume.
 - c. Identify area of responsibility of each subcontractor or installer, if more than one.
 - d. Local source of supply for parts and replacement.
 - e. Manufacturer.
4. Identify each product by product name and other identifying symbols as set forth in the Contract Documents.

B. Product Data

1. Include only those sheets that are pertinent to the specific product.
2. Annotate each sheet to achieve the following:
 - a. Clearly identify the specific product or part installed.
 - b. Clearly identify data applicable information.
 - c. Delete references to inapplicable information.

C. Drawings

1. Supplement product data with drawings as necessary to illustrate the following clearly:
 - a. Relations of component parts of equipment and systems.
 - b. Control and flow diagrams.
 - c. Owner Tag Numbers.
2. Coordinate drawings with information in Record Documents to ensure correct illustration of completed installation.
3. Do not use Record Documents as maintenance drawings.

D. Written text as required to supplement product data for the particular installation:

1. Organize in consistent format under separate headings for different procedures.
2. Provide a logical sequence of instructions for each procedure.
3. Describe how the complete system is to operate.

E. Copy of pertinent information related to warranty, bond, and service Contract issued.

1. Provide information sheet for Owner's personnel with the following information:
 - a. Proper procedures in event of failure.
 - b. Instances that might affect the validity of warranties or bonds.

F. Training manuals used in training courses will become part of this Manual.

1.05 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Content, for each electrical, mechanical, instrumentation, and communication system, as appropriate:

1. A table identifying each piece of equipment, each associated control or instrument, the location of the control or instrument, and the function of the control or instrument.
2. A description of the system and its component parts:
 - a. Function, normal operating characteristics, and limiting conditions for the system, the sub-system, and the component parts.
 - b. Performance curves, engineering data, and tests.
 - c. Complete nomenclature and commercial numbers of replaceable parts.
3. Circuit directories of panel board:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
4. As-installed color-coded wiring diagrams.
5. Instrument loop diagrams showing the path that a control or instrumentation signal takes from its origin to the action it takes.
 - a. An electrical schematic for each item.
 - b. A chart listing the controls/instruments in a loop identifying the equipment's abbreviated symbol, a description of the symbol,

design criteria, process flow, quantity supplied, and manufacturer's model and serial number.

6. Operating procedures:
 - a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
 7. Maintenance procedures:
 - a. Routine operations.
 - b. Guide to "trouble-shooting."
 - c. Disassembly, repair, and re-assembly.
 - d. Alignment, adjustment, and checking.
 8. The manufacturer's operating and maintenance instructions.
 9. A list of the original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
 10. Other data as required under other Sections of the Specifications.
 11. Abnormal and emergency operations:
 - a. Potential overloads.
 - b. Procedures for equipment breakdown.
 - c. Action to be taken in a power outage.
 - d. Identity of alarms by equipment location and action to correct.
 - e. Equipment safety features, requirements, and potential hazards.
 12. Programming manuals for programmable devices including list of standard programming.
- B. Content, for each unit of equipment and system, as appropriate:
1. Description of unit and component parts:
 - a. Function, normal operating characteristics, and limiting conditions.
 - b. Performance curves, engineering data, and tests.
 - c. Complete nomenclature and commercial number of replaceable parts.
 - d. Model number and name plate data for each piece of equipment.
 - e. Assembly drawings.

- f. List of all special tools required to service equipment and/or systems including where the tools are stored.
- 2. Operating procedures:
 - a. Start-up, break-in, routine, and normal operating instructions.
 - b. Regulation, control, stopping, shut-down, and emergency instructions.
 - c. Summer and winter operating instructions.
 - d. Special operating instructions.
 - e. Control settings and ranges.
- 3. Maintenance procedures:
 - a. Type and frequency of preventive maintenance activities required for each piece of equipment.
 - b. Guide to "trouble-shooting."
 - c. Disassembly, repair, and re-assembly.
 - d. Alignment, adjusting, and checking.
- 4. Servicing and lubrication schedule:
 - a. List of lubricants required.
 - b. Period between lubrications.
- 5. Manufacturer's printed operating and maintenance instructions. (This is not to be a generalized catalog of the entire product line.)
- 6. Description of sequence of operation.
- 7. The original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance:
 - a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked as spare parts.
- 8. As-installed control diagrams.
- 9. Each Contractor's coordination drawings.
- 10. List of the original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.
- 11. Other data as required under pertinent Sections of the Specifications.

12. Charts of equipment, instrument, and valve tag numbers with location and function:
 - a. Reference drawing which shows equipment, instrument, or valve location.
 - b. Manufacturer's model and serial number.
 - c. Valve actuator type (manual, hydraulic, electric, or pneumatic).
 13. Local services (process water and air, drains, HVAC, natural gas and steam).
- C. The Contractor shall prepare and include additional data when the need for such data becomes apparent during instruction of the Owner's personnel.
- D. Additional requirements for O&M data required by other Sections of the Specifications.

PART 2 PRODUCTS

2.01 O&M MANUALS

- A. Electronic Version: O&M Manuals shall be provided electronically. The manual files must be in PDF format capable of being read, annotated, and printed with Adobe Standard, Adobe Pro, or BlueBeam, unless other software and file format is approved by the Owner, at the time of the transmittal of documents. AutoCAD files for drawings shall be provided separately from PDF versions included in the manual.

PART 3 EXECUTION (NOT USED)

END OF SECTION

DIVISION 2
SITE CONSTRUCTION

SECTION 02070
GEOCOMPOSITE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install a the geocomposite as part of both the leak-detection and leachate-collection layers for the Landfill.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Manufacturer Information
1. Manufacturer's Information: Submit the following within 10 days of the Notice to Proceed.
 2. The Manufacturer's name, address, and primary contact.
 3. The Manufacturing plant name and address where the geocomposite for this project will be produced.
 4. The Manufacturer's qualifications including:
 - a. A minimum of 5 years of successful development and production of geonets and geocomposites.
 - b. Evidence of production of at least 10 million square feet of geocomposite that meets the specifications of Article 2.01.
 - c. Certification that the Manufacturer has sufficient capacity to provide required material in the given timeframe.
 - d. A list of at least 10 projects for which the Manufacturer has supplied geocomposite, three of which shall have been for projects of similar size.
 5. Certificate provided by the manufacturer stating the product name, style number, chemical composition of the geonet and geotextiles involved, and other pertinent information to fully describe the product along with five representative samples of the product (small samples approximately 5 inches long by 4 inches wide enclosed in plastic labeled with the product name) proposed for use on this project.

6. The Manufacturer's material properties sheet (cut sheet) of proposed geocomposite including transmissivity test results in accordance with ASTM D4716.
7. Available data on the long-term (10,000-hour) creep test on the geonet core in accordance with GRI-GS4 or ASTM D7406 for loads up to 10,000 psf at a reference temperature of 20°C. Provide Manufacturer's Quality Control (MQC) data for the geonet component of the geocomposite tested with long-term creep results.
8. Written instructions for storing, handling, installing, seaming, and repairing the proposed geocomposite, including recommendations for loading, unloading, and handling equipment (model number or load capacity) must be included.
9. Sample product warranty that meets the requirements of Article 1.07 and Section 01780, Warranties and Bonds.
10. The MQC plan, including examples of MQC certification documents, name and address of the quality control testing laboratory, quality control laboratory certification, examples of retesting notification, and documentation.

B. Installer Information

1. The Contractor shall submit the Installer's Information at least 30 days before geocomposite is scheduled to be installed.
2. Installer's name, address and primary contact.
3. Installer's qualifications including but not limited to a list of at least three previous projects of similar size to this project, including project name, location, size, date of installation, and evidence of the installation of at least 1 million square feet of geocomposite.
4. Construction quality control (CQC) plan including but not limited to the following:
 - a. Description of seaming equipment and techniques.
 - b. Description of methods for repairing geotextiles and geonet.
 - c. Description of method for removing rejected materials.
 - d. Proposed staffing.

- e. Proposed equipment.
 - f. Complete set of forms to be used for recording installation QC data, including but not limited to daily record documents.
 - 5. Installer's written procedures manual.
 - 6. Panel layout drawings identifying panels and seams.
- C. Project-Specific Product Acceptance Testing
- 1. After the CQA Consultant's review and approval of the Manufacturer's Information, representative samples of the geocomposite product intended for this project and manufactured at the same plant that will produce the product for this project shall be sent to the Product Acceptance Laboratory for Project-Specific Product Acceptance Testing as listed in Article 2.01, Table 2.
 - 2. Acceptance by the CQA Consultant of the geocomposite product proposed for use on this project will depend on the results of the Project-Specific Product Acceptance testing. Project-Specific Product Acceptance test results shall be submitted to the CQA Consultant 21 days before shipping the geocomposite. The geocomposite shall not be shipped before review and acceptance of the Project-Specific Product Acceptance Test results.
 - 3. Product samples shall be sent to the Product Acceptance Laboratory unless otherwise noted or specified by the CQA Consultant. The sample package should include a cover letter referencing the project location, project number, Manufacturer, date of sampling, lot and roll number, and MQC test data documented for the particular production run from which the sample was taken. This submittal shall conform to the requirements of Section 01330, Submittals and Acceptance. A copy of the cover letter shall be sent to the CQA Consultant.
 - 4. The Contractor shall bear the cost of all Project-Specific Product Acceptance Testing, including shipping samples to Product Acceptance Laboratory.
 - 5. Geocomposite Samples: The Manufacturer shall package and ship two 3-foot-long by the width-of-roll wide samples to the Product Acceptance Laboratory. The Manufacturer shall package the samples securely for shipping to prevent damage. The sampler shall mark the Manufacturer's roll identification number as well as the machine direction on the sample. The Contractor shall submit MQC data for the roll sampled with the test results.

6. Transmissivity Testing: The Product Acceptance Laboratory shall perform 100-hour transmissivity testing and report results in accordance with ASTM D4716. Laboratory procedures shall use digital gradient level indicators. The geocomposite must be tested with geomembrane on one side and Drainage Soil (meeting the gradation requirements of Section 02301, Earthwork for Landfill Construction) on the other. Test as follows:
 - a. Normal Load of 2,000 psf, gradient of 0.02 and test duration of 100 hours. Report results at 15 minutes, 1 hour, and then every 24 hours.
 - b. Normal load of 10,000 psf, gradient of 0.02 and test duration of 100 hours. Report results at 15 minutes, 1 hour, and then every 24 hours.
 - c. Normal load of 20,000 psf, gradient of 0.02 and test duration of 100 hours. Report results at 15 minutes, 1 hour, and then every 24 hours.
7. Interface Direct Shear Strength Testing: The Product Acceptance Laboratory shall perform one interface direct shear strength test for four normal load conditions in accordance with ASTM D5321 on representative samples of geocomposite in the configuration listed below. This requirement is in addition to the requirement for interface direct shear strength tests included in the Section 02072, Geosynthetic Clay Liner, and Section 02071, Geomembrane.
 - a. Test Configuration—Geocomposite versus Drainage Sand: Lower geotextile of geocomposite clamped to the bottom of the box and drainage sand compacted into the upper box. Upper components of geocomposite shall be allowed to slide along soil.
 - (1) Submit Drainage Soil sample in accordance with Section 02301, Earthwork for Landfill Construction.
 - (2) Drainage Soil shall be compacted to 80% relative compaction as determined by Modified Proctor Test ASTM D1557. Report Modified Proctor Test.
 - b. Saturate for 1 hour under full load before shearing and shear under fully saturated (tap water) conditions.
 - c. Normal loads: See Table 2 in Article 2.01.
 - d. Shear rate: 0.04 inch/minute.

- e. Provide complete shear versus displacement length to at least 3 inches of displacement.
 - f. Report peak (maximum) shear strength and post-peak shear strength measured at 3 inches of displacement for all three normal loads. Report location of the failure (i.e., slip plane).
 - g. Results shall meet the requirements of Table 2 in Article 2.01.
8. If the results of any test do not conform to the requirements of this Section, the Contractor may elect to retest from the same roll of product. The Contractor shall notify the CQA Consultant that a retest is planned. Retesting results shall be reported within 7 days. If the retest does not conform to the requirements of this Section, the product shall be rejected and the Contractor must submit Pre-Construction Submittals pertaining to the new product and perform Project-Specific Acceptance Tests for the new product.

D. Manufacturer's Quality Control (MQC)

- 1. The manufacturer is responsible for establishing and maintaining a quality control program to ensure compliance with the requirements of the Specifications. Documentation describing the quality control program shall be made available upon request.
- 2. The MQC data shall be submitted at least 21 days before geocomposite shipment.
- 3. The Contractor shall submit the MQC test results to demonstrate that the geocomposite is in accordance with this Section.
- 4. MQC sampling shall be in accordance with the test methods and minimum test frequencies provided in Article 2.01, Table 1. If no sampling protocol is specified in the test method, then the samples shall be taken evenly spaced across the entire roll width in accordance with ASTM D4354.
- 5. The manufacturer shall provide a manufacturer's certificate stating that the finished geocomposite meets the minimum average values and that the geotextile meets minimum average roll value (MARV) requirements of the Specifications as evaluated under the manufacturer's quality control program. A person having legal authority to bind the manufacturer shall attest to the certificate.

6. MQC data shall be submitted electronically in PDF and data format (.xls, .xlsx, .csv, .txt, .doc, .docx, .accdb, etc.) that the data can be readily copied.
7. Provide the following information with MQC test data:
 - a. Project Name, Project Location, Manufacturer, Product Name.
 - b. Roll and lot numbers and any additional production identification.
 - c. Results of MQC tests, including a description of test methods used.
8. The Owner will reject rolls for which quality control requirements are not met.
9. If the results of any test do not conform to the requirements of this Section, the Contractor may elect to retest from the same roll of product. The Contractor shall notify the CQA Consultant that a retest is planned. Retesting results shall be reported within 7 days. If the retest does not conform to the requirements of this Section, the product shall be rejected and removed from the site.
10. Either mislabeling or misrepresentation of material shall be reason to reject the products involved in this Section.

E. Construction Quality Control (CQC):

1. The Contractor's CQC representative will be responsible for quality control in accordance with the submitted CQC Plan. During construction, the Contractor shall submit CQC documentation weekly:
 - a. Material delivery report.
 - b. Rejected material removal report.
 - c. Records of daily installation including roll numbers placed.
 - d. Records of daily personnel activity.
 - e. Meeting reports.
 - f. Updated Record Drawings.

1.03 REFERENCES

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at bid time. The following documents are a part of this

Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM D751—Standard Test Methods for Coated Fabrics.
2. ASTM D792—Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
3. ASTM D1238—Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
4. ASTM D1505—Standard Test Method for Density of Plastics by the Density-Gradient Technique.
5. ASTM D1558—Standard Test Method for Moisture Content Penetration Resistance Relationships of Fine-Grained Soils.
6. ASTM D1603—Standard Test Method for Carbon Black Content in Olefin Plastics.
7. ASTM D3786—Standard Test Method for Bursting Strength of Textile Fabrics—Diaphragm Bursting Strength Tester Method.
8. ASTM D4218—Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
9. ASTM D4354—Standard Practice for Sampling of Geosynthetics for Testing.
10. ASTM D4491—Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
11. ASTM D4533—Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
12. ASTM D4632—Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
13. ASTM D4716—Standard Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
14. ASTM D4751—Standard Test Method for Determining Apparent Opening Size of a Geotextile.
15. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
16. ASTM D5199—Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
17. ASTM D5261—Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
18. ASTM D5321—Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear.
19. ASTM D6141—Standard Guide for Screening Clay Portion of Geosynthetic Clay Liner (GCL) for Chemical Compatibility to Liquids.

20. ASTM D7005—Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites.
21. ASTM D7361—Standard Test Method for Accelerated Compressive Creep of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method.
22. ASTM D7406—Standard Test Method for Time-Dependent (Creep) Deformation Under Constant Pressure for Geosynthetic Drainage Products.

B. Geosynthetics Research Institute (GRI)

1. GRI-GC8—Determination of the Allowable Flow Rate of a Drainage Geocomposite.
2. GRI-GS4—Test Method for Time Dependent (Creep) Deformation Under Normal Pressure (superseded by ASTM D7406)

1.04 QUALITY ASSURANCE

- A. MQC and CQC are the responsibility of the Manufacturer and Installer to document that the material and installation are in accordance with this Section. The Installer's CQC representative will be responsible for CQC in accordance with the submitted CQC Plan, which is independent of Construction Quality Assurance.
- B. The Owner will engage and pay for the services of an Engineer and/or CQA Consultant. The Owner will engage and pay for the services of an independent CQA Laboratory for monitoring the quality and installation of the geocomposite. The Manufacturer, Installer, and Contractor shall help the Owner and the Engineer with product sampling for Construction Quality Assurance (CQA) testing by providing samples, personnel, and equipment as necessary.
 1. CQA tests will be the measure of the acceptance of material. The Contractor will be responsible for the cost of retesting should the CQA tests fail. The retests will be paid by the Owner and reimbursed by the Contractor.
 2. Samples of geocomposite: After review of the project-specific Product Acceptance Test results the Engineer or representative may visit the manufacturing plant and/or select product rolls to be sampled by the Manufacturer. The Manufacturer will ship one 3-foot-long by the width-of-roll-wide sample for every 100,000 square feet of material to the Engineer's CQA Laboratory for CQA testing. The sample package should include a cover letter referencing the project location, project number, Manufacturer, date of sampling, lot and roll number, and MQC test data

documented for the particular production run from which the sample was taken. A copy of the cover letter shall be submitted to the Engineer.

1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.
- B. The Geocomposite Manufacturer shall warrant, in writing, the geocomposite material for 5 years on a pro rata basis from the date of Substantial Completion. The warranty shall apply to normal use and service in a sanitary landfill environment under exposure to sanitary landfill gas and leachate as well as other exposures which can be anticipated from the intended use.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. The Contractor shall conform to the Manufacturer's delivery, storage, and handling requirements submitted in accordance with documents as required in Article 1.02, paragraphs A and B of this Section (Manufacturer Information and Installer Information, respectively).
- C. Labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style, and roll number. Each shipping document should include a notation certifying that the material is in accordance with this Section.
- D. The Contractor shall deliver materials to the site only after the CQA Consultant approves the required submittals.
- E. The Contractor shall identify and separate damaged rolls from undamaged rolls and store damaged rolls at locations designated by the Owner. Rolls without proper labeling that identify roll number and dimensions will be considered damaged. Damaged material will be repaired or rejected at the discretion of the CQA Consultant. The cost of repair or replacement will be borne by the Contractor.
- F. The Contractor shall store geocomposite rolls in a location designated by the Owner. In the absence of a specific location, material must not be stored in areas that will impair the operations of the facility or harm the materials.

- G. The Contractor shall store geocomposite rolls to protect them from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.
- H. The Contractor shall store geocomposite rolls on a prepared surface and prevent water from accumulating beneath the rolls.
- I. The Contractor shall not store geocomposite outdoors for more than 12 months. If the geocomposite will be stored outdoors for more than 6 months, rolls shall be covered with a waterproof, plastic covering that is resistant to ultraviolet degradation in addition to the plastic wrap that covers each geocomposite roll.
- J. The Contractor shall not stack geocomposite higher than three rolls.
- K. The Contractor shall use appropriate handling equipment to unload and store geocomposite rolls. Appropriate equipment includes cloth chokers and spreader bars. The equipment must be of sufficient size and capacity to safely and efficiently handle geocomposite materials without damage to the materials or injury to personnel.
- L. The Contractor shall not drag panels or rolls on the ground.
- M. The Contractor shall not crease geocomposite material; creased material will be rejected.
- N. Shipping materials including straps are the property of the Owner and shall be set aside by the Contractor for the Owner's use.

1.07 QUALIFICATIONS

- A. Provide the Manufacturer's and Installer's qualifications in accordance with Article 1.03.

1.08 TESTING REQUIREMENTS

- A. Provide samples and testing for CQC testing in accordance with the requirements of this Section. Provide samples for CQA testing in accordance with the requirements of this Section. Please refer to the material requirement and testing frequencies provided in this Section.
- B. CQA testing shall be performed for the material properties list in Part 2 of this Section. The cost of CQA testing shall be paid by the Owner.

- C. If CQA tests fail the requirements of this Section, the retesting of material provided by the Contractor will be paid for by the Owner and the cost reimbursed by the Contractor as part of the Project's final change order.

1.09 RECORD DRAWINGS

- A. Record Drawings: The Contractor shall prepare, maintain, and submit Record Drawings showing geocomposite installation indicating panel locations, seam locations, and roll numbers for each panel in accordance with the requirements of the Contract Documents. The Record Drawings shall be updated throughout the project and are subject to field review by the Engineer any time upon request.

1.10 DEFINITIONS

- A. *Formulation*: The mixture of a unique combination of ingredients identified by type, properties, and quantity. For geocomposites, a *formulation* is defined as the percentages and types of resins, additives, and carbon black.
- B. *Installer*: The party responsible for field handling, transporting, storing, deploying, seaming, and temporarily restraining (against wind and thermal/solar expansion) the Geotextile.
- C. *Lot*: Group of consecutively numbered rolls from the same manufacturing line.
- D. *Geocomposite Manufacturer (Manufacturer)*: The party responsible for the production and quality of geocomposite.
- E. *Minimum Average Roll Value (MARV)*: Minimum value of a limited series of tests that represents a value two standard deviations lower than the overall average value. Ninety-five percent of any individual samples will have values greater than the MARV for any given property.

PART 2 PRODUCTS

2.01 GEOCOMPOSITE

The geocomposite must meet the following requirements:

- A. Description: A drainage geocomposite manufactured by heat-bonding non-woven needle punched geotextile to both sides of a polyethylene geonet.
- B. Manufactured with a thickness adequate to meet specified flow capacity.

- C. Manufactured with core material made of polyethylene that maintains the required flow under specified loads.
- D. Manufactured to meet or exceed the following product requirements in Articles 2.02 and 2.03, based on minimum average roll values.
- E. Conforming to the following minimum property values.

Table 1 Geocomposite Manufacturing Quality Control Test Requirements			
Test	ASTM Test Method	Minimum Test Frequency	Required Test Values
Geocomposite			
Transmissivity	D4716	1/540,000 sf	See Table 2
Flow Rate/Width (min. ave.)	D4716	1/540,000 sf	9.0 gal/min-ft
Ply Adhesion (min. avg.)	D7005	1/50,000 sf	> 0.50 lb/inch
Geonet Component of Geocomposite			
Thickness	D5199	1/50,000 sf	See Table 2
Melt Flow Index	D1238, E	1 per resin batch	< 1.0 g/10 mins
Density	D792 or D1505	1/100,000 sf	0.94 to 0.97 g/cc
Carbon Black Content (range)	D1603/4218	1/100,000 sf	2-3%
Tensile Strength (min. ave.)	D7179	1/100,000	300 lb
Compressive Strength (min. ave.)	D6364	1/200,000	120 lb/in ²
Flow Rate/Width (min. ave.)	D4716	1/540,000	9.0 gal/min-ft
Geotextile Component of Geocomposite (before lamination)			
Mass/unit area	D5261	1/100,000 sf	≥ 8.0 ounce per square yard
Apparent Opening Size	D4751	1/540,000 sf	< 0.18 mm 80 US Sieve
Grab Tensile Strength	D4632	1/100,000 sf	> 220 lbs.
Grab Elongation	D4632	1/100,000 sf	< 50%
Trapezoidal Tear	D4533	1/100,000 sf	> 90 lbs
CBR Puncture Strength	D6241	1/540,000 sf	> 575 lbs.
Flow rate	D4491	1/540,000 sf	> 95 gpm/ft ²
Permittivity	D4491	1/540,000 sf	> 1.3 s ⁻¹
UV Stability, % Retained (500 hours)	D4355	1/formulation	50%

Table 2 Project-Specific Product Acceptance Test Requirements				
Test	ASTM Test Designation	Minimum Test Frequency	Required Test Values	
Interface Shear Strength (see Article 1.03 for test configurations)	D5321	1/project	Minimum Peak Shear Strength	Normal Load (psf)
			55	250
			1,070	5,000
			3,200	15,000
			4,300	20,000
Transmissivity (100 hour Result)				
2,000 psf; 0.02	D4716	1/project	$> 2.94 \times 10^{-3} \text{ m}^2/\text{s}$	
10,000 psf; 0.02	D4716	1/project	$> 2.50 \times 10^{-3} \text{ m}^2/\text{s}$	
20,000 psf; 0.02			$> 1.50 \times 10^{-3} \text{ m}^2/\text{s}$	
Geonet Component of Geocomposite				
Thickness	D5199	1/project	$\geq 300 \text{ mil}$	
Creep Reduction Factor	D7361	1/formulation	$\text{RF}_{\text{CR}} < 1.10$	

2.02 GEONET COMPONENT OF GEOCOMPOSITE

The Geonet component of the geocomposite must meet the following requirements:

- A. Manufactured with a thickness adequate to meet specified flow capacity.
- B. Manufactured with material made of polyethylene that maintains the required flow under specified loads.
- C. Resistant to soil, chemicals, landfill gas, and leachate.
- D. The resin shall be virgin material with no more than 25% rework. If rework is used, it must be a similar formulation as the parent material.
- E. No post-consumer resin (PCR) of any type shall be added to the formulation.
- F. Conforming to the minimum property values specified in Article 2.01.

2.03 NON-WOVEN GEOTEXTILE COMPONENT OF GEOCOMPOSITE

The Geotextile component of the geocomposite must meet the following requirements:

- A. Products comprised of nonwoven needle-punched polypropylene yarn oriented into a stable network that maintains its structure during handling, placement, and long-term service.
- B. May not be heat-bonded as a primary process.

- C. Resistant to soil and leachate chemicals.
- D. New product made from virgin materials.
- E. Geotextile shall be certified by the Manufacturer as substantially needle-free. A certification on the Manufacturer's letterhead and signed by an authorized representative of the Manufacturer shall be provided to the CQA Consultant.
- F. Conforming to the minimum property values specified in Article 2.01.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Before installing the geocomposite, the Contractor shall examine the underlying construction for conformance with these Specifications. Verify the following:
 - 1. Underlying installations are complete, installed as designed, and Record Documentation has been obtained.
 - 2. There is no debris, excessive dust, or rocks on the geomembrane in the area where the geocomposite will be deployed.

3.02 DELIVERY, STORAGE, AND HANDLING

- A. Protect geocomposite from ultraviolet light exposure, precipitation, inundation, mud, dirt, dust, puncture, cutting, and other damaging or deleterious condition.
- B. Ship geocomposite in a closed trailer or flatbed trail if the geocomposite is wrapped in opaque plastic.
- C. Immediately restore damaged protective covering.

3.03 PROTECTION

- A. When placing other geosynthetics over the geocomposite ensure the following:
 - 1. No damage occurs to the geocomposite.
 - 2. The geocomposite does not slip on the underlying geosynthetics.
 - 3. There are no excessive tensile stresses in the geocomposite.

3.04 DEPLOYMENT

- A. Follow the Manufacturer's recommendations, standards, and guidelines.

- B. Examine underlying geomembrane for conformance with these Specifications.
- C. Deploy geocomposite as indicated in the Drawings.
- D. Do not entrap excessive dust, stones, or moisture in geocomposite that could damage or clog drains or filters or hamper subsequent seaming.
- E. Deploy rolls down slope, not across slope, with primary flow direction of rolls going down slope, perpendicular to the contour lines.
- F. Lay smooth with no wrinkles and free of stresses.
- G. Examine the geocomposite over the entire installed surface to ensure that no potentially harmful foreign objects, such as needles, are present. Remove any foreign objects.
- H. Do not drag the geocomposite across rough or textured surfaces to avoid damage to the geocomposite. Use a smooth geosynthetic slip sheet or rub sheet as necessary to reduce friction damage during deployment.

3.05 PANEL SEAMS

- A. Panel seams shall be in accordance with the requirements of this Section, the Manufacturer's recommendations, or GRI-GN2/GRI-GC13, whichever is more stringent.
- B. Adjacent edges along the length of the geocomposite roll shall be overlapped a minimum of 6 inches or as recommended by the Manufacturer and approved by the CQA Consultant.
- C. Adjacent Edge Seams—The overlapped edges shall be joined by tying the geonet structure with cable ties. These ties shall be spaced every 5 feet along the roll length or as recommended by the Manufacturer and approved by the CQA Consultant.
- D. Butt Seams—Adjoining geocomposite rolls (end to end) along the roll width should be shingled down in the direction of the slope with a minimum overlap of 24 inches across the roll width or as recommended by the Manufacturer and approved by the CQA Consultant. The geonet should be joined with cable ties spaced every 9 inches along the roll width or as recommended by the Manufacturer and approved by the CQA Consultant.

- E. The Contractor shall provide additional cable ties along points of high stress or as instructed by the CQA Consultant.
- F. The top layers of geotextiles shall be sewn together. The Contractor, upon approval by the CQA Consultant, may propose to wedge weld the top layers of geotextile in lieu of sewing. The method for performing this work must be submitted to the CQA Consultant for approval a minimum of 14 days before installation.
- G. Geotextiles shall have a minimum 1-inch overlap before seaming or wedge welding. If wedge welding is proposed and approved, the Contractor must ensure that the geotextile is not burned, damaged, or punctured by the wedge welding process. The geotextiles shall be joined continuously to the adjacent and adjoining rolls to prevent material from migrating into the geonet core of the geocomposite.

3.06 REPAIRS

- A. Before covering the deployed geocomposite, the Contractor shall inspect the geocomposite for damage resulting from construction.
- B. The Contractor shall remove and patch any rips, tears, or damaged areas on the deployed geocomposite. The patch shall be secured to the original geocomposite by tying every 6 inches with the approved cable ties. If the area to be repaired is more than 50% of the width of the panel, the damaged area shall be cut out and the two portions of the geonet shall be joined in accordance with Article 3.05.
- C. The Contractor shall remove damaged material and replace it with new geocomposite. The geonet component of the new material will be secured to the remaining geocomposite with cable ties. The overlying geotextile will be sewn or heat-bonded to the in-place geotextile.

3.07 ACCEPTANCE

- A. The Contractor retains ownership and responsibility for geocomposite until acceptance by Owner.
- B. The Owner accepts geocomposite when:
 - 1. The installation is complete.
 - 2. All required documentation from the Manufacturer, Installer, and Contractor has been received and accepted.
 - 3. Conformance test reports verifying material properties have been received and accepted.

4. The CQA Consultant has completed Final Inspection and any noted defects have been repaired.

END OF SECTION

SECTION 02071 GEOMEMBRANE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install a 60-mil, textured, high-density polyethylene (HDPE) geomembrane, rub sheets, and a geosynthetic clay liner (GCL)-protective geomembrane as a component of the geomembrane liner system as shown on the Drawings and specified in this Section.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Manufacturer's Information
 - 1. Manufacturer's Information shall be submitted within 10 days of the Notice to Proceed.
 - 2. The Manufacturer's name, address, and primary contact.
 - 3. The Manufacturing plant name and address where the geomembrane for this project will be produced.
 - 4. The Manufacturer's qualifications including:
 - a. A minimum of 5 years of successful development and production of geomembrane.
 - b. Evidence of production of at least 10 million square feet of geomembrane that meets the specifications of Article 2.02.
 - c. Certification that the Manufacturer has sufficient capacity to provide the required material in the given timeframe.
 - d. A list of at least 10 projects for which geomembrane has been supplied by the Manufacturer, three of which shall have been for projects of similar size.
 - 5. Product name and the Manufacturer's description of the proposed geomembrane and five representative samples of the product (small

samples approximately 5 inches long by 4 inches wide enclosed in plastic labeled with product name) proposed for use on this project.

6. The Manufacturer's material properties sheet (cut sheet) of the proposed geomembrane documenting it will meet or exceed specified requirements.
7. The Manufacturer's quality control (MQC) certificates for raw resin material. Testing must be done in accordance with the MQC plan with a minimum of one test per lot and include tests listed in the table in Paragraph 2.01C.
8. The MQC certificates for finished geomembrane. Testing must be done in accordance with the MQC plan on the actual material to be shipped and include tests and frequencies performed as listed in the table in Paragraph 2.02I.
9. Written instructions for storing, handling, installing, seaming, and repairing proposed geomembrane, including recommendations for loading, unloading, and handling equipment (model number or load capacity) must be included.
10. Sample product warranty that meets the requirements of Article 1.07 and Section 01780, Warranties and Bonds.
11. The MQC plan, including examples of MQC certification documents, name and address of the quality control testing laboratory, quality control laboratory certification, examples of retesting notification, and documentation.

B. Installer's Information

1. The Contractor shall submit the Installer's Information as part of the Pre-Qualification of Construction Bidders prior to Award described in Section 2 and at least 30 days before the geomembrane is scheduled to begin to be installed.
2. Installer's name, address, and primary contact.
3. The Geomembrane Installer shall have current Approved Installation Contractor (AIC) status issued by the International Association of Geosynthetic Installers.

4. Installer's qualifications including a list of at least three previous projects of similar size to this project, including project name, location, size and date of installation, and evidence of installing at least 1 million square feet of geomembrane.
5. The geomembrane installer shall be an approved installer by the geomembrane manufacturer.
6. The Installer must submit the following written information verifying qualifications:
 - a. A list of projects for which similar geomembrane has been installed for at least five projects totaling a minimum of 2 million square feet over the past 5 years.
 - b. The résumé of a Field Installation Supervisor who has directly supervised over 1 million square feet of installation.
 - c. The résumé of a Master Seamer who has seamed a minimum of 500,000 linear feet of seam.
 - d. The résumé of a CQC Representative who has conducted quality control on at least two projects with a total of at least 1 million square feet of geomembrane.
 - e. If any of the Installer's personnel changes during the project, the Contractor shall submit to the Engineer résumés of the replacement personnel from the Installer before the new personnel may work on the project.
7. Construction Quality Control (CQC) Plan including but not limited to the following:
 - a. Description of seaming equipment and techniques.
 - b. Description of methods for repairing.
 - c. Description of method for removing rejected materials.
 - d. Proposed staffing.
 - e. Proposed equipment.
 - f. Complete set of forms to be used for recording installation CQC data, including but not limited to daily record documents.
8. A preliminary panel layout plan, including at a minimum:
 - a. Panel layout.
 - b. Panel identification numbers.
 - c. Field seams.
 - d. Installed square footage of the geomembrane.
 - e. Details that do not conform to the Construction Drawings.

9. A complete set of forms to be used for record installation CQC data.
10. The geomembrane Installer's sample product warranty that the geomembrane installation is guaranteed in accordance with Section 01780, Warranties and Bonds, and Article 1.07.

C. Project-Specific Product Acceptance Testing

1. After the Engineer's review and approval of the Manufacturer's Information, representative samples of the geomembrane product intended for this project and manufactured at the same plant that will produce the product for this project shall be sent to the CQA Laboratory for Project-Specific Product Acceptance Testing as listed in Article 2.02.
2. The Engineer's acceptance of the geomembrane product proposed for use on this project will depend on the results of the Project-Specific Product Acceptance testing. Project-Specific Product Acceptance test results shall be submitted to the Engineer 21 days before the geomembrane material is shipped to the project site. The geomembrane shall not be shipped before review and acceptance of the project-specific Product Acceptance Test results.
3. Product samples shall be sent to the Product Acceptance Laboratory unless otherwise noted. The sample package should include a cover letter referencing the project location, engineer project number, Manufacturer, date of sampling, lot and roll number, and MQC test data documented for the particular production run from which the sample was taken. This submittal shall conform to the requirements of Section 01330, Submittals and Acceptance. A copy of the cover letter shall be sent to the Engineer.

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4. The Contractor shall bear the cost of all Project-Specific Product Acceptance Testing, including shipping samples to Product Acceptance Laboratory.
5. Geomembrane Samples: The Manufacturer shall package and ship two 3-foot-long by the width-of-roll-wide samples to the Product Acceptance Laboratory. The Manufacturer shall package the samples securely for shipping to prevent damage. The sampler shall mark the Manufacturer's

roll identification number as well as the machine direction (MD) on the sample. The Contractor shall submit MQC data for the roll sampled with the test results.

6. Interface Direct Shear Strength Testing: The CQA Laboratory shall perform two interface direct shear strength tests – four normal load conditions for each of the two test configurations – in accordance with ASTM D5321 on representative samples of geomembrane in the configuration provided below. This requirement is in addition to the requirement for interface direct shear strength tests included in Section 02070, Geocomposite, and Section 02072, Geosynthetic Clay Liner.
 - a. Test Configuration 1—Geomembrane versus Geocomposite: Geomembrane is clamped to the top of the box and lower geotextile of geocomposite clamped to the bottom of the box and upper components of geocomposite shall be allowed to slide along the geomembrane.
 - (1) Submit the geocomposite sample in accordance with Section 02070, Geocomposite.
 - (2) Saturate for 1 hour under full load before shearing and shear under fully saturated (tap water) conditions.
 - b. Test Configuration 2—Geomembrane versus Subgrade Soil: Geomembrane is clamped to the bottom of the box and compacted subgrade soil on top. Soil shall be compacted to 95% of Modified Proctor Test in accordance with ASTM D1557.
 - (1) Submit the geocomposite sample in accordance with Section 02070, Geocomposite.
 - (2) Saturate for 1 hour under full load before shearing and shear under fully saturated (tap water) conditions.
 - c. Normal loads: See Paragraph 2.02A.
 - d. Shear rate: 0.04 inch/minute.
 - e. Provide complete shear versus displacement length to at least 3 inches of displacement.

- f. Report peak (maximum) shear strength and post-peak shear strength measured at 3 inches of displacement for all four normal loads. Report the location of the failure (i.e., slip plane).
 - g. Results shall meet the requirements of Table 2 in Article 2.01.
- 7. If the results of any test do not conform to the requirements of this Section, the Contractor may elect to retest from the same roll of product. The Contractor shall notify the Engineer that a retest is planned. Retesting results shall be reported within 7 days. If the retest does not conform to the requirements of this Section, the product shall be rejected and the Contractor must submit Pre-Construction Submittals pertaining to the new product and perform Project-Specific Acceptance Tests for the new product.

D. Manufacturer's Quality Control

- 1. The MQC data shall be submitted at least 21 days before geomembrane shipment.
- 2. The Contractor shall submit the MQC test results to demonstrate that the geomembrane is in accordance with this Section.
- 3. MQC sampling shall be in accordance with the test methods and minimum test frequencies provided in Article 2.02. If no sampling protocol is specified in the test method, then the samples shall be taken evenly spaced across the entire roll width in accordance with ASTM D4354.
- 4. Certification reports shall be submitted by the Manufacturer on the Manufacturer's letterhead and signed by an authorized representative of the Manufacturer.
- 5. MQC data shall be submitted electronically in PDF and data format (.xls, .xlsx, .csv, .txt, .doc, .docx, .accdb, etc.) that the data can be readily copied.
- 6. Provide the following information with MQC test data:
 - a. Project Name, Project Location, Manufacturer, Product Name.
 - b. Roll and lot numbers and any additional production identification.
 - c. Results of MQC tests, including a description of test methods used.

7. The Owner will reject rolls for which quality control requirements are not met.
8. If the results of any test do not conform to the requirements of this Section, the Contractor may elect to retest from the same roll of product. The Contractor shall notify the Engineer that a retest is planned. Retesting results shall be reported within 7 days. If the retest does not conform to the requirements of this Section, the product shall be rejected and removed from the site.

E. Construction Quality Control

1. The Contractor's CQC representative will be responsible for quality control in accordance with the submitted CQC Plan. During construction the Installer shall submit the following weekly:
 - a. Material delivery report.
 - b. Rejected material removal report.
 - c. Soil subgrade acceptance.
 - d. Records of daily installation logs, including but not limited to:
 - (1) Deployment, including roll numbers placed.
 - (2) Destructive sample testing.
 - (3) Seaming.
 - (4) Non-destructive tests.
 - (5) Trial welds.
 - (6) Repairs.
 - e. Weekly installation log data shall be submitted electronically in PDF and data format (.xls, .xlsx, .csv, .txt, .doc, .docx, .accdb, etc.) that the data can be readily copied.
 - f. Records of daily personnel activity.
 - g. Meeting reports.
 - h. Updated Record Drawings.

- F. Record Drawings: The Contractor shall prepare, maintain, and submit Record Drawings showing geomembrane installation indicating panel locations, seam locations, and roll numbers for each panel in accordance with the requirements of

the Contract Documents. The Record Drawings shall be updated throughout the project and are subject to field review by the Engineer any time upon request. Record Drawings shall be in accordance with Article 1.12.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM D792—Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
2. ASTM D1004—Test Method for Initial Tear and Resistance of Plastics Film and Sheeting.
3. ASTM D1238—Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
4. ASTM D1505—Standard Test Method for Density of Plastics by the Density-Gradient Technique.
5. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
6. ASTM D1603—Standard Test Method for Carbon Black Content in Olefin Plastics.
7. ASTM D3895—Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry.
8. ASTM D4218—Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
9. ASTM D4354—Standard Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing.
10. ASTM D4437—Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
11. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
12. ASTM D5199—Standard Test Method for Measuring Nominal Thickness of Geosynthetics.
13. ASTM D5321—Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.

14. ASTM D5397—Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
15. ASTM D5596—Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
16. ASTM D5641—Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
17. ASTM D5721—Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
18. ASTM D5820—Standard Practice for Pressurized Air Channel Evaluation at Dual-Seamed Geomembranes.
19. ASTM D5885—Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
20. ASTM D5994—Test Method for Measuring the Core Thickness of Textured Geomembranes.
21. ASTM D6392—Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced using the Thermo-Fusion Methods.
22. ASTM D6497—Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.
23. ASTM D6693—Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
24. ASTM D7238—Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.
25. ASTM D7466—Test Method for Measuring the Asperity Height of Textured Geomembranes.
26. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.

B. Environmental Protection Agency (EPA)

1. EPA/600/R-93-182—Quality Assurance and Quality Control for Waste Containment Facilities.

C. Geosynthetics Research Institute (GRI)

1. GM-10—The Stress Crack Resistance of HDPE Sheet.
2. GRI Test Method GM-13—Test Methods, Test Properties, and Testing Frequency for High-Density Polyethylene (HDPE) Smooth and Textured Geomembranes.

3. GRI Test Method GM-19—Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembranes.

1.04 QUALITY ASSURANCE

- A. MQC and CQC are the responsibility of the Contractor and are performed by the Manufacturer and Installer to document that the material and installation are in accordance with this Section. The Installer's CQC representative will be responsible for CQC in accordance with the submitted CQC Plan, which is independent of Construction Quality Assurance (CQA).
- B. The Owner will engage and pay for the services of an Engineer and/or CQA Consultant. The Owner will engage and pay for the services of an independent CQA Laboratory for monitoring the quality and installation of the geomembrane. The Manufacturer, Installer, and Contractor must help the Owner and the Engineer with product sampling for CQA testing by providing samples, personnel, and equipment as necessary.
 1. CQA tests will be the measure of the acceptance of material. The Contractor will be responsible for the cost of retesting if the CQA tests fail. The retests will be paid by the Owner and reimbursed by the Contractor.
 2. Samples of geomembrane: After review of the project-specific Product Acceptance Test results, the Engineer or representative may visit the manufacturing plant and/or select product rolls to be sampled by the Manufacturer. The Manufacturer will ship one 3-foot-long by the width-of-roll-wide sample for every 100,000 square feet of material to the Engineer's CQA Laboratory for CQA testing. The sample package shall include a cover letter referencing the project location, project number, Manufacturer, date of sampling, lot and roll number, and MQC test data documented for the particular production run from which the sample was taken. A copy of the cover letter shall be submitted to the Engineer.

1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds, and as specified in this Section.
- B. The geomembrane manufacturer's warranty, in writing, that the geomembrane material is guaranteed for 5 years on a pro rata basis from the date of Substantial Completion. This warranty shall apply to normal use and service in a landfill bottom-liner application under exposure to landfill leachate and landfill gas as well as other exposures that can be expected from the intended use.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Material delivery, storage, and handling shall be in accordance with documents as required in Article 1.02, Manufacturer's Instructions and Installer's Procedures.
- C. The Contractor shall deliver materials to the site only after the CQA Consultant approves the required submittals.
- D. The Contractor shall identify and separate damaged rolls from undamaged rolls and store damaged rolls at locations designated by the Owner. Rolls without proper labeling that identify roll number and dimensions will be considered damaged. Damaged material will be repaired or rejected at the discretion of the CQA Consultant. The cost of repair or replacement will be borne by the Contractor.
- E. The Contractor shall store geomembrane rolls in a location designated by the Owner. In the absence of a specific location, material must not be stored in areas that will impair the operations of the facility or harm the materials.
- F. The Contractor shall store geomembrane rolls to protect them from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.
- G. The Contractor shall store geomembrane rolls on a prepared surface. Prevent water from accumulating beneath the rolls.
- H. The Contractor shall not store geomembrane outdoors for more than 6 months. The geomembrane shall be moved inside an enclosed facility for storage exceeding 6 months. If an enclosed facility does not exist, a temporary enclosure shall be constructed.
- I. The Contractor shall not stack geomembrane no more than three rolls high.
- J. The Contractor shall use appropriate handling equipment to unload and store geomembrane rolls. Appropriate equipment includes cloth chokers and spreader bars. The equipment must be of sufficient size and capacity to safely and efficiently handle geomembrane materials without damage to the materials or injury to personnel.

- K. The Contractor shall not drag panels or rolls on the ground.
- L. The Contractor shall not crease geomembrane material; creased material will be rejected.
- M. Shipping materials including straps are the property of the Owner and will be set aside by the Contractor for the Owner's use.

1.07 QUALIFICATIONS

- A. Provide the Manufacturer's and Installer's qualifications in accordance with Article 1.03.

1.08 TESTING REQUIREMENTS

- A. Provide samples and testing for CQC testing in accordance with the requirements of this Section. Provide samples for CQA testing in accordance with the requirements of this Section. Please refer to the material requirement and testing frequencies provided in this Section.
- B. CQA testing shall be performed for the material properties list in Part 2 of this Section. The cost of CQA testing shall be paid by the Owner.
- C. If CQA tests fail the requirements of this Section, the retesting of material provided by the Contractor will be paid for by the Owner and the cost reimbursed by the Contractor as part of the project's final change order.

1.09 RECORD DRAWINGS

- A. Geomembrane installation Record Drawings shall include complete CQC reports for the installation of the geomembrane. Reports shall be typed and provided in PDF format. The CQC reports shall include the following:
 - 1. Completed soil subgrade acceptance forms.
 - 2. Records of daily installation logs, including:
 - a. Deployment, including roll numbers placed.
 - b. Destructive sample testing.
 - c. Seaming.
 - d. Non-destructive tests.
 - e. Trial welds.
 - f. Repairs.

- B. The Record Drawings shall include an as-built panel layout drawing for the installation of the geomembrane. The as-built panel layout drawings shall be submitted on a full-size drawing (22 × 34 inches or 24 × 36 inches) and shall be submitted in AutoCAD and PDF formats. The as-built panel layout drawing shall indicate the following at a minimum:

1. Panel number.
2. Geomembrane roll number.
3. Anchor trench.
4. Tie-in to existing liner.
5. Repairs locations with unique identification number.
6. Destructive sample locations with unique identification number.

1.10 DEFINITIONS

- A. *Batch*: A quantity of resin, usually the capacity of one rail car, used in the fabrication of HDPE geomembrane sheet. A roll number corresponding to the particular quantity of resin used will identify the finished sheet.
- B. *Bridging*: The condition when geomembrane becomes suspended over its subgrade due to contraction of the material or poor installation.
- C. *Extrudate*: The molten polymer emitted from an extruder during seaming using either extrusion fillet or extrusion flat methods. The polymer is initially in the form of a ribbon rod, bead, or pellets.
- D. *Geomembrane*: An essentially impermeable membrane used as a solid or liquid barrier. Synonymous term for flexible membrane liner (FML).
- E. *Geomembrane Manufacturer (Manufacturer)*: The party responsible for producing the geomembrane rolls from resin and for the quality of the resin.
- F. *Geomembrane Subbase*: The soil or geosynthetic surface on which the geomembrane lies.
- G. *Installer*: The party responsible for field handling, transporting, storing, deploying, seaming, temporarily restraining (against wind), and installing the geomembrane.

- H. *Lot*: A group of consecutively numbered rolls manufactured from the same resin batch or production line. For this Section a lot may not exceed 180,000 pounds of raw resin material.
- I. *Manufacturing Quality Assurance (MQA)*: A planned system of activities that provides assurance that the materials were constructed as specified in the certification documents and Contract Specifications. MQA includes manufacturing facility inspections, verifications, audits, and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. *MQA* refers to measures taken by the MQA organization to determine if the Manufacturer complies with the product certification and Contract Specifications for the project.
- J. *Manufacturing Quality Control (MQC)*: A planned system of inspections that is used to directly monitor and control the manufacture of a material, which is factory originated. MQC is normally performed by the Manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the Manufacturer to determine compliance with the requirements of materials and workmanship as stated in certification documents and Contract Specifications.
- K. *Panel*: The unit area of geomembrane that will be seamed in the field. If the geomembrane is not fabricated into panels in a factory, a panel is identified as a roll or portion of a roll without any seams.

PART 2 PRODUCTS

The Manufacturer shall supply the following products:

2.01 GEOMEMBRANE RESIN

- A. The geomembrane resin shall be virgin materials with no more than 10% reworked material from the same formulation as the parent material.
- B. Do not add any post-consumer resin (PCR) of any type to the formulation.
- C. Use materials meeting the following requirements unless otherwise approved:

Table 1 Geomembrane Resin Test Requirements		
Test	Test Designation	Requirements
1. Melt Index	ASTM D1238	< 1.0g /10 min
2. Specific Gravity	ASTM D1505 or D792 Method B	> 0.932 g/mL

2.02 PROPERTIES FOR TEXTURED HDPE GEOMEMBRANE

The Manufacturer shall ensure that the textured HDPE Geomembrane has the following properties:

A. Project-Specific Product Acceptance Test Requirements

Table 2 Project-Specific Product Acceptance Test Requirements				
Test	ASTM Test Designation	Minimum Test Frequency	Required Test Values	
Interface Shear Strength (see Paragraph 1.02C.6 for test configurations)	D5321	1 per project	Normal Load (psf)	Required Peak Shear Strength (psf)
			250	55
			5,000	1,070
			15,000	3,200
			20,000	4,300

- B. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from agglomerated texturing material and defects that would affect the specified properties of the geomembrane (GRI GM-13).
- C. The geomembrane may not exceed a combined maximum total of 1% by weight of additives other than carbon black or pigment.
- D. The geomembrane may not exceed 3.5% by weight of finished geomembrane for total combined processing aids, antioxidants, carbon black, and other additives.
- E. All additives for UV protection, thermal stability, color, or processing agents must not “bloom” to the surface over time or inhibit welding.
- F. The finished product must be free from blemishes, holes, pin holes, bubbles, blisters, excessive gels, undispersed resins and/or carbon black, contamination by foreign matter, as well as nicks or cuts on edges. The Manufacturer shall continuously perform spark tests during manufacturing to locate holes in the geomembrane. Repair holes before shipping in accordance with Article 3.22.
- G. White co-extruded geomembrane may be used in place of black HDPE geomembrane.

H. Roll manufactured sheets for shipment.

I. The geomembrane must conform to the following requirements in general accordance with GRI GM-13 (some requirements are stricter than GM-13):

Table 3 Geomembrane Test Requirements			
Test	Test Designation	MQC Test Frequency	Requirements
1. Sheet Thickness	ASTM D5994	Per roll	60 mils minus 15% for any measurement, minus 10% for 8 out of 10 individual values, and the average of all measurements for any roll, not less than 57 mils.
2. Asperity Height (1)	ASTM D7466	Every second roll (1)	16 mils and as needed to meet shear-strength requirements
3. Sheet density	ASTM D1505 (preferred) or D792 Method B	1/50,000 sf	> 0.940 g/cc
4. Tensile Properties (2)			
a. Yield Strength	ASTM D6693 Type IV	1/50,000 sf	> 126 lb/in
b. Break Strength	ASTM D6693 Type IV	1/50,000 sf	> 90 lb/in
c. Yield Elongation	ASTM D6693, Type IV	1/50,000 sf	> 12% each sample
d. Break Elongation	ASTM D6693, Type IV	1/50,000 sf	> 100%
5. Tear Resistance	ASTM D1004, Die C	1/100,000 sf	> 42 lb
6. Puncture Resistance	ASTM D4833	1/100,000 sf	> 90 lb
7. Stress Crack Resistance (3)	ASTM D5397 (App.)	Per GRI GM10	> 500 hr
8. Carbon Black Content	ASTM D4218 (4)	1/50,000 sf	2.0 to 3.0%
9. Carbon Black Dispersion	ASTM D5596	1/100,000 sf	(5)
10. Standard Oxidation Induction Time of Polyolefins (6)	ASTM D3895 or ASTM D5885	One per formulation	Minimum average 100 minutes or Minimum average 400 minutes
11. Oven Aging at 85°C (6), (7)			
a. Standard OIT (min. ave.) – % retained after 90 days — or —	ASTM D5721 ASTM D3895	Per each formulation	55%
b. High Pressure OIT (min. ave.) – % retained after 90 days	ASTM D5885		80%

Table 3 Geomembrane Test Requirements			
Test	Test Designation	MQC Test Frequency	Requirements
12. UV Resistance (8) High Pressure OIT (min. ave.) – % retained after 1,600 hours (9)	ASTM D7238 ASTM D5885	Per each formulation	50%

Notes:

- (1) Alternate the measurement side for double-sided textured sheet.
- (2) MD and cross machine direction (XMD) average values should be on the basis of five test specimens each direction. Yield elongation is calculated using a gauge length of 1.3 inches. Break elongation is calculated using a gauge length of 2.0 inches.
- (3) P-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Test should be conducted on smooth edges of textured rolls or on smooth sheets made from the same formulation as being used for the textured sheet materials. The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- (4) Other methods such as D1603 (tube furnace) or D6370 (thermogravimetry) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.
- (5) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3.
- (6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- (7) Evaluating samples at 30 and 60 days to compare with the 90-day response is also recommended.
- (8) The condition of the test should be 20 hours. Ultraviolet (UV) cycle at 75°C followed by 4-hour condensation at 60°C.
- (9) UV resistance is based on percent-retained value regardless of the original HP-OIT value.

2.03 MANUFACTURER SOURCE QUALITY CONTROL TESTING

- A. The Manufacturer shall perform the MQC tests listed above.
- B. Submit as indicated in Part 1 of this Section.

2.04 EXTRUDATE ROD OR BEAD

- A. Made from same resin type as the geomembrane.
- B. Containing 2% to 3% carbon black.

PART 3 EXECUTION (INSTALLER)

3.01 CERTIFICATION OF GEOMEMBRANE SUBBASE

- A. The Installer shall verify in writing by submitting a subbase acceptance form to the CQA Consultant that the surface on which the geomembrane will be installed is acceptable.

- B. The Installer shall verify that no particles project from the underlying surface that could puncture or damage the geomembrane.

3.02 PREPARATION

- A. The Contractor shall repair any damage to the subbase before deploying the geomembrane. The subgrade shall meet the requirements of Section 02301, Earthwork for Landfill Construction, and the GCL shall meet the requirements of Section 02072, Geosynthetic Clay Liner.
- B. Round edges of anchor trenches or cushion with geotextiles.

3.03 TRIAL SEAM WELDS

The Contractor shall perform trial seam welds as follows:

- A. Perform trial welds on samples of geomembrane to verify the performance of welding equipment, welding personnel, seam welding methods, and weather conditions.
- B. Do not begin production seam welding until equipment and welders have successfully completed trial welds.
- C. Frequency of Trial Welds
 - 1. There shall be a minimum of two trial welds per day per equipment and per seamer with one before the start of work and one at mid shift.
 - 2. After any equipment shutdown or loss of power.
 - 3. When directed by the CQA Monitor.
- D. Make trial welds in the same surroundings and environmental conditions as the production welds (i.e., in contact with subgrade).
- E. Make trial weld sample at least 6 feet long for dual-hot-wedge welding machines and 6 feet long for extrusion welds.
- F. Allow welds to cool for 5 minutes and then cut excess material from the ends of the welds.

- G. Using a cutting die cut ten 1-inch specimens spaced evenly along the length of the weld.
- H. Using a field tensiometer, test specimens for peel adhesion and bonded seam strength (ASTM D6392). Test both sides of the weld for peel strength (fusion welds only). Test at a separation rate of 2 inches per minute.
- I. A weld is considered passing when the following results are achieved in accordance with GRI GM-19 Table 1(a):
 - 1. The break is a film-tearing bond (FTB). The following are unacceptable break codes according to their description in ASTM 6392 (in this regard, SIP is an acceptable break code):
 - a. Hot Wedge: AD and AD-Brk > 25%.
 - b. Extrusion Fillet: AD1, AD2, and AD-WLD.
 - 2. The peel strength is a minimum of 91 pounds per inch for 60-mil thick at yield for wedge welds or flat welds and a minimum of 78 pounds per inch for 60-mil thick at yield for extrusion welds. The peel separation (or incursion) shall not exceed 25%.
 - 3. There is no more than 25% separation of the weld. For wedge welds the width of the weld is considered the width of the nip roller.
 - 4. The shear strength is a minimum of 120 pounds per inch for all weld types. Set grips back 2 inches from the edge of the weld when testing. Minimum elongation between the grips must be 2 inches. The shear elongation at break shall exceed 50% (shear elongation testing shall be omitted during field testing but included in laboratory tests.)
 - 5. The test is acceptable when four out of five test specimens pass both peel and shear tests and the fifth specimen meets or exceeds 80% of the values listed for peel and shear.
- J. Repeat the trial weld in its entirety when any of the trial weld specimens fail in either peel or shear.
- K. When repeated trial weld fails, do not use the welding apparatus and welder until deficiencies or conditions are corrected and two consecutive successful trial welds are achieved.

3.04 DEPLOYMENT

- A. Carefully consider the timing and temperature during deployment. Focus on verifying that there are no bridging or stresses in the geomembrane and there are no wrinkles in the geomembrane.
- B. Deployment, welding, and covering would all occur at the same temperature. In a practical sense, strive to perform these activities within as narrow a temperature range as practical and avoid these activities during peak hot or cold conditions.
- C. Deploy manually or by use of spreader bar attached to equipment as approved by the Manufacturer. The equipment shall not damage the subbase, GCL, geomembrane, or other geosynthetic materials.
- D. Provide minimum overlap of 4 inches (for extrusion welding) or 6 inches (for fusion welding) between panels.
- E. Dual-hot-wedge welding is the preferred method of seaming. Extrusion welding shall be limited to areas that cannot be fusion welded (i.e., patches).
- F. Panel Identification: Assign each panel an identifying code number or letter consistent with the approved panel layout drawing. The coding is subject to approval by the CQA Monitor.
- G. Repair damage to subbase or other underlying materials before completing deployment of geomembrane.
- H. Do not deploy more panels in one shift than can be welded or secured during that same shift.
- I. Do not deploy in the presence of excessive moisture, precipitation, ponded water, or high winds.
- J. Do not damage the geomembrane when handling, with equipment traffic, due to leakage of hydrocarbons, or by any other means.
- K. Do not wear shoes that can damage the geomembrane.
- L. Unroll geomembrane panels using methods that will not damage, stretch, or crimp the geomembrane. Protect the underlying surface from damage.
- M. Place ballast on the geomembrane that will prevent wind from uplifting and moving the geomembrane.

- N. Use ballast that will not damage the geomembrane.
- O. Protect the geomembrane in areas of heavy traffic by placing a protective cover over the geomembrane.
- P. Do not allow any vehicular traffic directly on the geomembrane without approval from the Engineer.
- Q. Remove wrinkled or creased material.
- R. Install material to account for shrinkage and contraction while avoiding wrinkles. Install material stress-free with no bridging before it is covered. Add material as needed to avoid bridging.
- S. Before wrinkles fold over, attempt to push them out. For wrinkles that cannot be pushed out, cut them out and repair.
- T. Do not allow textured surfaces to be dragged over the installed geocomposite. Use a smooth geosynthetic slip sheet or rub sheet as necessary to reduce friction damage during deployment.
- U. Visually inspect geomembrane for imperfections. Mark faulty or suspect areas for repair.

3.05 SEAM LAYOUT

- A. Orient seams parallel to the line of a maximum slope, i.e., orient down, not across a slope.
- B. Minimize the number of field seams in corners, odd-shaped geometric locations, and outside corners.
- C. Keep horizontal seams (seams running approximately parallel to slope contours) at least 6 feet away from the toe or crest of slope.
- D. When full-roll lengths do not extend past the toe of slope, panel ends may be seamed provided the panel is cut at an angle greater than 45°. The use of 45° seams along the slope is limited to situations that are unavoidable due to slope geometry.
- E. Use a seam-numbering system compatible with the panel number system.
- F. Shingle panels on all slopes and grades to promote drainage over the seam, not into the seam.

3.06 WELDING EQUIPMENT

- A. The Contractor shall maintain sufficient operating seaming apparatus to continue work without delay.
- B. Use a power source capable of providing constant voltage under combined line load.
- C. Provide protective lining and splash pad large enough to catch spilled fuel under the electric generator if the generator is positioned on the geomembrane.
- D. Provide extrusion welders equipped with gauges showing temperatures in the extruder apparatus and at the nozzle.
- E. Provide a hot-wedge welder meeting the following requirements:
 - 1. Contained on wheeled chassis and self-propelled.
 - 2. Automated variable-speed capability.
 - 3. Equipped with devices for adjusting temperatures at the wedge.
 - 4. Pressure controlled by springs, pneumatics, or other system that allows for variation in sheet thickness.
- F. Rigid-frame fixed-position equipment is not acceptable.

3.07 TEST EQUIPMENT

- A. The Contractor shall provide a tensiometer capable of measuring seam strength. The tensiometer must be calibrated and accurate within 2 pounds. The Contractor shall provide calibration certification within the last 12 months for inspection upon request by the Engineer.
- B. The Contractor shall provide non-destructive testing equipment (i.e., vacuum box) (ASTM D4437).
- C. The Contractor shall provide dies for cutting seam samples.

3.08 GENERAL WELDING PROCEDURES

- A. Do not begin welding until the welder and equipment pass the trial weld tests.
- B. Clean seam area surfaces of grease, moisture, dust, dirt, debris, or other foreign material.

- C. Overlap panels a minimum of 4 inches for extrusion and 6 inches for hot-wedge welding.
- D. Construct the weld with adequate material width on each side of the weld to allow peel and shear testing.
- E. Extend welding to the outside edge of all panels.
- F. If required for firm support, provide a firm subbase under the seaming area.
- G. Cut fish mouths or wrinkles along the ridge of the wrinkle to achieve a flap overlap. Extrusion-weld the cut fish mouths or wrinkles where the overlap is more than 3 inches. When there is less than a 3-inch overlap, patch with an oval or round patch extending a minimum of 6 inches in all directions beyond the cut.

3.09 EXTRUSION TYPE OF WELDING

- A. The Contractor shall use procedures to tack bond adjacent panels together that do not damage geomembrane and allow CQA tests to be performed.
- B. Purge welding apparatus of heat-degraded extrudate before welding.
- C. Bevel top edges of geomembrane a minimum of 45° and the full thickness of the geomembrane before extrusion welding.
- D. Clean seam-welding surfaces of oxidation by disc grinder or equivalent not more than 30 minutes before extrusion welding. Change grinding discs frequently. Do not use clogged discs.
- E. Do not remove more than 4 mils of material when grinding.
- F. Grind across, not parallel to, welds.
- G. Cover entire width of grind area with extrudate.
- H. When restarting welding, grind ends of all welds that are more than 5 minutes old.

3.10 HOT WEDGE WELDING

- A. Place smooth insulating plate or fabric beneath hot welding apparatus after use.
- B. Protect against moisture build-up between panels.

- C. If welding cross seams, conduct field test welds at least every 2 hours; otherwise, conduct tests once before the start of work and once at mid-day.
- D. Bevel edges of top and bottom panels on cross seams.
- E. Extrusion-weld a repair patch over all tee and cross-seam intersections.

3.11 INSTALLATION QUALITY CONTROL

- A. Log the following every 4 hours:
 - 1. Extrudate temperatures in barrel and at nozzle (extrusion welder).
 - 2. Operating temperature of hot wedge (hot-wedge welder) and any pressure adjustments made.
 - 3. Preheat temperature.
 - 4. Speed of hot wedge welder in feet per minute.
- B. Weld only when ambient temperature measured 6 inches above the geomembrane is between 40°F and 130°F.
- C. If seaming at ambient temperatures below 40°F (5°C) or above 130°F (40°C), the Contractor shall demonstrate and certify that such methods produce seams which are entirely equivalent to seams produced at ambient temperatures above 40°F (5°C) and below 130°F (40°C). Certify that the overall quality of the geomembrane is not adversely affected. Perform work under a contract change order that states the seaming procedure will not cause any physical or chemical modification to the geomembrane which will generate short- or long-term damage to the geomembrane.
- D. Seaming below temperatures of 32°F must be performed under cold weather welding procedures approved by the Engineer.

3.12 NON-DESTRUCTIVE TESTING

- A. The Contractor shall non-destructively test all field seams over their full length using a vacuum test unit, air pressure (for dual-hot-wedge seams only), spark testing, or other approved methods (ASTM D4437).
- B. Perform testing as the seaming progresses and not at the completion of all the field seaming.
- C. Note all required repairs in CQC reports and then complete all required repairs in accordance with this Section.

3.13 NON-DESTRUCTIVE VACUUM TESTING

A. Equipment

1. A vacuum box assembly consisting of a rigid housing, a transparent viewing window, a soft neoprene gasket attached to the bottom porthole or valve assembly, and a vacuum gauge.
2. A vacuum pump assembly equipped with a pressure control.
3. A rubber pressure/vacuum hose with fittings and connections.
4. A soapy solution and an applicator.

B. Vacuum Box Test Procedures

1. Wet the seam area with a soapy solution.
2. Place the box over the wetted seam area. Ensure that a leak-tight seal is created.
3. Energize the vacuum pump.
4. Reduce the vacuum box pressure to approximately 10 inches of mercury (i.e., 5-psi gauge).
5. Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 10 seconds.
6. Mark areas where soap bubbles appear.
7. Repair in accordance with repair procedures described in this Section.

3.14 NON-DESTRUCTIVE AIR PRESSURE TESTING FOR DUAL-HOT-WEDGE WELD

A. Equipment

1. An air pump (manual or motor driven) equipped with a pressure gauge capable of generating and sustaining a pressure over 70 psi and mounted on a cushion to protect the geomembrane.
2. A rubber hose with fittings and connections.
3. A sharp hollow needle or other approved pressure-feed device.
4. A pressure gauge with an accuracy of plus or minus 1 psi.

B. Test Procedures

1. Seal both ends of the welded seam to be tested.
2. Insert needle or other approved pressure-feed device into the tunnel created by the weld.
3. Energize the air pump to a minimum pressure of 30 psi.
4. Maintain this pressure for 5 minutes.
5. Close the valve allowing 5 minutes relaxation time. During the relaxation time the air pressure cannot drop more than 2 psi.

6. If loss of pressure exceeds 2 psi or does not stabilize, the Contractor shall locate the faulty area and repair it in accordance with repair procedures described in this Section.
7. Puncture the opposite end of the seam to release air. If blockage is present, locate and test the seam on both sides of the blockage.
8. Remove the needle or other approved pressure-feed device.
9. Repair the penetration holes.

3.15 SPARK TEST PENETRATIONS OR OTHER DIFFICULT AREAS AS AN ALTERNATIVE TO VACUUM TESTING

A. Equipment and Materials

1. 24-gauge copper wire.
2. Low-amperage electric detector, 20,000 to 30,000 volt, with brush-type electrode capable of causing visible arc up to 3/4 inch from copper wire.

B. Spark Testing Procedures

1. During extrusion welding, place a copper wire within 1/4 inch of the edge of the extrusion weld.
2. Pass an electrode over the seam area and observe for spark. If a spark is detected perform a repair.

3.16 LABORATORY DESTRUCTIVE TESTING

A. Location and Frequency of Testing

1. Collect destructive test samples at a minimum frequency of one test location per 1,000 feet of seam length.
2. Determine test locations during welding. Locations may be prompted by suspicion or excess crystallinity, contamination, offset welds, or suspected defect. The CQA Monitor will be responsible for choosing the locations. The CQA Monitor will not notify the Installer in advance of selecting locations where weld samples will be taken.
3. The CQA Monitor may increase the test frequency based on marginal results.

B. Sampling Procedures

1. The Installer shall cut samples at locations designated by the CQA Monitor as the welding progresses. The Installer is to verify that passing laboratory test results have been obtained before the geomembrane is covered by another material.

2. The CQA Monitor will number each sample and mark the sample number and location in compliance with the CQA program.
- C. The Contractor shall immediately repair all holes in the geomembrane resulting from destructive test sampling in accordance with repair procedures described in this Section. Test the continuity of the repair in accordance with this Section.
- D. Size of Samples: Samples shall be a minimum of 12 inches wide by 52 inches long with the seam centered lengthwise. Cut ten 1-inch-wide strips evenly across the sample and test these for (shear and peel) in the field. Cut the remaining sample into three parts for distribution as follows:
 1. One portion for the Installer: 12 inches by 12 inches.
 2. One portion for the CQA Laboratory: 12 inches by 18 inches.
 3. One portion to the Owner for archive storage: minimum 12 inches by 12 inches.

3.17 FIELD TESTING (PERFORMED BY INSTALLER)

- A. Test the ten 1-inch-wide strips specified in Paragraph 3.03H above by tensiometer for peel and shear.
- B. The test strips must meet peel and shear requirements for welded seams specified in Paragraph 3.03I.
- C. If any field test sample fails, follow failed test procedures outlined in this Section.

3.18 LABORATORY TESTING PERFORMED INDEPENDENTLY BY CONSTRUCTION QUALITY ASSURANCE LABORATORY

- A. The Engineer will retain an independent CQA Laboratory to perform CQA testing.
- B. Test "seam strength" and "peel adhesion" (ASTM D6392).
- C. Test at least five specimens for each test method. Minimum acceptable values to be obtained for these tests are specified in Paragraph 3.03I.
- D. Select specimens alternately by test from the samples (i.e., peel, shear, peel, shear).
- E. Provide test results no more than 48 hours after receiving samples.
- F. For dual-hot-wedge welded samples, test both sides in peel.

- G. Seams failing testing and/or inspection shall be repaired, reinspected, and retested by the Owner until compliance is attained. However, the Contractor shall reimburse the Owner for all failed tests.

3.19 FAILED WELD PROCEDURES

- A. The Installer shall follow one of the following options when there is a destructive test failure:
 - 1. First Option:
 - a. Reconstruct the seam between any two passing test locations. Do not extrusion weld the flap.
 - 2. Second Option:
 - a. Trace the weld at least 10 feet minimum in both directions along the seam from the failed specimen.
 - b. Obtain specimens at these locations for additional field tests. Obtain specimens as described above.
 - c. If the additional test specimens meet seam quality requirements, repair the seam between the passing seam specimen locations or the passing specimen location and the end of the seam.
 - d. If any specimen fails to meet seam quality requirements, repeat the process to establish the zone in which the seam must be repaired.
- B. Shear or peel test: If a shear or peel test taken from a butt seam fails, cap the entire butt seam. Obtain a specimen from the cap and perform a shear and peel test. If the test from the cap specimen fails, repeat the capping until a passing test is obtained from a specimen of the cap weld.
- C. Whenever a sample fails, perform additional trial seams for the specific welder and welding apparatus.

3.20 ACCEPTABLE WELDED SEAMS

Welded seams are considered acceptable under the following conditions:

- A. The weld passes all non-destructive tests and the weld is bracketed by two locations from which all specimens have passed destructive tests.
- B. For reconstructed seams exceeding 50 feet, a specimen taken from within the reconstructed weld passes destructive testing and all non-destructive tests pass.

3.21 SEAMS THAT CANNOT BE DESTRUCTIVELY TESTED

- A. If the weld cannot be tested, cap strip the weld. The welding and cap-stripping operations must be observed by the CQA Monitor and Installer for uniformity and completeness. The cap strip must pass nondestructive testing.

3.22 DEFECT AND REPAIR PROCEDURES

- A. The repair procedures, materials, and techniques must be accepted in advance of the specific repair by the Owner, the Engineer, and the Installer.
- B. The Contractor shall examine all welds and non-weld areas of the geomembrane for defects, holes, blister, undispersed raw materials, and any sign of contamination by foreign matter. The surface of the geomembrane must be clean at the time of the examination.
- C. Repair and non-destructively test each suspect location regardless of whether it is in a weld area or discovered in the panel. Do not cover geomembrane at locations that have been repaired until test results with passing values are available.
- D. Extrusion weld a patch over all “cross” or “tee” welds and specimen locations.
- E. Remove damaged geomembrane and replace with acceptable geomembrane materials if damage cannot be satisfactorily repaired.
- F. Repair, removal, and replacement are at the Contractor's expense if the damage results from the Contractor's, Installer's, or the Contractor's subcontractor's activities.
- G. Repair any portion of the geomembrane exhibiting a flaw or failing a destructive or non-destructive test. The Owner, the Engineer, the Installer must agree on the appropriate repair method. Acceptable repair procedures may include:
 - 1. Patching: Used to repair large holes (over 3/8-inch diameter), tears (over 2 inches long), undispersed raw materials, and contamination by foreign matter and to cover cross and tee connections.
 - 2. Abrading and re-welding: Used to repair small sections of seams.
 - 3. Spot welding or seaming: Used to repair small tears (less than 2 inches long), pinholes, or other minor localized flaws.
 - 4. Capping: Used to repair large lengths (greater than 2 inches long) of failed seams.
 - 5. Complete replacement of the seam.

H. In addition, the Contractor must do the following:

1. Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than 1 hour before the repair.
2. Clean and dry all surfaces at the time of repair.
3. Extend patches or caps at least 6 inches beyond the edge of the defect and round all corners of material to be patched and the patches to a radius of at least 3 inches.
4. Unless otherwise instructed by the Owner, cut geomembrane below large caps to avoid water or gas collection between the sheets.

I. Verification of Repair

1. Number and log each repair.
2. Non-destructively test each repair using methods specified in this Section.
3. Destructive tests may be required at the discretion of the Owner's Representative or CQA Consultant.
4. Reconstruct repairs until tests indicate passing results.

3.23 GEOMEMBRANE ACCEPTANCE

A. The Contractor retains all Ownership and responsibility for the geomembrane until acceptance by the Owner.

B. The Owner will accept geomembrane installation when:

1. All required MQC and Installer records have been received and accepted.
2. The installation is finished.
3. Test reports verifying completion of all field seams and repairs, including associated testing, have been received.
4. Written certification documents and Drawings have been received by the Owner.

END OF SECTION

SECTION 02072
GEOSYNTHETIC CLAY LINER

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install geosynthetic clay liner (GCL) as a component of the liner system.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Manufacturer's Information
1. Manufacturer's information shall be submitted within 10 days of the Notice to Proceed.
 2. The Manufacturer's name and address and primary contact.
 3. The manufacturing plant name and address where the GCL for this project will be produced.
 4. The Manufacturer's qualifications including:
 - a. A minimum of 5 years of successful development and production of GCL.
 - b. Evidence of production of at least 10 million square feet of GCL that meets the specifications of Article 2.01.
 - c. Certification that the Manufacturer has sufficient capacity to provide the required material in the given timeframe.
 - d. A list of at least 10 projects for which GCL has been supplied by the Manufacturer, three of which shall have been for projects of similar size.
 5. Product name and the Manufacturer's description of the proposed GCL and five representative samples of the product (small samples approximately 5 inches long by 4 inches wide enclosed in a plastic bag with the product name) proposed for use on this project.

6. The Manufacturer's material properties sheets (cut sheets) of proposed GCL product meeting the requirements listed in the Article 2.01.
7. The Manufacturer's written instructions for storing, handling, installing, seaming, protecting from hydration, and repairing the proposed GCL, including recommendations for handling equipment (model number and load capacity).
8. Sample product warranty that meets the requirements of Article 1.07 and Section 01780, Warranties and Bonds.
9. The Manufacturer's quality control (MQC) plan, including examples of GCL certification documents, name and address of the quality control testing laboratory, quality control laboratory certification, examples of retesting notification, and documentation.

B. Installer's Information

1. The Contractor shall submit the Installer's Information at least 30 days before GCL is scheduled to be installed.
2. Installer's name and address and primary contact.
3. Installer's qualifications including a list of at least three previous projects of similar size to this project, including project name, location, size and date of installation, and evidence of installing at least 1 million square feet of GCL.
4. The construction quality control (CQC) plan, including examples of subgrade certification documents, daily record documents, methods for repairing GCL and Subbase and example documents to certify repairs, method for removing rejected materials, proposed staffing, and proposed equipment.
5. The Installer's written procedures manual.
6. Panel layout drawings identifying panels and overlaps.

C. Project-Specific Product Acceptance Testing

1. After the CQA Consultant review and approval of the Manufacturer's Information and, representative samples of the GCL product intended for this project and manufactured at the same plant that will produce the product for this project shall be sampled in accordance with ASTM D6072 and sent to the Product Acceptance Laboratory for Project-Specific Product Acceptance Testing as listed in Table 2 in Article 2.01.
2. The CQA Consultant's acceptance of the GCL product will depend on the results of the Project-Specific Product Acceptance testing. Project-Specific

Product Acceptance test results shall be submitted to the CQA Consultant 21 days before shipping the GCL. The GCL shall not be shipped before review and acceptance of the Project-Specific Product Acceptance Test results.

3. Samples shall be sent to the Product Acceptance Laboratory specified by the CQA Consultant unless otherwise noted. The sample package should include a cover letter referencing the project location, project number, Manufacturer, date of sampling, lot and roll number, and MQC test data documented for the particular production run from which the sample was taken. This submittal shall conform to the requirements of Section 01330, Submittals and Acceptance. A copy of the cover letter shall be sent to the CQA Consultant.
4. The Contractor shall bear the cost of all Project-Specific Product Acceptance testing, including shipping samples to the Product Acceptance Laboratory.
5. The GCL samples shall include two 3-foot-long-by-the-width-of-roll samples for laboratory testing. The Contractor may elect to have the Product Acceptance Laboratory collect the samples from the Manufacturer or direct the Manufacturer to ship the samples to the Product Acceptance Laboratory. The samples shall be packaged securely for shipping to prevent damage, bentonite loss, and hydration. Each sample shall be clearly marked with lot and roll number and date of sampling as the machine direction on the sample. The Contractor shall submit MQC data for the roll sampled with the test results.
6. The Product Acceptance Laboratory shall perform eight interface direct shear tests—four normal load conditions for each of two test configurations—in accordance with ASTM D6243. The test configurations are listed below. These tests are in addition to the requirements for interface direct shear tests included in Section 02070, Geocomposite, and Section 02071, Geomembrane (HDPE).
 - a. Test Configuration 1—GCL versus Textured Geomembrane: GCL clamped to top and textured geomembrane clamped to bottom of box. Textured geomembrane sample shall be provided by the Contractor using representative geomembrane product intended for use in this project. See Section 02071, Geomembrane (HDPE), for geomembrane sampling and shipping requirements.
 - b. See Section 02071, Geomembrane (HDPE), for geomembrane sampling and shipping requirements.
 - c. Normal loads: See Table 2 in Article 2.01.

- d. Saturate GCL sample for 48 hours under full normal load before shearing and shear under fully saturated (tap water) conditions.
 - e. Shear rate: 0.04-inch/minute.
 - f. Provide complete shear versus displacement graph to at least 3 inches of displacement.
 - g. Report peak (maximum) shear strength and post-peak shear strength measured at 3 inches of displacement for all four normal loads.
 - h. Report location of failure surface (i.e. slip plane).
 - i. Results shall meet the requirements of Table 2 in Article 2.01.
7. The Product Acceptance Laboratory shall perform GCL compatibility testing to verify that the site-specific leachate and groundwater will not adversely affect the hydraulic properties of the proposed GCL.
- a. The Contractor shall arrange with the Owner to obtain leachate and groundwater samples for use in compatibility testing. The Contractor shall bear the cost of shipping samples to the Product Acceptance Laboratory and all Project-Specific Product Acceptance testing and disposal costs.
 - b. Bentonite Screening Tests: The Product Acceptance Laboratory shall perform compatibility testing on the bentonite portion of the GCL in accordance with ASTM D6141 guidance, which includes swell index in accordance with ASTM D5890 and fluid loss in accordance with ASTM D5891. Results shall meet the requirements of Table 2 in Article 2.01. Bentonite screening tests shall include the following:
 - (1) Swell Index (ASTM D5890) – Deionized water
 - (2) Fluid Loss (ASTM D5891) – Deionized water
 - c. GCL Compatibility: The Product Acceptance Laboratory shall perform leachate compatibility testing on the GCL in accordance with ASTM D6766 for hydraulic properties using actual leachate obtained from the site as permanent. Confirm test configurations with the CQA Consultant before testing. Report the flux ($\text{m}^3/\text{m}^2\text{sec}$) and hydraulic conductivity (cm/sec). Results shall meet the requirements of Table 2 in Article 2.01.
 - (1) Leachate Compatibility: The GCL test specimen shall be hydrated with leachate for a minimum of 48 hours using sufficient backpressure to achieve a minimum B coefficient of 0.9 and using a confined effective consolidation stress

not exceeding 5 pounds per square inch (psi). The hydraulic conductivity test on the GCL specimen shall be conducted using leachate at a confined effective consolidation stress not exceeding 5 psi. The hydraulic conductivity test shall continue until steady state conditions are reached or a minimum of two pore volumes of permeant fluid have passed through the test specimen.

8. If the results of any test do not conform to the requirements of this Section, the Contractor may elect to retest from the same roll of product. The Contractor shall notify the CQA Consultant that a retest is planned. Retesting results shall be reported within 7 days. If the retest does not conform to the requirements of this Section, the product shall be rejected and the Contractor must submit pre-construction submittals pertaining to the new product and perform Project-Specific Acceptance Tests for the new product.

D. Manufacturer's Quality Control (MQC)

1. The MQC data shall be submitted at least 21 days before GCL shipment.
2. The Contractor shall submit the MQC test results to demonstrate that the GCL is in accordance with this Section.
3. MQC Sampling shall be in accordance with the specific test method listed in Table 1 of Article 2.01. If no sampling protocol is stipulated in the test method, then samples shall be taken evenly spaced across the entire roll width in accordance with ASTM D4354.
4. Certification reports shall be submitted by the Manufacturer on the Manufacturer's letterhead and signed by an authorized representative of the Manufacturer.
5. MQC data shall be submitted electronically in PDF and data format (.xls, .xlsx, .csv, .txt, .doc, .docx, .accd, etc.) that the data can be readily copied.
6. The Contractor shall submit MQC testing reports and certifications meeting requirements of Article 2.01. Before shipping the product, the Manufacturer shall submit the certification that GCL is essentially free of broken needle fragments on the Manufacturer's letterhead and signed by an authorized representative of the Manufacturer.

7. Provide the following information with MQC test data:
 - a. Project Name, Project Location, Manufacturer, Product Name.
 - b. Roll and lot numbers and any additional production identification.
 - c. Results of MQC tests, including a description of test methods used.
 8. The Owner will reject rolls for which quality control requirements are not met.
 9. If the results of any test do not conform to the requirements of this Section, the Contractor may elect to retest from the same roll of product. The Contractor shall notify the CQA Consultant that a retest is planned. Retesting results shall be reported within seven days. If the retest does not conform to the requirements of this Section, the product shall be rejected and removed from the site.
- E. Construction Quality Control (CQC): During construction, the Contractor shall submit CQC documentation weekly:
1. Material delivery report.
 2. Rejected material removal report.
 3. Soil subgrade certification signed by the Contractor.
 4. Records of daily installation, including roll numbers placed.
 5. Records of daily personnel activity.
 6. Meeting reports.
 7. Updated Record Drawings.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
1. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 2. ASTM D2216—Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
 3. ASTM D4354—Standard Practice for Sampling of Geosynthetics for Testing.
 4. ASTM D4439—Standard Terminology for Geosynthetics.

5. ASTM D4533—Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
6. ASTM D4632—Test Method for Breaking Load and Elongation of Geotextiles.
7. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
8. ASTM D5261—Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
9. ASTM D5887—Standard Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
10. ASTM D5888—Standard Guide for Storage and Handling of Geosynthetic Clay Liners.
11. ASTM D5889—Standard Practice for Quality Control of Geosynthetic Clay Liners.
12. ASTM D5890—Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.
13. ASTM D5891—Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.
14. ASTM D5993—Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners.
15. ASTM D6072—Standard Practice for Obtaining Samples of Geosynthetic Clay Liners.
16. ASTM D6141—Standard Guide for Screening Clay Portion of Geosynthetic Clay Liner (GCL) for Chemical Compatibility to Liquids.
17. ASTM D6243—Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.
18. ASTM D6496—Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners.
19. ASTM D6766—Standard Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids.
20. ASTM D6768—Standard Test Method for Tensile Strength of Geosynthetic Clay Liners.

1.04 QUALITY ASSURANCE

- A. MQC and CQC are the responsibility of the Manufacturer and Installer to document that the material and installation are in accordance with this Section.

- B. The Installer's CQC representative will be responsible for CQC in accordance with the submitted CQC Plan, which is independent of Construction Quality Assurance (CQA).
- C. The Owner will engage and pay for the services of an Engineer and/or CQA Consultant. The Owner will engage and pay for the services of an independent CQA Laboratory for monitoring the quality and installation of the GCL. The Manufacturer, Installer, and Contractor must help the Owner and CQA Consultant with product sampling for CQA testing by providing samples, personnel, and equipment as necessary.
 - 1. CQA tests will be the measure of the acceptance of material. The Contractor will be responsible for the cost of retesting should the CQA tests fail. The retests will be paid by the Owner and reimbursed by the Contractor.
 - 2. Samples of GCL: After review of the project-specific Product Acceptance Test results, the CQA Consultant or representative may visit the manufacturing plant and/or select product rolls to be sampled by the Manufacturer. The Manufacturer will ship one 3-foot-long by the width-of-roll-wide sample for every 100,000 square feet of material to the CQA Consultant's CQA Laboratory for CQA testing. The sample package shall include a cover letter referencing the project location, project number, Manufacturer, date of sampling, lot and roll number, and MQC test data documented for the particular production run from which the sample was taken. A copy of the cover letter shall be submitted to the CQA Consultant.

1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions and Section 01780, Warranties and Bonds.
- B. The GCL Manufacturer shall warrant in writing the GCL material for 5 years on a pro rata basis from the date of Substantial Completion. The warranty shall apply to normal use and service in a sanitary landfill environment under exposure to sanitary landfill gas and leachate as well as other exposures that can be expected from the intended use.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

- B. Material delivery, storage, and handling shall be in accordance with documents as required in Article 1.03, Manufacturer's Instructions and Installer's Procedures.
- C. The Contractor shall deliver materials to the site only after the CQA Consultant approves the required submittals.
- D. The Contractor shall do the following to ensure proper delivery, storage, and handling:
 - 1. Comply with the Manufacturer's instructions provided as part of the pre-construction submittals described in Paragraph 1.03A.
 - 2. Deliver materials to the site only after the Owner or their designated representative accepts pre-construction submittals and project-specific product acceptance submittals.
 - 3. Deliver GCL covered with a waterproof, tightly fitting, plastic covering resistant to ultraviolet degradation.
 - 4. Deliver GCL on a rigid core sufficient to prevent collapse during shipping, shattering or breaking during deployment, and to facilitate handling.
 - 5. Ship less than 1 month before scheduled installation.
 - 6. Deliver each roll with the following information marked on each label:
 - a. Manufacturer's name.
 - b. Project name.
 - c. Product identification.
 - d. Lot and roll numbers.
 - e. Roll dimensions and weight.
 - 7. Each roll shall have a label clearly visible and attached to the outside of the roll and at the end of the roll.
 - 8. Preserve integrity and readability of roll labels.
 - 9. Store rolls in space allocated by the Owner. Space shall be at high-ground level or elevated above ground surface.
 - 10. Stack no more than three rolls high.
 - 11. Protect rolls from precipitation, mud, dirt, dust, puncture, cutting, standing water, or any other damaging or deleterious conditions.

12. Use appropriate handling equipment meeting the Manufacturer's recommendations to load, move, or deploy GCL rolls.
13. Handle rolls to prevent damage to the product or to its protective wrapping and labels. Follow handling procedures outlined in ASTM D5888.
14. Immediately repair damage to protective covering due to mishandling or sampling. Repair to protect rolls from moisture or other deleterious conditions.
15. The Installer is responsible for off-loading, storing, and transporting material from the storage area to the installation site, installing the GCL, and performing or coordinating CQC activities.
16. The Contractor shall reject any roll that does not have an identifying roll number and lot number.
17. The Contractor shall not store GCL outdoors for more than 12 months. GCL rolls shall be covered with a waterproof, plastic covering that is resistant to ultraviolet degradation in addition to the plastic wrap that covers each GCL roll.

1.07 QUALIFICATIONS

- A. The Contractor shall provide the Manufacturer's and the Installer's qualifications as specified in Article 1.03.

1.08 TESTING REQUIREMENTS

- A. Provide samples and testing for CQC testing in accordance with the requirements of this Section. Provide samples for CQA testing in accordance with the requirements of this Section. Please refer to the material requirement and testing frequencies provided in this Section.
- B. CQA testing shall be performed for the material properties list in Part 2 of this Section. The cost of CQA testing will be paid by the Owner.
- C. If CQA tests fail the requirements of this Section, the retesting of material provided by the Contractor will be paid for by the Owner and the cost reimbursed by the Contractor as part of the project's final change order.

1.09 RECORD DRAWINGS

- A. Record Drawings shall be prepared, maintained, and submitted showing GCL installation in accordance with the requirements of the Contract Documents. Record Drawings shall be updated throughout the project and are subject to field review by the CQA Consultant any time upon request.

1.10 DEFINITIONS

- A. *Bentonite*: Clay soil, comprised primarily of sodium montmorillonite, characterized by high-swelling potential and low hydraulic conductivity.
- B. *Geosynthetic Clay Liner (GCL)*: Manufactured liner material consisting of a layer of granular bentonite encapsulated by geotextiles.
- C. *GCL Manufacturer (Manufacturer)*: The party responsible for the production and quality of GCL.
- D. *Geotextile*: Permeable geosynthetic comprised solely of textiles (ASTM D4439).
- E. *Installer*: The party responsible for field handling, transporting, storing, deploying, seaming, and protection against hydration of the GCL.
- F. *Lot*: A group of consecutively numbered rolls from the same manufacturing line.
- G. *Minimum Average Roll Value (MARV)*: Minimum value of a limited series of tests that represents a value two standard deviations lower than the overall average value. Ninety-five percent of any individual samples will have values greater than the MARV for any given property.
- H. *Overlap*: The width of a GCL panel in contact with an adjacent GCL panel. The distance is measured perpendicular from the overlying edge of one panel to the underlying edge of the other.

PART 2 PRODUCTS

2.01 GEOSYNTHETIC CLAY LINER (GCL)

The GCL must meet the following requirements:

- A. Manufactured with a layer of bentonite granules between two layers of geotextile, with the geotextiles needle punched together to provide internal shear strength. All GCL to be supplied and installed on this project will be reinforced GCL products.

- B. Manufactured rolls marked with continuous waterproof laplines and matchlines offset 6 inches from the edge of the rolls.
- C. Certified by the Manufacturer as needle-free.
- D. Polymer-enhanced GCL product may be used.
- E. Manufactured to meet the requirements listed in Table 1 and Table 2.

Table 1 Manufacturing Quality Control Test Requirements			
Test	ASTM Test Designation	Minimum Test Frequency	Required Test Values
Bentonite Component of GCL Requirements			
Bentonite Swell Index (Tap water)	D5890	Every 50 tons	≥ 24 mL/2g
Bentonite Fluid Loss (Tap water)	D5891	Every 50 tons	<18 mL
Nonwoven Geotextile Component of GCL			
Mass/Unit Area (cover and base)	D5261	1/200,000 sf	≥ 5.9 oz/sy MARV
Grab Tensile Strength	D4632	1/200,000 sf	Cover > 15 lb Base > 150 lb
GCL Requirements			
Bentonite Mass/Unit Area	D5993	1/40,000 sf	>0.75 lb/sf ⁽¹⁾
Tensile Strength	D6768	1/200,000 sf	>50 lb/in
Peel Strength	D6496	1/40,000 sf	>3.5 lb/in
Hydraulic Conductivity (Deionized Water)	D5887	1/250,000 sf	$<5 \times 10^{-9}$ cm/sec ⁽²⁾
Index Flux (Deionized Water)	D5887	1/250,000 sf	$<1.0 \times 10^{-8}$ m ³ /m ² /sec ⁽²⁾

Notes:

(1) Report bentonite mass per unit area at 0% moisture content.

(2) Hydraulic Conductivity and Index Flux testing in accordance with FDEP 62-701.400(3)(c)1, FAC.

Table 2 Project-Specific Product Acceptance Test Requirements				
Test	ASTM Test Designation	Minimum Test Frequency	Required Test Values	
			Minimum Peak Shear Strength	Normal Load (psf)
Shear Strength (min.) (see Article 1.02D for test configurations)	D6243	1 per project	55	250
			1,070	5,000
			3,200	15,000
			4,300	20,000
Leachate Compatibility (see Article 1.02D)				
Bentonite Swell Index (Deionized Water)	D5890	1 per project	≥ 24 mL/2g	
Bentonite Fluid Loss (Deionized Water)	D5891	1 per project	< 18 mL	
Hydraulic Conductivity (Leachate and Groundwater)	D6766	1 per project	<1.0 x10 ⁻⁷ cm/sec	

2.02 BENTONITE COMPONENT OF GCL

The Bentonite component of the GCL shall meet the following requirements:

- A. Greater than 90% sodium montmorillonite clay.
- B. Granular.
- C. Meeting the product requirements listed in Table 1 and Table 2 of Article 2.01.

2.03 NON-WOVEN GEOTEXTILE COMPONENT OF GCL

The Geotextile component of the GCL shall meet the following requirements:

- A. Products comprised of non-woven needle-punched polypropylene or polyester yarn oriented into a stable network that maintains its structure during handling, placement, and long-term service.
- B. May not be heat-bonded as a primary process. Heat burnishing after needle-punching is permitted.
- C. Resistant to soil and leachate chemicals.
- D. New product made from virgin materials.
- E. Geotextile used for GCL conforming to the requirements listed in Table 1.

PART 3 EXECUTION

3.01 EXAMINATION OF GCL SUBGRADE

- A. The Contractor shall verify in writing to the Owner and CQA Consultant with standard subgrade acceptance forms (Article 1.02) that the surface on which the GCL will be installed is acceptable.
- B. Subgrade acceptance forms shall also verify that the subgrade meets the requirements of Section 02301, Earthwork for Landfill Construction.

3.02 DEPLOYMENT

- A. Installation shall not begin until submittals have been received and approved (see Article 1.02).
- B. Do not deploy GCL in the presence of excessive moisture, precipitation, ponded water, or high winds.
- C. Deploy only after submittal of subgrade acceptance forms signed by the Installer, received and reviewed by the Owner and CQA Consultant, and accepted by the CQA Consultant.
- D. No equipment used shall damage the GCL by handling, deploying, leaking of hydrocarbons, or other means.
- E. Deploy panels parallel to slope, running panels down slope. Correct or make adjustments to panels that become askew to line parallel to slope.
- F. Seams should be located at least 5 feet from the toe and crest of slopes.
- G. Deploy manually or by use of spreader bar attached to a loader or backhoe.
- H. Use track- or rubber-tire-mounted equipment to deploy the GCL.
- I. Equipment shall be as described in the CQC plan and must not cause rutting of the subgrade surface. Equipment is subject to approval by the CQA Consultant.
- J. Do not make sharp turns during installation.
- K. Do not drive over the GCL unless approved in writing by the GCL Manufacturer and proven to not void the material's warranty (Article 1.05).

- L. Repair any damage to the subgrade or GCL that occurs during deployment. Any GCL surface showing damage due to scuffing, penetration by foreign objects or distress from rough subsurface shall, at the expense of the Contractor, be replaced or repaired in accordance with the CQC plan (Article 1.02).
- M. Do not trap objects or standing water beneath the GCL.
- N. To avoid damage to the GCL, do not drag textured geomembrane over the installed GCL. Use a smooth geosynthetic slip sheet or rub sheet as necessary to reduce friction damage during deployment.
- O. Avoid wrinkles during deployment. Areas that could potentially fold over or result in a crease in the GCL shall be removed and repaired in accordance with Article 3.06.
- P. The GCL shall be repaired in accordance with the CQC plan (Article 1.02) and Article 3.06.
- Q. Only deploy as much GCL as can be covered with geomembrane at the end of the working day. Do not leave the GCL uncovered overnight.
- R. If water is on the GCL or if stepping on the GCL expels water, the GCL is prematurely hydrated and shall be removed. The CQA Consultant shall be consulted if premature hydration is suspected, even if the GCL does not expel water or is covered. GCL that has been prematurely hydrated shall not be used, even after drying.
- S. Where dewatering is required, the Contractor shall maintain dewatering system as required in Section 02240, Dewatering, until installation of all overlying layers, including protective cover soil or gravel, is completed to prevent premature hydration of the GCL.

3.03 PANEL OVERLAPS

- A. Use the lapline as a guide.
- B. Overlap along roll length a minimum of 6 inches (or greater as recommended by the Manufacturer) on base slopes where slopes are less than 10%.
- C. Overlap along roll length a minimum of 9 inches (or greater as recommended by the Manufacturer) on side slopes where slopes are greater than 10%.

- D. Overlap a minimum of 24 inches at roll ends and apply supplemental bentonite as described in this Section and in accordance with the Manufacturer's installation requirements.
- E. Orient panels parallel to the line of a maximum slope (i.e., orient down, not across slope).
- F. Minimize the number of field seams in inside corners, odd-shaped geometric locations, and outside corners.
- G. Keep horizontal overlaps (overlaps running approximately perpendicular to slope contours) at least 5 feet away from the toe or crest of slope.
- H. Shingle panel overlaps on all slopes and grades so that surface water flows across the seam flap, not under it.
- I. Contact surfaces between two GCL panels shall be thoroughly cleaned of foreign material. Care should be taken to ensure that the overlap zone is not contaminated with loose soil or other debris.
- J. If the GCL material used for this work does not include self-seaming capabilities along the longitudinal overlaps, supplemental granular bentonite shall be used in the seams as provided in this Section as described in the Manufacturer's installation requirements.
- K. Where applicable, the granular bentonite sealing clay used for overlap seaming, penetration sealing, and repairs shall be made from the same natural sodium bentonite as used in the GCL and shall be as recommended by the GCL Manufacturer.

3.04 PROTECTION

- A. The Contractor shall deploy no more panels in 1 day than can be secured under geomembrane during that same day.
- B. Secure or anchor the GCL and overlying geomembrane at the end of each day to prevent damage from rain or wind.
- C. Protect the GCL from hydration caused by rain, run off, run on, groundwater infiltration, etc.

3.05 REPAIR PROCEDURES

- A. Remove punctured, torn, or hydrated material.
- B. Cover removed area with the same type of GCL material with the same side up.
- C. Overlap new GCL 18 inches in all directions over repair area.

3.06 QUALITY ASSURANCE

- A. Adhere to the Manufacturer's instructions and CQC plan. Project-Specific Product Acceptance results shall be received at least 21 days before material is shipped to project site.
- B. Project-Specific Product Acceptance tests and CQA tests will determine the product's compliance with specified values.
- C. The CQA Consultant will observe and document, among other things:
 - 1. Delivery and storing material.
 - 2. Subsurface preparation.
 - 3. Placement and seaming.
 - 4. Repairs.
 - 5. Quantities used.

3.07 ACCEPTANCE

- A. The Contractor retains ownership and responsibility of the GCL until Substantial Completion.
- B. The Owner will accept GCL installation when:
 - 1. The soil subgrade certification has been received.
 - 2. All pre-construction submittals and Project-Specific Product Acceptance documentation has been received and accepted.
 - 3. MQC and CQC test reports verifying material properties have been received and accepted.
 - 4. Defects have been repaired and rejected material has been removed from the site.

GCL INSTALLER’S CERTIFICATE
OF
ACCEPTABLE INSTALLATION

The GCL Installer, _____(Installer), for
the _____(Project) hereby certifies that
the installation of the subgrade for the liner system is in accordance with our recommendations,
approved CQC Plan, and the quality of the work has been to our satisfaction.

Area Accepted:

GCL Installer

Signature	Name	Title	Date

Earthwork Contractor

Signature	Name	Title	Date

CQA Representative

Signature	Name	Title	Date

END OF SECTION

SECTION 02074
GEOTEXTILE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install non-woven geotextile in the leachate collection and leachate detection systems.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Pre-construction Submittals: Submit the following within 10 days of Notice to Proceed:
1. Manufacturer's Information:
 - a. A minimum of 5 years of successful development and production of geotextiles.
 - b. The Manufacturer's name, address, and primary contact.
 - c. The manufacturing plant name and the address where the geotextile for this project will be produced.
 - d. The Manufacturer's qualifications including:
 - (1) Evidence of production of at least 10 million square feet of geotextile that meets the specifications of Articles 2.01 and 2.02.
 - (2) Certification that the Manufacturer has sufficient capacity to provide the required material in the given timeframe.
 - (3) A list of at least 10 projects for which the Manufacturer has supplied geotextile, three of which shall have been for projects of similar size.
 - e. The Manufacturer's quality control (MQC) certificates. Testing must be done in accordance with the quality control plan and in accordance with Articles 2.01 and 2.02.

- f. Product name and the Manufacturer's description of the proposed geotextile and five representative samples of the product (small samples approximately 5 inches long by 4 inches wide enclosed in plastic labeled with product name) proposed for use on this project.
- g. The Manufacturer's material properties sheet (cut sheet) of proposed geotextile documenting it will meet or exceed the requirements specified in Articles 2.01 and 2.02.
- h. Written instructions for delivering, storing, handling installing, seaming, and repairing the proposed geotextile, including recommendations for loading, unloading, and handling equipment (model number or load capacity).
- i. Sample product warranty that meets the requirements of Article 1.05 and Section 01780, Warranties and Bonds.

B. Installer's Information

- 1. The Contractor shall submit the Installer's information at least 30 days before geotextile is scheduled to be installed.
 - a. Installer's name, address, and primary contact.
 - b. Installer's qualifications, including but not limited to a list of at least three previous projects of similar size and scope to this project including project name, location, size, and date of installation.
 - c. CQC plan, including but not limited to the following:
 - (1) Description of seaming equipment and techniques.
 - (2) Description of methods for repairing geotextiles.
 - (3) Description of method for removing rejected materials.
 - (4) Proposed staffing.
 - (5) Proposed equipment.
 - (6) Complete set of forms to be used for recording installation quality control data, including but not limited to daily record documents.
 - d. Installer's written procedures manual.

C. Manufacturer's Quality Control (MQC)

1. The MQC data shall be submitted at least 21 days before geotextile shipment.
2. The Contractor shall provide the following information with the MQC test data: project name, project location, Manufacturer, product name, and lot and roll numbers.
3. MQC sampling shall be in accordance with the test methods and minimum test frequencies provided in Article 2.01, Table 1, and Article 2.02, Table 2. If no sampling protocol is specified in the test method, then the samples shall be taken evenly spaced across the entire roll width in accordance with ASTM D4354.
4. The Contractor will bear the cost of all Manufacturer's certification testing, including shipping samples to the Product Acceptance Laboratory.
5. The Manufacturer shall submit certification reports on the Manufacturer's letterhead and signed by an authorized representative of the Manufacturer.
6. MQC data shall be submitted electronically in PDF and data format (.xls, .xlsx, .csv, .txt, .doc, .docx, .accdb, etc.) that the data can be readily copied.
7. Provide the following information with MQC test data:
 - a. Project Name, Project Location, Manufacturer, Product Name.
 - b. Roll and lot numbers and any additional production identification.
 - c. Results of MQC tests, including a description of test methods used.
8. The Engineer will reject rolls for which quality control requirements are not met.
9. If the results of any test do not conform to the requirements of this Section, the Contractor may elect to retest from the same roll of product and/or perform bracket sampling to bracket the problem. The Contractor shall notify the CQA Consultant that a retest is planned. Retesting results shall be reported within 7 days. If the retest does not conform to the requirements of this Specification, the material shall be rejected and removed from the site.
10. If retesting of the roll is performed, two additional specimen sets shall be selected from the failed roll. Each of these specimens is required to pass

unique sampling/testing events. If the additional testing events result in failure or if retesting of the roll in question is not undertaken, the extent of the failure shall be bracketed by selecting samples from rolls produced before and after the failed roll. Unique sampling/testing events shall be performed until passing results are obtained bracketing the failure. All rolls falling between the bracketing passing rolls shall be rejected.

D. Construction Quality Control (CQC)

1. During construction the Contractor shall submit the following CQC documentation weekly:
 - a. Material delivery report.
 - b. MQC testing reports and certifications.
 - c. Rejected material removal report.
 - d. Records of daily installation including roll numbers placed.
 - e. Records of daily personnel activity.
 - f. Meeting reports.
 - g. Updated Record Drawing.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at bid time. The following documents are a part of this Specification. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM D4439—Standard Terminology for Geosynthetics.
2. ASTM D4491/D4491M—Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
3. ASTM D4533/D4533M—Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
4. ASTM D4632/D4632M—Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
5. ASTM D4751—Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
6. ASTM D4833/D4833M—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
7. ASTM D5035—Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method).
8. ASTM D5261—Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

9. ASTM D6241—Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.
10. ASTM D7238—Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.

1.04 QUALITY ASSURANCE

- A. MQC and CQC are the responsibility of the Contractor who must document that the material and installation are in accordance with this Section.
- B. The Owner will engage and pay for the services of a CQA Consultant and an independent CQA Laboratory for monitoring the quality and installation of the geotextile.
- C. The Installer's quality control representative will be responsible for construction quality control in accordance with the submitted CQC Plan, which is independent of the Plan.
- D. The Installer must help the CQA Consultant with product sampling by providing personnel and equipment when necessary.
- E. The Manufacturer and the Installer shall coordinate activities with the CQA Consultant.
- F. Manufacturer
 1. The Contractor shall perform the MQC tests for geotextile manufactured for this project. Perform tests necessary to verify that the geotextile meets the specified product requirements. Perform each MQC test at the minimum frequencies listed Articles 2.01 and 2.02.
 2. The CQA Consultant will reject rolls for which quality control requirements are not met.
- G. Owner
 1. The CQA Laboratory will receive geotextile samples 21 days before material is shipped to the project site and will perform conformance tests as required in the CQA Plan to determine product compliance with specified values.

2. Among other tasks, the CQA Consultant will observe and document the following:
 - a. Delivery and storing material.
 - b. Subsurface preparation.
 - c. Placement and seaming.
 - d. Repairs.
 - e. Quantities used.

1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplemental Conditions, and Section 01780, Warranties and Bonds.
- B. The geotextile Manufacturer shall warrant, in writing, the geotextile material for 5 years on a pro rata basis. The warranty shall apply to anticipated liquid and gas exposure from the intended use.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Material delivery, storage, and handling shall be in accordance with documents as required in Article 1.02, Manufacturer's Instructions and Installer's Procedures.
- C. Geotextile labeling, shipment, and storage shall follow ASTM D4873. Product labels shall clearly show the manufacturer or supplier name, style, and roll number. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate.
- D. Each geotextile roll shall be wrapped with a material that will protect the geotextile, including the ends of the roll, from damage due to shipment, water, sunlight, and contaminants. The protective wrapping shall be maintained during periods of shipment and storage.
- E. During storage, geotextile rolls shall be elevated off the ground and adequately covered to protect them from the following: site construction damage, precipitation, extended ultraviolet radiation including sunlight, chemicals that are strong acids or strong bases, flames including welding sparks, temperatures exceeding 160°F (71°C), and any other environmental condition that may damage the property values of the geotextile.

1.07 RECORD DRAWINGS

- A. Record Drawings shall be prepared, maintained, and submitted in accordance with Section 01785, Record Documents.

1.08 DEFINITIONS

- A. *Construction Quality Assurance (CQA)*: A planned system of activities that provides assurance that the materials to be installed on the project are in accordance with the Contract plans and specifications. CQA includes manufacturing facility inspections, testing verifications, and evaluation of the products to assess the quality of the material. CQA refers to the measures taken by the CQA Consultant to determine compliance of the materials with the product and contract specifications.
- B. *Construction Quality Control (CQC)*: A planned system that provides procedures for delivering a construction project that meets the requirements defined in the contract plans and specification. CQC is performed by the Contractor and includes process control testing, inspection and control procedures, description of records to be maintained, and personnel qualifications.
- C. *CQA Laboratory*: An independent laboratory contracted by the Owner to monitor the quality and installation of the product.
- D. *CQA Consultant*: An independent consultant contracted by the Owner to manage the quality and installation of the product. Responsibilities include field observations, laboratory observation and testing, and construction certification.
- E. *Geotextile*: Permeable geosynthetic composed solely of textiles (ASTM D4439).
- F. *Geotextile Manufacturer (Manufacturer)*: The party responsible for the production and quality of geotextile.
- G. *Installer*: The party responsible for field handling, transporting, storing, deploying, seaming, and protection of the material.
- H. *Lot*: A group of consecutively numbered rolls from the same manufacturing line.
- I. *Manufacturing Quality Assurance (MQA)*: A planned system of activities that provides assurance that the materials were manufactured as specified in the certification documents and contract specifications. MQA includes manufacturing facility inspections, verifications, audits, and evaluation of the raw materials (resins and additives) and geosynthetic products to assess the quality of the manufactured materials. MQA refers to measures taken by the MQA organization

to determine if the Manufacturer is in compliance with the product certification and contract specifications for the project.

- J. *Manufacturing Quality Control (MQC)*: A planned system of inspections used to directly monitor and control the manufacture of a material that is factory originated. MQC is normally performed by the Manufacturer of geosynthetic materials and is necessary to ensure minimum (or maximum) specified values in the manufactured product. MQC refers to measures taken by the Manufacturer to determine compliance with the requirements of materials and workmanship as stated in certification documents and contract specifications.

PART 2 PRODUCTS

2.01 NON-WOVEN GEOTEXTILE FOR SEPARATION

- A. Products composed of non-woven polypropylene or polyester filaments that maintain their structure during handling, placement, and long-term service.
- B. Resistant to soil chemicals, landfill gas, and leachate.
- C. New product made from virgin materials.
- D. Geotextile used for separation conforming to the following minimum property values:

Table 1 Nonwoven Geotextile for Separation Test Requirements			
Test	ASTM Test Designation	Minimum MQC Test Frequency	Required Test Values ⁽¹⁾
Mass per Unit Area	D5261	1/100,000 ft ²	8.0 oz/sy
Grab Tensile Strength	D4632	1/100,000 ft ²	180 lb
Grab Elongation	D4632	1/100,000 ft ²	<50%
Trapezoid Tear	D4533	1/100,000 ft ²	68 lb
Puncture (CBR) Strength	D6241	1/540,000 ft ²	380 lb
Permittivity	D4491	1/540,000 ft ²	1.26 sec ⁻¹
Mullen Burst	D3786	1/540,000 sf	290 psi
Water Flow Rate	D4491	1/540,000 ft ²	95 gpm/ft ²
Apparent Opening Size	D4751	1/540,000 ft ²	< 0.60 mm > 30 US Sieve No.
UV Resistance ⁽²⁾	D7238	1/formulation	70%

- (1) All required test values are minimum average roll values (MARV) except ultraviolet (UV) stability, which is a minimum average value.
- (2) Evaluation to be on 2.0-inch strip tensile specimens in accordance with ASTM D5035 after 500 light hours' exposure.

- E. The Contractor shall be responsible for the cost of retesting if the conformance CQA tests fail. The tests will be paid for by the Owner and reimbursed by the Contractor.

2.02 NON-WOVEN GEOTEXTILE FOR PROTECTION (CUSHION)

- A. Products composed of nonwoven polypropylene or polyester filaments that maintain their structure during handling, placement, and long-term service.
- B. Resistant to soil chemicals, landfill gas, and leachate.
- C. New product made from virgin materials.
- D. Geotextile used for protection (cushion) conforming to the following minimum property values:

Table 2 Nonwoven Geotextile for Geomembrane Protection (Cushion) Test Requirements				
Test	ASTM Test Designation	Minimum MQC Test Frequency	Required Test Values ⁽¹⁾	
Mass per Unit Area	D5261	1/100,000 ft ²	16 oz/sy	32 oz/sy
Grab Tensile Strength	D4632	1/100,000 ft ²	370 lb	500 lb
Grab Elongation	D4632	1/100,000 ft ²	50%	50%
Trapezoid Tear	D4533	1/100,000 ft ²	145 lb	215 lb
Puncture (CBR) Strength	D6241	1/540,000 ft ²	900 lb	1,700 lb
UV Resistance ⁽²⁾	D7238	1/formulation	70%	70%

- (1) All required test values are MARV except UV stability, which is a minimum average value.
- (2) Evaluation to be on 2.0-inch strip tensile specimens in accordance with ASTM D5035 after 500 light hours' exposure.

- E. The Contractor will be responsible for the cost of retesting if the conformance CQA tests fail. The tests will be paid for by the Owner and reimbursed by the Contractor.

PART 3 EXECUTION

3.01 PROTECTION

- A. Before installing the geotextile, the Contractor shall confirm that the underlying geomembrane, geocomposite, and gravel layer have been approved by the CQA Consultant.
- B. When placing soil materials over geotextile ensure the following:
 - 1. No damage to geotextile.
 - 2. No slippage of geotextile on underlying layers.
 - 3. No excessive tensile stresses are applied to geotextile.

3.02 PREPARATION

- A. Underlying components must be completed and accepted by the CQA Consultant.
- B. The surface shall be smooth and free of debris of any kind.
- C. Geotextile shall not be placed in standing water.

3.03 DEPLOYMENT

To ensure proper deployment, the Contractor shall do the following:

- A. Follow the Manufacturer's recommendations, standards, and guidelines.
- B. Weight geotextile with sandbags or equivalent as ballast during deployment. Leave ballast in place until the geotextile is about to be covered. Remove ballast before placing overlying soil.
- C. Cut geotextile using approved cutter only. Take care to protect other in-place geosynthetic materials when cutting geotextile.
- D. Do not entrap excessive dust, stones, or moisture in the geotextile that could damage or clog drains or filters or hamper subsequent seaming.
- E. Examine the geotextile over the entire completed surface to ensure that no potentially harmful foreign objects are present. Remove any foreign objects.
- F. Do not drag the geotextile across rough or textured surfaces to avoid damage to the geotextile. Use a smooth geosynthetic slip sheet or rub sheet as necessary to reduce friction damage during deployment.

3.04 SEAMING AND OVERLAPPING

- A. Sew all seams for non-woven geotextiles used in separation and cushion applications. Overlap the geotextile 3 inches minimum before seaming. Do not seam horizontal on slopes steeper than 10% (i.e., seam along, not across slopes). Stagger horizontal butt seams.
- B. Ensure that no soil is inadvertently inserted into the seams of geotextiles.
- C. Sew with polymeric thread having chemical resistance and strength properties equal to or exceeding those of the geotextile.
- D. For sewing, use a 401 two-thread chain stitch, or equivalent.

3.05 REPAIRING

- A. Patching: Repair holes or tears in geotextiles with a patch from the same geotextile material continually sewn or heat bonded in place with a minimum seam overlap of 12 inches in all directions. Sew or heat bond the geotextile within 1 inch of the outside edge of the patch materials.
- B. Remove any soil or other material that may have penetrated the torn geotextile.

3.06 ACCEPTANCE

- A. The Contractor retains all Ownership and responsibility for geotextile until acceptance by the Owner.
- B. The Owner accepts geotextile when:
 - 1. The installation is complete.
 - 2. Conformance tests verify product requirements.
 - 3. Documentation of installation, including the CQA Consultant's final inspection, is complete.
 - 4. Verification of the adequacy of all seams and repairs, including associated testing, is complete.

END OF SECTION

SECTION 02220
DEMOLITION AND MODIFICATIONS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and demolish, modify, remove, and dispose of work shown on the Drawings and as specified in this Section.
- B. The work includes but is not limited to demolishing, modifying, and removing existing materials, equipment, or work necessary to install the new work as shown on the Drawings and as specified in this Section and to connect with existing work in an approved manner.
- C. Demolition, modifications, and removals which may be specified under other Sections shall conform to requirements of this Section.
- D. Demolition and modifications may include but are not limited to:
 - 1. Removal and disposal onsite of existing concrete structures, pads, piping, and miscellaneous items as shown on the Drawings.
 - 2. Removal and stockpiling of roadway materials.
 - 3. Removal and reuse of edge of liner markers and wellheads.
 - 4. Demolition, removal, and/or reuse of other miscellaneous items indicated in the Contract Documents.
- E. Blasting and the use of explosives will not be permitted for any demolition work.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Submit to the Engineer proposed methods, schedule, and operations of demolition of the structures and modifications before beginning work. Include in the schedule for the coordination of shutoff, capping, and continuation of utility service.
- B. Furnish a detailed sequence of demolition and removal work to ensure the uninterrupted progress of the Owner's operations. The sequence shall be compatible with sequence of construction and shutdown coordination requirements.

- C. Before beginning demolition work, the Contractor shall complete all modifications necessary to bypass the affected structure. Actual work shall not begin until the Engineer has observed and approved the modifications and authorized beginning the demolition work in writing.

1.03 JOB CONDITIONS

- A. Protection

- 1. The Contractor shall conduct the demolition and removal work to prevent damage or injury to structures, equipment, piping, instrumentation, conduit, environmental monitoring devices, etc., and to adjacent features.

- B. Notification

- 1. At least 48 hours before beginning demolition or removal, the Contractor shall notify the Engineer in writing of the proposed schedule of the demolition or removal. The Engineer shall inspect the existing equipment and identify and mark those items that are to remain on the property of the Owner. No removals shall be started without the permission of the Engineer.

- C. Conditions of Structures

- 1. The Owner and the Engineer assume no responsibility for the actual condition of the items to be demolished or modified.
 - 2. Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. However, variations within a structure may occur before the start of demolition work.

- D. Repairs to Damage

- 1. The Contractor shall promptly repair damage caused to adjacent facilities by demolition operation when directed by the Engineer and at no cost to the Owner. Repairs shall be made to a condition at least equal to that which existed before construction.

- E. Traffic Access

- 1. The Contractor shall conduct demolition and modification operations and remove equipment and debris to ensure minimum interference with roads on site.

1.04 DISPOSAL OF MATERIAL

- A. Salvageable material and equipment shall become the property of the Owner. The Contractor shall dismantle all such items to a size that can be readily handled and deliver them to a designated storage area at the North Central Landfill.
- B. All other material and items of equipment shall become the Contractor's property and must be removed from the site or disposed of in the Active Class I Landfill if allowed by the site's permit. All materials disposed of at the landfill shall be weighed at the onsite scale house.
- C. Storing (except as otherwise noted in this Section) or selling removed items will not be allowed on the project site.
- D. Excavated soil is not considered a demolition material and shall be stockpiled or reused in the construction in accordance with the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

- A. All materials and equipment removed from existing work shall become the property of the Contractor, except for those which the Owner has identified for reuse, salvage, or stockpiling. All materials and equipment identified by the Owner for reuse, salvage, or stockpiling shall be carefully removed so as not to be damaged and stockpiled where indicated by the Engineer or Owner.
- B. The Contractor shall dispose of all demolition materials, debris, and all other items.
- C. Pollution Controls
 - 1. Use water sprinkling, temporary enclosures, and other suitable methods to limit the amount of dust and dirt rising and scattering in the air to the lowest practical level. Comply with governing regulations pertaining to environmental protection.
 - a. Do not use water when it may create hazardous or objectionable conditions such as flooding and pollution.
 - b. Clean adjacent structures, facilities, and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to conditions existing before starting the work.

3.02 CLEAN-UP

- A. The Contractor shall dispose of all debris resulting from the demolition operations as it accumulates.

END OF SECTION

SECTION 02230 SITE PREPARATION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, and equipment required and perform all site preparation, complete as shown on the Drawings and as specified in this Section.
- B. The Contractor shall obtain all permits required for site preparation before proceeding with the Work.

1.02 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Submit to the Engineer copies of all permits required before clearing, grubbing, and stripping work.

1.03 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

- A. The Contractor shall cut and remove brush, shrubs, roots, grass, weeds, rubbish, and any other objectionable material resting on or protruding through the surface of the ground.

3.02 GRUBBING

- A. The Contractor shall grub and remove all stumps, roots in excess of 1-1/2 inches in diameter, matted roots, brush, logs, concrete rubble, and other debris encountered to a depth of 18 inches below the bottom of foundations, or bottom liner, whichever is deeper.
- B. The Contractor shall refill all grubbing holes and depressions excavated below the original ground surface with suitable materials and compact to a density conforming to the surrounding ground surface in accordance with Section 02301, Earthwork for Landfill Construction.

3.03 DISPOSAL

- A. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved on-site disposal area. No rubbish or debris of any kind shall be buried by the Contractor on the project site.
- B. Burning of cleared and grubbed materials or other fires for any reason will not be permitted.

END OF SECTION

SECTION 02240
DEWATERING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the work necessary to perform dewatering activities before, during, and after constructing the bottom-liner system. Tasks associated with dewatering activities include the following: developing a Dewatering Plan, installing piezometers for groundwater elevation measurement, monitoring dewatering, managing dewatering effluent, and operation and maintenance of dewatering activities during the construction period.
- B. All work in this Section shall be done in accordance with the requirements of the South Florida Water Management District (SFWMD) and the Florida Department of Environmental Protection (FDEP) permits.
- C. Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control groundwater flow into excavations and permit construction to proceed on dry, stable subgrade.
 - 1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrade and permanent structures is prevented.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means of surface water control.
 - 3. Operate the dewatering system until all Protective Soil has been installed above the leachate collection trenches or unless otherwise authorized by the Engineer. The Contractor shall provide an as-built survey of the Protective Soil that is signed and sealed by a Florida-licensed professional surveyor for Engineer approval before dewatering activities may cease.
 - 4. Remove dewatering system if no longer needed.
- D. The Contractor shall design the dewatering system. The Contractor shall be responsible for obtaining whatever investigations are necessary before bidding to design the dewatering system.
- E. The Dewatering Contractor shall dewater so as to prevent damage to existing work. The Contractor shall repair or replace any damage resulting from the dewatering activities promptly, remedy environmental damage as approved by the Engineer, and pay any and all fines levied to the Owner at no additional cost or time to the Owner.

- F. All groundwater shall be recharged to the aquifer from where it was dewatered via an infiltration pond.

1.02 DEFINITIONS

- A. *Contractor* – the General Contractor.
- B. *Dewatering Contractor* – the Contractor responsible for developing the Dewatering Plan and performing dewatering activities.
- C. *Steady State* – the condition after the initial water removal when dewatering continues to maintain the groundwater level at least 2 feet below the bottom of liner in order to ensure dry working conditions (for silty and clayey soils, groundwater level may need to be maintained about 3 to 5 feet below the slopes and the bottom of liner to prevent water from pumping to the surface through capillary action to prevent wet and spongy conditions).

1.03 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01330, Submittals and Acceptance:

- A. At least 30 days before commencing any dewatering activity, the Dewatering Contractor shall submit a Dewatering Plan to the Engineer. The Dewatering Plan shall be signed and sealed by a Florida-licensed Professional Engineer responsible for its preparation. The Dewatering Plan shall provide a detailed description of the proposed dewatering system. This Plan shall include, but is not limited to, the following information:
 - 1. Description and understanding of the site's and regional hydrogeology.
 - 2. Layout, type, and spacing of dewatering devices.
 - 3. Estimated volume of dewatering effluent to be discharged into the infiltration pond.
 - 4. Estimated time to reach steady state, as defined in Paragraph 1.02C, of this Section.
 - 5. Specifications for pumps including pump curves.
 - 6. Capacities of pumps and standby equipment.
 - 7. Performance certification of flow-meters.
 - 8. Filter material specifications, if used.
 - 9. Other equipment with a description of the installation and operating procedures.
 - 10. Recharge means, location(s) and path.
 - 11. Means for prevention of erosion and sedimentation.

12. A specific discussion of the understanding and expected impacts from the intermediate confined aquifer on the confining unit, surficial aquifer, and the dewatering system.
 13. Personnel responsible for monitoring the dewatering system, recharge system, and dewatered excavations.
 14. Supporting design documentation demonstrating adequacy of systems and selected equipment.
 15. Drawings indicating the location and size of any berms, dikes, ditches, sumps, vacuum and discharge lines, flow-meters, silt tanks, and additional monitoring wells.
 16. A written report outlining control procedures to be followed if dewatering problems arise (backup plans for continued dewatering).
 17. Shop drawings signed and sealed by the qualified professional engineer responsible for their preparation.
 18. Method(s) of pumped water quality monitoring.
 19. Quantity and type of standby equipment.
 20. Plan for abandonment of dewatering wells or sock drains and contingencies.
 21. Methods for stormwater management that will ensure 24-hour protection of the work during a storm event.
 22. Methods to ensure geosynthetic clay liner (GCL) is not prematurely hydrated.
- B. The Dewatering Contractor shall be responsible for abiding by the facility's dewatering permit. The Contractor is responsible for obtaining the required information to demonstrate compliance with the permit and providing it to the Engineer and Owner/Owner representative.
- C. The Dewatering Contractor shall provide a pre-construction site assessment / inspection report including photographs and/ or videotape with sufficient details of existing conditions of adjoining properties, facilities, and other construction and site improvements that might be later misconstrued as damage caused by dewatering operations.
- D. The Dewatering Contractor shall maintain daily records of the dewatering system installation and performance data. The records shall include well locations, depths, elevations, dates of installation, approximate flow rate(s), water levels at various times during construction, and sump and piping locations. The records shall be submitted to the Owner/Owner representative after completion of construction dewatering activities, or as required by the Engineer.

- E. Throughout the duration of construction, the Dewatering Contractor shall submit weekly reports on dewatering and recharge operations on the form provided at the end of this Section. The reports shall present the following information:
1. Number of wells and/or collection trenches in operation for each system.
 2. Average rate of water pumped from each pump and well.
 3. Total volume of water pumped and total volume of water recharged from the date of the last report to the date of the current report.
 4. Description of any problems with dewatering system equipment or operations.
 5. Water level elevation in each monitoring well and piezometer, as outlined in Article 3.06.
 6. Resubmit revised working drawings and calculations as necessary to reflect changes required by field conditions.
- F. Provide photographs or videotape, sufficiently detailed, of existing conditions of adjoining properties, facilities, and other construction and site improvements that might be later misconstrued as damage caused by dewatering operations.
- G. Submit Record Drawings at Project closeout identifying and locating utilities and other subsurface structural, electrical, or mechanical items encountered during dewatering.
1. Note locations and capping depth of wells and well points.

1.04 WORK SEQUENCE

- A. Dewatering shall not begin until the temporary monitoring piezometers have been installed and developed as shown on the Drawings.
- B. Water levels shall be monitored and recorded beginning a minimum of 30 days before dewatering commences.
- C. Abandonment of the existing piezometers within the landfill footprint shall be coordinated with the construction of the landfill subgrade and geosynthetic liners. Existing piezometers within the landfill footprint shall not be abandoned without prior written approval by the Engineer.
- D. The Contractor shall operate the dewatering system until all Protective Soil has been installed and approved by the Engineer.
- E. Dewatering well point and/or sock drain abandonment shall be performed after dewatering activities are complete.

1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction over the project site.
- B. Pre-installation Conference: Conduct conference at the project site to present and discuss dewatering means, methods, and monitoring program at least two weeks prior to any commencement of installation work.
- C. The Dewatering Contractor shall provide persons who shall be emergency contacts at all times during the execution of this portion of the work and who shall be thoroughly familiar with the dewatering system being installed for this project, the referenced standards, environmental and permit requirements, the requirements of this work, and who shall direct all work performed under this section. The emergency contacts shall be notified automatically via a programmable auto-dialing system when the pumps malfunction by using an alarm system.
- D. It shall be the responsibility of the Dewatering Contractor to determine the water levels before and during the dewatering work.
- E. Water levels shall be submitted to the Engineer upon request.

1.06 QUALIFICATIONS

- A. The Dewatering Contractor must have at least five years successful experience in the field of dewatering and submit the following written information verifying qualifications:
 - 1. Evidence that the Dewatering Contractor is experienced and competent to construct and operate a dewatering system as described herein. The Contractor shall submit at least 10 example projects, three of which were performed in the past 5 years which include the installation of a dewatering system of similar size, scope, and subsurface conditions.
 - 2. The example projects shall include project location, dewatering method, pump model(s), depth of dewatering activities, periods of operation, types of soils encountered, and date of installation. This evidence shall indicate that the Dewatering Contractor will have sufficient competent experienced personnel to carry out the operations specified.
 - 3. The capacity to bond such a dewatering job.
 - 4. Experience performing dewatering in Florida.
 - 5. In-house engineering staff capable of assessing hydrogeologic conditions and preparing signed-and-sealed Dewatering Plans.

6. Sufficient competent experienced personnel to carry out the dewatering required.

1.07 MAINTENANCE

- A. The Dewatering Contractor shall be responsible for operating, maintaining, and monitoring the dewatering system. Maintenance of the dewatering system shall include, but is not limited to, at least daily supervision by a responsible person skilled in the operation, maintenance, and monitoring of flow rates from wells and/or collection trenches, sumps, replacement of system components, and any other work required, to maintain the performance of the system. The system operation shall be continuous, and interruptions shall not be permitted.

1.08 RECORD DRAWINGS

- A. Record Drawings shall identify and locate all existing utilities and other subsurface structural, electrical, or mechanical items and newly installed utilities during dewatering system construction.
- B. Note locations and capping depth of wells and well points.

1.09 PRE-BID INSPECTION AND TESTING

- A. The Dewatering Contractor is advised that site soil borings may indicate groundwater levels below the levels which may occur in response to normal, seasonal high, extreme, or prolonged rainfall. The Dewatering Contractor is further advised that site soil borings may not necessarily represent soil conditions to be encountered elsewhere on the job site, other than at the specific boring locations.
- B. Before bidding, the Dewatering Contractor shall perform a detailed site inspection and, if desired, obtain the Owner's permission to perform site-specific testing as he deems necessary to obtain all required information relative to project dewatering requirements.
- C. The Contractor shall include as part of his Bid the total cost of all dewatering as required to construct and maintain the Project in full compliance with the Drawings and these Specifications.

1.10 PROJECT CONDITIONS

- A. The Dewatering Contractor shall not interrupt utilities serving facilities occupied by Owner or others unless approved by the Owner and Engineer and then only

after arranging to provide temporary utility services according to requirements indicated.

- B. Soil boring, slug test, and groundwater data are provided as Bid Supplementals.
 - 1. A geotechnical report has been prepared for this Project and is available by request for information only. The opinions expressed in this report are those of the Geotechnical Engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the Geotechnical Engineer. The Owner will not be responsible for interpretations or conclusions drawn from these data.
 - 2. The Dewatering Contractor may make additional test borings and conduct other exploratory operations necessary for dewatering design and operations.
- C. Survey adjacent structures and improvements, employing a professional land surveyor licensed in Florida to establish exact elevations at fixed points to monitor settlement. Clearly identify monitoring points and reference vertical datum and benchmarks. Monitor and record existing initial elevations.
 - 1. During dewatering, regularly resurvey benchmarks maintaining an accurate log of surveyed elevations for comparison with original elevations. Promptly notify the Engineer if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction and existing structures.

PART 2 PRODUCTS

2.01 PUMPS

- A. Pumps shall be electrically powered and include an hour meter.

2.02 FLOWMETERS

- A. Flowmeters shall measure flow in gallons per minute. The Contractor shall provide all calibration and documentation related to the operation of the flow meter. Flow meter readouts shall be accessible to the Engineer at all times.

PART 3 EXECUTION

3.01 PERFORMANCE REQUIREMENTS

- A. The dewatering system shall be adequate to drain the soils to be excavated to the extent that the piezometric water level in the construction area is a minimum of

2 feet below the bottom of the excavation, side slopes of excavations, or bottom of the footings at all times, or as otherwise required to obtain the specified compaction and installation conditions. Pipeline trenches must be dewatered at least 2 feet below the trench bottom.

- B. The Dewatering Contractor shall control groundwater such that softening of the bottom of excavations, or formation of “quick” conditions, or “boils” during excavation shall not occur.
- C. Unless otherwise noted and before any excavating below or within 2 feet above the groundwater level, a dewatering system shall be placed into operation to lower water levels to the extent specified previously and then shall be operated continuously 24 hours a day, 7 days a week.
- D. Where used, well points, sock drains, and/or collection trenches shall be installed in an Engineer-approved manner and in sufficient numbers to provide the necessary removal of water as stated previously. Well points, pumps, and header piping shall be installed so that traffic on public thoroughfares and site access roads will not be impeded.
- E. The Dewatering Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the specified work.
- F. To prevent excessive noise, exhaust from all pumps and engines shall be silenced and muffled. The Dewatering Contractor shall ensure that the noise emanating from this equipment does not exceed the permissible sound levels defined in the local County ordinances.
- G. Groundwater or surface water pump discharge shall be controlled to prevent erosion, undermining, and all other damage and be piped to approved locations.
- H. The Dewatering Contractor shall provide adequate protection and warning signs where equipment crosses over, or is in the vicinity of dewatering equipment such as discharge piping, wells and/or collection trenches, pumps, etc.
- I. The Dewatering Contractor shall provide separate flow meters at each of the main line dewatering header pipes so that flow rates can be monitored on a daily basis.
- J. The Dewatering Contractor shall perform all dewatering work in strict compliance with Section 01350, Environmental Protection Procedures, and the Contract Drawings.

- K. Excavations shall be kept free from water during the placing of concrete and for 36 hours after or until concrete forms are removed.
- L. Protect structures, utilities, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.
 - 1. Prevent surface water and groundwater from entering excavations, ponding on prepared subgrade, or flooding the site and surrounding area.
 - 2. Protect subgrade and foundation soils from softening and damage by rain or water accumulation.
- M. Install sufficient dewatering equipment to drain water-bearing strata above and below the bottom of the landfill.
 - 1. Open-sump pumping which leads to loss of fines, subgrade softening, and slope instability shall not be permitted.
- N. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water in a manner that avoids flooding or accumulation on private property. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- O. Design dewatering system to prevent pumping of fines below grade or disturbing materials exposed at the excavation bottom. Wells shall be cased and filters shall be provided to prevent such pumping of fines.
- P. Excavations shall be kept free from water and the subgrade shall be maintained in a dry condition during the placement of geomembranes and GCL until overlying geosynthetics and soil layers are installed to prevent premature hydration of the GCL or flotation of the liner system.

3.02 DESIGN REQUIREMENTS

- A. The Dewatering Plan shall be prepared and stamped and signed by a Professional Engineer licensed in the State of Florida. The Professional Engineer shall be experienced in the design of dewatering systems for similar excavations.
- B. The electrical service used for dewatering shall be supplied by the Contractor and shall be separate from all other Contractor electrical requirements as noted on the drawings. The service shall be dedicated solely to the operation of the dewatering systems.

- C. The Dewatering Contractor shall be responsible for taking all reasonable precautions necessary to ensure continuous, successful operation of the dewatering system. This includes adequate marking of all well, pump and pipeline locations. Wherever dewatering wells and/or collection trenches, vacuum headers or discharge lines shall be crossed for access and egress, ramps shall be used to protect the system from vehicular and foot traffic. All ramps shall be capable of supporting the heaviest equipment on site and shall provide at least 6 inches of clearance between the dewatering system element and the underside of the ramp. All vehicular access points across the dewatering system shall be clearly identified on each side of the access point. Routings affecting regular vehicular traffic patterns in the vicinity of the project must be approved by the Engineer before installation.
- D. Design and construct the dewatering system such that foundation soils, natural or engineered, will not be subject to fines removal upon pumping.
- E. Install dewatering system to ensure minimum interference with roads and other adjacent occupied and used facilities.
 - 1. Do not close or obstruct roads or other adjacent occupied or used facilities without permission from the Engineer and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

3.03 STANDBY EQUIPMENT

- A. The Dewatering Contractor shall at all times have on hand sufficient pumping equipment, replacement parts, and staff for all reasonably predictable emergencies, including but not limited to equipment maintenance, malfunction, storms, hurricanes, and power outage. Standby pumps and generators shall be on-hand at all times.
- B. The Dewatering Contractor shall maintain on site sufficient equipment and materials to ensure continuous and successful operation of the dewatering, recharge, and monitoring systems.
- C. The Dewatering Contractor shall provide one hundred percent standby electrical generating capacity for the dewatering system.
- D. The Dewatering Contractor shall maintain on site a minimum of one additional of each size/type of dewatering system components, including valves, flow-meters, pumps and piping, or other system hardware to insure immediate repair or modification of any part of the system as necessary.

- E. Stand-by equipment shall be installed and ready to operate to assure continuous pumping in the event of an emergency.

3.04 DAMAGES

- A. The Contractor shall be responsible for and shall repair without cost to the Owner any damage to work in place, the excavation, and adjacent structures resulting from dewatering activities.
- B. The Dewatering Contractor shall operate the system so that there are no negative impacts to nearby private groundwater wells and on-site wetlands.
- C. The Dewatering Contractor shall be responsible for any damage to the liner system due to mechanical or electrical failure of the dewatering system.

3.05 OBSERVATION WELLS

- A. The Dewatering Contractor shall install observation wells as may be required to record accurate water levels.
- B. The Dewatering Contractor shall be responsible for maintaining all observation wells and observing and recording the elevation of the piezometric water levels daily.
- C. Wells damaged or destroyed shall be replaced at no additional cost to the Owner.

3.06 WATER LEVEL MONITORING PROCEDURES

- A. The Contractor shall collect water-level monitoring data daily upon beginning dewatering activities. The frequency of data collection may be reduced to a weekly basis upon notification from the Engineer. The data collection shall continue throughout the contract duration. Upon reaching steady-state conditions as defined in Article 1.02 of this Section and approved by the Engineer, water-level data collection may decrease to weekly.
- B. The monitoring data will include, but should not be limited to, the following:
 - 1. Water level collection dates.
 - 2. Identification numbers of all piezometers and groundwater monitoring points in the dewatering monitoring network.
 - 3. Water levels recorded with elevations referenced to the top of casing and land surface at each well to within 0.1 foot (NGVD 29).

3.07 ABANDONMENT

- A. The Contractor shall abandon well points and sock drains upon completing dewatering activities. Methods for well abandonment shall be in accordance with the approved Dewatering Plan.
- B. Sock drains shall be grouted in place. The Contractor shall fill sock drains using a Tremie or similar method to ensure that grout is filled along the entire length of each sock drain. The Contractor shall verify that the amount of grout is sufficient to fill the entire sock drainpipe.
- C. Dewatering wells and well points shall be completely removed and abandoned as follows:
 - 1. Fill well screen interval with clean silica sand to at least 1 foot above the screen interval.
 - 2. Seal the well to be abandoned by grouting from the bottom—top of the sand filling the screen interval—to ground surface. This will be done by placing a tremie pipe to the bottom of the well and pumping grout through the pipe until undiluted grout flows from the boring at ground surface.
 - 3. Remove the well casing and cut a minimum of 5 feet below finished grade if present.
 - 4. Remove well protective casing and concrete pad. Properly dispose of well protective casing and concrete.
 - 5. After 24 hours, the site representative should check the abandonment site for grout settlement. Any settlement will be filled with grout back up to ground surface. Additional grout will be installed using a tremie pipe inserted to the top of the firm grout in the well. If the top of firm grout in the well is fewer than 5 feet below land surface, using a tremie pipe is not required. This process should be repeated until firm grout remains at ground surface.
 - 6. Cover and level the surface expression of the abandoned well with soil or concrete depending upon the composition of the original surface.

3.08 CLEANUP

- A. The Contractor shall leave the project site in a neat, clean, and acceptable condition satisfactory to the Owner.
- B. All excavations shall be adequately backfilled and compacted to prevent settlement.

DEWATERING REPORT

Report Completed by: _____

Date: _____

Number of Wells in Operation	
Number of Collection Trenches in Operation	
Average rate of water pumped from each trench and well (gpm)	
Total volume of water pumped from date of last report to date of current report (gal)	
Total volume of water recharged from date of last report to date of current report (gal)	
Equipment or operations problems	

Water level for the following (to be measured to the tenth of a foot)	Measured Depth Below Grade	Surveyed Elevation of Well/Piezometer	Calculated Elevation of Groundwater

Note: Resubmit revised working drawings and calculations as necessary to reflect changes required by field conditions.

END OF SECTION

SECTION 02301
EARTHWORK FOR LANDFILL CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, equipment, tools, appliances, and materials and perform all operations necessary for the earthwork associated with the construction of the Landfill and the site access roads including the following:
1. Excavating
 2. Loading
 3. Hauling
 4. Soil Stockpiling
 5. Preparing Existing Subgrade
 6. Backfilling
 7. Soil Filling: General Fill and Structural Fill Filling
 8. Compacting
 9. Grading
 10. Anchor Trench Backfilling
 11. Drainage Soil Filling
 12. Trench Gravel Filling

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Pre-Construction Submittals: Submit the following within 30 days of Notice to Proceed and 30 days before beginning excavation.
1. Excavation and Fill Plan
 - a. The Excavation and Fill Plan shall be submitted 30 days before beginning earthwork.
 - b. The Contractor shall provide a detailed Excavation and Fill Plan signed by the Contractor.
 - c. The Owner's site soil investigation reports are available for reference but are not Contract Documents included in this Section. The Contractor shall verify site subsurface conditions.
 - d. The Excavation and Fill Plan shall include procedures for site clearing and proposed disposal methods of cleared materials.

- e. The Excavation and Fill Plan shall include project title, Engineer's project number, Owner's project number, project location, methods and locations of excavation, excavation quantities, fill quantities, stockpiling areas, procedures for segregating soil for use on this project, backfilling procedures, compaction procedures, excavation slope stabilization, and shoring.
- f. The Excavation and Fill Plan shall include a breakdown of estimated volume for each of the soil types specified for backfill from each of the possible sources. The Excavation and Fill Plan shall show that sufficient quantity is available from the borrow sources to complete the project.
- g. The Excavation and Fill Plan shall include procedures and locations for excavation, segregating, stockpiling, loading, and removing the unsuitable soils from the site.
- h. The Excavation and Fill Plan shall identify stockpile and staging areas indicated in accordance with the Drawings and the Owner's requirements.
- i. The Excavation and Fill Plan shall include safety procedures and a statement verifying that the Contractor will meet Occupational Safety and Health Administration (OSHA), Federal, State, and local safety requirements.
- j. The Excavation and Fill Plan shall include a description of adjacent on-site facilities and activities and procedures for protecting the site facilities from damage and the site activities from interruption.
- k. The Excavation and Fill Plan shall include controls for stormwater runoff and groundwater management in accordance with Section 02240, Dewatering, and erosion control in accordance with Section 01350, Environmental Protection Procedures. The Excavation and Fill Plan shall include procedures to prevent surface water and dewatering water from flowing into excavated areas.

2. Construction Quality Control Plan

- a. The Construction Quality Control (CQC) Plan shall be submitted 30 days before beginning earthwork.
- b. The Contractor shall provide a detailed CQC Plan signed by the Contractor addressing procedures and schedules for material source certifications, testing soils, testing in-place soils, submitting test results to the Engineer for review, and retesting failed tests.
- c. The CQC Plan shall include project title, Engineer's project number, Owner's project number, project location, sample test

identification numbering procedures, sample soil test and retest reports, and sample test location site plans.

- d. The Contractor shall retain an independent Geotechnical Testing Agency to perform CQC testing of the material sources, materials, and in-place density and moisture content (see Article 1.06).
- e. The CQC Plan shall include certification that the Contractor's independent Geotechnical Testing Agency meets the requirements of ASTM E329 and ASTM D3740 to conduct material and in-place testing.
- f. The CQC Agency contracted by the Contractor shall not be the same as the CQA Agency contracted by the Owner.

3. Drainage Material Installation Plan

- a. The Drainage Material Installation Plan shall be submitted 30 days before installing Trench Gravel and Drainage Soil.
- b. The Contractor shall provide a detailed Drainage Material Installation Plan signed by the Contractor addressing placement methods of the Drainage Soil and Trench Gravel to demonstrate that the bottom liner geosynthetic materials will be protected and safeguarded from damage during placement of the overlying materials.
- c. The Drainage Material Installation Plan shall include project title, Engineer's project number, Owner's project number, project location, material types, minimum thickness of each lift of materials during placement, description of thickness markers, methods for measuring material thicknesses, and methods for removing markers, number and duties of personnel, make and model of equipment to be used, maximum equipment speeds, equipment handling procedures, and site plan showing placement areas and equipment travel routes.
- d. The Drainage Material Installation Plan shall include a sample of the proposed marker to be used for measuring Drainage Soil and Trench Gravel thicknesses during placement. The marker shall be free standing and shall not be sharp or pointed so it cannot damage the geosynthetic liner materials if hit by equipment.
- e. The Drainage Material Installation Plan shall include a method for removing markers without disturbing in-place materials. The Contractor shall obtain the Engineer's approval if markers cannot be removed without disturbing materials and will be left in-place.

- B. Project-Specific Material Source Certificates of Compliance: The Contractor shall submit the Material Source Certificates prior to moving material to the site of filling with excavated material. The Contractor may submit duplicate samples for

Quality Assurance Testing and verification. In the event duplicate samples fail quality assurance testing the Contractor shall reimburse the Owner for the cost of the failed test. The Engineer may require removal of fill material not conforming to material requirements as determined by Quality Control Testing.

1. Material Source Certificates of Compliance signed by the Contractor for each proposed material from each proposed source to the Engineer in accordance with tests listed in Table 1 and meeting material requirements listed in Part 2.
2. The Material Source Certificates of Compliance shall include project title, Owner's project number, project location, soil type, source name and description, proposed use and material type, location of sample, time and date of sampling, test identification number, a brief description of the material, applicable test standards, and laboratory test results for tests listed in Table 1.
3. The Material Source Certificates of Compliance shall be submitted for each proposed use as General Fill, Structural Fill, Anchor Trench Fill, Drainage Soil and Trench Gravel from each of the proposed sources.

Table 1 Material Source Certification		
Property	Test Designation	Frequency
USCS Soil Classification	ASTM D2487 (excluding hydrometer)	1 test per source or change in material.
Standard Classification for Sizes of Aggregate for Road and Bridge Construction (Trench Gravel)	ASTM D448	One test per source or change in material.
Compaction Characteristics (for Subgrade, General, Structural, and Anchor Trench Fill)	ASTM D1557	1 test per source or change in material.
Gradation (Drainage Soil)	ASTM D6913	One test per source or change in material.
Carbonate Content	ASTM D4373	1 test per source or change in material.
Organic Content	ASTM D2974 Method C or D	1 test per source or change in material.
Permeability (for Drainage Soil)	ASTM D2434	1 per source or change in material - samples compacted to 90% Modified Proctor dry density.

C. Construction Quality Control (CQC) Submittals

1. CQC is the responsibility of the Contractor and includes material and process control testing as listed in Table 2, inspection and control procedures, construction records, and personnel qualifications.
2. During Construction, the Contractor shall submit CQC Test Reports and documentation signed and sealed by a Professional Engineer or Geologist licensed in Florida to the Engineer for review. Electronic copies shall be submitted to the Engineer within 72 hours after sampling or testing for each test required. Signed-and-sealed test report shall be submitted to the Engineer within 7 days of sampling or testing for each test required.
3. Copies of the CQC Test Reports and documentation shall be transmitted at the same time by the testing agency as follows:
 - a. One copy for the Owner.
 - b. Three copies to the Engineer.
 - c. One copy to the Contractor.
4. CQC Test Reports shall include project title, Owner's project number, project location, soil type, source name and description, location of test or sample, time and date of testing or sampling, test identification number, a brief description of the material, applicable test standards, and laboratory test results.

Table 2 Construction Quality Control Testing		
Property	Test Designation	Frequency
Material Source		
USCS Soil Classification	ASTM D2487 (excluding hydrometer)	Before placement: 1 per source or change in material.
Gradation	ASTM D448 (gravel) ASTM D6913 (soil)	One test per source or change in material.
Compaction Characteristics (for Subgrade, General, Structural, and Anchor Trench Fill)	ASTM D1557	Before placement: 1 per source or change in material.
Carbonate Content	ASTM D4373	Before placement: 1 per source or change in material.
Organic Content	ASTM D2974 Method C or D	Before placement: 1 per source or change in material.

Table 2 Construction Quality Control Testing		
Property	Test Designation	Frequency
Permeability (for Drainage Soil)	ASTM D2434	Before placement: Minimum 1 per 3,000 CY – samples compacted to 90% Modified Proctor dry density.
In-Place Testing		
USCS Soil Classification	ASTM D2487 (excluding hydrometer)	1 per 10,000 CY before compaction or before covering with next lift.
Compaction Characteristics (for Subgrade, General, Structural, and Anchor Trench Fill)	ASTM D1557	1 per 10,000 CY before compaction.
In-place density (for Subgrade, General, Structural, and Anchor Trench Fill)	ASTM D2937, D1556, or D6938	2 per acre (for Subgrade) 1 per 10,000 sf per lift (for General and Structural Fill) 1 per 250 linear feet per lift (for Anchor Trench Fill)
In-place moisture content (for Subgrade, General, Structural, and Anchor Trench Fill)	ASTM D2216, D4643 or D6938	2 per acre (for Subgrade) 1 per 10,000 sf per lift (for General and Structural Fill) 1 per 250 linear feet per lift (for Anchor Trench Fill)
Thickness (for Drainage Soil and Trench Gravel)	—	4 per acre before covering with next lift (Drainage Soil) 1 per 50 linear feet before covering with geotextile (for Trench Gravel)

5. The test or sample location shall be identified by giving coordinates and elevations using site control monuments for reference.
6. CQC Test Reports for the in-place density and in-place moisture content of the compacted materials shall also include the referenced laboratory compaction curve according to ASTM D1557. In-place density and in-place moisture content CQC Test Reports shall include a site map showing the location of the current test, previous tests, and retests for each material or test type.
7. CQC Test Reports for different material types or standards shall receive a unique submittal number and shall not be combined with other material types on any page in the report.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM D422—Standard Test Method for Particle-Size Analysis of Soils.
2. ASTM D653—Standard Terminology Relating to Soil, Rock, and Contained Fluids.
3. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ [600 kN-m/m³]).
4. ASTM D1140—Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75- μ m) Sieve.
5. ASTM D1556—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
6. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ [2,700 kN-m/m³]).
7. ASTM D2216—Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.
8. ASTM D2423—Standard Test Method for Surface Wax on Waxed Paper or Paperboard.
9. ASTM D2434—Standard Test Method for Permeability of Granular Soils (Constant Head).
10. ASTM D2487—Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
11. ASTM D2488—Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
12. ASTM D2937—Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
13. ASTM D2974—Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
14. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
15. ASTM D4220—Standard Practices for Preserving and Transporting Soil Samples.
16. ASTM D4318—Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

17. ASTM D4373—Standard Test Method for Rapid Determination of Carbonate Content of Soils.
18. ASTM D4375—Standard Practice for Basic Statistics in Committee D-19 on Water
19. ASTM D4643—Standard Test Method for Determination of Water (Moisture) Content of Soil by Microwave Oven Heating.
20. ASTM D4974—Standard Test Method for Hot Air Thermal Shrinkage of Yarn and Cord Using a Thermal Shrinkage Oven.
21. ASTM D6026—Standard Practice for Using Significant Digits in Geotechnical Data.
22. ASTM D6141—Standard Guide for Screening Clay Portion of Geosynthetic Clay Liner (GCL) for Chemical Compatibility to Liquids.
23. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
24. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
25. ASTM E2586—Standard Practice for Calculating and Using Basic Statistic.

B. Occupational Safety and Health Administration (OSHA):

1. 29 CFR 1926— Safety and Health Regulations for Construction.

1.04 QUALITY ASSURANCE

A. The Owner will engage and pay for the services of an Engineer and a testing agency to perform Construction Quality Assurance (CQA) testing in addition to the Construction Quality Control (CQC) testing performed by the Contractor. The Contractor shall help the Owner's agent with CQA sampling and testing by providing samples, personnel, and equipment necessary.

1. The Owner will engage and pay for CQA testing of the materials in accordance with test procedures listed in Table 2. The CQC Testing Agency contracted by the Contractor shall not be the same as the CQA Testing Agency contracted by the Owner.
2. The Contractor shall provide a 10-gallon sample of Drainage Soil meeting requirements of Article 2.05 to the CQA Testing Agency for interface direct shear testing 30 days before shipment of geocomposite in accordance with Section 02070, Geocomposite.
3. The Contractor shall provide a 10-gallon sample of Structural Fill meeting requirements of Article 2.03 to the CQA Testing Agency for interface direct shear testing 30 days before shipment of GCL in accordance with Section 02072, Geosynthetic Clay Liner.

4. The CQA tests will be the basis of acceptance of material and construction. The Contractor is responsible for the cost of retesting if the CQA test fails. The retest will be paid for by the Owner and reimbursed by the Contractor. The Contractor, at his discretion, may retain and bear all costs for a testing agency to confirm or dispute the results of the CQA tests.
- B. The Contractor shall coordinate construction and CQC activities with the Engineer.

1.05 QUALIFICATIONS

- A. The Contractor shall provide the CQC Geotechnical Testing Agency's qualifications as specified in Article 1.03.

1.06 TESTING REQUIREMENTS (NOT USED – SEE PRODUCTS)

1.07 RECORD DRAWINGS

- A. Record Drawings shall be prepared, maintained, and submitted showing prepared Subgrade, General Fill, Structural Fill, Anchor Trench Fill, Trench Gravel, and Drainage Sand final constructed elevations in accordance with the requirements of Section 01785, Record Documents, and the Contract Documents. Record Drawings shall be updated throughout the project and are subject to field review by the Engineer any time upon request.
- B. The bottom-liner slopes shall be surveyed after completion before installation of the overlying liner-system components using a 50-foot grid in areas that drain to the leachate collection trench and at 50-foot intervals where pipes of the leachate-collection system are to be installed. The surveyed slopes must demonstrate that positive drainage is shown in the direction of flow between any two grid or interval points and the slopes have been constructed in accordance with specified construction tolerances.

1.08 DEFINITIONS

- A. *Anchor Trench Fill*: Soil fill that meets the characteristics in Article 2.04 and is placed over the liner in the anchor trench to specified relative compaction densities and moisture contents to lines and grades shown as Anchor Trench Fill on the Drawings.
- B. *Backfill*: Soil fill that meets the characteristics of Anchor Trench Fill, General Fill, or Structural Fill installed at the required locations in accordance with the Contract Documents.

- C. *Clearing*: The felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, stumps, roots, and rubbish occurring in the areas to be cleared.
- D. *Compacted Subgrade*: Existing subgrade soils that meet the characteristics in Article 2.01 and that are prepared in accordance with the requirements of Article 3.08.
- E. *Completed Course*: Layer that is complete and ready for testing and/or the next layer or phase of construction.
- F. *Construction Quality Assurance (CQA)*: A planned system of activities that provides assurance that the materials to be installed on the project are in accordance with the Contract Plans and Specifications. CQA includes inspections, testing, and evaluations to assess the quality of the materials and the construction. CQA refers to the measures taken by the Owner to determine compliance and conformance of the materials with the Contract Specifications.
- G. *Construction Quality Control (CQC)*: A planned system that provides procedures for delivering a construction project that meets the requirements defined in the Contract Plans and Specifications. CQC is performed by the Contractor and includes surveying, documentation, sampling, testing, and personnel qualifications.
- H. *Drainage Soil*: Soil fill that meets the characteristics in Article 2.05 and is placed over the liner and over the Trench Gravel to lines and grades shown as Drainage Soil on the Drawings.
- I. *Existing Subgrade Soil*: Soil that meets the characteristics in Article 2.01 and is in-place and proof-rolled to specified relative densities and moisture contents to lines and grades shown on the Drawings.
- J. *General Fill*: Soil fill that meets the characteristics in Article 2.02 and is placed to specified relative compaction densities and moisture contents to lines and grades shown on the Drawings.
- K. *Lift*: *Lift* in these Specifications refers to a constructed segment of 12 inches thick (unless otherwise stated in the Specifications), loose, soil of one material type, over a defined area performed within 1 day.
- L. *Optimum Moisture Content*: Moisture content corresponding to the maximum dry density as determined by the Modified Proctor Method (ASTM D1557).

- M. *Relative Compaction*: Ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by the Modified Proctor Method (ASTM D1557).
- N. *Structural Fill*: Soil fill that meets the characteristics in Article 2.03 and is placed under the GCL and under and around structures to specified relative compaction densities and moisture contents to lines and grades shown on the Drawings.
- O. *Trench Gravel*: Soil fill that meets the characteristics in Article 2.07 and is placed over the liner in the leachate trench to lines and grades shown as Trench Gravel on the Drawings.

PART 2 PRODUCTS

2.01 EXISTING SUBGRADE SOIL

- A. The Contractor shall certify that Subgrade Soils meet the requirements listed in Table 3 and this Article. Unsuitable Subgrade soils shall be excavated to 2 feet below and around bottom liner or structure grades as shown on the Drawings. Excavated Subgrade shall be backfilled with General Fill that meets these requirements listed below.
- B. Subgrade Soils shall be non-organic, free of debris, sticks, roots, and stones larger than 3 inches in any dimension.
- C. Unsuitable Subgrade Soils
 - 1. ASTM D2487 Soil Classification Groups: CH, MH, OH, OL, and PT.
 - 2. Soils not meeting requirements listed in Table 3.
 - 3. Unsuitable soils also include satisfactory soils not maintained within 3% of optimum moisture content at time of compaction.

Table 3 Subgrade Soil and General Fill Requirements				
Classification (USCS)	Maximum Allowable Fines (%)	Other Requirements	Maximum Allowable Carbonate Content (%)	Maximum Allowable Organic Content (%)
CL, ML	50	PI<20, LL<50 Max Size = 3 inches	< 30	< 5
GP-SC, GP-SM, GW-SC, GW-SM, SW-SC, SW-SM, SP-SC, SP-SM	12	PI<20, LL<50 Max Size = 3 inches		
GW, GP, SW, SP	5	Max Size = 3 inches		

2.02 GENERAL FILL

- A. The Contractor shall certify that General Fill meets the requirements listed in Table 3 and this Article. General Fill may be obtained from site excavation or an approved borrow source if material meets these requirements. General Fill shall be placed where structural fill is not required and compacted to lines and grades shown on the Drawings.
- B. Satisfactory General Fill Soils shall be free of debris, sticks, roots, and stones larger than 3 inches in any dimension.
- C. Unsuitable General Fill
 - 1. ASTM D2487 Soil Classification Groups CH, MH, OH, OL, and PT.
 - 2. Soils not meeting requirements listed in Table 3.
 - 3. Unsuitable soils also include satisfactory soils not maintained within 3% of optimum moisture content at time of compaction.

2.03 STRUCTURAL FILL

- A. The Contractor shall certify that Structural Fill meets the requirements listed in Table 4 and this Article. Structural Fill may be obtained from site excavation or an approved borrow source if the material meets these requirements. Structural Fill shall be placed below the liner and below and around structures and compacted to lines and grades shown on the Drawings.
- B. Satisfactory Structural Fill shall be non-carbonate, non-organic, free of debris, sticks, roots, and stones larger than 1/2 inch in any dimension. Structural Fill shall be chemically compatible with GCL in accordance with ASTM D6141.
- C. Unsuitable Structural Fill:
 - 1. ASTM D2487 Soil Classification Groups GW, GP, GC, GM, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
 - 2. Soils not meeting requirements listed in Table 4.
 - 3. Unsuitable soils also include satisfactory soils not maintained within 2% of optimum moisture content at time of compaction.

Table 4 Structural Fill and Anchor Trench Fill Requirements				
Classification (USCS)	Maximum Allowable Fines (%)	Other Requirements	Maximum Allowable Carbonate Content (%)	Maximum Allowable Organic Content (%)
SW, SP	5	Max Size = 1/2 inch	< 30	< 5
SP-SC, SP-SM, SW-SC, SW-SM	12	PI<20, LL<50 Max Size = 1/2 inch		

2.04 ANCHOR TRENCH FILL

- A. The Contractor shall certify that the Anchor Trench Fill meets the requirements listed in Table 4 and this Article. Anchor Trench Fill may be obtained from site excavation or an approved borrow source if the material meets these requirements. Anchor Trench Fill shall be placed over the liner in the anchor trench and compacted to lines and grades shown on the Drawings.
- B. Satisfactory Anchor Trench Fill shall be non-carbonate, non-organic, free of debris, sticks, roots, and stones larger than 1/2 inch in any dimension. Anchor Trench Fill shall be chemically compatible with GCL in accordance with ASTM D6141.
- C. Unsuitable Anchor Trench Fill:
 1. ASTM D2487 Soil Classification Groups GW, GP, GC, GM, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
 2. Soils not meeting requirements listed in Table 4.
 3. Unsuitable soils also include satisfactory soils not maintained within 3% of optimum moisture content at time of compaction.

2.05 DRAINAGE SOIL

- A. The Contractor shall certify that Drainage Soil meets the requirements listed in Table 5 and this Article. Drainage Soil may be obtained from site excavation or an approved borrow source if it meets these requirements.
- B. Satisfactory Drainage Soils:
 1. Drainage Soil shall be non-carbonate, non-organic, free of debris, waste, vegetation, sticks, roots, organic, or other deleterious material and stones larger than 1/2 inch in any dimension.
 2. Drainage Soil shall meet requirements of ASTM D2487 Soil Classification Groups SW or SP. See Table 5 for Satisfactory Soil Requirements.

3. Drainage Soil shall have a hydraulic conductivity of greater than or equal to 0.001 cm/sec in accordance with this Section. The laboratory hydraulic conductivity test shall be performed in accordance with ASTM D2434 on a sample compacted to 90% Modified Proctor dry density in the laboratory.
4. Drainage Soil shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Maximum Percent Passing</u>
No. 4	100
No. 200	5

5. Meet the following modified coefficient of uniformity requirements:

If $1 < Cu' < 3$, then $(Cu') * (d_{50})$ must be greater than $(0.5) * (AOS)$

Where: $Cu' = [d_{100}/d_0]^{1/2}$ = Linear Coefficient of Uniformity
 AOS = Apparent Opening Size (AOS) of the geotextiles
 (see Section 02074, Geotextile).
 d_{50} = Represents the soil particle size such that 50% by weight of the soil particles are smaller -
 corresponding to 50% finer cumulative particle size distribution curve.

If the $Cu' > 3$, then d_{50} / Cu' must be greater than the AOS / 18.

6. Meet the minimum interface shear strength requirements as listed in Section 02070, Geocomposite, Article 1.03.

C. Unsuitable Drainage Soil:

1. ASTM D2487 Soil Classification Groups GW, GP, GC, GM, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
2. Soils not meeting requirements listed in Table 5.

Table 5 Drainage Soil Requirements				
Classification (USCS)	Maximum Allowable Fines (%)	Other Requirements	Maximum Allowable Carbonate Content (%)	Maximum Allowable Organic Content (%)
SW, SP	5	Max Size = 1/4 inch Hydraulic Conductivity ≥ 0.001 cm/sec.	< 5	< 5

2.06 PROTECTIVE SOIL (NOT USED)

2.07 TRENCH GRAVEL

- A. The Contractor shall certify that the Trench Gravel meets the requirements of this Article. Trench Gravel may be obtained from site excavation or an approved borrow source if it meets these requirements. Trench Gravel shall be placed over the bottom liner in the leachate collection trench and wrapped in geotextile to lines and grades shown on the Drawings.
- B. Satisfactory Trench Gravel
 1. Trench Gravel shall be non-carbonate (< 5%), non-organic (< 5%), free of debris, waste, vegetation, sticks, roots, organic or other deleterious material, and stones larger than 2 inches in any dimension.
 2. Trench Gravel shall be quartz or granite gravel and may be:
 - a. Rounded to well-rounded.
Or:
Subrounded or sub-angular as defined by ASTM D2488 if the Contractor provides adequate geomembrane protection with a minimum of 32 oz/sy nonwoven geotextile that meets the requirements of Section 02074, Geotextile, between all trench gravel and geomembranes in the primary leachate collection and removal system and secondary leak detection system. The subrounded or sub-angular gravel shall be a processed, consistent product that is produced with a gyratory or cone crusher creating a uniform product that meets the gradation requirements without being flat or elongated.

3. Trench gravel shall meet the following gradation requirements:

<u>Sieve Size</u>	<u>Maximum Percent Passing</u>
2 inches	100
1 inch	20 to 50
½ inch	10 to 30
No. 4	0 to 5

C. Unsuitable Trench Gravel

1. ASTM D2487 Soil Classification Groups GC, GM, SW, SP, SC, CL, CH, SM, ML, MH, OH, OL, and PT.
2. Soils not meeting requirements listed in Paragraph 2.07.B.

PART 3 EXECUTION

3.01 PROTECTION

- A. The Contractor shall verify that any existing vegetation or trees designated to remain are tagged or identified by the Owner. Protect vegetation and any features designated to remain.
- B. Locate, identify, and protect utilities from damage.
- C. Protect benchmarks, wells, and existing structures from damage or displacement, unless scheduled to be removed or relocated.

3.02 CLEARING, GRUBBING, AND STRIPPING

- A. Clear areas required for access to site and execution of work. Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be completely removed except such trees and vegetation as may be indicated or directed to be left standing by the Owner.
- B. The Contractor shall adhere to the site-clearing activities and proposed disposal methods presented in the Excavation and Fill Plan.
- C. Site-clearing activities shall be conducted to ensure minimum interference with roads, streets, walks, and other adjacent in-service facilities. The Contractor shall not close or obstruct streets, walks, or other facilities or interfere with the operations of the landfill or other contractors working on-site without coordinating with the Engineer.

- D. The Contractor shall provide protection as required to prevent damage to existing improvements indicated to remain in place.
- E. Grub logs, boulder, stumps, debris, and other material protruding through the ground surface. This material shall be excavated and removed to a depth of not less than 18 inches below the original ground surface.
- F. Place cleared and grubbed material in stockpile area identified by the Owner.
- G. General: Remove shrubs, grass and other vegetation, improvements or obstructions as required to allow the installation of the Project. Soils containing roots, vegetation, organics, or other deleterious materials shall be removed until acceptable material is encountered vertically and laterally. Removal includes digging out stumps and root systems to the extent acceptable to the Engineer.
- H. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable materials. Fill depressions caused by clearing and grubbing operations with General Fill - unless otherwise specified on the Drawings – to prevent ponding and direct surface water and groundwater away from excavation. Before filling, subgrade surfaces of depressions shall be free of standing water. Unsatisfactory soil materials shall be removed. Stripping of topsoil shall be to a minimum depth of 6 inches, with rocks, roots, vegetation, or other deleterious materials exceeding 1 inch in the smallest dimension being removed from the soil. The top soil material shall be placed in a separate stockpile to be identified by the Owner or Engineer.
- I. Site-clearing material shall be disposed of in accordance with the following:
 - 1. Materials shall be incorporated into the project or transported and disposed of as directed by the Engineer.
 - 2. On-site stockpile areas will be provided for the Contractor's use. Materials not incorporated into the project shall be segregated according to material type and stockpiled at the designated on-site stockpile area as directed by the Engineer.
 - 3. Burning is not permitted at the site.
 - 4. The Owner retains all rights and title of ownership to all excavated soil materials from onsite sources regardless of whether it is used for the work described in these Specifications.

3.03 PREPARATION

- A. Before beginning any excavation or grading, the Contractor shall survey the project area to determine the soil excavation volume available for backfill and the volume of borrow required (see Article 1.03 – Excavation and Fill Plan). Should

the Contractor discover any inaccuracies, errors, or omissions in the survey data, the Contractor shall immediately notify the Engineer of the differences and the impact to the bid. If the Contractor begins any excavation or grading, this shall be held as an acceptance of the survey data by him, after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the survey data.

- B. Ensure that the foundation surface is clean and free of loose material of any kind when placing fill material.
- C. Ensure that all material limits shall be excavated or constructed within a tolerance of 0.1 foot except where dimensions or grades are shown or specified as minimum. All grading shall be performed to strictly maintain slopes and drainage as shown on the Drawings.
- D. Perform all Material Source Certification and in-place CQC testing for the materials and fill in accordance with Table 1, Table 2, and Part 2. Rework areas that do not meet specified in-place density and moisture requirements.
- E. Set required lines, levels, contours, and datum by construction staking.
- F. Locate, identify, and protect utilities, benchmarks, existing structures, monitoring wells, piezometers, and paving from damage.
- G. Notify utility company to locate utilities, if applicable.
- H. Provide fencing or other safety barrier along the entrance road to separate the excavation area from traffic areas.
- I. Coordinate excavation operations with landfill operations.

3.04 REMOVAL OF WATER

- A. The Contractor shall be responsible for the control and maintenance of groundwater and stormwater through all phases of construction. Under no circumstances shall stormwater be allowed to run into the excavation or pond therein. The Contractor shall provide temporary stormwater control methods including berms, swales, ponds, and pumps, to prevent stormwater runoff from outside the construction area from entering the construction area.
- B. Dewatering necessary to allow for excavation is the responsibility of the Contractor. The Contractor shall submit a Dewatering Plan in accordance with Section 02240, Dewatering, to the Engineer. The Contractor is responsible for Water Management District, County, and local agency permits.

3.05 TEMPORARY EROSION CONTROL

- A. It is the Contractor's responsibility to provide temporary erosion control to protect slopes and other areas from erosion as indicated in the Plan (see Article 1.03) and in accordance with Section 01350, Environmental Protection Procedures. Measures such as toe-in silt fence, temporary slope flumes, and erosion control matting shall be used to protect completed work. Damage to facilities under construction shall be repaired at the Contractor's sole expense. Any conditions which the Contractor believes endangers the site and cannot be addressed by taking reasonable measures should be immediately brought to the attention of the Engineer in writing.

3.06 EXCAVATION

- A. The Contractor shall excavate soil as required to the lines, grades, and elevations shown on the Drawings as needed to construct the subgrade. Excavate unsuitable Subgrade Soils to 2 feet vertically and horizontally from lines and grades shown on the Drawings. Backfill excavated unsuitable subgrades soil with General Fill.
- B. Machine grade slopes and base to design grades.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- D. Notify the Engineer of unexpected subsurface conditions and discontinue affected work in the area until notified to resume work.
- E. Correct areas over-excavated by placing soil to meet required grade and requirements as in Article 3.08. Correction of all overexcavated areas shall be at the Contractor's sole expense unless over-excavated area was directed and authorized in writing by the Engineer.
- F. Excavated material shall be stockpiled in a location identified by the Owner or used for Soil Fill if the excavated material meets the requirements of Part 2.

3.07 SOIL STOCKPILING

- A. Coordinate selective soil and debris stockpiling with the Engineer.
- B. Excavate, load, haul, and stockpile excavated soil and debris so that stockpiles have maximum slopes of 3 horizontal to 1 vertical (3:1).

- C. Stabilize the stockpiles and provide erosion and sedimentation controls in accordance with Section 01350, Environmental Protection Procedures. The erosion and sedimentation control measures to be used shall be detailed in the Stormwater and Pollution Prevention Plan and the Excavation and Fill Plan.
- D. The Owner retains all rights and title of ownership to all excavated soil materials from onsite sources regardless of whether it is used for the work described in these Specifications.

3.08 PREPARATION FOR SOIL FILL

- A. Moisture condition and compact existing satisfactory subgrade soil to a minimum of 90% relative compaction at a moisture content within 3% of optimum as determined by ASTM D1557.
- B. Proof-roll a minimum of six passes the finished Subgrade Soil surface before installing soil fill using a vibratory steel drum roller with vibrator on.
- C. Areas that pump or rut shall be reworked.
- D. Before placing soil fill, verify that no loose or poorly compacted soil is present in the fill area.
- E. Before placing soil fill, verify that Subgrade Soil surface has been accepted by the Engineer.
- F. The Contractor shall maintain the groundwater level during construction as required in Section 02240, Dewatering.

3.09 SOIL FILL PLACEMENT AND COMPACTION

- A. Load and haul Soil Fill from the excavation, stockpile, or borrow site and place to the lines and grades shown on the Drawings. The Contractor shall not damage liner materials or previously completed courses, including Geosynthetics, during placement and compaction of Soil Fill.
- B. Place in loose lift thickness not exceeding 12 inches.
- C. Each lift of Soil Fill shall be compacted until moisture contents and densities have been achieved.
 - 1. General Fill and Anchor Trench Fill: Compact each lift to a minimum of 90% relative compaction at a moisture content within 3% of optimum as determined by ASTM D1557.

2. Structural Fill: Compact each lift to a minimum of 90% relative compaction at a moisture content within 3% of optimum as determined by ASTM D1557.
- D. Completed lifts of Soil Fill cannot yield under equipment loads. Compaction equipment used is at the discretion of the Contractor. Compaction equipment shall be operated in strict accordance with the manufacturer's instructions and recommendations and be maintained in such condition that it will deliver the manufacturer's rated compactive effort.
 - E. Areas that pump or rut shall be reworked by the Contractor, at the Contractor's expense. The groundwater level shall be maintained during construction as required in Section 02240, Dewatering.
 - F. Maintain moisture content within the specified range until covered with subsequent lifts.
 - G. Grade final surface to a vertical tolerance of 0.1 foot unless preparing surface for geosynthetic materials. See Article 3.10 for preparing Soil Fill for Geosynthetics Materials.

3.10 PREPARING SOIL FILL FOR GEOSYNTHETIC MATERIAL

- A. Remove any angular or sharp rocks, debris, ruts, or protrusions from the surface greater than 1/2-inch. Smooth surface to remove rutting and tire marks. The Contractor shall avoid sharp turns, sudden starts or stops, spinning and digging of tracks, or any other operation that could damage the surface.
- B. Grade to a tolerance of plus or minus 0.10 foot of straight line grade between any two points 10 feet apart. Areas of grading include all areas requiring placement of a geosynthetic.
- C. Maintain soil moisture until covered by GCL and liner materials. The groundwater level shall be maintained during construction as required in Section 02240, Dewatering.
- D. The Contractor shall verify in writing to the Owner and Engineer with standard subgrade acceptance forms (see Section 02072, Geosynthetic Clay Liner, Article 1.03) signed by the Contractor and the GCL Installer's representative that the surface on which the GCL will be installed meets these Specification requirements.
- E. Submit Record Drawings of subgrade surface before placement of GCL and geosynthetic materials.

3.11 DRAINAGE SOIL AND TRENCH GRAVEL PLACEMENT

- A. Load and haul Drainage Soil and Trench Gravel from the excavation, stockpile, or borrow site and place only when underlying geosynthetic installations are complete and approved in accordance with these Specifications. Placement of Drainage Soil and Trench Gravel shall be in accordance with the Drainage Material Installation Plan signed by the Contractor.
- B. The Contractor shall submit a Drainage Material Installation Plan to the Engineer for approval in accordance with Article 1.03. Placement of Drainage Soil and Trench Gravel shall begin by placing material from outside of cell limits to create a path by which to enter the cell in accordance with the Drainage Material Installation Plan.
- C. Drainage Soil shall be placed in one lift with a minimum thickness as specified in this Section and as shown on the Drawings. The Contractor shall provide sufficient thickness of Drainage Soil to maintain the minimum specified thickness and to maintain the surface grades shown.
- D. Track-mounted equipment with low ground pressure treads (less than 6 psi) no larger than a Caterpillar Model D-6 or equal shall be used for spreading Drainage Soil. Equipment shall not be allowed to operate on less than 12 inches of cover over the geomembrane liner system. No other equipment, including dump trucks or scrapers, will be permitted to travel on the liner and Drainage Soil. The Contractor shall avoid sharp turns, sudden starts or stops, spinning and digging of tracks, or any other operation that could damage the liner system.
- E. Maximum equipment speed over the Drainage Soil shall be 5 miles per hour.
- F. Drainage Soil shall be placed in such a manner that no air is trapped underneath the geosynthetic liner. The Contractor shall exercise extreme caution in spreading sand to prevent puckering of geocomposite and geotextile damage.
- G. Take precautions necessary to preclude any damage to the liner system due to thermal expansion or contraction during all phases of liner construction and especially during placement of the Drainage Soil.
- H. The Contractor shall provide and maintain a means of continuously observing the depth of the Drainage Soil and Trench Gravel, such as by freestanding markers at intervals of 50 feet maximum each way as described in the Drainage Material Installation Plan (see Article 1.03). Sharpened stakes or other rigid items which may damage the underlying liner system if they were contacted by on-site equipment shall not be allowed. If possible, markers shall be removed after use

and shall not be abandoned in-place unless removal will disturb the in-place material. A sample of the proposed marker shall be submitted to the Engineer with the Drainage Soil Installation Plan (see Article 1.03).

- I. Trench Gravel shall be placed around leachate collection pipes as shown on the Drawings. Trench Gravel shall be worked in and provide contact with and support to the pipe. Pipe shall not be damaged during Trench Gravel placement.

3.12 ANCHOR TRENCH FILL PLACEMENT

- A. The Contractor shall load and haul Anchor Trench Fill soil from the excavation, stockpile, or borrow site and place only when underlying geosynthetic installations have been completed in accordance with deployment and seaming requirements in Section 02074, Geotextile.
- B. Place fill to the lines, grades, and dimensions shown on the Drawings.
- C. Place in loose lift thickness not exceeding 12 inches.
- D. Compact bottom lifts with a vibratory plate compactor and upper lift by tracking in with rubber-tracked skid steer or wheel rolling with a rubber-tired loader.
- E. Do not damage underlying geosynthetic installation.

END OF SECTION

SECTION 02305
EARTHWORK FOR UTILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall provide all materials, equipment, labor, and work necessary to completely construct the project in accordance with the Contract Documents. This work includes but is not limited to the following:
1. Excavating and removing unsatisfactory materials.
 2. Preparing trench foundations.
 3. Providing satisfactory material for all trenches as specified and as required.
 4. Obtaining, storing, maintaining, and disposing of materials.
 5. Dewatering, shoring, and sheeting.
 6. Placing, compacting, testing, final grading, and demolishing subgrade.
 7. Performing all other work required by the Contract Documents.
- B. The Contractor is responsible for performing all work so as not to damage existing roadways, facilities, utilities, structures, etc., and shall repair and replace such damage to equal or better than its original undamaged condition without cost to the Owner.
- C. The Contractor shall examine the site before submitting a bid, taking into consideration all conditions that may affect the work.
- D. The Contractor shall coordinate all additional subsurface investigations and testing included with this work with the Engineer before performing the excavation and foundation preparation work. In general, if the Contractor finds different and unsuitable/unsatisfactory soil conditions during the work, the Contractor shall notify the Engineer immediately.

1.02 SUBMITTALS

The Contractor shall submit the following shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D2487 of each onsite and borrow soil material proposed for fill and backfill.

2. Laboratory compaction curve according to ASTM D1557 for each onsite and borrow soil material proposed for fill and backfill.
- B. The Contractor shall submit records before the start of this work. The Contractor shall verify that the existing conditions are correct as shown on the plans and mentioned in these Specifications. The Contractor shall note any discrepancies found immediately and notify the Engineer.

The records shall include the following:

1. Location of all existing underground utilities, structures, etc., surrounding the areas to be excavated that may be impacted by the work.
2. Location of test excavations.
3. Location of inspections.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply:

- A. American Society for Testing and Materials (ASTM)
1. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 2. ASTM D1557—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 3. ASTM D2487—Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 4. ASTM D2937—Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.
 5. ASTM D3282—Standard Practice for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
 6. ASTM D3740—Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction.
 7. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 8. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

- B. Florida Statutes (FS)
 - 1. Florida Trench Safety Act (90-96, Laws of Florida).
- C. Occupational Safety and Health Administration (OSHA)
 - 1. 29 CFR 1926, Subpart P—Safety and Health Regulations for Construction, Excavations.
 - 2. OSHA 2226—Trenching and Excavation Safety.

1.04 QUALITY ASSURANCE

- A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E329 to conduct soil materials and definition testing, as documented according to ASTM D3740.
- B. The Contractor shall do the following:
 - 1. Ensure that excavations provide adequate working space and clearance for the work to be performed and for installing piping and buried utilities. In no case shall excavation faces be undercut.
 - 2. Ensure that foundation surfaces are clean and free of loose material of any kind when pipelines and buried utilities are placed on them.
 - 3. Excavate, trench, and backfill in compliance with applicable requirements of governing authorities having jurisdiction.
 - 4. Ensure that shoring and sheeting for excavations are designed by a Florida-registered Professional Engineer and are in accordance with OSHA 2226.
 - 5. Before beginning any excavation or grading, ensure the accuracy of all survey data indicated on the Contract Drawings and in these Specifications and/or as provided. If the Contractor discovers any inaccuracies, errors, or omissions in the survey data, the Contractor shall immediately notify the Owner so that proper adjustments can be anticipated or ordered. If the Contractor begins any excavation or grading, this shall be considered an acceptance of the survey data by the Contractor, after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions, or inaccuracies of the survey data.
 - 6. Ensure that tolerances for excavation are ± 0.10 foot to the required line and to the required grade. Tolerance for compaction of in-place material shall be ± 0.10 foot to the required grade.
 - 7. Ensure that all trench materials derived from the project site and imported to this site are examined, tested, and classified by an Engineer-approved soils testing laboratory.

8. Remove unsatisfactory materials and unsuitable materials including muck, silts, peat, and other loose and very loose compressible soils from excavations before placing pipe foundation, bedding, and buried utilities.

1.05 PROJECT CONDITIONS

- A. Existing Utilities: The Contractor shall not interrupt utilities serving facilities occupied by the Owner or others unless permitted to do so in writing by the Engineer and then only after arranging to provide temporary utility services according to the requirements indicated.
 1. Notify the Engineer not less than 2 days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without the Engineer's written permission.
 3. Contact utility-locator service and obtain utility locations for the Project Area before excavating.
- B. The Contractor shall demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

1.06 DEFINITIONS

- A. *Backfill*: Soil material or controlled low-strength material used to fill an excavation.
 1. *Initial Backfill*: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 2. *Final Backfill*: Backfill placed over initial backfill to fill a trench.
- B. *Bedding Course*: The course placed over the excavated subgrade in a trench before laying pipe.
- C. *Borrow Soil*: Satisfactory soil imported from off-site for use as fill or backfill.
- D. *Drainage Course*: The course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- E. *Excavation*: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
 1. *Authorized Additional Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by the Engineer.

Authorized additional excavation and replacement material will be paid for according to the Contract provisions.

2. *Bulk Excavation*: Excavation more than 10 feet in width and more than 30 feet in length.
3. *Unauthorized Excavation*: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by the Engineer. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be without additional compensation.

- F. *Fill*: Soil materials used to raise existing grades.
- G. *Structures*: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- H. *Subgrade*: The surface or elevation remaining after completing excavation, or the top surface of a fill or backfill immediately below drainage fill, or topsoil materials.
- I. *Utilities*: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.07 TESTING REQUIREMENTS

- A. The Contractor shall furnish a soil survey for satisfactory material and samples of materials.
- B. Testing for source material, for classification, and for prequalification of material (on or off site) shall be performed by an independent testing agency retained by the Contractor and approved by the Engineer.
- C. Testing for in-place compacted fill shall be performed by the same independent testing agency as approved by the Engineer and retained by the Contractor.
- D. The number and location of the tests shall be as specified in these Specifications and as directed by the Engineer during construction.
- E. The Contractor shall coordinate activity with the Engineer and the testing agency to permit testing as directed in the presence of the Engineer.
- F. The cost of all testing to achieve specified requirements shall be borne by the Contractor. The Contractor shall be reimbursed by the Owner for passing field tests.

- G. The costs of any and all retests due to failure to achieve specified requirements shall be solely borne by the Contractor and are not reimbursable under this contract.
- H. All materials proposed for use shall be tested as follows:

Material	Required Test	Min. No. Tests
Satisfactory Soil Materials	Soil Classification using ASTM D2487 (including all tests contained therein)	One per source of materials to determine conformance with materials specified in these Specifications; additional tests whenever there is any apparent change.
	Soil moisture-density relationship using Modified Proctor ASTM D1557	One per source of material or apparent change in material.

- I. Soil materials shall be tested during construction as follows:

Material	Required Test	Min. No. Tests
Satisfactory Soil Material in-place after compaction	Field Density ASTM D1556/D1556M – Sand Cone Method, or ASTM D6938 – Nuclear Density Method, or ASTM D2937 – Drive Cylinder Method	For each layer of trench bottom subgrade before addition of soil materials, refill, bedding, and backfill, and for each 400 lineal feet of trench or fraction thereof, whichever is greater; two tests for each drainage, additional test whenever there is any change in native soil, groundwater, or soil moisture conditions.

- J. The approved testing agency shall transmit copies of required laboratory test results as follows:

- One copy to the Owner.
- Three copies to the Engineer.
- One copy to the Contractor.

The laboratory test reports shall include, at a minimum, project title; project location; location of sample; source, time, and date of testing; testing agency's name, address, and telephone number; and test results. Each test report shall be signed and sealed by the Professional Engineer representing the testing agency as specified in these Specifications.

- K. The approved testing agency shall transmit copies of field testing results as follows:

- One copy to the Owner.

2. Three copies to the Engineer.
3. One copy to the Contractor.

The field test reports shall include, at a minimum, project title; project location; location of sample(s) tested; time of testing; date of testing; testing person's full name; testing agency name, address, and telephone number; and test results.

- L. No soil material shall be used until 1) the Engineer has reviewed and approved test reports and 2) the Contractor submits certification that the soil material proposed for construction is clean and meets gradation and other parameters specified in these Specifications.
- M. At no cost to the Owner, the Contractor shall remove and replace or correct all materials and work that tests indicate do not conform, in the opinion of the Engineer, to the requirements of these Specifications.
- N. The results of in-place density tests shall be considered satisfactory if the density in each instance is equal to or greater than the specified density. Soil moisture content at the time of testing shall conform to requirements of these Specifications.
- O. Where the tests reveal unsatisfactory compaction, the Contractor shall re-excavate, backfill, recompact, and/or rework the backfill as required to obtain the required degree of compaction over the entire depth of the excavation.
- P. The testing agency shall transmit to the Engineer copies of all testing agency invoices submitted to the Contractor for payment. Invoices shall clearly indicate specific services and date and time services are rendered and shall indicate if the invoiced testing cost is an initial test of the Contractor's work or is a re-test required due to the Contractor's failure to initially achieve the specified requirements.

PART 2 PRODUCTS

2.01 STRUCTURAL MATERIALS

- A. Materials used for shoring and bracing, such as sheet piling, uprights, stringers, and crossbraces, shall be in good serviceable condition. Any timber used shall be sound and free from large or loose knots.
- B. Pressure-treated timber shall be used where wood sheeting or piling is specified or indicated to be cut and left in place.

2.02 TRENCH SOIL MATERIALS

- A. Materials used for trench construction shall be free of clumps of clay, rock or gravel, debris, waste, frozen materials, and other deleterious matter as determined by the Engineer and shall be satisfactory soil materials as follows:

Area Classification	Soil Materials
In excavations and trenches	Excavated and borrow material that has been sampled, tested, and approved as "Satisfactory Soil Material."

B. Satisfactory Soil Materials

1. Soil Classification Groups:

- a. Satisfactory soil materials for each trench shall be as follows:

Satisfactory Soil Material (ASTM D3282, Soil Classification Groups)		
In-situ Foundation	Bedding, Haunching, and Initial Backfill	Final Backfill
SW	SW	SW
SP	SP	SP

2. Maximum Particle Size Limitations for Satisfactory Soil Materials:

- a. The maximum allowable particle size for satisfactory soil materials within each trench for each type of utility shall be as follows:

Conduit	Maximum Allowable Particle Size		
	In-situ Foundation	Bedding, Haunching, and Initial Backfill	Final Backfill
Plastic Pipe (PVC, CPVC, HDPE, etc.) Less than 6-inch-diameter	See Note 1	1/2 inch	3 inches
Plastic Pipe (PVC, CPVC, HDPE, etc.) 6-inch-diameter and Larger	See Note 1	3/4 inch	3 inches
Concrete Pipe			
Other Conduit Materials	See Note 2	See Note 2	See Note 2

- (1) There is no requirement when satisfactory undisturbed native soil material is used. Disturbed portions of the foundation and/or unsatisfactory native soil material shall be replaced with satisfactory soil materials meeting all the requirements for Bedding Course.
- (2) The maximum allowable particle size shall be in accordance with the manufacturer's written recommendation.

3. Additional Requirements of Satisfactory Materials:

- a. Satisfactory soil materials shall be free of debris, waste, frozen materials, vegetation, or other deleterious matter. Soils within

4 inches of the exterior surface of the pipe shall be free of gravel, stones, or other materials that may abrade the pipe surface.

C. Unsatisfactory Materials

1. Unsatisfactory soil material shall mean ASTM D2487, Soil Classification Groups GW, GP, GM, GC, SC, CL, ML, OL, CH, MH, OH, PT, and other highly organic soils and soil materials of any classification that have a moisture content at the time of compaction beyond the range of 1 percentage point below and 3 percentage points above the optimum moisture content of the soil material as determined by moisture-density relations test.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

The Contractor shall do the following:

- A. Carefully verify by hand methods the location of all surrounding underground utilities before performing utility excavations and trenches.
- B. Protect utilities to be left in place from damage.
- C. Do not interrupt existing utilities serving facilities occupied and used by the Owner, except when permitted in writing by the Engineer.
- D. Protect benchmarks, survey points, and existing structures, roads, sidewalks, monitoring wells, paving, curbs, etc. against damage from equipment, vehicular or foot traffic, settlement, lateral movement, undermining, washout, and all construction-related activities.
- E. Repair and replace damage to existing facilities to equal or better than their original undamaged condition without cost to the Owner and to the approval of the Engineer.
- F. Excavate and trench in ways that will prevent surface water and subsurface water from flowing into excavations and will also prevent flooding of the site and surrounding area.
- G. Protect excavations and trenching by shoring, bracing, sheet piling, underpinning, or other methods as required to prevent cave-ins or loose dirt from falling into excavations and trenches.

- H. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for depositing or compacting backfill material.
- I. Compact the backfill material placed next to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.
- J. Excavate, fill, backfill, and grade to elevations required by the Contract Documents.
- K. Pile excavated materials suitable for backfill in an orderly manner a sufficient distance from excavations to prevent overloading, slides, and cave-ins.
- L. Do not obstruct access ways, roadways, and plant facilities.
- M. Refer to the Contract Drawings for additional requirements related to earthwork and protection of existing features.

3.02 TRENCH EXCAVATION

- A. Before excavating the trench, the Contractor shall prepare the surface including clearing and grubbing as specified in Section 02230, Site Preparation.
- B. The Contractor shall be required to fully comply with all applicable OSHA Excavation Safety Standards and to abide by them as covered by the most current version of the Florida Trench Safety Act (90-96, Laws of Florida).
- C. The Contractor shall ensure that mechanical equipment used for trench excavation shall be of a type, design, and construction and shall be so operated that conduit/utility, when accurately laid to specified alignment, will be centered in the trench with adequate clearance between the conduit/utility and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.
- D. The Contractor shall not use mechanical equipment in locations where its operation would cause damage to culverts, other existing property, utilities, structures, etc. above or below ground. In all such locations, the Contractor shall use hand-excavating methods.
- E. The Contractor shall not use blasting.
- F. The Contractor shall cut trenches sufficiently wide to enable proper installation of services and to allow for testing and inspection. The Contractor shall also trim and shape trench bottoms and leave them free of irregularities, lumps, and projections. Trench width shall be excavated as specified on the Contract Drawings.

- G. The Contractor shall construct trench walls to avoid side wall collapse or sloughing. Trenches shall be either braced or open construction in accordance with the Contract Documents. No separate payment will be made for any special procedure used in connection with the excavation.
- H. Where sheeting and bracing are not required, the Contractor shall construct trench walls in the bottom of the excavation as vertical as possible to the maximum height allowable by OSHA. Trench walls above this height shall be sloped to guard against side wall collapse or sloughing as specified on the Contract Drawings.
- I. Where sheeting and bracing are required, the sheeting and bracing system shall meet the requirements in these Specifications.
- J. Excavations shall be to the design elevations shown on the Contract Drawings or as specified, unless unsatisfactory or unsuitable foundation materials are encountered in the bottom of the excavation. Where unsatisfactory or unsuitable foundation materials are encountered, this material shall be undercut and removed as indicated on the Contract Drawings and replaced with satisfactory soil material meeting all the requirements for Bedding Course. The lift thicknesses and compaction requirements for the replacement soil shall also meet the requirements for Bedding Course.
- K. The Contractor shall be careful not to overexcavate except where necessary to remove unsatisfactory or unsuitable materials, irregularities, lumps, rock, and projections. Unnecessary overexcavation shall be replaced as specified in these Specifications at the Contractor's sole expense.
- L. The Contractor shall accurately grade bedding soil materials at the bottoms of the trenches to provide uniform bearing and support for each section of conduit/utility at every point along its entire length except where it is necessary to excavate the bedding for conduit/utility bells (e.g., pipe bells), etc., or for proper sealing of conduit/utility joints. Abrupt changes in grade of the trench bottom shall be avoided.
- M. The Contractor shall dig bell holes and depressions after the bedding has been graded to ensure that the conduit/utility rests on the prepared bedding for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint.
- N. The Contractor shall do the following:
 - 1. Pile all excavated material in a manner that will not endanger the work or erode into stormwater management facilities or water courses.
 - 2. Avoid obstructing roadways and landfill operations.

3. Leave hydrants, valve pit covers, valve boxes, or other utility controls unobstructed and accessible.
 4. Keep gutters, drainage inlets, natural water courses, and miscellaneous drainage structures clear or make other satisfactory provisions for their proper operation.
- O. The Contractor shall keep all satisfactory materials that are suitable for use/reuse in the trench construction separated from unsatisfactory materials.
- P. Except where otherwise authorized, indicated, or specified, the Contractor shall replace, at the Contractor's own expense, all materials excavated below the bottom of concrete walls, footings, slabs on grade, and foundations with concrete or flowable fill, as directed by the Engineer.
- Q. The Contractor shall adhere to these Additional Excavation Requirements for piping:
1. Excavate trenches so that the piping can be laid to the lines, grades, and elevations indicated on the Contract Drawings.
 2. For piping designated to be laid to a minimum cover requirement, grade trenches to avoid high and low points to the extent practical. Record Drawings of such pipes shall present top-of-pipe and grade elevations at all high and low points along each pipe segment, at the end points of each pipe segments, and at intervals not to exceed 100 feet along each pipe segment. If, in the opinion of the Engineer, additional air release and/or vacuum relief valves are required, the Contractor shall install the additional items as directed by the Engineer.
 3. Except at locations specifically indicated otherwise on the Contract Drawings, the required minimum cover over the top of the pipe from finished grade for various pipe diameters shall be as follows:

	Pipe Diameter			
	48-inch or less	66-inch	72-inch	96-inch
Minimum Cover	3 feet	4 feet	4.5 feet	5 feet

4. Continue dewatering operations along each pipe segment until the required minimum cover is provided. During the dewatering operations, the ground water level in the trench shall remain at all times a minimum of 1 foot below bottom of trench excavations.

R. The Contractor shall adhere to these Additional Excavation Requirements for Electrical Utilities:

1. Avoid abrupt changes in grade of the trench bottom.
2. The required minimum cover over the top of electrical conduits from finished grade shall be as follows:

	Electrical Conduits (Lines less than 5 kV)	Electrical Conduits (Lines 5 kV and up)
Minimum Cover	2 feet	3 feet

3. The required minimum clearance from the bottom of mat foundations and/or footings shall be 2 feet. Provide additional cover where necessary to satisfy the minimum clearance requirement.
4. Provide additional cover depth if necessary to avoid interference of other cables, ducts, piping, structures, and other utilities.

S. The Contractor shall adhere to this Additional Excavation Requirement for Appurtenances:

1. Ensure that excavations for valves and similar appurtenances shall be sufficient to leave at least 12 inches in the clear between the outer surfaces and the embankment or timber used to hold and protect the walls.

3.03 PROTECTION OF PERSONS AND PROPERTY

A. The Contractor shall do the following:

1. Barricade and post excavations with warning signs for the safety of persons. Provide warning lights if construction occurs during hours of darkness.
2. Protect structures, utilities, sidewalks, pavements, and other facilities immediately adjacent to excavations against damage including loading, settlement, lateral movement, undermining, and washout.

B. Conduct topsoil removal operations to ensure the safety of persons and to prevent damage to existing structures and utilities, construction in progress, trees and vegetation to remain standing, and other property.

3.04 SHEETING AND BRACING

A. Where sheeting and bracing are required to support the side walls of the excavation, the Contractor shall retain a Professional Engineer, registered in

Florida, to design sheeting and bracing. The design shall establish requirements for sheeting and bracing and shall comply with all applicable codes; authorities having jurisdiction; and federal, state, and local regulations.

- B. The sole responsibility for the design, methods of installation, and adequacy of sheeting and bracing shall be and shall remain that of the Contractor and the Contractor's Professional Engineer. The Contractor shall provide all necessary sheeting and bracing or other procedures as required to ensure safe working conditions and to protect the excavations.
- C. Sheeting and bracing shall consist of braced steel sheet piling, trench box, braced wood lagging, and soldier beams or other approved methods.
- D. The Contractor shall immediately fill and compact voids formed outside the sheeting. Where soil cannot be properly compacted to fill the void, the Contractor shall use Class B concrete as backfill at no additional cost to the Owner.
- E. The Contractor shall install sheeting outside the required clearances and dimensions. Sheeting shall be plumb, securely braced, and tied in position. Sheeting shall be adequate to withstand all pressure to which it may be subjected. The Contractor shall correct any movement or bulging at no expense to the Owner to provide the necessary clearances and dimensions.
- F. The Contractor shall maintain sheeting and bracing in excavations and trenches for the entire time excavations will be open.
- G. The Contractor shall not brace sheeting against pipe being laid. Sheeting shall be braced so that no concentrated load of horizontal thrust is transmitted to the pipe.
- H. Sheeting shall not be withdrawn if driven below the spring line of any pipe. The Contractor shall cut off tops as indicated on the Contract Drawings and leave bottoms permanently in place.

3.05 DEWATERING, WATER REMOVAL, AND DRAINAGE MAINTENANCE

- A. Water shall not be permitted to accumulate in excavations. The Contractor shall provide dewatering systems to convey water away from excavations so that softening of foundations bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur.
- B. Dewatering systems and equipment shall be in place as required to eliminate water during the excavation period until the work is completed. The Contractor shall provide ample means and equipment with which to remove promptly and dispose of properly all water entering any excavation. This includes the use of

sand or gravel as required to maintain adequate flow during the pipe laying or installation of other items of work within the excavation.

- C. Water pumped or drained shall be disposed of in a suitable manner without damage to adjacent property, to other work under construction, or to roads. Water shall not be discharged onto surface improvements without adequate protection of the surface at the point of discharge. All gutter, drains, culverts, sewers, and inlets shall be kept clean and open for surface drainage. Water shall not be directed across or over pavements except through approved pipes or properly constructed troughs. The Contractor shall obtain permission from the Owner of any property involved before constructing water courses or installing discharge pipe or hose for removal of water and provide for disposal of the water without ponding or creating a public nuisance.
- D. All pumps used for dewatering shall have noise-reduction features and shall be able to run continuously with minimal attendance. If required by the Owner or Engineer, the pumps shall be enclosed on all sides with a plywood enclosure, with padded material suitable for outdoor conditions on the inside of the enclosure, to further reduce pump engine noise to an acceptable level. All applicable ordinances and codes for noise abatement shall be followed. The Contractor shall maintain pumps at all times, as necessary. When pumps are no longer required, the Contractor shall remove the pumps, wellpoints, pipes, and other apparatus from the area.
- E. Trenches shall be constructed on the upstream side of the traffic way across roadways, driveways, or other traffic ways adjacent to drainage ditches or water to prevent impounding water after the pipe has been laid. The Contractor shall construct and maintain bridges and other temporary structures required to maintain traffic across such unfilled trenches. Backfilling shall be done so that water will not accumulate in unfilled or partially filled trenches. After backfilling is completed, the Contractor shall immediately remove all material deposited in roadway ditches or other water courses crossed by the line of trench and restore the original section, grades, and contours of ditches or water courses. Surface drainage shall not be obstructed longer than necessary.
- F. Where trenches are constructed in ditches or other water courses, backfill shall be protected from surface erosion. Where the grade of the ditch exceeds 1%, the Contractor shall install ditch checks. Unless otherwise indicated on the Contract Drawings, ditch checks shall be concrete or as otherwise approved by the Engineer. Ditch checks shall extend not less than 2 feet below the original ditch or water course bottom for the full bottom width and at least 18 inches into the side slopes and shall be at least 12 inches thick.

3.06 BACKFILLING AND COMPACTION

- A. The Contractor shall not backfill trenches until required tests are performed.
- B. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified, or the condition shall be otherwise corrected as directed.
- C. The Contractor shall perform the following steps to ensure compaction at the bottom of the trench or excavation before bedding:
 - 1. Remove disturbed native soil material and/or any soils not meeting the requirement of satisfactory soil material as indicated on the Contract Drawings.
 - 2. Compact the bottom of the trench excavation (undisturbed native subsurface soil) to no less than 95% of the Modified Proctor maximum dry density in accordance with ASTM D1557, before placement of foundation, bedding, piping, and backfill.
- D. To backfill below and around pipe to the spring line of the pipe, the Contractor shall do the following:
 - 1. Construct foundation and bedding as indicated on the Contract Drawings before placement of pipe.
 - 2. Install each pipe at proper grade, alignment, and final position.
 - 3. Deposit satisfactory soil material uniformly and simultaneously on each side of pipe in completed course layers to prevent lateral displacement.
 - 4. Compact under pipe haunches and on each side of pipe to the pipe spring line as shown on the Contract Drawings to hold the pipe in the proper position during subsequent pipe backfilling and compaction operations.
 - 5. Construct haunching as indicated on the Contract Drawings.
- E. To trench backfill above pipe spring line to finished grade, the Contractor shall do the following:
 - 1. Deposit satisfactory soil material around and above pipe in uniform layers as shown on the Contract Drawings.
 - 2. Backfill and compact trenches from the spring line of the pipe to the top of the trench in completed course layers as shown on the Contract Drawings.
 - 3. Use material previously defined in these Specifications as satisfactory soil material.
 - 4. Compact by hand or mechanical tampers.

3.07 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. The Contractor shall remove and legally dispose of waste materials, including excavated material classified as unsatisfactory soil material, trash, and debris from the property at no additional cost to the Owner.

END OF SECTION

SECTION 02370
EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall take every reasonable precaution throughout construction to prevent the erosion of soil and the sedimentation of the stormwater system, wetlands, streams, or other water impoundments, ground surfaces, or other property as required by federal, state, and local regulations.
- B. The Contractor shall provide protective covering for disturbed areas upon suspension or completion of land-disturbing activities. Permanent vegetation shall be established at the earliest practicable time. Temporary and permanent erosion-control measures shall be coordinated to ensure economical, effective, and continuous erosion and siltation control throughout the construction and post-construction period.

1.02 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. Florida Department of Transportation (FDOT)
 - 1. FDOT Section 103—Temporary Work Structures.
 - 2. FDOT Section 104—Prevention, Control, and Abatement of Erosion and Water Pollution.
 - 3. FDOT Section 530—Revetment Systems.
 - 4. FDOT Section 982—Fertilizer.
 - 5. FDOT Section 985—Geosynthetic Materials.

1.04 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.06 REGULATORY REQUIREMENTS

- A. The Contractor shall prevent damage to properties outside the construction limits from siltation due to construction of the project and assume all responsibilities to the affected property owners for correction of damages which may occur. Erosion-control measures shall be performed conforming to the requirements of and in accordance with plans approved by applicable state and local agencies and as specified by the erosion-control portion shown on the Drawings and as required by these Specifications. The Contractor shall not allow mud and debris to accumulate in the streets or enter drainage ditches, or stormwater system. Should the Contractor pump water from excavations during construction, appropriate siltation preventative measures shall be taken before the pumped water is discharged.

1.07 PRACTICES

The Contractor shall adhere to the following:

- A. Avoid dumping soil or sediment into any stream bed, pond, ditch, or watercourse.
- B. Maintain an undisturbed vegetative buffer where possible between a natural watercourse and trenching and grading operations.
- C. Avoid equipment crossings of and the stormwater system where practicable.

1.08 EROSION AND SEDIMENT-CONTROL DEVICES AND FEATURES

- A. The Contractor shall construct all devices (silt fences, retention areas, etc.) for sediment control at the locations required to protect federal, state, and local water bodies and water courses and drainage systems before beginning to excavate the site. All devices shall be properly maintained in place until a structure, paving, or other completed construction makes the device unnecessary or until directed by the Engineer to permanently remove the device.

- B. The Contractor shall use mulch to temporarily stabilize areas subject to excessive erosion and to protect seed beds after planting where required.
- C. Filter fabric, hay bales, or other approved methods shall be placed and secured over the grates of each existing inlet, grating, or storm pipe opening near the area of excavation to prevent silt and debris from entering the storm systems.
- D. The Contractor shall use silt fences, hay bales, and floating turbidity barriers as shown on the Plans or as directed by the Engineer to restrict movement of sediment from the construction area.
- E. The Contractor shall establish vegetative cover on all unpaved areas outside the lined landfill area disturbed by the work.

PART 2 PRODUCTS

2.01 GENERAL

- A. Open-mesh biodegradable mulching cloth.
- B. Fertilizer shall be 10-10-10 grade or equivalent.
- C. Lime shall be Dolomitic Agricultural Ground limestone, in accordance with FDOT Section 982.
- D. Grass shall be in accordance with Section 02920, Seeding and Sodding.
- E. Silt fence shall consist of non-biodegradable filter fabric (Trevira, Mirafi, etc.), in accordance with FDOT Section 985, wired to galvanized wire mesh fencing and supported by wood or metal posts.
- F. Floating or staked turbidity barriers as specified in FDOT Section 985 and FDOT Section 104.
- G. Erosion Stone: FDOT Section 530.
 - 1. Sand-Cement Riprap.
 - 2. Concrete Block.
 - 3. Rubble 20 to 300 pounds each.

- H. Filter Fabric for placing under Riprap shall meet the requirements of FDOT Section 985.
- I. Baled hay or straw in accordance with FDOT Section 104.

PART 3 EXECUTION

3.01 CLEARING

- A. The Contractor shall schedule and perform clearing and grubbing so that subsequent grading operation and erosion-control practices can follow immediately after. Excavation, borrow, and embankment operations will be conducted as a continuous operation. All construction areas not otherwise protected shall be planted with permanent vegetative cover within 30 working days after completing active construction.

3.02 STABILIZING

- A. The angle for graded slopes and fills shall be no greater than the angle that can be retained by vegetative cover or other adequate erosion-control devices or structures or as otherwise indicated in the Construction Documents. All disturbed areas outside of embankment left exposed will, within 30 working days of completion of any phase of grading, be planted or otherwise provided with either temporary or permanent ground cover, devices, or structures sufficient to restrain erosion.

3.03 REGULATORY REQUIREMENTS

- A. Whenever land-disturbing activity is undertaken on a tract, a ground cover sufficient to restrain erosion must be planted or otherwise provided within 30 working days on that portion of the tract upon which further active construction is to be undertaken.
- B. If any earthwork is to be suspended for any reason for longer than 30 calendar days, the areas involved shall be seeded with vegetative cover or otherwise protected against excessive erosion during the suspension period. Suspension of work in any area of operation does not relieve the Contractor of the responsibility to control erosion in that area.

3.04 VEGETATIVE COVER

- A. Preparation of Seedbed. Areas to be seeded shall be scarified a depth of 4 inches until a firm, well-pulverized, uniform seedbed is prepared. Fertilizer shall be applied during the scarification process in accordance with the following rates:
 - 1. Fertilizer—10 to 15 pounds per 1,000 square feet.
- B. Seeding. Disturbed areas along embankments shall be permanently seeded with mix specified in Section 02920, Seeding and Sodding.
- C. The Contractor shall mulch all areas immediately after seeding. Mulch shall be applied.

3.05 MAINTENANCE

- A. The Contractor shall maintain all temporary and permanent erosion-control measures in functioning order. Temporary structures shall be maintained until such time as vegetation is firmly established and grassed areas shall be maintained until completion of the project. Areas which fail to show a suitable stand of grass or which are damaged by erosion shall be immediately repaired. No additional payment will be made to the Contractor for re-establishing erosion-control devices, which may become damaged, destroyed, or otherwise rendered unsuitable for their intended function during the construction of the project.
- B. The Contractor shall remove all silt, sediment, and debris buildup regularly to maintain functioning storm systems and erosion-control devices.

3.06 REMOVAL OF SEDIMENT CONTROL DEVICES

- A. Near completion of the project, when directed by the Engineer, the Contractor shall dismantle and remove the temporary devices used for sediment control during construction. All erosion-control devices in seeded areas shall be left in place until the grass is established. The Contractor shall seed areas around devices and mulch after removing or filling temporary control devices.
- B. The Contractor shall clean up all areas at the completion of the project.

END OF SECTION

SECTION 02600
STORMWATER FACILITIES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall construct stormwater handling facilities, including filter point erosion control mat (FPM), culverts, and swales as shown on the Drawings.
- B. The work includes excavating, embankment, trenching, and backfilling (including excavating unsuitable material and backfill with satisfactory material) for the construction of stormwater facilities. The work also includes work associated with removing, replacing, and disposing of unsuitable soils encountered in the work.

1.02 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance. In general, shop drawings and related manufacturer's product certification shall be done in accordance with the General and Special Conditions of the Contract for approval before construction or fabrication of the material by the manufacturer.

1.03 REFERENCE STANDARDS

- A. The latest edition of the Florida Department of Transportation (FDOT) *Standard Specifications for Road and Bridge Construction* (Standard Specifications) and the *Roadway and Traffic Design Standards* shall be referred to for specific and general standards for materials, details, construction, workmanship, and quality control as specified in this Section with exceptions as noted.
- B. Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.
 - 1. American Association of State Highway and Transportation Officials (AASHTO)
 - a. AASHTO M294—Standard Specification for Corrugated Polyethylene Pipe, 300 to 1,500-mm (12- to 60-Inch) Diameter.
 - b. AASHTO SECTION 12—Buried Structures and Tunnel Liner.

2. American Society of Testing and Materials (ASTM)
 - a. ASTM C31/C31M—Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - b. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
 - c. ASTM C39/C39M—Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - d. ASTM C76—Standard Specification for Reinforced Concrete, Culvert, Storm Drain and Sewer Pipe.
 - e. ASTM C150/C150M—Standard Specification for Portland Cement.
 - f. ASTM C361—Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
 - g. ASTM C443—Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - h. ASTM C939/C939M—Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
 - i. ASTM D422—Standard Test Method for Particle-Size Analysis of Soils.
 - j. ASTM D698—Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
 - k. ASTM D1248—Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - l. ASTM D1556/D1556M—Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
 - m. ASTM D1777—Standard Test Method for Thickness of Textile Materials.
 - n. ASTM D1784—Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - o. ASTM D2321—Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - p. ASTM D2412—Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
 - q. ASTM D3212—Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - r. ASTM D3350—Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

- s. ASTM D4355/D4355M—Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
- t. ASTM D4632/D4632M—Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- u. ASTM D5034—Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
- v. ASTM D6938—Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
- w. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- x. ASTM F477—Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- y. ASTM F794—Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- z. ASTM F949—Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings.
- aa. ASTM F1803—Standard Specification for Poly (Vinyl Chloride)(PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter.
- bb. ASTM F2306—Standard Specification for 12 to 60 in. Annular Corrugated Profile-Wall Polyethylene (PE) Pipe and Fittings for Gravity-Flow Storm Sewer and Subsurface Drainage Applications.

1.04 QUALITY ASSURANCE

- A. Before beginning any excavation or grading, the Contractor shall satisfy himself as to the accuracy of all survey and other data as indicated on the Drawings and in the Specifications. Should the Contractor discover any inaccuracies, errors, or omissions in the survey data, he shall immediately notify the Engineer so that proper adjustments can be anticipated or ordered. If the Contractor begins any excavation or grading, this shall be held as an acceptance of the survey and drawing data.
- B. The Contractor shall certify backfill and subgrade material, perform density and moisture testing, and perform in-place density and moisture testing in accordance with Section 02305, Earthwork for Utilities.
 - 1. Trench bottoms, each lift of backfill for culvert installation, and under FPM installations shall have densities tested on intervals not to be less than two tests per installation per lift or one per 100 linear feet per lift, whichever is greater.

2. Line and grade shall be field-checked on intervals not to exceed 100 feet. Such checking shall apply to all stormwater-related facilities. Line and grade tolerance shall be ± 0.10 foot; however, grading shall in no case be allowed which will permit ponding to occur outside the stormwater retention basins.
 3. The Engineer may require additional testing as deemed necessary. The Engineer shall be responsible for interpreting test results and the Contractor shall perform remedial work, at the Contractor's own expense, as directed by the Engineer. The Contractor shall provide labor as required by the Engineer to help perform tests and/or check line and grade.
- C. The Contractor shall test the grout mix used in FPM installation for each FPM installation or as required by the Engineer. It should be noted that one test includes three cylinders, three sets of mortar cubes, or three nylon bags. If selected, cylinders shall be 3 inches by 6 inches.
- D. The Contractor shall remove and replace or correct, at no cost to the Owner, all materials and work that tests indicate do not conform to the requirements of these Specifications.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery, storage, and handling shall be in accordance with the manufacturer's recommendations and Section 01650, Delivery, Storage, and Handling.

1.06 RECORD DRAWINGS

- A. Record Drawings shall be in accordance with Section 01785, Record Drawings.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide all new materials free from defects impairing strength and durability and of the best commercial quality for the purpose specified. All materials shall have structural properties sufficient to safely sustain or withstand strains and stresses which they will be normally subjected to and be true to detail.

2.02 FILL MATERIALS

- A. *Satisfactory trench backfill materials* are defined as those soils meeting the requirements of Section 02301, Earthwork for Landfill Construction.

- B. *Unsatisfactory soil materials* are defined in Section 02301, Earthwork for Landfill Construction.

2.03 PIPE CULVERTS

A. RCP Stormwater Culvert Piping

- 1. The following sections of the FDOT Standard Specifications shall apply:
 - a. Section 430-1, Description.
 - b. Section 430-2, Materials.
 - c. Section 449-4, Concrete Pipe.
 - d. Joints shall be profile rubber gaskets in accordance with Section 430-7. All joints shall be covered with filter fabric wrap.

B. CMP Stormwater Culvert Piping

- 1. The following sections of the FDOT Standard Specifications shall apply:
 - a. Section 430-1, Description.
 - b. Section 430-2, Materials.
 - c. Section 943, Corrugated Steel Pipe and Pipe Arch.
 - d. Section 945, Corrugated Aluminum Pipe and Pipe Arch.
- 2. Field joints shall be made in accordance with FDOT Section 430-8.

2.04 INLETS, MANHOLES, AND JUNCTION BOXES

A. Inlets

- 1. The following sections of the FDOT Standard Specifications shall apply:
 - a. Section 425-1, Description.
 - b. Section 425-2, Composition and Proportioning.
 - c. Section 425-3, Materials.
 - d. Section 425-4, Forms.
 - e. Section 425-5, Precast Inlets, Manholes, and Junction Boxes.

2.05 FILTER POINT MAT (FPM) EROSION-CONTROL MATERIAL

- A. FPM-type erosion-control material shall be a formed mat of cement-filled, double-layer, filter-point-type fabric.

- B. Filter-point fabric forming material shall consist of double-layer, open-selvage fabric joined in a mat configuration to provide filter points 5 inches on center when cast in place. Fabric shall be woven of 100% continuous multifilament nylon (tire cord) of which more than 50% by weight consists of textured nylon fiber for optimum filtering characteristics and adhesion to the injected fine aggregate concrete (grout). Nylon fabric shall have a minimum thickness of 22 mils (as stated in ASTM D1777), minimum grab breaking load of 270 pounds per inch in the fill and warp (as in ASTM D4632/D4632M), and minimum UV light resistance of 85.0% strength retention after 500 hours (as in ASTM D4355/D4355M). The filter points shall be designed and installed to provide relief of hydrostatic uplift beneath the completed mat. The average mat thickness shall be 2.2 inches with a dry weight of 25 pounds per square foot (lb/sf).
- C. Grout shall consist of a mixture of ASTM C150/C150M Portland cement, fine aggregate, water, and entrapped air so proportioned and mixed as to provide a pumpable grout. The mix shall exhibit a minimum compressive strength of 2,500 psi at 28 days when specimens are made and tested in accordance with ASTM C31/C31M and ASTM C39/C39M. Grout consistency shall be in the 9- to 11-second range through the 3/4-inch orifice of the standard flow cone described in the ASTM C939/C939M.

2.06 MITERED END SECTIONS

- A. The following sections of the FDOT Standard Specifications shall apply:
 - 1. Section 430-1, Description.
 - 2. Section 430-4.6, End Treatment.

PART 3 EXECUTION

3.01 PROTECTION

- A. Before starting earthwork, the Contractor shall accurately locate and record abandoned and active utility lines, rerouted or extended, on project record documents.
- B. Do not interrupt existing utilities serving occupied facilities except when permitted, in writing, by the Engineer.
- C. Maintain, reroute, or abandon existing utility lines that pass through the work area as indicated on the Drawings.
- D. Protect benchmarks and existing structures, roads, sidewalks, paving, and curbs against damage from equipment, vehicular or foot traffic, settlement, lateral

movement, undermining, and washout. The Contractor shall repair and replace damage to existing facilities to equal or better than original condition without cost to the Owner and to the approval of the Engineer.

- E. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods as required to prevent cave-ins or loose dirt from falling into excavations.
- F. The Contractor shall stockpile excavated materials suitable for backfill a sufficient distance from excavations to prevent overloading, slides, and cave-ins, and shall prevent obstruction of accessways and roadways.
- G. Underpin adjacent structure(s) that may be damaged by excavation work, including service lines.
- H. Notify the Engineer of unexpected subsurface conditions and discontinue work in area until the Engineer provides notification to resume work.
- I. The Contractor shall perform excavations so as to prevent surface and subsurface water from flowing into excavations and also prevent flooding of the site and surrounding area.
- J. Do not operate earth-moving equipment within 5 feet of walls of concrete structures for depositing or compacting backfill material. Compact backfill adjacent to concrete walls with hand-operated tampers or similar equipment that will not damage the structure.
- K. Protect the bottom of excavations to prevent soil loss around and beneath foundations and slabs as required. All excavations shall be conducted in-the-dry.
- L. The Contractor shall barricade and post excavations with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness.

3.02 PIPING

- A. The Contractor shall perform backfilling as specified and shall provide full contact between the backfill material and the full perimeter of the pipe.
- B. Before final acceptance, the Contractor shall completely flush and clean all parts of the system. Remove all accumulated construction debris, rocks, sand, gravel, and any other foreign material.
- C. The Contractor shall ensure that the installation provides watertight piping from water inlet to outlet.

- D. The Contractor shall install stormwater culverts as specified in this Section and in accordance with the manufacturer's written recommendations.
- E. The following sections of the FDOT Standard Specifications shall apply:
 - 1. Section 430-4, Laying Pipe.
 - 2. Section 430-7, Specific Requirements for Concrete Pipe.
- F. The Contractor shall supply the Engineer with Drawings showing as-constructed pipe invert elevations at every 50 feet of pipeline for inclusion in the Record Documents.
- G. During laying operations, do not permit debris, tools, clothing, or similar items to be placed in pipes. Pipe interior shall be free of mud and kept clean at all times.
- H. Pipe ends shall be kept clear and clean and the Contractor shall ensure that inside surfaces are maintained smooth and free from any projections that may interfere with joint assembly or flow through the completed line.
- I. Care shall be exercised when lowering pipe into trenches or on subgrade to prevent damaging or twisting the pipe. After laying and before completing backfill or cover operations, pipe shall be protected from any vehicular traffic.

3.03 TRENCH EXCAVATION

- A. Before excavating the trench, the Contractor shall prepare the surface including clearing and grubbing as specified in Section 02230, Site Preparation.
- B. The Contractor shall be required to fully comply with all applicable OSHA Excavation Safety Standards and to abide by them as covered by the most current version of the Florida Trench Safety Act (90-96, Laws of Florida).
- C. The Contractor shall ensure that mechanical equipment used for trench excavation shall be of a type, design, and construction and shall be so operated that conduit/utility, when accurately laid to specified alignment, will be centered in the trench with adequate clearance between the conduit/utility and sidewalls of the trench. Undercutting the trench sidewall to obtain clearance will not be permitted.
- D. The Contractor shall not use blasting.
- E. The Contractor shall cut trenches sufficiently wide to allow for proper installation of services and to allow for testing and inspection. The Contractor shall also trim and shape trench bottoms and leave them free of irregularities, lumps, and

projections. Trench width shall be excavated as specified on the Contract Drawings.

- F. The Contractor shall construct trench walls so as to avoid side wall collapse or sloughing. Trenches shall be either braced or open construction in accordance with the Contract Documents. No separate payment will be made for any special procedure used in connection with the excavation.
- G. Where sheeting and bracing are not required, the Contractor shall construct trench walls in the bottom of the excavation as vertical as possible to the maximum height allowable by OSHA. Trench walls above this height shall be sloped to guard against side wall collapse or sloughing as specified on the Contract Drawings.
- H. Where sheeting and bracing are required, the sheeting and bracing system shall meet the requirements in these Specifications.
- I. Excavations shall be to the design elevations shown on the Contract Drawings or as specified, unless unsatisfactory or unsuitable foundation materials are encountered in the bottom of the excavation. Where unsatisfactory or unsuitable foundation materials are encountered, this material shall be undercut and removed as indicated on the Contract Drawings and replaced with satisfactory soil material meeting all the requirements for Bedding. The lift thicknesses and compaction requirements for the replacement soil shall also meet the requirements for Bedding.
- J. The Contractor shall be careful not to overexcavate except where necessary to remove unsatisfactory or unsuitable materials, irregularities, lumps, rock, and projections. Unnecessary overexcavation shall be replaced as specified in these Specifications at the Contractor's sole expense.
- K. The Contractor shall accurately grade bedding soil materials at the bottoms of the trenches to provide uniform bearing and support for each section of conduit/utility at every point along its entire length except where it is necessary to excavate the bedding for conduit/utility bells (e.g., pipe bells), etc., or for proper sealing of conduit/utility joints. Abrupt changes in grade of the trench bottom shall be avoided.
- L. The Contractor shall dig bell holes and depressions after the bedding has been graded to ensure that the conduit/utility rests on the prepared bedding for as much of its full length as practicable. Bell holes and depressions shall be only of such length, depth, and width as required to make the joint.

- M. The Contractor shall do the following:
1. Pile all excavated material in a manner that will not endanger the work or erode the stormwater management facilities or water courses.
 2. Leave hydrants, valve pit covers, valve boxes, or other utility controls unobstructed and accessible.
 3. Keep drainage inlets and miscellaneous drainage structures clear or make other satisfactory provisions for their proper operation.
- N. The Contractor shall keep all satisfactory materials that are suitable for use/reuse in the trench construction separated from unsatisfactory materials.

3.04 REMOVAL OF UNSATISFACTORY SOIL MATERIALS

- A. Areas of unsatisfactory soils, as specified in Section 02305, Earthwork for Utilities, and established by the Engineer, shall be undercut to competent soils and replaced with suitable fill as specified in Section 02305, Earthwork for Utilities. Unsuitable soils located under FPM and culverts shall be excavated to a minimum depth of 2 feet 0 inch below the finished installation. Backfill of undercut areas shall comply with Section 02305, Earthwork for Utilities.

3.05 BACKFILLING AND COMPACTION

- A. The Contractor shall not backfill trenches until required tests are performed.
- B. Trenches improperly backfilled shall be reopened to the depth required for proper compaction, then refilled and compacted as specified or the condition shall be otherwise corrected as directed.
- C. The Contractor shall perform the following steps to ensure compaction at the bottom of the trench or excavation before bedding:
1. Remove disturbed native soil material and/or any soils not meeting the requirement of satisfactory soil material as indicated on the Contract Drawings.
 2. Compact the bottom of the trench excavation (undisturbed native subsurface soil) to no less than 95% of the Modified Proctor maximum dry density in accordance with ASTM D1556, before placing foundation, bedding, piping, and backfill.

D. To backfill below and around pipe to the spring line of the pipe, the Contractor shall do the following:

1. Construct foundation and bedding as indicated on the Contract Drawings before placing pipe.
2. Install each pipe at proper grade, alignment, and final position.
3. Deposit satisfactory soil material uniformly and simultaneously on each side of pipe in completed course layers to prevent lateral displacement.
4. Compact under pipe haunches and on each side of pipe to the pipe spring line as shown on the Contract Drawings to hold the pipe in the proper position during subsequent pipe backfilling and compaction operations.

E. To backfill above pipe spring line to finished grade, the Contractor shall do the following:

1. Deposit satisfactory soil material around and above pipe in uniform layers as shown on the Contract Drawings.
2. Backfill and compact trenches from the spring line of the pipe to the top of the trench in completed course layers as shown in the Contract Drawings.
3. Use material previously defined in these Sections as satisfactory soil material.
4. Compact by hand or mechanical tampers.

3.06 FILTER POINT MAT EROSION-CONTROL MATERIAL

- A. Fabric Storage: Immediately after fabric is received on the job site, the Contractor shall inspect and store the fabric in a clean dry area where it will not be subject to mechanical damage or exposure to moisture or direct sunlight.
- B. Fabric Placement: Fabric form panels shall be joined, placed, and injected with grout in accordance with the fabric manufacturer's written instructions and as approved by the Engineer. In no case will simple butt joints between panels be allowed. Before injecting grout, the Contractor shall stake, lay out, and staple the fabric for final approval by the Engineer.
- C. Anchor Trench: All edges of the inclined FPMs shall be placed in an anchor trench a minimum of 2 feet long at an angle of 45 degrees from horizontal grade except adjacent to the concrete wall where the anchor trench shall be vertical. When grout placement is completed, all anchor trenches shall be backfilled and compacted as specified in this Section for excavations. The finished appearance of the FPM shall be such that the elevation of the mat top is flush with the surrounding grade. Dimensions of FPM shown on the Drawings do not include additional material required to construct the FPM anchor trench.

- D. Grout Injection: Grout injection shall begin with the anchor trench and then proceed from the lower portions of the mat working back up the slope. The sequence of grout injection shall be such as to ensure complete filling of the fabric to thickness specified by the fabric manufacturer. Foot traffic shall not be permitted on the freshly pumped mat when such traffic will cause permanent indentations in the mat surface. Vehicular traffic shall not be permitted on the mat surface at any time. Grout shall be vibrated during placement. Mortar shall be washed out of the filter points.
- E. Grout Thickness Testing: During grout injection, mat thickness shall be measured by inserting a short piece of wire through the crowns of the mat midway between filter points at several locations from the crest to the toe of the slope. Any mat measuring less than 90% of the average of all thickness measurements shall be reinjected with grout until average thickness in accordance with the manufacturer's recommendations has been attained. The results of this testing shall be recorded by the independent testing laboratory and reported to the Engineer, as specified in this Section.

3.07 MITERED END SECTIONS

- A. Mitered end sections shall be installed as specified in FDOT Index 272.

3.08 INLETS

- A. The following section of the FDOT Standard Specifications shall apply:
 - 1. Section 425-6, Construction Methods.

3.09 DEWATERING

- A. If subsurface water is encountered, the Contractor shall use approved means to dewater the excavation. A well point system or other approved equipment shall be installed, if necessary, to maintain the excavation in a dry condition for placing of concrete and laying pipelines. Dewatering shall be in accordance with Section 02240, Dewatering.

END OF SECTION

SECTION 02635
REINFORCED CONCRETE DRAIN PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary and install and test reinforced concrete pipe for drains complete as shown on the Drawings and as specified in this Section.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Within 30 days of the Effective Date of the Agreement submit the name of the pipe and fitting supplier and a list of materials to be furnished.
- B. Submit shop drawings showing layout and details of reinforcement, joint, method of manufacture and installation of pipe, specials and fittings, and a schedule of pipe lengths by diameter for the entire job.
- C. Submit with the shop drawings certification from the manufacturer that the fine and coarse aggregates used in manufacture of the concrete pipe comply with the requirements of Paragraph 2.01C.
- D. Before each shipment of pipe, submit the manufacturer's certification that the pipe for this Contract conforms to the ASTM Standards specified in this Section.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33/C33M—Standard Specification for Concrete Aggregates.
 - 2. ASTM C76—Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - 3. ASTM C150/C150M—Standard Specification for Portland Cement.

4. ASTM C361—Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
5. ASTM C443—Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
6. ASTM E329—Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

1.04 QUALITY ASSURANCE

- A. The manufacturer shall perform the acceptance tests specified in ASTM C76, Paragraph 5.1.2.
- B. Reinforced concrete pipe manufactured for this Contract may be inspected at the plant for compliance with this Section by an independent testing laboratory provided by the Owner. The manufacturer's cooperation in these inspections shall be required. The cost of this inspection of all pipe approved for this Contract plus the cost of inspection of a reasonable amount of disapproved pipe will be borne by the Owner. The pipe manufacturer shall be required to:
 1. Have sufficient pipe made in advance so that pipe can be approved in one inspection. Pay for additional plant inspections if the inspection does not result in all reinforced concrete pipe being approved, the cost being deducted from monthly progress payments.
 2. Notify the independent testing laboratory at least 48 hours before requesting pipe inspection.
- C. The Engineer will examine the pipe after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements specified in this Section even though pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job.

PART 2 PRODUCTS

2.01 REINFORCED CONCRETE PIPE

- A. Except as otherwise specified in this Section, pipe should conform to ASTM C76, Class III. The pipe interior shall be smooth and even, free from roughness, projections, indentations, offsets, or irregularities of any kind. The concrete mass shall be dense and uniform. The manufacturer in accordance with Section 7.2 of ASTM C76 shall design minimum reinforcement and wall thickness for sizes not tabulated in ASTM C76.

- B. Cement shall be non-air-entraining Portland cement conforming to ASTM C150/C150M, Type II. The use of any admixture shall be subject to the specific approval of the Engineer.
- C. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM C33/C33M, except for gradation, with a maximum loss of 8% when subjected to five cycles of the soundness test using magnesium sulfate. Coarse aggregate shall consist of well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33/C33M, except for gradation, with a maximum loss of 8% when subjected to five cycles of the soundness test using magnesium sulfate. Documentation that the aggregates to be used in the manufacture of reinforced concrete pipe meet these requirements shall be submitted to the Engineer as stated in Article 1.02.
- D. The 28-day compressive strength of the concrete, as indicated by cores cut from the pipe, shall be equal to or greater than the design strength of the concrete. The concrete mass shall be dense and uniform. Reinforcement shall be circular for all concrete pipes. Quadrant steel shall not be used. Reinforcement shall be installed in both the bell and the spigot. At least one circumferential reinforcement wire shall be in both the bell and spigot area and reinforcement in the bell and spigot shall be adequate to prevent damage to concrete during shipping, handling, and after installation. When cores indicate that reinforcing steel has less than 85% bond the pipe shall be subjected to a three-edge bearing test to 13 pounds per square inch (psi) to verify strength and water tightness.
- E. Pipe may be rejected for any of the following reasons:
1. Exposure of any wires, positioning spacers or chairs used to hold the reinforcement cage in position, or steel reinforcement in any surface of the pipe, except as permitted by Section 8.2 of ASTM C76.
 2. Transverse reinforcing steel found to be in excess of 1/4 inch out of specified position after the pipe is molded.
 3. Any shattering or flaking of concrete at a crack.
 4. Voids, with the exception of a few minor bugholes, on the interior and exterior surfaces of the pipe exceeding 1/4-inch in depth unless properly and soundly pointed with mortar or other approved material.
 5. Unauthorized application of any wash coat of cement or grout. Any pipe dressing procedures shall be subject to approval of the Engineer.

6. A hollow spot (identified by tapping the internal surface of the pipe), which is greater than 30-inch in length or wider than three times the specified wall thickness. Repair of such defective areas not exceeding these limitations may be made as specified in Paragraph 2.01R.
 7. Defects that indicate imperfect molding of concrete; or any surface defect indicating honeycomb or open texture (rock pockets) greater in size than area equal to a square with a side dimension of 2-1/2 times the wall thickness or deeper than two times the maximum graded aggregate size. Repair of such defects not exceeding these limits may be made as specified in Paragraph 2.01R.
 8. Any of the following:
 - a. A crack having a width of 0.005 to 0.01 inch throughout a continuous length of 36 inches or more.
 - b. A crack having a width of 0.0 to 0.03 inch or more throughout a continuous length of 1 foot or more.
 - c. Any crack greater than 0.005 inch extending through the wall of the pipe and having a length in excess of the wall thickness.
 - d. Any crack showing two visible lines of separation for a continuous length of 2 feet or more or an interrupted length of 3 feet or more anywhere in evidence, both inside and outside.
 - e. Cracks anywhere greater than 0.03 inch in width.
- F. The pipe shall be clearly marked as required by ASTM C76 in a manner acceptable to the Engineer. The markings may be at either end of the pipe for the convenience of the manufacturer, but for any one size shall always be at the same end of each pipe length. Pipe shall not be shipped until the compressive strength of the concrete has attained 4,000 psi.
- G. Pipe shall have a minimum laying length of approximately 8 feet, except for closure and other special pieces as approved by the Engineer. Sufficient pipe of various lengths should be available at the site to affect closure at manholes or structures that cannot be located to accommodate standard lengths. Short lengths of pipe made for closure, etc. may be used in the pipeline at the end of construction if properly spaced. The length of the incoming and outgoing concrete pipe at each structure shall not exceed 4 feet, except where the joint is cast flush with the exterior wall of the structure, where steel wall fittings are provided or where otherwise noted on the Drawings. Maximum laying length shall not exceed 16 feet, but the installation of 16-foot lengths will depend upon the ability to handle such lengths of pipe in sheeted trenches, comply with trench width requirements, maintain the integrity of the sheeting, and avoid disturbance to the

adjacent ground. If in the opinion of the Engineer the use of 16-foot lengths is impracticable, shorter lengths shall be used.

- H. Each length of pipe shall be checked against the length noted on the shop drawings. Pipe more than 1 1/2 inches longer than that shown on the shop drawings shall not be used on this project. Variations in length of the same pipe shall not exceed ASTM C76 requirements.
- I. During manufacturing, measuring devices shall be used to ensure joint assembly is within the tolerance of ASTM C76 and this Section.
- J. The Engineer shall have the right to take samples of the concrete after it has been mixed or as it is being placed in the forms or molds and to make such inspection and tests of the concrete as he/she may wish.
- K. At the start of the work, a set of test cylinders shall be taken each day on which pipe is manufactured for the project or more often if required. This may ultimately be reduced to one set of three specimens for every 50 cubic yards of concrete placed, if the uniformity of results warrants and if approved by the Engineer. At the start of the work, a relationship shall be established between ultimate strength of test cylinders stored in a standard manner compared to cylinders steam cured with the pipe and compared to cores taken from the corresponding finished pipe. At least five sets of tests shall be made.
- L. The Engineer shall have the right to cut cores from such pieces of the finished pipe as he/she selects for inspection and such tests as he/she may wish to apply. Holes left by the removal of cores shall be filled in an approved manner by and at the expense of the manufacturer. Core drilling shall be carried out by the pipe manufacturer at his/her expense. The number of cores shall not exceed the requirements of ASTM C76.
- M. Test cores may be taken for every 500 linear feet of pipe manufactured, but not less than once each day on which pipe is manufactured for the project. Cores may be reduced to one set of two per week (or possibly fewer, but not less than one set for every 1,500 linear feet), if a satisfactory relationship is established between cores and cylinders made and cured in the standard manner. This relationship shall not vary by more than 10% more or less from the average ratio. Cores may be drilled in any manner that will provide a smooth core face. All pipe cylinders and cores shall be 4 inches in diameter. Cores shall be carefully saw-trimmed and capped in a vertical position with a sulfur cap of minimum thickness, at least 1 day before being tested.
- N. Core testing shall conform to Standard ASTM Methods.

- O. At the time of inspection, the pipe will be carefully examined for compliance with the appropriate ASTM standard, as specified in this Section and shop drawings. All pipes shall be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, soundness, etc. All pipes will be checked for soundness by being tapped and scratched at least once on every 50 square inches of pipe surface. The surface shall be dense and close-textured. Cores also shall serve as a basis for rejection of pipe, particularly if lamination or poor bond of reinforcement is apparent.
- P. The manufacturer shall use measuring devices to ensure joint assembly is within tolerances of ASTM C76 and as specified in this Section. If, during construction, the pipes cannot be satisfactorily joined, the manufacturer shall pre-join the pipe at the plant.
- Q. Unsatisfactory or damaged pipe will be either permanently rejected or returned for minor repairs. Only pipe actually conforming to the Specifications and accepted will be listed for approval, shipment, and payment. Approved pipe will be so stamped or stenciled on the inside before it is shipped. All pipe which has been damaged after delivery will be rejected and if such pipe already has been laid in the trench, it shall be acceptably repaired, if permitted, or removed and replaced, entirely at the Contractor's expense.
- R. Pits, blisters, rough spots, breakage, and other imperfections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs shall be carefully inspected before final approval. Non-shrink cement mortar used for repairs shall have a minimum compressive strength of 6,000 psi at the end of 7 days and 7,000 psi at the end of 28 days, when tested in 3-inch cylinders stored in the standard manner. Subject to the approval of the Engineer, epoxy mortar may be used for repairs.

2.02 JOINTS FOR CONCRETE PIPE

- A. Joints for concrete pipe less than 72 inches in diameter shall be concrete and rubber tongue-and-groove or bell-and-spigot-type joint conforming to ASTM C361 with provisions for using a round rubber O-Ring gasket in a recess in the spigot end of the pipe. The bevel on the bell of the pipe shall be between $1\text{-}1/2^\circ$ and $2\text{-}1/2^\circ$. The diameters of the joint surfaces that compress the gasket shall not vary from the true diameters by more than $1/16$ inch.
- B. The round rubber O-Ring gaskets shall conform to ASTM C443 except as otherwise specified in this Section.
- C. The gaskets shall be designed and manufactured so that the completed joint will withstand an internal water pressure in excess of 13 psi for 10 minutes without

showing any leakage by the gasket or displacement of it. The pipe manufacturer shall provide facilities for testing the effectiveness of the joints against leakage and one such test may be required for each 500 feet of pipe for each type of joint manufactured. Such tests shall be made by an internal or external pressure against the joint of at least 13 psi for 10 minutes in accordance with ASTM C443. The completed joint, when installed in place in the work, shall be capable of withstanding a groundwater pressure of 13 psi without exceeding the allowable leakage specified for the pipe testing.

- D. The ends of the pipe shall be made true to form and dimension and the bell shall be made by casting against steel forms. The manufacturer shall inspect all pipe joint surfaces for out-of-roundness and pipe ends for squareness. The manufacturer shall furnish to the Engineer a notarized affidavit stating all pipe meets the requirements of ASTM C76, as specified in this Section and the joint design.

PART 3 EXECUTION

3.01 LAYING CONCRETE PIPE

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe or fittings and the joint surfaces. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before laying and no piece shall be installed which is found to be defective.
- B. As soon as the excavation is completed to the normal grade of the bottom of the trench, place crushed stone in the trench and the pipe shall be firmly bedded in this stone to conform accurately to the lines and grades indicated on the Drawings. Crushed stone shall conform to the requirements of Section 02230, Site Preparation. Blocking under the pipe will not be permitted.
- C. Crushed stone shall be placed and compacted to give complete vertical and lateral support for the lower section of the pipe as indicated on the Drawings. A depression shall be left in the supporting gravel at the joint to prevent contamination of the rubber gasket immediately before being forced home. Before the pipe is lowered into the trench, the spigot and bell shall be cleaned and free from dirt. A vegetable lubricant that is not soluble in water, furnished by the pipe manufacturer and harmless to the rubber gasket, shall lubricate the gasket and bell. The pipe shall be properly aligned in the trench to avoid any possibility of contact with the side of the trench and fouling the gasket. As soon as the spigot is centered in the bell of the previously laid pipe, it shall be forced home with jacks or come-alongs. After the gasket is compressed and before the pipe is brought fully home, each gasket shall be carefully checked for proper position around the full circumference of the joint. Steel inserts shall be used to prevent the pipe from

going home until the feeler gauge is used to check the final position of the gasket. The jacks or come-alongs shall be anchored sufficiently back along the pipeline (a minimum of five lengths) so that the pulling force will not dislodge the pieces of pipe already in place. Only a jack or come-along shall be employed to force the pipe home smoothly and evenly and hold the pipe while backfilling is in progress. Under no circumstances shall crowbars be used nor shall any of the motor-driven equipment be used.

- D. As soon as the pipe is in place and before the come-along is released, backfill shall be placed as indicated on the Drawings and compacted for at least one-half the length of pipe. Not until this backfill is placed shall the come-along be released. If any motion at joints can be detected, a greater amount of backfill shall be placed before pressure is released. When pipe laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by a watertight plug or other approved means.
- E. Carefully regulate the equipment and construction operations so that the loading of the pipe does not exceed the loads for which the pipe is designed and manufactured. Any pipe damaged during construction operations shall promptly and satisfactorily be repaired or replaced at the Contractor's expense.

3.02 TESTING

A. General

1. Drains shall be tested by an exfiltration test using water.
2. Test the first section of pipeline as soon as it is installed to demonstrate that the work conforms to this Section.

B. Exfiltration Test

1. Leakage tests by exfiltration shall be made before or after backfilling at the discretion of the Engineer. The length of pipe to be tested shall be such that the head over the crown at the upstream crown is not less than 2 feet and the head over the downstream crown is not more than 6 feet. The pipe shall be plugged by pneumatic bags or mechanical plugs in such a manner that the air can be released from the pipe while it is being filled with water. Before any measurements are made, the pipe shall be kept full of water long enough to allow absorption and the escape of any trapped air to take place. Following this, a test period of at least 1 hour shall begin. Provisions shall be made for measuring the amount of water required to maintain the water at a constant level during the test period.
2. If any joint shows an appreciable amount of leakage, the jointing material shall be removed and the joint repaired. If any pipe is defective, it shall be

removed and replaced. If the quantity of water required to maintain a constant level in the pipe does not exceed 100 gallons per inch of diameter per day per mile of pipe and if all the leakage is not confined to a few joints, workmanship shall be considered satisfactory. If the amount of leakage indicates defective joints or broken pipes, they shall be corrected or replaced.

3.03 CLEANING

- A. At the conclusion of the work, thoroughly clean all pipelines by flushing or power jetting with water or other means to remove all dirt, stones, pieces of wood, or other material that may have entered the pipes during the construction period. Debris cleaned from the lines shall be removed from the low end of the pipeline. If after this cleaning obstructions remain, they shall be removed. After the pipelines are cleaned and if the groundwater level is above the pipe or following a heavy rain, the Engineer will examine the pipes for leaks. If any defective pipes or joints are discovered, they shall be repaired.

END OF SECTION

SECTION 02920 SEEDING AND SODDING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes requirements for the following areas of work:
 - 1. Fine grading.
 - 2. Preparation of areas to receive seeding and sodding.
 - 3. Fertilizing of areas to receive seeding and sodding.
 - 4. Maintenance.
 - 5. Seeding.
 - 6. Hydroseeding.
 - 7. Sodding of new areas to receive seeding and sodding.
 - 8. Mulching.

1.02 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Certificates
 - 1. Fertilizer, seed, hydroseed, and sod shall be accompanied by certificate from vendors certifying these items meet the requirements of these Specifications, stating botanical name, percentage by weight, and percentage of purity.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. Federal Specification (FS) O-F-241D—Fertilizer, Mixed, Commercial.
- B. American Society for Testing and Materials (ASTM)—Equivalent AASHTO standards may be substituted as approved.

- C. The Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction (Standard Specifications) shall be referred to for both specific and general standards for materials, construction, workmanship, and quality control as specified in this Section with exceptions, as noted herein. Note that any reference in the Standard Specifications to the terms “Department” or “District Materials Engineer” shall be replaced by the term “Owner.”

1.04 QUALITY ASSURANCE

- A. The Contractor shall provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Deliver, store, protect, and handle products to the site and prevent damage from wetness and weather conditions.
- C. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable.
- D. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of the manufacturer.
- E. No sod that has been cut for more than 72 hours may be used unless specifically authorized. A letter of certification from the grassing Contractor as to when the sod was cut and what type shall be provided to the Engineer upon delivery of the sod to the job site.

1.06 MAINTENANCE

- A. Maintenance shall be as indicated under Part 3, Execution, of this Section.

1.07 DEFINITIONS

- A. *Weeds:* Weeds include but are not limited to Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.08 REGULATORY REQUIREMENTS

- A. The Contractor shall comply with regulatory agencies for fertilizer and herbicide composition.

PART 2 PRODUCTS

2.01 TOPSOIL

- A. The Contractor shall provide topsoil from off-site borrow or from project on-site excavation as approved by the Engineer.

2.02 SEED MIXTURE

Seed Mixture:

- A. March 15 to October 15
 - 1. Argentine Bahia.
- B. Remainder of the Year
 - 1. 1/3 Argentine Bahia.
 - 2. 1/3 Common Bermuda grass.
 - 3. 1/3 Rye.

2.03 SOD

- A. The Contractor shall provide strongly rooted sod, not less than 2 years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant) Sod shall be provided in rectangles a minimum of 12 by 24 inches or in rolls at least 12 inches in width and length consistent with the equipment used to handle the rolls and place the sod. Provide sod composed principally of the following:
 - 1. Argentine Bahia (Palletized Sod).
 - 2. Common Bermuda (Rolled Sod).

2.04 FERTILIZER FOR SOD

- A. The Contractor shall provide commercial fertilizer of neutral character, with some elements derived from organic sources, containing not less than 8% phosphoric acid, 8% potassium, and percentage of nitrogen required to provide 0.5 pound of actual nitrogen per 1,000 square feet of area. Provide nitrogen in form that will be

available to the seeded and sodded area during initial period of growth. The chemical designation shall be 5-10-10.

- B. The Contractor shall ensure that the fertilizer is delivered to the site in labeled bags or containers.

2.05 FERTILIZER FOR SEED

- A. Fertilizer: FS O-F-241, Type I, Grade A; recommended for grass, with 50% of the elements derived from organic sources, of a proportion necessary to eliminate any deficiencies of topsoil to the following proportions:
 - 1. Seeded Areas – 5% nitrogen, 10% phosphoric acid, 10% soluble potash.

2.06 WATER FOR SEEDING AND SODDING

- A. Water shall be free of acid, alkali, or organic materials and shall have a pH of 7.0 to 8.5. The Contractor shall provide all water needed for grassing by providing permanent or temporary piping valves and temporary trucks to convey water from the source to the point of use. The Contractor shall provide any meters required and pay for water used if the water is taken from a public water system. Water shall be free of petroleum products, pesticides, and any other deleterious impurities.

2.07 EROSION-CONTROL FABRIC

- A. The Contractor shall provide 70% agricultural straw with 30% coconut fiber matrix stitches with degradable nettings designed to degrade within 18 months. Erosion-control anchors shall be as recommended by the manufacturer.

2.08 STRAW MULCH

- A. Straw mulch shall be used on all newly graded and topsoiled areas sloped 3:1 or steeper to protect areas against washouts and erosion. Straw mulch shall consist of threshed straw of oats, wheat, barley, or rye that is free from noxious weeds, mold, or other objectionable material. The straw mulch shall contain at least 50% by weight of material that is 10 inches or longer. Straw shall be in an air-dry condition and suitable for placement with blower equipment.

2.09 TACKIFIER

- A. Latex acrylic copolymer shall be Soil Sealant with coalescing agent as manufactured by Soil Stabilization Products Company, Inc., Merced, CA, or equal and shall be used as straw mulch tackifier.

PART 3 EXECUTION

3.01 COORDINATION OF WORK

- A. The Contractor shall coordinate all work activities to provide for establishing grass cover at the earliest possible time in the construction schedule to minimize erosion of topsoil.

3.02 SOIL PREPARATION

Concerning soil preparation, the Contractor shall do the following:

- A. Dispose of any existing sod, growth, rocks, or other obstructions that might interfere with tilling, seeding, sodding, or later maintenance operations. Remove stones over 1-1/2 inches in any dimensions and sticks, roots, rubbish, and other extraneous matter. Remove from the work area or site; do not stockpile.
- B. Till to a depth of not less than 4 inches. Thoroughly loosen and pulverize topsoil.
- C. Grade areas to be seeded and sodded to a smooth, even surface with loose, uniformly firm texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future.
- D. Moisten prepared areas to be seeded and sodded before planting if the soil is dry. Water thoroughly and allow the surface to dry off before seeding and sodding. Do not create a muddy soil condition.
- E. Restore prepared areas to specified condition if eroded or otherwise disturbed after the fine grading and before planting.
- F. Spread the planting soil mixture to depth required to meet thickness, grades, and elevations indicated after light rolling and natural settlement. Do not spread if the material is frozen or if the subgrade is frozen.
- G. Preparing Unchanged Grades
 - 1. Where seeding and sodding in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil as follows:
 - a. Till to a depth of not less than 12 inches.
 - b. Apply soil amendments and initial fertilizers.
 - c. Remove high areas and fill in depressions.

- d. Till soil to a homogeneous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.
- H. Allow for a 3-inch sod thickness in areas to be added next to paving.
- I. Before preparing unchanged areas, remove existing grass, vegetation, and turf. Dispose of such material outside of the Owner's property: do not turn over into soil being prepared for seeding and sodding.
- J. Place approximately one-half of the total amount of planting soil required. Work into the top of the loosened subgrade to create a transition layer and then place the remainder of the planting soil.

3.03 FERTILIZING FOR SEEDING

- A. Seeding: The Contractor shall spread fertilizer uniformly at a rate of 10 pounds per 1,000 square feet.
- B. Apply after smooth raking of topsoil and before roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2 inches of topsoil.
- E. Lightly water to aid the dissipation of fertilizer.

3.04 SEEDING

- A. Apply seed at the rate designated on the schedule evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on the same day.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Roll seeded area with appropriate equipment to achieve seed embedment and soil compaction.
- E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.05 HYDRO-SEEDING

- A. Apply seeded slurry with a hydraulic seeder at the rate designated on schedule evenly in two intersecting directions.
- B. Do not hydro-seed area in excess of that which can be mulched on the same day.
- C. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.

3.06 SEED PROTECTION

- A. When seeding is complete, apply straw mulch at a rate of 4,000 pounds/acre. Apply tackifier as required.
- B. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- C. Lay fabric smoothly on surface, bury top end of each section in 6-inch-deep excavated topsoil trench. Provide a 2- to 4-inch overlap of adjacent rolls. Backfill the trench and rake smooth, level with the adjacent soil.
- D. Secure outside edges and overlaps in accordance with the manufacturer's recommendations.
- E. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- F. At the sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges a minimum of 6 inches.

3.07 SODDING NEW AREAS

When sodding new areas, the Contractor shall do the following:

- A. Before laying sod, contact the Engineer to observe soil preparation work. Lay sod within 24 hours of the time of stripping. Do not plant dormant sod or if the ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger to offset joints in adjacent courses. Employ installation methods to avoid damage to subgrade or sod. On slopes, install the sod with an overlap that allows water to flow over the adjacent strip and not under it. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into

minor cracks between pieces of sod; remove excess to avoid smothering adjacent grass.

- C. Anchor sod on slopes greater than 3:1 with wood pegs as required to prevent slippage.
- D. Water sod thoroughly with a fine spray immediately after planting.

3.08 RECONDITIONING SEEDED AND SODDED AREAS

The Contractor shall ensure that seeded and sodded areas are properly reconditioned by doing the following:

- A. Recondition seeded and sodded areas that are damaged by work operations, including storage of materials or equipment and movement of vehicles. Also recondition seeded and sodded areas where settlement or washouts occur or where minor regrading is required. Recondition other existing seeded and sodded areas where indicated.
- B. Provide fertilizer, topsoil, seed, or sod amendments as specified for new seeded and sodded areas and as required to provide satisfactory reconditioning. Provide new planting soil as required to fill low spots and meet new finish grades.
- C. Cultivate bare and compacted areas thoroughly to provide a good deep planting bed.
- D. Remove diseased or unsatisfactory seeded and sodded areas; do not bury into soil. Remove topsoil containing foreign materials resulting from operations including oil drippings, stone, gravel, and other construction materials. Replace with new topsoil.
- E. Where substantial seeding and sodding remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or, if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
- F. Water newly planted areas and keep moist until new grass is established.

3.09 PROTECTION

- A. The Contractor shall erect barricades, warning signs, and fencing to protect newly planted areas from traffic. Maintain barricade fencing and warning signs throughout the maintenance period until project is substantially completed.

3.10 MAINTENANCE

To maintain the seeded and sodded area, the Contractor shall do the following:

- A. Mow sod to a height of 2 inches as soon as there is enough top growth to cut with a mower. Remove no more than 40% of grass leaf growth in initial or subsequent mowing. Do not delay mowing until grass blades bend over and become matted.
- B. Maintain grass growth by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, re-grading, and replanting as required to establish a smooth, acceptable seeding and sodding, free from eroded or bare areas.
- C. Remove weeds by pulling or chemical treatment.
- D. Perform maintenance until the date of final completion of project.
- E. Apply the second fertilizer application after the first mowing and when grass is dry. Use fertilizer that will provide 0.5 pound of actual nitrogen per 1,000 square feet of seeded and sodded areas.
- F. Replant bare areas using the same materials specified for seeded and sodded areas.
- G. Watering: Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep seeded and sodded areas uniformly moist as required for proper growth. Do not apply more than 1 inch of water per week to sustain grass growth.
- H. Lay out temporary watering system and arrange watering schedule to avoid walking over muddy areas. Use equipment and water to prevent puddling and water erosion and displacing seed or mulch (if any).
- I. Apply water in sufficient quantities and as often as seasonal conditions require to keep the grassed areas moist.
- J. Provide supplemental water and irrigation to sod areas when the rainfall is not adequate to maintain soil moisture necessary for growth of the grass. The Contractor is responsible for determining the quantities of water required and when to irrigate. This obligation shall remain in full force and effect until final acceptance of the work by the Owner and shall be provided at no additional cost to the Owner.

- K. The Owner, at its discretion, may relieve the Contractor of this obligation at such time as the Owner is able to provide irrigation if available. This action, however, does not relieve the Contractor of the provisions and guarantees set forth in the Contract Documents.

3.11 ACCEPTANCE OF SEEDED OR SODDED AREAS

- A. When seeding or sodding work, including maintenance, is substantially complete, the Engineer and the Owner will, upon request, observe to determine satisfactory growth and acceptability:
 - 1. The term "Satisfactory Growth" as used in this Section is defined as even plant growth in healthy condition without bare spots larger than 1 square foot in seeded areas and without bare spots in sodded areas. Bare spots in sodded areas shall be resodded. The Contractor shall maintain all grassed and sodded areas until satisfactory growth has been demonstrated at project final completion. If the subsequent stand of grass is found contaminated with weeds or other obnoxious or undesirable growth, the Contractor shall eliminate such undesirable growth at the Contractor's own expense.
- B. The Contractor shall re-plant rejected work and continue specified maintenance until the work is accepted by the Engineer and the Owner and found to be acceptable.
- C. Sodded areas will be acceptable provided requirements, including maintenance, have been complied with and a healthy, well-rooted, even-colored, viable seeded or sodded area is established, free of weeds, open joints, bare areas, and surface irregularities.

3.12 CLEANUP

- A. The Contractor shall promptly remove soil and debris created by seeding and sodding work from paved areas. Clean wheels of vehicles before they leave the site to avoid tracking soil onto surfacing of roads, walks, or other paved areas.

END OF SECTION

DIVISION 9

FINISHES

SECTION 09900
PAINTING AND COATING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes materials for and application of painting and coating systems for the following surfaces:
 - 1. Exposed metal.
 - 2. Buried metal.
 - 3. PVC.
 - 4. Metal in contact with concrete.
 - 5. Fusion-bonded epoxy coated steel.

1.02 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.
- B. Submit manufacturer's data sheets showing the following information:
 - 1. Percent solids by volume.
 - 2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
 - 3. Recommended surface preparation.
 - 4. Recommended thinners.
 - 5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
 - 6. Application instructions including recommended equipment and temperature limitations.
 - 7. Curing requirements and instructions.
- C. Submit color swatches.
- D. Submit certificate identifying the type and gradation of abrasives used for surface preparation.
- E. Submit material safety data sheets for each coating.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. American Society for Testing and Materials (ASTM)

1. ASTM A780/A780M—Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
2. ASTM C501—Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser.
3. ASTM D520—Standard Specification for Zinc Dust Pigment.
4. ASTM D522/D522M—Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings.
5. ASTM D1002—Standard Test Method for Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal).
6. ASTM D2240—Standard Test Method for Rubber Property—Durometer Hardness.
7. ASTM D2697—Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings.
8. ASTM D2794—Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
9. ASTM D3734—Standard Specification for High-Flash Aromatic Naphthas.
10. ASTM D4060—Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
11. ASTM D4138—Standard Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means.
12. ASTM D4258—Standard Practice for Surface Cleaning Concrete for Coating.
13. ASTM D4260—Standard Practice for Liquid and Gelled Acid Etching of Concrete.
14. ASTM D4261—Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.
15. ASTM D4263—Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
16. ASTM D4787—Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.

17. ASTM D6386—Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.
 18. ASTM D7091—Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
 19. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. American Water Works Association (AWWA)
1. AWWA C203—Coal-Tar Protective Coatings and Linings for Steel Water Pipelines – Enamel and Tape – Hot Applied.
 2. AWWA C209—Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings.
- C. International Concrete Repair Institute (ICRI)
1. ICRI CSP 3-5—Light to Medium-Heavy Shotblast.
 2. ICRI CSP 5—Medium-Heavy Shotblast.
- D. National Association of Corrosion Engineers International (NACE)
1. NACE SP0188—Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
- E. NSF International (NSF)
1. NSF 61—Drinking Water System Components – Health Effects.
- F. Steel Structure Painting Council (SSPC)
1. SSPC PA-1—Shop, Field, and Maintenance Painting of Steel.
 2. SSPC PA-2—Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 3. SSPC SP-1—Solvent Cleaning.
 4. SSPC SP-2—Hand Tool Cleaning.
 5. SSPC SP-3—Power Tool Cleaning.
 6. SSPC SP-5/NACE No. 1—White Metal Blast Cleaning.
 7. SSPC SP-6/NACE No. 3—Commercial Blast Cleaning.
 8. SSPC SP-7/NACE No. 4—Brush-Off Blast Cleaning.
 9. SSPC SP-8—Pickling.
 10. SSPC SP-10/NACE No. 2—Near-White Blast Cleaning.

11. SSPC SP-11—Power Tool Cleaning to Bare Metal.
12. SSPC SP-13—Surface Preparation of Concrete.
13. SSPC SP WJ-1—Waterjet Cleaning of Metals – Clean to Bare Substrate.
14. SSPC SP WJ-2—Waterjet Cleaning of Metals – Very Thorough Cleaning.
15. SSPC SP WJ-3—Waterjet Cleaning of Metals – Thorough Cleaning.
16. SSPC SP WJ-4—Waterjet Cleaning of Metals – Light Cleaning.

G. U.S. Department of Defense (MIL)

1. MIL-C-5541—Chemical Conversion Coatings on Aluminum and Aluminum Alloys.
2. MIL-C-18480B—Coating Compound, Bituminous, Solvent, Coal-Tar Base.
3. MIL-DTL-24441—General Specification for Paint, Epoxy-Polyamide.
4. MIL-P-21035—Paint High Zinc Dust Content, Galvanizing Repair.

PART 2 PRODUCTS

2.01 PAINTING AND COATING SYSTEMS

The following index lists the various painting and coating systems by service and type:

PAINT COATINGS SYSTEM INDEX		
No.	Title	Generic Coating
Submerged Metal Coating Systems		
7.	Submerged Metal, Potable or Nonpotable Water	Epoxy
Exposed Metal Coating Systems		
10.	Exposed Metal, Corrosive Environment	High-build epoxy (two-coat system) with polyurethane topcoat
13.	Exposed Metal, Corrosive Environment	Epoxy with urethane topcoat
15.	Exposed Metal, Atmospheric Weathering Environment	Alkyd
18.	Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up	Organic zinc
Buried Metal Coating Systems		
21.	Buried Metal	Epoxy
23.	Buried Metal	Thixotropic coal-tar pitch
24.	Buried Metal	Corrosion-resisting grease
Coating Systems for Nonferrous Metals		
51.	Insulate Aluminum (Insulation) from Concrete and Carbon Steel	Bituminous

PAINT COATINGS SYSTEM INDEX		
No.	Title	Generic Coating
PVC, CPVC, and FRP Coating Systems		
52.	PVC, CPVC, and FRP, Ultraviolet Exposure or Color Coding	Epoxy/aliphatic acrylic polyurethane

These systems are specified in detail in the following Paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses.

A. Submerged Metal Coating Systems

1. System No. 7—Submerged Metal, Potable or Nonpotable Water:
 - a. Type: Epoxy: 100% sbv Polyamine Epoxy with near “0” VOC.
 - b. Service Conditions: For use with structures, valves, piping, or equipment immersed in potable or nonpotable water.
 - c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
 - d. Coating System: Apply the manufacturer’s recommended number of coats to attain the specified minimum coating thickness. Products: Devoe Bar-Rust 233H; Tnemec N140; Sherwin-Williams Tank Clad HS B62-80 Series/B60V80; PPG AQUAPON® LT NSF Low Temperature Epoxy Coatings 95-172; Carboline Super Hi-Gard 891; Ameron 395; International Interline 785HS; Wisconsin Protective Coating Corp. Plasite 9133, Keysite 740, or equal; 30 mils total. Color of topcoat: white. Each coat shall be a different color than the one preceding it. Tnemec Series N140 Pota-Pox Plus Polyamidoamine epoxy at 6.0 to 8.0 mils/coat. Apply two coats. Total system should not exceed 17 mils.

B. Exposed Metal Coating Systems

1. System No. 10—Exposed Metal, Corrosive Environment:
 - a. Type: High-build epoxy finish coat having a minimum volume solids of 60%, with an inorganic zinc prime coat Service Conditions: For use with metal structures or pipes subjected to

water condensation, chemical fumes such as hydrogen sulfide, salt spray, and chemical contact.

- b. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
- c. Prime Coat: Self-curing, two-component inorganic zinc-rich coating recommended by the manufacturer for overcoating with a high-build epoxy finish coat. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Tnemec Series 90-97; Devoe Catha-Coat 304 or 304V; International Interzinc 180HS; Ameron 9HS; Carboline 11 HS; Sherwin-Williams Zinc-Clad II Plus, B69VZ12/B69VZ13/B69D11 at 2.5 to 4.0 mils DFT; PPG METALHIDE® 28 Inorganic Zinc-Rich Primer 97 – 672, or equal.
- d. Intermediate Coat: Tnemec Series 104; ICI Devoe Devran 224 HS; International Interguard 760HS; Ameron 385; Carboline 888 or 890; Sherwin-Williams Macropoxy 646 B58-600/B58V600 at 4.0 to 8.0 mils DFT; PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 Series, or equal; 5 mils. Film thickness 5.0 to 8.0 mils/coat. Minimum solids by volume should be 82%.
- e. Finish Coat: Two-component pigmented acrylic or aliphatic polyurethane, minimum 70% sbv recommended by the manufacturer for overcoating a high-build epoxy coating. Apply to a thickness of at least 2 mils. Products: Tnemec Series 1075; ICI Devoe Devthane 379; International Interline 990HS; Ameron 450 HS; Carboline 134 HG; Sherwin-Williams Hi-Solids Polyurethane B65-300 Series/B60V30 at 2.5 to 4.0 mils DFT; PPG PITTHANE® Ultra-Gloss Urethane Enamel 95-812 Series; or equal.

2. System No. 13—Exposed Metal, Corrosive Environment:

- a. Type: High-build self-priming Cycloaliphatic Amine epoxy minimum 82% sbv prime coat with a pigmented high-build aliphatic with a minimum 71% sbv.
- b. Service Conditions: For use with metal structures or pipes subjected to water condensation, chemical fumes such as hydrogen sulfide, salt spray, and chemical contact.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
- d. Prime Coat: Two-component high-build epoxy. Apply to a thickness of 8 mils. Products: Ameron 400; ICI Devoe 235; Tnemec Series 104; International Interseal 670HS; Carboline

- 890LT; Sherwin-Williams Macropoxy 646 B58-600/B58V600 at 4.0 to 8.0 mils DFT; PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 Series; or equal.
- e. Finish Coat: Two-component pigmented high-build Aliphatic Acrylic polyurethane. Apply one or more coats to a total thickness of 5 mils. Products: Ameron “Amershield”; ICI Devoe Devthane 359; Tnemec Series 1075; International Interthane 990HS; Carboline 133 HB; Sherwin-Williams Hi-Solids Polyurethane B65-300 series/B60V30 at 2.5 to 4.0 mils DFT/coat; PPG PITTHANE® Ultra Gloss Urethane Enamel 95-812 Series; or equal.
3. System No. 15—Exposed Metal, Atmospheric Weathering Environment:
- a. Type: Gloss alkyd enamel having a minimum volume solids content of 46% with alkyd primer.
 - b. Service Conditions: For use on exterior metal and piping subject to sunlight and weathering.
 - c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-6/NACE No. 3.
 - d. Prime Coat: Carboline Shop Primer No. 1; ICI Devoe 4140; Ameron 5105; International Interlac 260HS; Sherwin-Williams Kem-Bond HS B50NZ Series at 2.0 to 4.0 mils DFT; PPG SPEEDHIDE® Int/Ext Rust Inhibitive Steel Primer 6-208 Series; or equal, applied to minimum dry-film thickness of 2 mils. Tnemec Series 10 primer at 2.0 to 3.5 mils DFT with 56% sbv.
 - e. Finish Coat: Two coats of Carboline Carbocoat 139; two coats of ICI Devoe 4348; two coats of Tnemec Series 2H; two coats of Ameron 5401 HS; two coats of International Interlac 820; two coats of Sherwin-Williams Industrial Enamel B54Z Series at 2.0 to 3.0 mils DFT/coat; two coats of PPG MetalMax Int/Ext Gloss Alkyd 7-914 Series, or equal. Apply to a minimum dry-film thickness of 1.5 to 3.5 mils DFT/coat.
4. System No. 18—Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up:
- a. Type: Organic zinc primer having a minimum zinc content of 14 pounds per gallon.
 - b. Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.

- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
- d. Coating: Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Tnemec 90-97; International Interzinc 308; Ameron 68HS; ICI Devoe 313; Carboline 859; Sherwin-Williams Zinc-Clad III HS B69A100/B69D11/B69D11 at 3.0 to 5.0 mils DFT; PPG Durethane™ MCZ 97-679; or equal. Applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.

C. Buried Metal Coating Systems

1. System No. 21—Buried Metal:

- a. Type: High solids Cycloaliphatic Amine epoxy or phenolic epoxy having minimum volume solids of 80% (ASTM D2697).
- b. Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
- d. Coating System: Apply three or more coats of Ameron 400; Tnemec 104 HS (6.0 to 8.0 mils per coat); ICI Devoe Bar-Rust 233H; Carboline 890LT; Sherwin-Williams Tank Clad HS B62-80 Series/B60V80 Series at 5.0 to 8.0 mils/coat or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2. System No. 23—Buried Metal:

- a. Type: Thixotropic, coal-tar pitch having minimum volume solids of 68% and complying with MIL-C-18480B.
- b. Service Conditions: Buried metal, such as flanges, nuts and bolts, fittings, and structural steel especially subjected to corrosive conditions such as acidic groundwater.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Abrasive blast in accordance with SSPC SP-10/NACE No. 2.
- d. Prime Coat: Not required.
- e. Finish Coat: Apply two coats of Carboline Bitumastic 50, 15 mils each; two or more coats of Tnemec 46-465, to a total thickness of 30 mils; or equal. Apply two to three coats.

3. System No. 24—Buried Metal:

- a. Type: Corrosion-resisting grease.
- b. Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.
- c. Surface Preparation: Solvent clean in accordance with SSPC SP-1 to remove contaminants from the surface. Power tool clean in accordance with SSPC SP-3 as a minimum. Abrasive blasting in accordance with SSPC SP-6/NACE No. 3 is preferred.
- d. Coating: NO-OX-ID GG-2 as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4 inch.
- e. All buried ductile iron fittings and valves shall be bagged before backfilling in accordance with Article 3.04 of Section 15110, Manual, Check, and Process Valves.

D. Coating Systems for Miscellaneous Metals

1. System No. 51—Insulate Aluminum (Insulation) from Concrete and Carbon Steel:

- a. Type: Bituminous paint having a minimum volume solids of 68% coal-tar pitch based.
- b. Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.
- c. Surface Preparation: Solvent or steam clean in accordance with SSPC SP-1; do not use alkali cleaning. Then dust blast.
- d. Prime Coat: Apply synthetic resin or epoxy primer to metal surface before finish coats. Products: International Intervinux VTA528/529, or equal. No primer required for Carboline or Tnemec.
- e. Finish Coat: Carboline Super Service Black; Tnemec 46-465; International Intertuf 100; or equal. Apply two coats to a minimum dry-film thickness of 8.0 to 12.0 mils/coat.

E. PVC, CPVC, and FRP Coating Systems

1. System No. 52—PVC, CPVC, and FRP, Ultraviolet Exposure or Color Coding:

- a. Type: Tnemec Series 1095 Endura-Shield Aliphatic Acrylic Polyurethane (66% sbv) finish with a Series 66 Hi-Build

Epoxoline Polyamide Epoxy (56% sbv) prime coat at a total dry film thickness of 4.5 to 10.0 mils.

- b. Service Conditions: Color coding of PVC, CPVC, or FRP exposed to sunlight.
- c. Surface Preparation: Clean the surface in accordance with SSPC SP-1. Then, thoroughly and uniformly scarify and de-gloss the surface.
- d. Prime Coat: Tnemec Series 66 at 2.0 to 3.0 mils.
- e. Finish Coat: Tnemec Series 1095 Endura-Shield at 2.5 to 5.0 mils. Series 1095 is semi-gloss. For a different sheen, apply Series 1094 (gloss) or Series 1096 (eggshell) at the same thickness.

F. Abrasives for Surface Preparation

- 1. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:
 - a. 16- to 30- or 16- to 40-mesh silica sand or mineral grit.
 - b. 20- to 40-mesh garnet.
 - c. Crushed iron slag, 100% retained on No. 80 mesh.
 - d. SAE Grade G-40 or G-50 iron or steel grit.
- 2. In the above gradations, 100% of the material shall pass through the first stated sieve size and 100% shall be retained on the second stated sieve size.

PART 3 EXECUTION

3.01 WEATHER CONDITIONS

- A. Do not paint in the rain, wind, snow, mist, or fog or when steel or metal surface temperatures are less than 5°F above the dew point.
- B. Do not apply paint when the relative humidity is above 85%.
- C. Do not paint when temperature of metal to be painted is above 120°F.
- D. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours.
- E. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

3.02 SURFACE PREPARATION PROCEDURES

- A. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting. Powerwashing with a biodegradable degreaser is also acceptable.
- B. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
- C. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter. Prime all areas before rust bloom forms and within the same day.
- D. Do not abrasive blast PVC, CPVC, or FRP piping or equipment. Do not abrasive blast epoxy- or enamel-coated pipe that has already been factory coated, except to repair scratched or damaged coatings.
- E. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within 2 hours of blasting or before any rust bloom forms.
- F. Surface preparation shall conform to the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Before Recoating	SP-12
Surface Preparation of Concrete	SP-13

- G. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these Specifications or in the paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC (Steel Structure Painting Council), surface preparation specifications listed above.
- H. *Dust blasting* is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide and to provide a surface profile for the coating.
- I. *Brush-off blasting* of concrete and masonry surfaces is defined as opening subsurface holes and voids and etching the surface for a coating to bond.
- J. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Engineer. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Engineer. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Engineer.
- K. Do not apply any part of a coating system before the Engineer has reviewed the surface preparation. If coating has been applied without this review, if directed by the Engineer, remove the applied coating by abrasive blasting and reapply the coat in accordance with this Specification.

3.03 ABRASIVE BLAST CLEANING

- A. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.
- B. After abrasive blast cleaning and before coating is applied, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within an 8-hour working day. Do not apply coating over damp or moist surfaces. Reclean any blast-cleaned surface not coated within the 8-hour period before applying primer or touch-up coating.
- C. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.

- D. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating so that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.
- E. Dust, dirt, blast particles, old coatings, rust, mill scale, etc., from abrasive blast cleaning shall not be discharged into any water, including stormwater ditches and ponds. If these materials are discharged to the ground, they shall be removed and properly disposed after painting and coating operations are complete.

3.04 PREPARATION OF CONCRETE AND MASONRY SURFACES TO BE COATED (NOT USED)

3.05 COATING STAINLESS STEEL (NOT USED)

3.06 PROCEDURES FOR ITEMS HAVING SHOP-APPLIED PRIME COATS

- A. After applying primer to surfaces, allow coating to cure for a minimum of 2 hours before handling to minimize damage.
- B. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.
- C. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- D. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless the ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

3.07 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

- A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.
- B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with

a solution of Trisodium Phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.

- C. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that the remaining primers are not damaged by the blast cleaning operation. The remaining primers shall be firmly bonded to the steel surfaces with blast-cleaned edges feathered.
- D. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that the remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared in accordance with SSPC SP-11. The remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.
- E. Use repair procedures on damaged primer that protect adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
- F. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
- G. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer as specified in System No. 18 to cover scratches or abraded areas.
- H. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

3.08 PAINTING SYSTEMS

- A. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.
- B. Deliver paints to the jobsite in the original, unopened containers.

3.09 PAINT STORAGE AND MIXING

- A. Store and mix materials only in areas designated for that purpose by the Engineer. The area shall be well ventilated, with precautionary measures taken to prevent fire hazards. Post “No Smoking” signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.
- B. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.10 PROCEDURES FOR THE APPLICATION OF COATINGS

- A. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer, including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.
- B. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
- C. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner before mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
- D. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility in working area before applying coating. Remove dust from coated surfaces by dusting, sweeping, and vacuuming before applying succeeding coats.

- E. Apply coating systems to the specified minimum dry-film thicknesses as determined in accordance with SSPC PA-2.
- F. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Before applying coating, re-clean surfaces that have surface colored or become moist by blast cleaning.
- G. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces before applying the primer and finish coat. Apply the brush coat before and in conjunction with the spray coat application. Apply the spray coat over the brush coat.
- H. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer's recommendation.
- I. Each coat shall cover the surface of the preceding coat completely and there shall be a visually perceptible difference in applied shade or tint of colors.
- J. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Engineer.
- K. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

3.11 SURFACES NOT TO BE COATED

- A. Do not paint the surfaces listed below unless otherwise noted in the Drawings or in other Sections. Protect the following surfaces during the painting of adjacent areas:
 - 1. Stainless steel.
 - 2. Nameplates.
 - 3. Grease fittings.
 - 4. Buried pipe, unless specifically required in the piping Sections.
 - 5. Aluminum handrail, stairs, and grating.

3.12 PROTECTION OF SURFACES NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from

falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

3.13 SURFACES TO BE COATED

- A. The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as “corrosive environment,” “buried metal,” or “submerged metal.” Coat surfaces with the specific coating systems as described below:
1. Coat mechanical equipment, such as pumps, as described below or in the various mechanical equipment specifications. The color of the finish coat shall match the color of the connecting piping.
 2. Coat aboveground and exposed piping or piping in vaults and structures as described below. The color of the finish coat shall be as shown below.

Piping Designation	Color of Finish Coat
Leachate	Yellow

3. Coat valves as described the same as the adjacent piping. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.
4. Coat aluminum surfaces in contact with concrete as specified in System No. 51.
5. Coat buried flanges, nuts, and bolts, valves, flexible pipe couplings, exposed rebar in thrust blocks, and valve boxes as specified in System No. 21. Coat buried bolt threads, tie bolt threads, and nuts as specified in System No. 24.

3.14 DRY-FILM THICKNESS TESTING

- A. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Measure coating thickness specified for stainless steel, and aluminum surfaces with an eddy-current-type thickness gauge in accordance with ASTM D7091. Provide certification that the gauge has been calibrated by a certified laboratory within the past 6 months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.

- B. Check each coat for the correct dry-film thickness. Do not measure within 8 hours after application of the coating.
- C. For metal surfaces, make five separate spot measurements (average of three middle readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80% nor more than 120% of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.
- D. Perform tests in the presence of the Engineer.

3.15 REPAIR OF IMPROPERLY COATED SURFACES

- A. If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish the coat in accordance with the Specifications. The work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.16 CLEANING

- A. During the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.
- B. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.
- C. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

DIVISION 11

EQUIPMENT

SECTION 11000 GENERAL EQUIPMENT REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies general work requirements regarding the products and execution services that are specified in the Division 11 Sections incorporated in the Contract Documents. The requirements specified shall apply to all of the Division 11 Sections, unless noted otherwise.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The submittal contents for equipment, instrumentation, controls, and appurtenances specified in the Division 11 Sections shall contain the general information listed below. Additional submittal requirements are contained in the Division 11 Sections.
 - 1. A list and description of all deviations from the Contract Documents.
 - 2. A list of equipment and components on each drawing with each product identified by legend reference. Include product name, manufacturer, and model number.
 - 3. Completely dimensioned plans, elevations, and cross-sections of system equipment and sub-assemblies.
 - 4. Shop and erection drawings showing details, anchor bolt locations, and field connections.
 - 5. Manufacturers' equipment installation instructions.
 - 6. Descriptive literature, technical bulletins, and catalog data sheets for all equipment and purchased sub-components.
 - 7. Installation, operation, maintenance and start-up procedures.
 - 8. Total equipment weight (while operating).
 - 9. Drive mechanism torque rating and bearing life rating.
 - 10. Motor data and catalog information.
 - 11. Submit complete electrical drawings, schematics, and interconnecting wiring diagrams and schedules for the equipment control system, instrumentation, and control panel(s) showing numbered wiring terminals in the control panel conforming to NEMA ICS-1-101. Identify field device terminals, wire number, wire sizes, control and power wire types, and interfaced elements.

12. Control panel construction and panel layout drawings.
13. Complete technical literature for all factory-applied paint systems. Clearly indicate the components to be coated and the corresponding paint system.
14. Manufacturers' descriptive literature, product specifications, and published details.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

A. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS-1—Industrial Control and Systems: General Requirements.

1.04 QUALITY ASSURANCE

- #### A. Requirements of Regulatory Agencies: The Contractor shall comply with construction requirements of State, County, and other local political subdivision specifications as may exceed the requirements of the codes, standards, and approving bodies referenced in this Section.
1. NFPA Standards: The Contractor shall comply with requirements of the National Fire Protection Association (NFPA) Standards referenced in the various Specifications Sections and as directly appropriate to the work and workmanship.
 2. Electrical Requirements: The Contractor shall comply with requirements for both the Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals and the National Electrical Manufacturers' Associations (NEMA) Stamps or Seals as applicable to electrical equipment or apparatus forming parts of the Mechanical Equipment.
- #### B. Certificates and Permits: Upon completion of work and before final payment, the Contractor shall furnish to the Engineer formal certification of final inspections from authorities having jurisdiction over the work in this project and secure required permits, if any, from such authorities. Additionally, the Contractor shall prepare any detailed diagrams and drawings that are required by those authorities having jurisdiction over the work of this project at no additional cost to the Owner.
- #### C. Source Quality Control: Products used throughout these Specifications and as indicated on the Drawings shall be from companies having established reputations

in the manufacture of the particular materials, equipment, or apparatus specified. Such products may be of their own make or products of others for which they assume full responsibility when used in finished products which are not manufactured completely by them and with replacement parts available.

- D. Products: The equipment specified in the Division 11 Sections was based on the latest models that were available from the specified equipment manufacturers at the time the Contract Documents were developed. If any equipment models specified in the Division 11 Sections have been discontinued or will be discontinued within 1 year after the bid date, the Contractor shall furnish and install the latest and most recent equipment model at no additional cost to the Owner.
- E. For each category of materials and equipment (Products) specified in the Division 11 Sections, the Contractor shall provide Products of the same manufacturer and type.
- F. Equipment Selection: The Contractor may furnish equipment of higher electrical characteristics, physical dimensions, capacities, and ratings provided such proposed equipment is approved by the Engineer in writing. Upon receiving the Engineer's approval to provide such equipment, the Contractor shall furnish the connecting mechanical and electrical services including but not limited to circuit breakers, conduit, increased control panel enclosure size, motors, bases, and any other electrical equipment needed to accommodate the higher electrical characteristics at no additional cost to the Owner.
- G. If minimum energy ratings or efficiencies of equipment are specified in Division 11, Equipment, the Contractor shall furnish and install equipment that meets or exceeds the specified design and commissioning requirements (no exceptions) as determined by the Engineer.
- H. All the equipment specified in the Contract Documents shall be standard units of proven ability as manufactured by a competent organization that is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed, constructed, and installed in accordance with the best practice and methods and shall operate satisfactorily when installed.

1.05 WARRANTIES

- A. Warranties shall be in accordance with the General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.

1.07 QUALIFICATIONS

- A. The manufacturer of each piece of equipment described in the Division 11 Sections shall meet the following requirements, unless noted otherwise:
 - 1. Have a record of operation, manufacturing and servicing the items specified in the Division 11 Sections for a minimum of 10 years before the Bid Date.
 - 2. Have a minimum of five installations of equipment similar to that specified in this Section.
 - 3. Have been in business for at least the 10 consecutive years before the Bid Date.
- B. If the equipment manufacturer that the Contractor proposes to furnish and install the equipment described in the Division 11 Sections does not meet these qualifications and is not specified in the Contract Documents, the Engineer reserves the right to reject the equipment from this manufacturer for use on this project. Any costs incurred by the Contractor as a result of providing equipment from a manufacturer that does not meet the qualifications described in this Section shall not be incurred by the Owner.
- C. The Contractor shall furnish documentation that the manufacturer meets these qualifications as part of the submittals specified in Section 01330, Submittals and Acceptance.

1.08 MAINTENANCE

- A. Spare Parts
 - 1. The Contractor shall furnish the spare parts specified in the Division 11 Sections. The Contractor shall also submit a list of recommended spare parts, special tools, and lubricants for each equipment item. The list shall include contact information for local sources for supply of all parts and professional service.

1.09 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

PART 2 PRODUCTS

2.01 MOTORS

- A. All motors identified in Division 11 Sections shall be furnished and installed under Division 11, Equipment, and in accordance with Division 16, Electrical.

2.02 CONTROLS

- A. General
 - 1. All control panels specified in the Division 11 Sections shall be furnished and installed under Division 11, Equipment, and in accordance with Division 16, Electrical.
 - 2. The Contractor shall furnish and install controls designed to operate on 120-volt, single-phase, 60 Hertz electric service unless otherwise specified. The Contractor shall furnish and install 120-volt step-down voltage transformers as specified in Division 16, Electrical, in each control panel as required.
 - 3. The Contractor shall furnish and install elapsed time meters in each control panel for each piece of motor-driven equipment being controlled by that control panel. All elapsed-time meters shall be furnished and installed in accordance with Division 16, Electrical.
 - 4. All control panels shall be furnished with a main circuit breaker to enable/disable electric service to the panelboard.
 - 5. All control panels that will annunciate a local and/or remote alarm shall be furnished with an ALARM ACKNOWLEDGE reset pushbutton switch (momentary contact) wired to each alarm contact.
 - 6. All indicating lamps in each control panel shall be furnished in accordance with the color-coded scheme:
 - a. ON indicating lamps: Green.
 - b. OFF indicating lamps: Red.

- c. Alarm indicating lamps: Amber.
 - d. POWER ON indicating lamp: White.
- 7. Provide a heater inside of each control panel enclosure to prevent condensation. Heater size shall be in accordance with the equipment manufacturer's recommendations.
- 8. The face of each control panel shall be installed so it is facing north whenever possible, or provided with a sunshield when not possible.

2.03 EQUIPMENT ANCHORING SYSTEMS

- A. All anchoring systems including, but not limited to, expansion anchors, adhesive anchors, anchor bolts, cinch anchors, and screws that are required to install the equipment and appurtenances specified in the Division 11 Sections shall be AISI Type 316 stainless steel unless noted otherwise. The Contractor shall furnish and install all equipment anchoring systems in accordance with the manufacturer's recommendations.

2.04 EQUIPMENT NAMEPLATES

- A. The Contractor shall provide engraved laminated phenolic nameplates with white legend and black field that provides the following information for each piece of equipment described in the Division 11 Sections.
 - 1. Equipment Description (i.e., Leachate Collection Pump, Leak Detection Pump, etc.).
 - 2. Equipment Identification Label No.
- B. Letter height on each nameplate shall not be less than 3/4-inch. Nameplates shall be factory drilled for fasteners. Secure nameplates to equipment or nearby wall using AISI Type 304 stainless steel fasteners. The locations of each nameplate shall be coordinated with the Engineer and approved by the Engineer before their installation.
- C. The Contractor shall obtain the Engineer's approval for the nameplate information for each equipment item described in the Division 11 Sections before ordering these nameplates from the manufacturer.

2.05 PRESSURE GAUGE ASSEMBLIES – PUMPING UNITS

- A. General: The Contractor shall provide a pressure gauge assembly on the suction and discharge piping. The intent of the Drawings is not to show the locations of every pumping unit pressure gauge. Rather, the Contractor shall mount each

pressure gauge as close to the pump suction and discharge connections as possible, but so as not to impede the operation and maintenance of the pressure gauge assembly, pumping unit, and valves installed on the pumping unit suction and discharge piping. Coordinate the location of all pressure gauge assemblies with the Engineer before installation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: The Contractor shall install the equipment in accordance with the manufacturer's instructions and recommendations and approved submittals at the locations shown on the Drawings. If the equipment locations shown on the Drawings are in conflict with the manufacturer's recommendations or will interfere with the installation or operation of any other item indicated in the Contract Documents, the Contractor shall relocate this equipment and provide the necessary appurtenances to install the equipment in accordance with the manufacturer's recommendations at no additional cost to the Owner. The Contractor shall not install any equipment at locations not in accordance with the Contract Documents or approved submittals.
- B. The Contractor shall install equipment, slabs, walls level and plumb, parallel, and perpendicular to other components unless otherwise shown on the Drawings.
- C. The Contractor shall apply an anti-seize compound to threaded fasteners of equipment components that require removal, replacement, or adjustment as part of any maintenance or inspection procedure.
- D. The Contractor shall furnish and install the required oil and grease for initial operation in accordance with the manufacturer's recommendations.
- E. The Contractor shall furnish and apply touch-up paint to any equipment's factory painting finish that is chipped or damaged during installation. All factory-finish touch-up paint shall be mutually compatible with the factory finish on the equipment and shall be furnished by the manufacturer of the equipment to be touched up in the field.
- F. The Contractor shall furnish and install all mechanical equipment to facilitate service, maintenance, and repair or replacement of the equipment components. The Contractor shall connect equipment for ease of disconnecting, with minimum interference to other installations.

3.02 FIELD TESTING

- A. General: The Contractor shall provide services of a factory-authorized service representative to perform, approve, and certify the field testing specified in this Section. Field testing shall generally consist of performing the pre-startup and startup tests as specified in the Division 11 Sections and the final mechanical performance test specified in this Section. The Contract Documents may require the Contractor to perform factory testing on equipment items before the Engineer approves their use for this project. The Contractor shall refer to the Division 11 Sections regarding equipment shop testing requirements.
- B. The Contractor shall adhere to the following requirements regarding the field testing to be provided for this project:
 - 1. The service representative shall be employed by the manufacturer of the equipment specified at the time field testing is being performed. The service representative shall be authorized by the factory to perform the field testing specified in Division 11, Equipment. Upon request by the Engineer, the Contractor shall submit a letter from a company officer of the equipment manufacturer stating that the service representative performing the field testing is authorized by the manufacturer.
 - 2. Before scheduling each field test with the equipment manufacturer, the Contractor shall coordinate with the Engineer to obtain a list of dates that both parties would be available to attend the testing. The Contractor shall notify the Engineer of the field testing dates no less than 14 calendar days before the date of the field test.
 - 3. If directed by the Engineer, the Contractor shall perform a second pre-startup and/or startup test, in accordance with the procedures specified in the Division 11 Sections, at no additional cost to the Owner if the original pre-startup and/or startup test did not pass because of any work that was deemed by the Engineer to be non-compliant with the Contract Documents and/or manufacturer's recommendations.
 - 4. The Contractor shall furnish, install, and remove any temporary piping, valves, appurtenances, and equipment necessary to perform the pre-startup and startup testing to the Engineer's satisfaction.
 - 5. All field testing shall be performed Monday through Friday at the project site, unless otherwise approved by the Engineer.
 - 6. The duration that the manufacturer's representative is required to be on site to perform the pre-startup and startup training is specified in the Division 11 Sections.

C. Operating Costs

1. Costs for Pre-startup and Startup Testing: The Contractor shall include in the Contract Price the following operating costs for satisfactorily completing the Initial Mechanical Performance Tests on equipment being tested:

- a. Lubricating grease.
- b. Lubricating oils.
- c. Such other materials or utilities not specifically identified in this Section, but required to conduct the pre-startup and startup testing.

- D. The intent of the field testing for each equipment item specified in the Division 11 Sections is provided in this Section. If the individual equipment field testing procedures specified in the Division 11 Sections are not sufficient to obtain a Manufacturer's Certification or to demonstrate compliance with the Contract Documents, the Contractor shall perform these additional field test procedures at no additional cost to the Owner.

1. Pre-startup Testing: Upon the Contractor's completion of the installation and adjustment of the equipment; the Contractor, with his own forces and with the manufacturer's representative(s), shall demonstrate to the Engineer's satisfaction that the equipment has been furnished and installed in accordance with the Contract Documents and the manufacturer's recommendations.

- a. The Contractor shall repair any equipment items that do not pass the pre-startup test, as identified by the Engineer and/or manufacturer's representative, to the satisfaction of the Engineer before performing the startup testing for that equipment.

2. Startup Testing: Upon successful completion of the pre-startup testing, the Contractor shall demonstrate that the mechanical performance and controls of each equipment item, when operated in accordance with the design intent indicated by the Contract Documents, are satisfactory to the Engineer.

- a. Startup testing shall be performed with each equipment item simulated under operating conditions. For equipment that will operate while being submerged as shown on the Drawings, the Contractor shall fill the respective sump with sufficient water to operate the system and perform startup testing while that equipment is submerged.

- b. After the startup testing procedures specified in the Division 11 Sections have been completed to the satisfaction of the Engineer, the Contractor shall operate that equipment for one successful continuous 72-hour period unless otherwise approved by the Engineer without assistance from the Owner or Engineer as a condition of startup testing. If the equipment needs to be taken out of service for repair during this 72-hour period because it is not operating in accordance with the intent of the Contract Documents, this operating period shall cease. A new operating period will not begin until the equipment has been operating in accordance with the Contract Documents and manufacturer's recommendations for at least 72 consecutive hours. The Contractor shall furnish any additional supervision or provisions necessary to verify that each equipment item was successfully operated during this 72-hour operating period.
- 3. Final Mechanical Performance Testing: The Contractor shall perform final mechanical performance testing of the equipment specified in the Division 11 Sections once the following conditions have been satisfied:
 - a. The Contractor has successfully completed the pre-startup and startup testing requirements specified in the Division 11 Sections.
 - b. The Contractor has performed the training services specified in this Section.
 - c. The Engineer has received and approved all of the manufacturer's certifications of compliance, warranties, and O&M manuals for all required items as specified in the Contract Documents.

3.03 TRAINING SERVICES

- A. Upon completion of the pre-startup and startup testing, the manufacturer of the equipment specified in Division 11 and 15 Sections shall provide an authorized representative to train the Owner's personnel in the operation and maintenance of the equipment. The representative shall provide additional onsite startup and troubleshooting services during this training upon request by the Engineer while performing these training services. The duration of the training services for each equipment item are specified in the Division 11 Sections.

3.04 MANUFACTURER'S CERTIFICATIONS OF COMPLIANCE

- A. Upon successful completion of the pre-startup testing, startup testing, and training services specified in this Section, the Contractor shall obtain the equipment manufacturer's certification that the equipment specified in the respective Division 11 Sections has been installed, adjusted, and tested in accordance with

the manufacturer's recommendations. The Contractor shall furnish the Engineer with Manufacturer's Certificates of Compliance and Equipment Manufacturer's Certificate of Installation Testing and Instruction for each specified equipment item before performing the final mechanical performance testing specified in this Section.

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER _____

EQPT SERIAL NO: _____

EQPT TAG NO: _____

EQPT/SYSTEM: _____

PROJECT NO: _____

SPEC. SECTION: _____

I hereby certify that the above-referenced equipment/system has been: (Check Applicable)

_____ Installed in accordance with Manufacturer's recommendations.

_____ Inspected, checked, and adjusted.

_____ Serviced with proper initial lubricants.

_____ Electrical and mechanical connection meet quality and safety standards.

_____ All applicable safety equipment has been properly installed.

_____ System has been performance tested, and meets or exceeds specified performance requirements (when complete system of one manufacturer).

Comments: _____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment, and (iii) authorize the make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20____

Manufacturer: _____

By Manufacturer's Authorized Representative: _____

(Authorized Signature)

**EQUIPMENT MANUFACTURER'S CERTIFICATE OF
INSTALLATION TESTING AND INSTRUCTION**

OWNER _____

PROJECT _____

CONTRACT NO. _____

JONES EDMUNDS NO. _____

EQUIPMENT SPECIFICATION SECTION _____

EQUIPMENT DESCRIPTION _____

I _____, Authorized representative of
(Print Name)

(Print Manufacturer's Name)

hereby CERTIFY that _____
(Print equipment name and model with serial No.)

Installed for the subject project has/have been installed in a satisfactory manner, has/have been satisfactorily tested, is/are ready for operation, and that Owner assigned operating personnel have been suitably instructed in the operation, lubrication, and care of the units on Date:

_____ Time: _____.

CERTIFIED BY: _____ DATE: _____
(Signature of Manufacturer's Representative)

OWNER'S ACKNOWLEDGEMENT OF MANUFACTURER'S INSTRUCTION

I/We the undersigned, authorized representatives of the _____
and/or Plant Operating Personnel have received classroom and hands on instruction on the
operation, lubrication, and maintenance of the subject equipment and am/are prepared to assume
normal operational responsibility for the equipment:

_____ DATE: _____

_____ DATE: _____

_____ DATE: _____

END OF SECTION

SECTION 11300 LEACHATE PUMPS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, new materials, equipment, and incidentals necessary for the complete installation of the Cell 2A Class III Landfill Construction submersible leachate collection pumps, including but not limited to pumps, motors, retrieval cables, junction boxes, transducers, flow sensors, controls, instrumentation, and other appurtenances as shown on the Drawings and specified in this Section and other applicable sections. Three pumps shall be provided with two pumps installed and one spare.
- B. The Contractor shall furnish controls, instrumentation, conduit, wiring, appurtenances, and all labor for the complete electrical installation of the submersible leachate collection pumps as shown on the Drawings and specified in this Section and other applicable Sections.
- C. The pump supplier shall be responsible for overall supply and quality of these items and shall be responsible for testing, start-up, troubleshooting, Operations and Maintenance (O&M) Manuals, and personnel training for the submersible leachate collection pumps.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Shop Drawings: The Contractor shall submit integrated shop drawings for the pumping systems at each of the three pump stations illustrating the mechanical and electrical equipment and components specified in this Section and including the following:
 - 1. Product Data: For each mechanical and electrical component include the manufacturer's descriptive literature, product specifications, published details, technical bulletins, performance, and capacity-rating curves with primary and secondary design conditions clearly noted, charts, and schedules, catalog data sheets, and other submittal materials as required to

verify that the proposed products conform to the quality and function of the specified products.

- a. Identification: Clearly indicate by an arrow on submissions covering more than one product type or style exactly which product is being submitted for approval.
 - b. Equipment Characteristics: Provide bearing ratings, complete motor data, service factors, and weights of principal parts and assembled equipment.
 - c. Manufacturer: Include the catalog name, company name, address, and telephone number for each product submitted.
 - d. Full description and schematic of mechanical seal design, operation and protection devices, including oil lifter design and operation. A mechanical seal oil lifter must be included in the seal design.
 - e. Full description and schematic of motor cable entrance. Must indicate anti-wicking device as well as cable strain relief design.
2. Equipment Drawings: Submit completely dimensioned plan, elevations, and cross-sections of system equipment and sub-assemblies. Comprehensive two-dimensional CAD drawing of the pump stations control panel exterior as viewed from the front and side. Submittal shall also include complete control panel interior layout showing location of panel component parts as well as full electrical schematic of control panel operation and associated ladder logic diagrams.
3. Layout Drawing: Submit completely dimensioned drawing of a riser pump assembly that includes pump wheel/skid details, pump discharge and riser connections and materials, installation notes, and other pertinent details.
4. Product List: Provide a list of equipment and components on each drawing with each product identified by legend reference. Include product name, manufacturer, and model number. The Contractor shall submit a complete list of materials and equipment to be incorporated in the control panel. The list shall include catalog numbers, cut sheets, diagrams, and other descriptive data required to demonstrate conformance with the Specifications. Partial lists shall not be acceptable. The basis of acceptance shall be the manufacturer's published ratings for the equipment. The manufacturer shall be regularly engaged in the manufacture of products specified.
5. Additional Requirements: See Division 16, Electrical, for additional submittal requirements for the control panels furnished under this Section and specified below.

- B. The Contractor shall submit written certification from the pump supplier that the riser size and layout are acceptable for the pump installation.
- C. Pump Test Report: Submit certified copies of factory-run pump performance test curves. Factory certified performance test curves shall indicate the following:
 - 1. Flow in gallons per minute.
 - 2. Pressure in feet of water.
 - 3. Horsepower.
 - 4. Pump efficiency.
 - 5. Pump data:
 - a. Model number.
 - b. Serial number.
 - c. Impeller diameter and type.
 - d. Impeller speed.
 - 6. Test condition data:
 - a. Date of test.
 - b. Mean water temperature.
- D. Operating Instruction: For the pump furnished under this Section, the Contractor shall submit operation and maintenance manuals. At a minimum these manuals shall include:
 - 1. General—Equipment function, description, normal and limiting operating characteristics.
 - 2. Installation instructions.
 - 3. Operation instructions—start-up procedure, normal operating conditions, and emergency and normal shut-down procedures.
 - 4. Lubrication and maintenance instructions.
 - 5. Troubleshooting guide.
 - 6. Suggested parts that should be held on site as spares that are mandatory.
 - 7. Drawings—Cross-sectional views, assembly and wiring diagrams.
 - 8. Pump performance curves.
- E. Factory Performance Test Data: A qualified technician shall be provided for 1 day to instruct representatives of the Owner and the Engineer on proper operation and

maintenance. With the permission of the Engineer, this work may be conducted in conjunction with the inspection of the installation and system start up per Part 3 of this Section. If during start up there is an equipment failure due to the pump manufacturers design or fabrication of the equipment, additional services shall be provided at no additional cost to the Owner. System start up shall be completed by a factory technician. This technician should be a direct employee of the manufacturer who has had first-hand dealings with the equipment through its production at the factory.

- F. Certifications: The Contractor shall furnish the Consultant with a written certification signed by the manufacturer that the equipment has been properly installed and is free from stress imposed by piping or mounting bolts. The form should indicate that all equipment has been operated without fault under load conditions and that satisfactory operation has been obtained.
- G. Warranty: Submittals shall include manufacturer's warranty that is in accordance with Article 1.05, Warranties, of this Section and Section 01780, Warranties and Bonds.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American National Standards Institute (ANSI)
 - 1. ANSI C2—National Electrical Safety Code (NESC).
 - 2. ANSI C62.41—Guide on Surge Voltages in AC Power Circuits Rated up to 600V.
 - 3. ANSI C62.45—Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and less) AC Power Circuits.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A48—Standard Specification for Gray Iron Castings.
- C. Federal Specifications and Standards (FSS)
 - 1. FSS W-C-596G(2)—Connector, Electrical Power (General Specification).
 - 2. FSS W-P-115C—Panel, Power Distribution.

- D. Hydraulic Institute (HI)
 - 1. HI-01—Standards for Centrifugal, Rotary and Reciprocating Pumps.
- E. Institute of Electrical and Electronics Engineers (IEEE)
 - 1. IEEE 112—Standard Test Procedure for Polyphase Induction Motors and Generators.
 - 2. IEEE 117—Standard Test Procedure for Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery.
- F. International Standards Organization (ISO)
 - 1. ISO 5199—Technical Specifications for Centrifugal Pumps, Class II.
 - 2. ISO 7005-2—Metallic Flanges Part 2: Cast Iron Flanges.
- G. National Electrical Manufacturer's Association (NEMA)
 - 1. NEMA ICS 1—Industrial Control and Systems: General Requirements.
 - 2. NEMA ICS 6—Industrial Controls and Systems: Enclosures.
 - 3. NEMA MG 1—Motors and Generators.
 - 4. NEMA PB 1—Panelboards.
 - 5. NEMA ST 20—Dry-Type Transformers for General Applications.
 - 6. NEMA WD 1—General Color Requirements for Wiring Devices.
- H. National Fire Protection Association (NFPA)
 - 1. NFPA 70—National Electrical Code (NEC).
 - 2. NFPA 79—Electrical Standard for Industrial Machinery.
 - 3. NFPA 101—Life Safety Code.
- I. Underwriters Laboratories (UL)
 - 1. UL 50—Enclosures for Electrical Equipment.
 - 2. UL 67—Panelboards.
 - 3. UL 83—Thermoplastic-Insulated Wires and Cables.
 - 4. UL 467—Grounding and Bonding Equipment.
 - 5. UL 508—Industrial Control Equipment.
 - 6. UL508A—Industrial Control Panel.
 - 7. UL 698A—Standard for Safety Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.04 QUALITY ASSURANCE

- A. Unit Responsibility: The pumps shall be supplied by the pump supplier. The pump supplier shall have experience in providing equipment for leachate removal.
- B. Factory Tests: The pump supplier shall perform the following tests on each pump before shipment from the factory.
 - 1. Pump performance test.
 - 2. Megger the pump to check for insulation breaks or moisture.
- C. Each submittal for equipment, components, or system components shall be accompanied by an *Equipment Warranty and Certification Form*. The form shall be duly executed by an authorized principal of the manufacturer warranting and certifying that the equipment and system components proposed meet or exceed the Specifications, are suitable for their intended purpose, and will provide satisfactory performance at the design criteria specified. If the manufacturer is not the supplier, an authorized principal of the supplier shall also execute the Equipment Warranty and Certification Form.

1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.
- B. All work, equipment, and materials furnished and installed shall be warranted against defective design, materials, and workmanship for 2 years. The warranty period shall begin at the date of Substantial Completion.
- C. The warranty shall cover replacement equipment materials, parts, and/or repair, including labor, travel time, shipping costs, and other miscellaneous expenses, at no additional cost to the Owner for the full warranty period.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, and this Section for storing and protecting the items specified in this Section.
- B. The Contractor shall deliver a complete system including all parts listed in the submittal sent to the Engineer.
- C. Store in a weather-tight building or suitable covering to protect against damage of any nature.

1.07 QUALIFICATIONS

- A. The manufacturer(s) of the equipment specified shall meet the following requirements:
 - 1. Shall have been in business for at least 10 years before the Bid Date.
 - 2. Shall have a record of operating, manufacturing, and servicing the types of items specified for a minimum of 10 years before the Bid Date.
 - 3. Shall have a minimum of five installations of equipment similar to and meeting the requirements specified in this Section at landfills in Florida before the Bid Date.

1.08 TESTING REQUIREMENTS

- A. Testing shall be performed as specified in Part 3 of this Section.

1.09 OPERATIONS AND MAINTENANCE (O&M) MANUALS

O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals, and shall include the following:

- A. Installation instructions.
- B. Functional description of the pumping control system for each mode of operation of equipment.
- C. Automatic and manual operation.
- D. Alarms and fail-safe features.
- E. Interlocked and/or interfaced equipment operation and control.
- F. Exploded view drawings and illustrations with descriptions for assembly and disassembly of equipment.
- G. Comprehensive parts and materials maintenance and repair list for each equipment element indicating the manufacturer and the manufacturer's identification number. Include name, address, and telephone number of local sales and service office for major equipment items.
- H. Schedules of recommended spare parts to be stocked, including part number, inventory quantity, and ordering information.

- I. Performance rating and nameplate data for each major system component.
- J. Procedures for starting, operating, adjusting, calibrating, testing, and shutting down system equipment.
- K. Emergency operating instructions and trouble-shooting guide.
- L. Schedule of routine maintenance requirements and procedures, and preventative maintenance instructions required to ensure satisfactory performance and equipment longevity.
- M. Maintenance instructions for extended out-of-service periods.
- N. Field-verified power and control wiring schematics. Submit the approved schematics in each manual. After initial start-up and operation, correct these schematics to reflect any required field changes and submit the required copies for inclusion in the manuals.
- O. Preliminary copies of the O&M manuals shall be submitted to the Engineer before arrival of the equipment to the site in accordance with Section 01830, Operations and Maintenance Manuals. The Contractor shall not be compensated for the pumping equipment until the Engineer receives the preliminary O&M manuals. Copies of the final O&M manuals shall incorporate the Engineer's comments and be submitted with copies of the approved shop drawings and test reports in accordance with Section 01830, Operations and Maintenance Manuals.
- P. Installation Certificate: Submit a certificate from the manufacturer or from the manufacturer's qualified, factory-authorized representative for each pump furnished and installed and specified in this Section, stating that the installed equipment has been installed, inspected, and adjusted as required in accordance with the manufacturer's written installation procedures and operating instructions and is ready for acceptance by the Engineer.

PART 2 PRODUCTS

2.01 MANUFACTURER OF PUMPING SYSTEM, INCLUDING CONTROL PANELS AND COMPONENTS

- A. Interstitial pumping system, including sensors and control panels, shall be designed and supplied by Tsurumi Pump, Inc., and/or approved equal.

- B. Other suppliers seeking to furnish products must obtain 10 days prior approval and demonstrate that they are able to furnish products equal to Tsurumi Pump.
 - 1. UL approved control panel must be factory tested with pumps and operating sensors.
- C. Materials and equipment shall conform to the referenced publications or as specified and indicated and shall be the products of manufacturers regularly engaged in the manufacture of such products.

2.02 SUMMARY OF PUMPS

The pumps shall be the following or Engineer-approved equal:

A. Leachate Collection Submersible Risers Pumps

1. Pumped Liquid Characteristics

a.	Liquid	Class I Landfill Leachate
b.	Temperature Range	18 to 30°C
c.	pH range	6 to 8.5
d.	Solids Content	Some abrasive grit and fine sand

2. Pump Characteristics

a.	Number of pumps:	3 total – one install per riser and one uninstalled spare
b.	Primary Design Condition (each)	30 gpm @ 90 feet total dynamic head (TDH)
c.	Secondary Design Condition (each)	90 gpm @ 55 feet TDH
d.	Shut-Off Head	100 feet
e.	Solids Handling Size	0.33 inch
f.	Configuration	Sled or wheel-mounted
g.	Discharge Size	2-inch National Pipe Thread (NPT)
h.	Motor Horsepower	3.0 horsepower (HP)
i.	Electrical Service:	460-volt (V), 600-hertz (Hz), three-phase

3. Acceptable Manufacturers

- a. Tsurumi Model KTZ22.2-61. Two pumps shall be installed in the leachate collection risers, one per riser. One pump shall be provided to the Owner as a spare.
- b. Engineer-approved equal.

2.03 SUBMERSIBLE PUMPS

A. The Contractor shall furnish and install complete pumping systems at the pump station.

1. Two leachate collection pumps and one spare pump.

B. Construction of major parts of the pumping unit(s) shall be as follows:

1. Pump casing shall be gray cast iron, ASTM A48 Class 30B.
2. Motor frame shall be gray cast iron, ASTM A48 Class 25B.
3. Field adjustable/replaceable, wear plate shall be ductile cast iron.
4. Impellers shall be of the multi-vane semi-open design and shall be high chrome cast iron.
5. Impellers shall be equipped with back pump out vanes, slip fit to the shaft and key driven.
6. Internal and external surfaces coming into contact with the leachate shall be protected by a fused polymer coating.
7. All exposed fasteners shall be stainless steel.
8. All units shall be furnished with 2-inch NPT discharge connector.

C. Mechanical Seals

1. All units shall be furnished with a dual inside mechanical shaft seal located completely out of the pumpage, running in a separate oil-filled chamber, and further protected by an exclusionary oil seal located between the bottom seal faces and the fluid being pumped.
2. The oil chamber shall be fitted with a device that shall provide positive lubrication of the top mechanical seal (down to one-third of the standard oil level). The device shall not consume any additional electrical power.
3. Mechanical seals shall rated to preclude the incursion of water up to 42.6 pounds per square inch (psi) (98.4 feet) submergence.
4. Units shall have silicon carbide mechanical seal faces.
5. Mechanical seal hardware shall be stainless steel.

D. Power Cable and Cable Entrance

1. Units up to 3 HP shall be supplied with a cable entrance that incorporates built-in strain relief, a one-piece, three-way mechanical compression seal, and a fatigue-reducing cable boot.
2. The pump power cable shall be suitable for submersible pump applications.
3. The cable entrance assembly shall contain an anti-wicking block to eliminate water incursion into the motor due to capillary wicking if the power cable is accidentally damaged.

E. Each pumping system shall include level sensors (transducers), retrieval cables, breakout boxes, and control panel. Retrieval cables shall be of sufficient strength (a minimum of 3/16 inch diameter), made of Type 316 stainless steel and of sufficient length to secure pump at the top of the riser pipe while the pump is in operating position at the sump bottom. The Contractor shall confirm length. The submersible pressure transmitter level sensor shall have adequate range of operation with a 4-20MA output signal. The transmitter shall be constructed with a stainless steel body, stainless steel diaphragm, and Viton seals. The signal cable must be vented and chemical resistant. The transmitter circuit must be protected by intrinsically safe barriers by the Contractor.

F. The Contractor shall furnish junction boxes as shown on the drawings. Enclosures shall be NEMA 7 and suitable for hazardous locations. Furnish and provide a complete discharge piping assembly to connect the pump to the existing piping as shown on the plans.

G. The submersible pumps shall be capable of handling raw leachate.

H. The pump must be capable of ingesting and passing at least 1/8 inch solids without damaging the pump or causing a reduction in pump flow/head performance. Solids include but are not limited to silt, sand, sediment, high-density polyethylene (HDPE) shavings and rock particles.

I. The pump shall include a motor cable entrance with an anti-wicking block created by a break in the power cable insulation to prevent liquid migration into the motor housing in the event that the power cable is damaged. Power cable shall be of sufficient length to connect to the junction box mounted at the top of the riser when the pump is in operating position at the sump bottom. The Contractor shall confirm length.

J. All materials coming in contact with leachate shall be Type 304 stainless steel, Teflon, Viton, or E-Glide.

- K. The pump shall permit the unit to "pump down" to within 8 inches to 10 inches of the sump bottom without any loss of performance or damage to the pump.
- L. External "priming" shall not be required.
- M. The motor and any seals (including mechanical seals) shall not require the use of oil or grease for lubrication.
- N. The pump shall be fabricated for use in a riser pipe application. The pumping unit shall be able to slide down the riser pipe and negotiate bends without hanging up on seams or any riser pipe imperfections. The pumps shall be horizontal submersible pumps.
- O. No built-in check valve inside the pump will be permitted. Check valves shall be located on the discharge hose assembly and easily accessible for maintenance. If a check valve is to be located at the pump discharge, the valve should be bored with a 3/16-inch bleed hole that will allow the discharge line to be emptied before removing the pump for maintenance.
- P. Pump and motor assemblies shall be spark free and suitable for a Class I Division I environment.
- Q. Pump shall operate off 460V/three-phase/60-hz electric service.
- R. All hose fittings shall be Type 316 stainless steel and shall be suitable for the application. All hose bands shall be hi-torque Type 316 stainless construction.

2.04 MOTOR

- A. The motor and its integral protective controls shall be suitable for use in a Class I, Division 1, Group D area.
- B. The pump motor(s) shall be:
 - 1. 3 HP, 2.2 kilowatt (kW), 460V, 60 Hz, three-phase and shall be NEMA MG 1, Design Type B, equivalent.
 - 2. Motor(s) shall be rated at 4.5 full load amps.
 - 3. Motor(s) shall have a 1.15 service factor and shall be rated for 20 starts per hour.
 - 4. Motor(s) shall be air filled, copper wound, Class F insulated with built-in thermal and over-amperage protection for each winding.
 - 5. Motor shaft shall be Type 420 stainless steel, fitted with a replaceable Type 304 stainless steel shaft sleeve and shall be supported by two

- permanently lubricated, high temperature ball bearings with a B-10 life rating at best efficiency point of 60,000 hours.
6. Bearings on all units shall be single row, double shielded, C3, deep groove type ball bearing.
 7. Motors shall be suitable for across the line start or variable speed applications using a properly sized variable frequency drive.
 8. The motors shall have hermetically sealed windings.
- C. The power cable shall be of sufficient length to connect to the electrical explosion-proof junction box at the top of the HDPE riser when the pump is in operating position at the sump bottom. No cable splices within the HDPE riser will be permitted. The Contractor shall confirm actual cable length required in the field before pump is delivered.
- D. The motor shall not require the use of oil or grease for lubrication.
- E. The motor shall have a Kingsbury type thrust bearing capable of handling the maximum thrust load of the pump.
- F. The motor pressure equalizing diaphragm assembly shall be Viton.

2.05 CONTROL PANEL

- A. The Leachate Pump Station Control Panel (PCP) shall be provided by the pump manufacturer.
- B. The PCP shall provide local and automatic pump station control functions and monitor local statuses.
- C. Pump cable shall be sized and furnished by the pump manufacturer in accordance with IPECA.
- D. As a minimum, the PCP shall incorporate the following features:
1. The pump control panel enclosure shall be gasketed NEMA 4X stainless steel fitted with a three-point lockable latch and dead front panel. The enclosure shall include a UV resistant Lexan viewing window to allow the operators to view the components mounted on the dead front without the need to open the cabinet. No controls shall be mounted on the face of the enclosure.
 2. On-Board 12-button operator interface keypad and 4x20-character LCD display. Configuration parameters shall be adjustable via the 12-button operator interface keypad or required RS-232 service port.

3. The LCD display shall provide the elapsed runtime of each pump, the average runtime of each pump, and the time of day.
4. The pump control shall be configured for duplex operation for the leachate collection pumps and simplex operation for the Leachate Detection pump via the on-board keypad.
5. Three elapsed time meters and three time delay relays for 0 to 180 seconds.
6. Three on-board HOA switches (one for each pump). Local-manual-control provided by the HOA switches. Each HOA switch shall be fail-safe and operate in the OFF and HAND position without power applied to the PCP.
7. Integrated pump alternation. The pump alternation function will operate based on the number of pumps configured. Automatic alternation around non-operational pumps shall be provided.
8. Pumps/Starter/Breaker Fault alarms. These alarms shall be activated when a pump is called to run, but fails to run, or if the pump is turned off by the pump controller but continues to run.
9. Multiple level control input options. The PCP shall provide local automatic level control from the transducer. Redundancy of level inputs shall be supported.
10. On-board 480 VAC three-phase-power monitor and motor protection. The phase monitor shall be transformer-isolated and detect loss of phase, phase reversal, low phase and high phase faults. All phase monitor adjustments shall be adjustable from the phase monitor's operator keypad. The power-monitoring function shall provide inputs to the control system identifying operating currents outside preset levels and providing alarms.
11. Phase voltages from phase A to B, B to C, and from phase A to C shall be displayed locally.
12. Integrated Alarm Light output and Alarm Horn output, each capable of driving 120 VAC loads to 1/2 amp. An input shall be supplied for external alarm silence button, which shall be used to silence the Alarm Horn. Interposing relays for the light and horn terminations shall be provided and installed by the PCP supplier.
13. All inputs and outputs shall be optically or magnetically isolated and surge suppressed.
14. A local RS-232 service port shall provide local access for a programming unit or portable computer to monitor and/or configure all the functions of the PCP.
15. The PCP shall be easily removed/replaced.
16. Supply voltage to the power supply shall be 120 VAC and shall be derived from the PCP via an onboard provided dry transformer.
17. The transient voltage surge suppresser (TVSS) shall be installed on the load side of the main circuit breaker in the PCP. The transient voltage surge suppresser shall be manufactured by Advance Protection

Technologies, or approved equal, which is suitable for a 480V, three-phase, secondary power source.

- E. As a minimum, the PCP local operator interface terminal shall indicate the following process control parameters.

1. Process Control Parameters

- a. The following points shall be monitored at the PCP for each pump station:

- (1) Leachate Collection Pump 1 Status.
- (2) Leachate Collection Pump 1 Start Fault.
- (3) Leachate Collection Pump 2 Status.
- (4) Leachate Collection Pump 2 Start Fault.
- (5) Leachate Collection Pump 1 HOA in AUTO.
- (6) Leachate Collection Pump 2 HOA in AUTO.
- (7) Leachate Collection 1 Well Level Transducer (4-20 mA).
- (8) Leachate Collection 1 Well Level Transducer Fault.
- (9) Leachate Collection 2 Well Level Transducer (4-20 mA).
- (10) Leachate Collection 2 Well Level Transducer Fault.
- (11) Leachate Collection 1 Flow Meter Input (4-20mA).
- (12) Leachate Collection 2 Flow Meter Input (4-20mA).
- (13) Phase Voltage Fault.
- (14) Phase Sequence Fault.
- (15) Phase AB Voltage.
- (16) Phase AC Voltage.
- (17) PCP Controller Fault.
- (18) AC Power current outside of range or Fault for each of the pumps. An overall AC Power Fault shall also be provided.
- (19) Alarm Horn Status.
- (20) Alarm Light Status.
- (21) RS-485 Serial Modbus Interface (for current monitoring) connected to phase monitor.

- F. The pump controller shall automatically control each pump based on level settings when the associated pump's HOA is in the Auto position. Automatic control functions shall be disabled when the pump's HOA switch is in the "Off" or "Hand" position.

- G. No-flow protective logic for all sump pumps.

1. Using coordination through the externally mounted flow transmitters, through the user interface, the Owner shall have the ability to set the

- “pump no-flow setting”, the “pump no-flow delay time”, and the “pump no-flow retry time”.
2. If the pump is running and the measured flow rate does not exceed the “pump no-flow setting” within the “pump no flow delay time”, the pump shall be stopped.
 3. After stopping a pump for a no-flow condition, the controller shall wait for the “pump no-flow retry time” and then try running the pump again. If flow rate is detected, then automatic operation will continue. If flow is not detected, then the retry process described above shall continue. After the third failed retry process, a fault will be issued and an alarm sounded.
 4. If the Owner sets the “pump no-flow setting” to zero, the no-flow protective logic shall be disabled. This will allow the Owner to continue running the pump in the event that the flowmeter is faulted.

H. Low-Current protective logic (as a proxy for no-flow) for all sump pumps.

1. Through the user interface, the Owner shall have the ability to set the “pump low-current setting”, the “pump low-current delay time” and the “pump no flow retry time”.
2. If the pump is running and the pump motor current does not exceed the “pump low-current setting” within the “pump low-current delay time”, the pump shall be stopped.
3. After stopping a pump for a Low-Current condition, the controller will wait for the “pump low-current retry time” and then try to run the pump again. If current is normal, automatic operation shall continue in accordance with the standard control sequence. If the current is still below the “pump low-current setting” then the retry process described above will continue. After the third failed retry process, a fault will be issued and an alarm sounded.
4. If the Owner sets the “pump low-current setting” to zero, the Low-Current protective logic will be disabled. This will allow the customer to continue running the pump in the event that the current transducer is faulted.

2.06 LEVEL TRANSDUCER

- A. Submersible transducers with adequately sized cable shall be provided for the collection sump and the detection sump.
- B. For each pump station, one level transducer shall be used for controlling each of the two leachate collection pumps in two interconnected side slope riser sumps. The transducer attached to the lead pump shall normally be the active transducer. The active transducer shall alternate with the lead and lag pumps unless one of the transducers is out of service. The transducers shall be constructed of 300 Series stainless steel and shall be mounted to the pump carriage. Transducers shall

provide a 4 to 20 mA output signal and come equipped with built-in surge protection. Static accuracy shall be no less than 1.0%.

- C. A properly sized sensor cable suitable for leachate service shall be provided in a length suitable for the application, field trimmed by the installing contractor. No cable splices will be permitted within the sump or riser for any reason. The vent tube required for these transducers shall terminate within the NEMA 7 junction box and shall include a desiccant reservoir.
- D. A submersible pressure transducer system shall be provided. Air bubbler systems are not acceptable.

2.07 FLOW METERS AND TRANSMITTERS

- A. Four magnetic flow meters (4-20mA) and four flow transmitters with totalizers used for station flow indication at the pump station shall be provided and installed by the Contractor. Two flow meters shall indicate the leachate collection flow at each pump station.
- B. The flow transmitters shall have an LCD display, which shall provide the instantaneous flow of each pump, the derived flow of the station, the time of day, and the totalized flow.

2.08 PUMP RETRIEVAL CABLE

- A. The retrieval cable shall be supplied by the Contractor and should be a minimum of 3/8 inch diameter, made of stainless steel and of sufficient length to secure pump at the top of the sump when the pump is in operating position at the sump bottom. (Contractor shall confirm length.) All cable retaining hardware shall be made of Type 300 Series stainless steel.
- B. Cable shall be attached to the top of the pump in a secure manner as to facilitate its removal from the riser pipe assembly.

2.09 SPARE PARTS

- A. Parts Stocking Program: The pump supplier shall provide the Owner the following spare parts which should be retained on the landfill site for use as necessary:
 - 1. Spare Power Cable equivalent in length to the installed pump power cables (Includes cable entrance and gland fittings).
 - 2. Spare level transducer with cable equivalent in length to the installed cables.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All materials and equipment shall be installed as shown on the Drawings and as recommended by the manufacturer. All electrical work shall conform to NFPA 70 and the requirements of Division 16, Electrical.

3.02 INSPECTION AND TESTING

- A. Field supervisor: The manufacturer will furnish a suitably qualified technician to inspect the completed installation, make necessary adjustments and instruct operating personnel in the proper care and operation of the equipment, before the final acceptance of the pumping stations. No distributor, representative, or agent acting on behalf of the manufacturer shall be approved to complete start up services. This task must be reviewed and completed by a direct employee of the manufacturer.
- B. Field Test: When the pumping facility is complete and ready for operation, then the station shall be inspected and tested for compliance to the contract documents. Test of equipment shall be made by the Contractor in the presence of the Engineer, electrical sub-Contractor, and equipment manufacturer. The equipment tests shall include, but will not be limited to the following:
 - 1. Pumps and motors: Performance of the pumps shall meet the specified criteria when field tested.
 - 2. Electrical: Readings shall be made of the voltage and amperage draw and recorded on the manufacturers start up form. This form should be kept by the manufacturer, Contractor, and Engineer for future reference.
 - 3. Controls: Control primary elements shall be tested to determine satisfactory performance for starting and stopping at the proper liquid levels. Pump sequence and alarm functions will also be tested.
 - 4. Equipment: Equipment shall be operated to determine that the pump is located in the correct position in the riser assembly. A check will be conducted to ensure that there is no overloading of the pump or any overheating in any of the controls. A check will be conducted for any abnormal vibration that may be evident in the discharge plumbing. Pump will be raised and reset to ensure correct placement in riser pipe.
 - 5. Inspection: An inspection of all mechanical and electrical equipment, controls, piping, valves, fittings, brackets, mountings, seals, conduit, painting, and component features shall be made while the station is being tested to determine performance and compliance with design requirements and the specification.

6. Structure: The stations shall be inspected for performance, structural soundness and water tightness.
7. Repairs, adjustments, and replacement: The Contractor shall make any and all necessary repairs, adjustments and replace any component parts until performance has been demonstrated to the satisfaction of the Consultant. The Contractor shall bear the cost of any repair, adjustment and replacement.
8. The pumps, control panels, flow meters, and breakout boxes shall be supplied by the same supplier. Coordination of manufacturer representatives for the inspection and startup services shall be provided by the supplier.
9. The Contractor shall provide qualified manufacturer's representative(s) for a minimum of one 8-hour day to provide complete instruction of the Owner's personnel in the operation and maintenance of all systems provided in this Section.

END OF SECTION

DIVISION 13
SPECIAL CONSTRUCTION

SECTION 13421 FLOW METERS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall perform all work necessary to furnish, install, commission, test, document, and start up the instrumentation. The Contractor shall provide all materials, labor, equipment, incidentals, and services required for a complete and operational system.

1.02 RELATED WORK

- A. The provisions of all other Sections of the Specifications are fully applicable to this Section as if incorporated in this Section.
- B. The Contractor shall be responsible for coordinating work with the Owner and Subcontractors.

1.03 SUBMITTALS

- A. The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance.

1.04 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM).
- B. American National Standards Institute (ANSI).
- C. National Electrical Manufacturers Association (NEMA).
- D. International Society of Automation (ISA).
- E. Underwriter's Laboratories, Inc. (UL).

1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.

- B. All work, equipment, and materials supplied shall be warranted against defective design, materials, and workmanship for 1 year. The warranty period shall begin at the time of project completion and acceptance by the Owner.
- C. The warranty shall cover replacement equipment and/or repair, including labor, travel time and miscellaneous expenses, at no cost to the Owner for the full warranty period.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. Deliver materials and equipment with the manufacturer's tags and labels and UL labels intact. Deliver packaged material in the manufacturer's original, unopened containers bearing the manufacturer's name, brand, and UL label.
- C. Throughout this Contract the Contractor shall provide suitable protection for materials and equipment against loss or damage and the effects of weather and the construction environment. The Contractor shall be responsible for the condition of materials and equipment until the acceptance of equipment by the Owner.
- D. Before installation, store material and equipment indoors in a dry, clean location. Handle and store to avoid damage. Heat storage areas that contain items subject to corrosion under damp conditions.
- E. Turn off power to panels and equipment and close and cover control panels and equipment during any dusty construction to prevent degrading the operation or service life.
- F. Follow the manufacturer's installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturer's instructions and these Contract Documents, follow the Engineer's decision at no additional cost to the Owner. Keep a copy of the manufacturer's installation instructions on the job site and available for review at all times.
- G. Keep the premises free of waste material or rubbish. Before final inspection and testing and upon completion of the work, remove materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment.
- H. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, and consistency of the original finish.

1.07 RECORD DRAWINGS

- A. Record Drawings shall be submitted in accordance with Section 01785, Record Documents, and this Section.

1.08 OPERATION AND MAINTENANCE (O&M) MANUAL

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.
- B. Before final acceptance of this project, the Contractor shall submit an O&M Manual to the Engineer for all components provided under this Section. The manual shall comply with the following:
 - 1. The literature shall have sufficiently detailed descriptions and figures to facilitate the operation, removal, installation, adjustment, calibration, and maintenance of each component to the printed circuit board level.
 - 2. The manual shall include an updated set of the manufacturer's literature, data sheets, loop descriptions of operations, drawings corrected in accordance with shop drawing review comments and Record Drawing modifications and components parts list.
 - 3. Instructions and parts lists shall have been prepared for the specific equipment furnished.
 - 4. List of suppliers and/or service shops that can provide parts and accessories and equipment repair for the components provided under this Section. The list shall include a contact name, telephone number, and address.

1.09 MANUFACTURER'S LITERATURE

- A. The Contractor shall provide descriptive literature for all equipment provided under this Section. The literature shall include major components, electrical devices, panel materials, panel components, panel paints and colors, mechanical devices, equipment tags, tubing, valves, fittings, fasteners, and appurtenances. This descriptive literature shall include catalog information, external wiring information, dimensional data, and mounting requirements.
- B. Provide data (specification) sheets for all equipment and components. Provide a separate data sheet for each major component. The data sheets shall show the "component name," tag numbers, quantities, specific catalog/ordering numbers, specific features, and special options.

- C. Provide a components parts list with exact and complete (including options and accessories) manufacturer's part number. Group the list by the component name used in these Specifications. Group each component type by tag number used in these Specifications. Components without tag numbers shall be grouped by the manufacturer's part number.
- D. Provide a list of recommended spares, spare parts, and expendables with tag number and part number.
- E. Provide storage requirements for all components provided under this Section.

1.10 CERTIFICATION/DOCUMENTATION

- A. The instrument system supplier(s) shall verify the calibration and operation of all control, instrumentation, and telemetry components and shall present written certification of the operation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The manufacturer(s) and/or supplier(s) shall have regularly engaged in the manufacture of major components and/or assembly or instrumentation and control systems of the type and scope required for this project for a minimum of 5 years.
- B. It is recognized that one manufacturer may not make all the equipment required and specified under this Section. The Contractor shall be responsible for ensuring that the various manufacturers and equipment suppliers' products are coordinated and are compatible so that the equipment performs the specified functions. The Contractor shall ensure that they are fully aware and understand the requirements of the system.

2.02 GENERAL EQUIPMENT REQUIREMENTS

- A. All components and items of equipment that are necessary, whether indicated or not, to affect the required functions and performance shall be provided. In general and unless otherwise noted, corrosion-resistant materials such as Type 316 stainless steel shall be used. Working pressures, spans, and other ratings shall be selected to best fit the application. All like equipment shall be by the same manufacturer.
- B. Whenever any material or product is indicated by patent or proprietary name, by name of manufacturer, or by catalog number, such specifications shall be deemed to be used to establish a standard of quality to expand the description of the

material or product desired. Materials and products equal to the named material or product may be provided unless specifically noted otherwise.

- C. All equipment furnished under this Section shall be new and unused and shall be the standard product of a manufacturer having a minimum of 5 years successful experience in the manufacture of the equipment. Wherever possible, equipment items having the same or similar rated capacity or function shall be identical. Equipment shall be of the manufacturer's latest proven design.
- D. Electrical Transient Protection: All instrumentation shall be equipped with suitable surge-arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines by lightning discharges or by nearby electrical devices.
 - 1. Voltage surge and transient protectors for both power and analog field circuits shall be provided on the field end and destination end of the circuits. All instrument 120-volt power and signal circuits shall be protected by EDCO SLAC Series suppressor.
 - 2. The devices shall be connected to the system ground. The total resistance of the ground circuit from the device to the driven ground rod shall not exceed 0.1 ohm.
- E. Signal Characteristics
 - 1. Analog signals shall be 4-20 mA DC and shall conform to the compatibility requirements of ISA Standard S50.1. Unless otherwise noted, circuits shall be Type 2 two-wire. Transmitters shall have a load-resistance capability conforming to Class L. Transmitters and receivers shall be fully isolated.
 - 2. Discrete signals are two-state logic signals of two types. Control signals shall use 120-VAC sources. Alarm signals that interface directly with an annunciator shall use less than 30-VDC sources. All alarm signals shall be "normally open, close to alarm" isolated contacts rated for 5 amperes at 120 VAC and 2 amperes at 30 VDC.
- F. Environmental Conditions
 - 1. Unconditioned air: 20 °F to 105 °F, 10% to 100% humidity, subject to wash down or rain, corrosive (assume marine salts and H₂S as a minimum), and nonhazardous. Enclosures shall be NEMA 4X.
 - 2. Other conditions as noted or approved.

- G. Nameplates, Name Tags, and Service Legends: All field- and panel-mounted components provided under this Section shall be provided with permanently mounted name tags bearing the entire ISA tag number of the component.
1. Panel-mounted tags shall be engraved plastic. Field-mounted tags shall be stamped 16-gauge Type 316 stainless steel with 3/16-inch-high characters.
 2. Nameplates shall be inscribed to identify the component listed and mounted near a panel-face-mounted instrument.
 3. Service legends shall be integrally mounted on a panel-mounted instrument. Unless otherwise noted, service legends shall be engraved with the functional explanation.
 4. Nameplates and service legends shall be engraved, rigid, laminated plastic plates attached to enclosure with stainless steel screws maintaining NEMA rating of enclosure. Unless otherwise noted, plate color shall be black with 3/16-inch-high white lettering. Panel nameplates shall have 1/2-inch-high lettering.
- H. Power Supplies: Provide DC power supplies as required to power instruments requiring external DC power.
1. Power supplies shall convert 120-VAC power to DC power of the appropriate voltage(s) with sufficient voltage regulation and ripple control to ensure that the instruments being supplied can operate within their required tolerances.
 2. Output overvoltage and overcurrent protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure.
 3. Each power supply shall be provided with a NEMA 1 enclosure for mounting within other enclosures. Power supplies shall be mounted so that dissipated heat does not adversely affect other components.
 - a. Wiring: All electrical wiring and wiring identification shall be in accordance with the applicable requirements of Section 16401, Low-Voltage Electrical Work—General Requirements.

2.03 INSTRUMENTATION

A. Flow Meter

1. Flow Element-Magnetic Meter

a. Tags:

ISA Designation	Line Size (Inches)	Service
FT-1A-1	6	Leachate

- b. Flow element shall be of the electromagnetic type using the pulsed DC-type coil excitation principle with high preamp input impedance. The flow measuring system, consisting of flow element, transmitter, and appurtenances, shall have an overall accuracy of 1% of rate with a 10:1 turndown for all flows resulting from pipe velocities of 1 to 33 feet per second. The system shall operate on 120-volt (10%), 60-Hz power. The unit shall have a zero-stability feature, thereby eliminating the need to stop flow to check zero alignment.
- c. The flow element shall be of watertight, NEMA 4 construction, unless otherwise noted. The meter shall consist of a Type 316 stainless-steel meter tube, 150-pound ANSI carbon steel raised face flanges, Teflon liner, and Type 316 stainless-steel electrodes, unless otherwise noted. Electrodes shall be either flush or bullet-nose type. Meters 4 inches and smaller with Teflon liners shall be wafer-style design. Suitable covers shall be provided for flow element ends to protect the tube liner during shipment. The unit shall be furnished with grounding rings or shall be provided with built-in grounding electrodes.
- d. The integral flow transmitter shall be indicating, both flow rate and totalized flow, with integral indicators and totalizers furnished. The indicators display shall face north. The transmitter output shall be a 4 to 20mA DC signal in linear proportion to flow and shall drive loads with impedances in the range of 0 to 800 ohms without load adjustments for a 24V DC supply. Output span and zero shall be manually adjustable. Both transmitter and primary element shall be powered from the same 120-volt, 60-Hz source.
- e. Sufficient special cable(s) shall be provided for interconnection between the flow element and the transmitter. Cable(s) shall

facilitate both signal and power for the flow element (120-volt, 60-Hz power will be made available at the transmitter).

- f. For each size of flow tube, provide one spool piece with identical laying length and flanges. Provide lifting rings on each spool piece to facilitate the replacement of a flow tube by the spool piece.
- g. Provide an aluminum sunshield and transient surge protection for the incoming 120VAC and DC signals as manufactured by EDCO. Transient surge protection shall be mounted in a NEMA 4X stainless steel enclosure.
- h. The flow meters shall be Siemens Mag 5100 or Engineer approved equal.

PART 3 EXECUTION

3.01 GENERAL

- A. The Contractor shall lay out the work and be responsible for necessary lines, levels, elevations, and measurements. Installations shall comply with the applicable requirements of Section 16401, Low-Voltage Electrical Work—General Requirements. The Drawings indicate the extent and general arrangement of the components. The Contractor shall familiarize himself with work of other trades engaged in the construction. Exact routing of raceways, piping, and locations of equipment may be governed by structural conditions and obstructions. The Contractor shall coordinate the details of equipment shop drawings for connections to equipment furnished by others. This is not to be construed to permit redesigning systems.

3.02 INSTALLATION

- A. The Contractor shall comply with referenced standards, National Electrical Code (NEC), National Electrical Safety Code, local codes, and rules and regulations of local agencies having jurisdiction. The size of conductors, circuit breakers, motor controllers, and protective devices indicated or specified shall meet all requirements of the NEC.

3.03 INSTALLER QUALIFICATIONS

- A. The installer shall be acceptable to the manufacturer and/or supplier of the instrumentation and control systems. The installer shall have a minimum of 5 years of experience installing instrumentation and control systems of a similar type and scope.

3.04 WORKMANSHIP

A. General

1. Install materials and equipment in a workmanlike manner using craftsmen skilled in the particular trade. Provide work which has a neat and finished appearance.
2. Coordinate the work with the Owner, the Engineer, and the work of other trades to avoid conflicts, errors, delays, and unnecessary interference.

3.05 TESTING

A. General: All elements of the instrumentation shall be tested in accordance with Section 11000, General Equipment Requirements, to demonstrate that the total system satisfies all of the requirements of this Specification.

1. All testing materials and equipment shall be provided by the Contractor. Where it is not practical to test with real process variables, the Contractor shall provide a suitable means of simulation. These simulation techniques shall be acceptable to the Engineer.
2. The Contractor shall have an updated set of Drawings and Specifications, a master copy of approved test procedures, and the master copy of current test failures and solutions to test failures.
3. Testing will not to be considered complete until all portions of the test have been approved by the Engineer. Ifs a test or a portion of a test fails to the point where it needs to be rescheduled, the additional testing cost shall be borne by the Contractor.

B. Factory Testing: The components shall be tested with simulated inputs and outputs at the factory. Factory tests shall generally conform to the applicable sections of ISA RP55.1.

3.06 TRAINING

A. Training shall be in accordance with Section 11000, General Equipment Requirements.

END OF SECTION

DIVISION 15
MECHANICAL

SECTION 15055
PIPING SYSTEMS—GENERAL

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Specification describes responsibilities and requirements for Piping Systems including the following:
 - 1. Labor, materials, tools, equipment, and services to be furnished in accordance with the provisions of the Contract Documents. The materials to be used for the piping systems are shown in the Drawings and the Specifications.
 - 2. Coordination of work with other trades.
 - 3. Furnishing and installing all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, although such work is not specifically indicated.
 - 4. Furnishing Record Drawings and documents for piping systems.

1.02 SUBMITTALS

The Contractor shall submit the following in accordance with Section 01330, Submittals and Acceptance:

- A. If the Contractor deviates from the piping layout as shown on the Contract Drawings, the Contractor shall submit scaled piping drawings showing locations and dimensions to and from fittings, valves, equipment, structures, and related appurtenances. Provide scaled drawings to a minimum scale of 1 inch equals 10 feet. Provide details to minimum scale of 1/8 inch equals 1 foot. Elevations shall correspond to reference vertical elevation datum shown or provided for this project.
- B. Copies of any manufacturer's written directions regarding material handling, delivery, storage, and installation.
- C. Record piping drawings shall meet the requirements of Section 01785, Record Documents. During the work, the Contractor shall maintain accurate, up-to-date Record Drawings of piping systems installed in the project, including pre-existing piping discovered, relocated, or at locations other than as originally shown on the Drawings. When the work is completed and accepted by the Engineer, the Contractor shall submit Record Drawings in accordance with Section 01785,

Record Documents. The Contractor shall identify complete location, elevations, and description of piping systems.

- D. Submit copies of forms documenting required field pressure testing work and results.
- E. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.
- F. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.
- G. Support Systems
 - 1. Drawings of each piping system locating each support, guide, and anchor.
 - 2. Identify support, guide, and anchor type by catalog number and shop/contract drawing detail number.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society of Mechanical Engineers (ASME)
 - 1. ASME B1.1—Unified Inch Screw Threads (UN and UNR Thread Forms).
 - 2. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
 - 3. ASME B16.21—Nonmetallic Flat Gaskets for Pipe Flanges.
 - 4. ASME B18.2.1—Square, Hex, Heavy Hex, and Askew Head Bolts, and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).
 - 5. ASME B18.2.2—Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
 - 6. ASME B31.1—Power Piping.
 - 7. ASME B31.3—Process Piping.
 - 8. ASME BPVC—Boiler and Pressure Vessel Code.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A183—Specification for Carbon Steel Track Bolts and Nuts.

2. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 3. ASTM A194/A194M—Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
 4. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 5. ASTM D1330—Standard Specification for Rubber Sheet Gaskets.
 6. ASTM F467—Standard Specification for Nonferrous Nuts for General Use.
- C. American Water Works Association (AWWA)
1. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
1. MSS SP-58—Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
- E. NSF International (NSF)
1. NSF 61—Drinking Water System Components – Health Effects.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. The Contractor shall protect the pipe from kinks, cuts, end damage, and other defects when transporting all piping. Binding and tie-down methods shall not damage or deflect the pipes in any way. Pipe damaged during shipment shall be rejected.
- C. Pipe shall be stored on level ground, preferably turf or sand, free of sharp objects that could damage the pipe. Stacking of any pipe shall be limited to a height that will not cause excessive deformation of the lower layers of pipe under anticipated temperature conditions. When necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such widths to not allow deformation of the pipe at the point of contact with the sleeper or between

supports. Pipe shall not be removed from storage until bedding or sub-grade work is complete and ready to receive the pipe.

- D. The joined pipe shall be handled in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. Ropes, fabric, or rubber-protected slings and straps shall be used when handling pipe. Chains, cables, or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe. Pipe or fittings shall not be dropped. Sections of the pipes with cuts and gouges shall be removed and the ends of the pipe rejoined. In accordance with the pipe manufacturer's written instructions, the Contractor shall repair all pipe with damaged linings and pipe exterior coatings that have been damaged before the pipe is installed.
- E. The Contractor shall cover all pipe stored on the site with canvas or other opaque material to protect it from sunlight. Provide air circulation under the covering.
- F. The Contractor shall inspect all pipe, fittings, and other accessories upon delivery and during the work. Any defective or damaged materials found during field inspection or during tests shall be removed from the site and replaced by, and at the expense of, the Contractor.
- G. The interior of all pipe, fittings, and other accessories shall be kept free from dirt and foreign matter at all times. Fittings shall be drained and stored in a manner that will protect them from damage.
- H. Gaskets shall be placed in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products. Gaskets shall be used on a first-delivered-to-site and first-to-be-installed rotation basis. Mechanical-joint glands, bolts, and washers shall be handled and stored in a manner that will ensure proper use with respect to types and sizes.

1.05 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

1.06 DEFINITIONS OF BURIED, EXPOSED, AND SUBMERGED PIPING

- A. Buried piping is piping buried in soil, beneath a structure and/or encased in concrete. Where an exterior pipe coating is specified to be factory- or field-applied, the Contractor shall provide the coating up to the penetration of a structure. Piping encased in concrete does not require an exterior coating other than what is factory furnished.

- B. Exposed piping is piping in any of the following conditions or locations:
 - 1. Above ground.
- C. Submerged piping is considered to be all piping within side slope riser pipes.

1.07 SYSTEM DESIGN REQUIREMENTS

- A. General
 - 1. The Specifications and Drawings are not all inclusive of explicit piping details.
 - 2. Pressure ratings and materials specified represent minimum acceptable standards for piping systems.
 - 3. Piping Systems: Suitable for the services specified and intended.
- B. Support Systems
 - 1. The absence of pipe supports and details on the Drawings shall not relieve the Contractor of responsibility for sizing and providing supports for this project.
 - 2. Select and design within the specified spans and component requirements.
 - 3. Comply with requirements of MSS SP-58.
 - 4. Criteria for structural design and selection of pipe support system components:
 - a. Dead loads imposed by the weight of the pipes filled with water, within specified spans and component requirements, plus any insulation.
 - b. Safety factor: Minimum of 5.
 - 5. Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor the support, to withstand the shear and pullout loads imposed by loading and spacing on each particular support.
 - a. Supports are shown only where specific types and locations are required; additional pipe supports may be required and are to be provided and installed by the Contractor at no additional cost to the Owner.

C. Adapters

1. No attempt has been made to show all adapters, spool pieces, reducers, bushings, or other fittings required to accommodate the connection of pipes, fittings, and valves of various joint design and sizes throughout the project. The Contractor is completely responsible for providing, at his expense, all adapters, reducers, sleeves, spool pieces, and other fittings and appurtenances necessary for connection of pipe (for the same pipe material of or a transition of pipe materials), valves, fittings, and appurtenances throughout the project, which shall be constructed of appropriate materials, coated and lined to match the materials, coatings, and linings specified for the connected components. All adapters, reducers, sleeves, spool pieces, and other fittings shall be coated and lined in accordance with the specifications for each individual pipe system.

PART 2 PRODUCTS

2.01 PIPING SYSTEM GENERAL REQUIREMENTS SCHEDULE

- A. Unless noted otherwise in the Drawings, piping system materials, fittings, and appurtenances are subject to requirements of the individual Specifications for the piping systems.

2.02 PIPING SCHEDULE

- A. Unless otherwise noted in the Drawings, piping system materials, fittings, and appurtenances are subject to the requirements of the individual Specifications for the piping systems.

2.03 THREAD FORMING FOR STAINLESS STEEL BOLTS

- A. Form threads for stainless steel bolts by rolling, not by cutting or grinding.

2.04 BOLTS AND NUTS FOR FLANGES FOR DUCTILE IRON PIPE FLANGES (NOT USED)

2.05 BOLTS AND NUTS FOR HDPE PIPE FLANGES

- A. Bolts, washers, and nuts for pipe installed outdoors, above and below ground, and in vaults and structures shall be as specified in Section 15146, High-Density Polyethylene (HDPE) Pipe.

2.06 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

- A. Anti-seize thread lubricant shall be applied to the thread portion of all (above grade and below grade) stainless steel bolts (stainless steel tie rods, etc.) during assembly. Anti-seize lubricant shall be chloride free and shall be nongalling NSF approved. Anti-seize thread lubricant shall be Jet-Lube “Nikal,” John Crane “Thred Gard Nickel,” Never-Seez “Pure Nickel Special,” or Permatex “Nickel Anti-Seize.”

2.07 FLANGE GASKETS FOR DUCTILE IRON AND HDPE PIPE

- A. Flange gaskets shall be in accordance with Section 15146, High-Density Polyethylene (HDPE) Pipe.

2.08 DETECTABLE PIPELINE MARKING TAPE

- A. All 1-1/2-inch and larger buried non-metallic piping shall be laid with underground detectable caution tape, 2-inch tape for a maximum of 12-inch depth and 6-inch tape for a maximum of 24-inch depth.

PART 3 EXECUTION

3.01 PREPARATION

- A. Field Alignment
 - 1. The piping shown on the Contract Drawings is generally indicative of the work, with symbols and notations provided for clarity. However, the Contract Drawings are not an exact representation of all conditions involved; therefore, install piping to suit actual field conditions and measurements as approved by the Engineer. No extra compensation will be made for work due to differences between indicated and actual dimensions.
 - 2. The Contractor shall install all adapters, fittings, flanged connections, closures, restrained joints, etc. not specified but necessary for a complete installation acceptable to the Engineer.
 - 3. The Contract Drawings do not indicate all adapters, fittings, spool pieces, supports, and other items required to accommodate the installing and connecting of pipe, fittings, valves, and equipment of various joint designs and sizes. Provide such required items of appropriate designs, materials, coatings, and linings.
 - 4. An extensive network of underground piping, conduit, direct-buried conductors, and related structures of various sizes, materials, alignments, age, and function exist within the project site. Conclusive information

concerning these facilities is not available. Consequently, the design of new piping indicated on the Contract Drawings is approximate. Adjust alignment, fitting, valve, and joint locations as required and as approved by the Engineer to accommodate and protect existing facilities and provide the intended functionality of new piping.

3.02 FIELD LAYOUT AND MODIFICATIONS

- A. Unless directed otherwise, the Contractor shall be responsible for setting construction layout stakes and/or offsets required to complete the designated work. The Contractor shall ensure that those stakes and/or offsets are protected and any re-staking required for any reason including work stoppage shall be included in the bid price and no additional compensation to the Contractor will be made.
- B. The Engineer has the right to make any modifications the Engineer deems necessary due to field conditions, conflicts with other utilities, or to protect other properties.

3.03 PIPE PRODUCTS INSPECTION

- A. The Contractor shall obtain from the pipe manufacturer a certificate of inspection to the effect that the pipe, fittings, gaskets, glands, bolts, and nuts supplied for this Contract have been inspected at the plant and that they meet the requirements of these Specifications. The Contractor shall submit these certificates to the Engineer before installing the pipe materials. The Contractor shall visually inspect all pipe and fittings at delivery and before they are lowered into the trench to be installed. Pipe or fittings that do not conform to these Specifications or have been damaged in any manner will be rejected and the Contractor must remove them immediately. The entire product installation may be rejected when, in the opinion of the Engineer, the methods or quality assurance and uniformity of manufacturer fail to secure acceptable and uniform pipe products or where the materials used produce inferior pipe products.

3.04 REMOVAL OF EXISTING PIPE AND FITTINGS

- A. Pipe specifically identified on the Drawings to be removed or replaced from service shall be physically taken out of the ground. The limits of pipe to be removed shall be specifically called for in the plans or shall be approved in writing by the Engineer. Any other removal not specifically called for shall be approved in writing and shall be considered incidental to construction of other items in the contract and the Contractor will not receive compensation for such work.

- B. When removing pipe, the Contractor shall excavate a trench wide enough to dislodge the pipe from the surrounding soil and long enough to be able to handle the pipe without causing any damage to nearby utilities, structures, or adjacent property.
- C. The removed pipe, fitting, and appurtenances will become the Contractor's property and the Contractor shall be responsible for proper disposal and any required permits for disposal.
- D. Regarding pipe remaining in the ground subsequent to removal of connected pipe or pipe fittings, the remaining buried pipes, openings, and fittings shall be plugged or capped as approved by the Engineer.
- E. Pipe that will be abandoned in place shall be plugged or capped as approved by the Engineer.

3.05 BURIED PIPING AND PIPE FITTINGS

- A. Trenching and backfilling for all pipe and fittings shall also be in accordance with Section 02305, Earthwork for Utilities.
- B. Installation
 - 1. Inspect all piping for defects and remove all lumps or excess coatings before installation. The inside of the mechanical joint and outside of plain-end pipe shall be cleaned before joining pipe. Caution shall be taken to prevent damage to the pipe during lowering into the trench. Remove all foreign matter that has entered the pipe during storage and installation. The Contractor shall cover the pipe ends during installation to prevent debris from entering the pipe. No debris, tools, clothing, or other material shall be placed in the pipe.
 - 2. After being placed in the trench, the pipe shall be brought to the proper line and grade by compacting the approved backfill material under it, except at open ends or otherwise as may be required prior to testing. Joint deflection shall not exceed 75% of the manufacturer's limit.
 - 3. The Contractor shall install temporary water-tight plugs on the pipe ends during the time that the pipe is in the trench but no work is in progress. If there is water in the trench upon beginning work, this plug shall remain in place until the trench has been pumped dry, unless otherwise approved by the Engineer..
 - 4. Buried carbon steel bolts and nuts shall be coated in accordance with System No. 24 as specified in Section 09900, Painting and Coating..
 - 5. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.

6. Restrained plugs or caps shall be inserted into all buried dead end pipes, tees, or crosses. Provide blind flanges for all flanged exposed piping. Restrained plugs and caps installed for pressure testing shall be fully secured and blocked to withstand the test pressure.

3.06 FLANGED JOINTS FOR EXPOSED PIPE AND FITTINGS

- A. When bolting flanged joints, the Contractor shall avoid restraint on the opposite end of the pipe or fitting, which would prevent uniform gasket compression or which would cause unnecessary stress in the flanges. One flange shall be free to move in any direction while the flange bolts are being tightened. Bolts shall be tightened gradually and at a uniform rate to ensure uniform compression of the gasket, in accordance with pipe and fitting manufacturer's recommendations.
- B. Coat threaded portions of stainless steel bolts and nuts with lubricant before assembly.

3.07 PIPING CONNECTIONS TO PUMPS AND OTHER EQUIPMENT

- A. When connecting to pumps and equipment, the Contractor shall ensure that piping stresses are not transmitted to the pump and equipment. All connecting pipe shall be permanently supported and aligned so that accurate matching of bolt holes and uniform contact over the entire surface of pump flanges are obtained before any bolts are installed in the flanges or pipe is threaded into pump and equipment. In addition, pump connection piping shall be free to move parallel to its longitudinal center line while the bolts are being tightened.
 1. Pumps and equipment shall be leveled, aligned, and wedged into a position that will fit the connecting pipe, but shall not be grouted until the initial fitting and alignment of the pump and equipment may be shifted on its foundation if necessary to properly install the connecting pipe. Each pump and piece of equipment shall, however, be grouted before final bolting of the connecting piping.
 2. After final alignment and bolting, the pump and equipment connections shall be tested for applied piping stresses by loosening the flange bolts which, if the piping is properly installed, should result in no movement of the piping relative to the pump or opening of the pump connection joints. If any movement is observed, the piping shall be loosened and re-aligned as required and then the flanges bolted back together. The flange bolts then shall be loosened, and the process repeated until no movement is observed.
 3. All carbon steel bolts and nuts shall be coated with the same exterior coating applied to the piping system.

3.08 ANCHORING AND RESTRAINING

- A. Thrust blocks shall be used in new lines and shall be limited to areas in which a new fitting has been installed in an existing line and field restraining joints are not feasible or when directed by the Engineer.

3.09 FLUSHING, CLEANING, TESTING AND INSPECTION OF PIPING

- A. See Section 15144, Pressure Testing of Piping, for the requirements of pipe flushing, cleaning, pressure testing, and inspection requirements.

3.10 PIPE COLOR CODING

- A. The Contractor shall coordinate with the Engineer to generate a list of acceptable pipe colors for exposed piping systems. Where color-coding is achieved by painting exterior surfaces of the piping systems, painting shall be provided in accordance with Section 09900, Painting and Coating.

END OF SECTION

SECTION 15060 PIPE SUPPORTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section includes requirements for materials and installation of pipe supports, including accessory items such as anchor bolts and screws, and neoprene isolation pads.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Provide line drawings of each piping system to the scale shown on the Drawings, locating each support. Identify each type of support by the manufacturer's catalog number or figure.
- B. Provide installation drawings and manufacturer's catalog information on each type of support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the supports.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. For standards that have been withdrawn, the last version of the document before it was withdrawn. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
 - 2. ASTM A47/A47M—Standard Specification for Ferritic Malleable Iron Castings.
 - 3. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
 - 4. ASTM A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

6. ASTM A276/A276M—Standard Specification for Stainless Steel Bars and Shapes.
7. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
8. ASTM A575—Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
9. ASTM A576—Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
10. ASTM A635/A635M—Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
11. ASTM A1011/A1011M—Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
12. ASTM D256—Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
13. ASTM E84—Standard Test Method for Surface Burning Characteristics of Building Materials.
14. ASTM F593—Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
15. ASTM F594—Standard Specification for Stainless Steel Nuts.

B. American Society of Mechanical Engineers (ASME)

1. ASME B31.1—Power Piping.

C. Manufacturer's Standardization Society (MSS)

1. MSS SP-58—Pipe Hangers and Supports – Materials, Design, Manufacture, Selection, Application, and Installation.
2. MSS SP-69—Pipe Hangers and Supports – Selection and Application.

1.04 QUALITY ASSURANCE

- A. All supports, and appurtenances shall conform to the latest applicable requirements of ASME B31.1, except as supplemented or modified by the requirements of this Section.
- B. All supports, and appurtenances shall be of approved standard design where possible and shall be adequate to maintain the supported load in proper position under all operating conditions. The minimum working factor of safety for all supporting equipment, with the exception of springs, shall be five times the

ultimate tensile strength of the material, assuming 10 feet of water-filled pipe being supported.

- C. All pipe and appurtenances connected to equipment shall be supported so as to prevent any strain being imposed on the equipment. When manufacturers have indicated requirements that piping loads shall not be transmitted to their equipment, the Contractor shall submit certification stating that such requirements have been complied with.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All supports shall be crated, delivered, and uncrated to protect against any damage.
- C. All parts shall be properly protected so that no damage or deterioration shall occur during a prolonged delay from the time of shipment until installation is completed.
- D. Finished iron or steel surfaces not galvanized or painted shall be properly protected to prevent rust and corrosion.

1.06 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

PART 2 PRODUCTS

2.01 GENERAL

- A. Not all pipe supports required are shown on the Drawings. The Contractor shall provide pipe supports for every piping system installed. Support piping by pipe support where it connects to pumps or other mechanical equipment.
- B. The Contractor shall ensure that pipe support components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water) plus valve actuators and any insulation and shall have a minimum safety factor of 5 based on the material's ultimate strength.

- C. All of the equipment specified in this Section is intended to support the various types of pipe and piping systems. The details shown on the Drawings are intended to indicate the generally desired methods of support under normal conditions. The Contractor shall develop final details and any details associated with special conditions not already covered to meet the system conditions specified in the respective Division 15 Pipe Sections.
- D. All pipe shall be supported as required to prevent significant stresses in the pipe material, valves, fittings, and other pipe appurtenances and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact
- E. Supports shall be spaced in accordance with ASME B31.1 except that the maximum unsupported span shall not exceed 10 feet unless otherwise specified in this Section.
- F. Where flexible couplings are required at equipment, the end opposite to the piece of equipment, tank, etc., shall be rigidly supported.
- G. All pipe and appurtenances connected to the equipment shall be supported so as to prevent any strain from being imposed on the equipment or piping system.
- H. All rods, clamps, inserts, anchor bolts, brackets, and components for exterior pipe supports shall be Type 316 stainless steel.
- I. Supports shall be sufficiently close together so that the sag of the pipe is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads between supports.
- J. Pipe supports shall be provided as follows:
 - 1. Cast-iron and ductile-iron piping shall be supported at a maximum support spacing of 10 feet with a minimum of one support per pipe section at the joints.
 - 2. Individually supported HDPE pipes shall be supported as recommended by the manufacturer except that support-spacing shall not exceed 3 feet. Pipe supports shall be provided to minimize lateral forces through valves, both sides of split-type couplings, and sleeve-type couplings and to minimize all pipe forces on pump housings. Pump housings shall not be used to support connecting pipes.
 - 3. Effects of thermal expansion and contraction of the pipe shall be accounted for in the pipe support selection and installation.

- K. Any required pipe support for which the supports specified in this Section are not applicable shall be fabricated or constructed from standard structural steel shapes and concrete and anchor hardware similar to items previously specified in this Section and shall be subject to the approval of the Engineer.

2.02 SUPPORT SYSTEMS

- A. Pipe supports shall be as manufactured by Anvil, Unistrut, Cooper B-Line, Aikinstrut, Superstrut, or equal.
- B. Pipe supports shall comply with MSS SP-58 for the standard types referenced on the Drawings. The Contractor shall construct special supports if detailed in the Drawings.
- C. Pipe supports shall be hot-dipped galvanized according to ASTM A153 carbon steel (ASTM A36, A575, or A576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48). Pipe clamps shall be Type 316 stainless steel as described above.
- D. Offset pipe clamp.
- E. Anvil Figure 103, Cooper B-Line B3148, or equal. Material shall be Type 316 stainless steel unless otherwise noted.

2.03 MISCELLANEOUS PIPE SUPPORTS

- A. Pipe Anchor Chair: Anvil Figure 198 or equal.
- B. One Hole Clamp: Anvil Figure 126 or equal.
- C. Roller Chair: Anvil Figure 175 or equal.

2.04 NEOPRENE ISOLATING SLEEVES FOR METAL PIPE 6 INCHES AND SMALLER

- A. Unistrut P2600, B-Line "Vibrocushion," or equal.

2.05 ANCHOR BOLTS AND SCREWS

- A. Anchor bolts and screws for attaching pipe supports to walls, and slabs shall be Type 316 stainless steel, ASTM A276/A276M or F593. Nuts shall be Type 316 stainless steel, ASTM A194/A194M, Grade 8M, or ASTM F594, Type 316 stainless steel.

PART 3 EXECUTION

3.01 PIPE SUPPORT SPACING FOR SUPPORTS ON TOP OF SLABS OR GRADE

- A. The Contractor shall install pipe supports on horizontal runs at the spacing shown or detailed on the Drawings. Provide supports of the type shown or detailed on the Drawings.

3.02 INSTALLING PIPE SUPPORTS

The Contractor shall do the following:

- A. Provide separate supports at each valve. Provide one support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional supports to relieve eccentric loadings imposed by offset valve actuators.
- B. Provide separate supports at each pipe elbow, tee, or fitting. Provide separate supports on both sides of each nonrigid joint or flexible pipe coupling.
- C. Install leveling bolts beneath support baseplates. Provide 3/4-inch-thick grout pad beneath each base.
- D. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

3.03 INSTALLING STEEL AND FRP CHANNEL FRAMES

- A. The Contractor shall use 1-5/8-inch-high channel frames, unless 3-1/4 inches is needed, to provide clearance from walls. Use multiple back-to-back channels if additional clearance is needed.

3.04 INSTALLING NEOPRENE ISOLATING SLEEVES

- A. The Contractor shall install a sleeve around each metal pipe 6 inches and smaller at the point of bearing or contact with the pipe support.

3.05 PAINTING AND COATING

The Contractor shall do the following regarding painting and coating:

- A. Grind the welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.

- B. Paint the supports as directed by the Engineer.

END OF SECTION

SECTION 15110
MANUAL, CHECK, AND PROCESS VALVES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals required and install complete and ready for operation all valves as shown in the Drawings and as specified in this Section. All valves shall be complete with all necessary manual actuators, valve boxes, extension stems, and floor stands, which are required for proper valve operation and completion of the work.
 - 1. All valves shall be of the sizes shown in the Drawings. All equipment of the same type shall be from one manufacturer, unless authorized in writing by the Engineer.
 - 2. The valves shall include but not be limited to the following:
 - a. Air Valves.
 - b. Ball Valves.
 - c. Check Valves.
 - d. Plug Valves.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Product technical submittal data shall contain the following information and data:
 - 1. Acknowledgment that products submitted meet requirements of standards referenced.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's operation and maintenance manuals.
 - 4. Data of valves, actuators, and accessories:
 - a. Pressure and temperature rating.
 - b. Materials of construction, with ASTM reference and grade.
 - c. Linings and coatings.

- d. Dimensions and weight.
 - e. Flow coefficient.
 - f. Actuators and accessories details.
 - g. Manufacturer's product brochure, cut-sheets, and parts diagrams.
- B. Dimensions and orientation of valve actuators as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.
- C. The following test reports: Performance Tests; Leakage Tests; Hydrostatic Tests; and Proof-of-Design Tests as applicable or required.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing of Materials (ASTM)
 - 1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
 - 2. ASTM A47/A47M—Standard Specification for Ferritic Malleable Iron Castings.
 - 3. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
 - 4. ASTM A105/A105M—Standard Specification for Carbon Steel Forgings for Piping Applications.
 - 5. ASTM A108—Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - 6. ASTM A126—Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 7. ASTM A148/A148M—Standard Specification for Steel Castings, High Strength, for Structural Purposes.
 - 8. ASTM A181/A181M—Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
 - 9. ASTM A182/A182M—Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - 10. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.

11. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
12. ASTM A216/A216M—Standard Specification for Steel Castings, Carbon, Suitable for Fusion-Welding, for High-Temperature Service.
13. ASTM A240/A240M—Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
14. ASTM A269/A269M—Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
15. ASTM A276/A276M—Standard Specification for Stainless Steel Bars and Shapes.
16. ASTM A313/A313M—Standard Specification for Stainless Steel Spring Wire.
17. ASTM A322—Standard Specification for Steel Bars, Alloy, Standard Grades.
18. ASTM A351—Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
19. ASTM A395/A395M—Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
20. ASTM A436—Standard Specification for Austenitic Gray Iron Castings.
21. ASTM A439/A439M—Standard Specification for Austenitic Ductile Iron Castings.
22. ASTM A449—Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
23. ASTM A479/A479M—Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
24. ASTM A494/A494M—Standard Specification for Castings, Nickel and Nickel Alloy.
25. ASTM A516/A516M—Standard Specification for Pressure Vessel Plates, Carbon-Steel, for Moderate- and Lower-Temperature Service.
26. ASTM A536—Standard Specification for Ductile Iron Castings.
27. ASTM A564/A564M—Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
28. ASTM A582/A582M—Standard Specification for Free-Machining Stainless Steel Bars.
29. ASTM A666—Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
30. ASTM A743/A743M—Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
31. ASTM A744/A744M—Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.

32. ASTM A890/A890M—Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application.
33. ASTM B16/B16M—Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
34. ASTM B21/B21M—Standard Specification for Naval Brass Rod, Bar, and Shapes.
35. ASTM B61—Standard Specification for Steam or Valve Bronze Castings.
36. ASTM B62—Standard Specification for Composition Bronze or Ounce Metal Castings.
37. ASTM B98/B98M—Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
38. ASTM B99/B99M—Standard Specification for Copper-Silicon Alloy Wire for General Applications.
39. ASTM B127—Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
40. ASTM B148—Standard Specification for Aluminum-Bronze Sand Castings.
41. ASTM B150/B150M—Standard Specification for Aluminum Bronze Rod, Bar, and Shapes.
42. ASTM B164—Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
43. ASTM B169/B169M—Standard Specification for Aluminum Bronze Sheet, Strip, and Rolled Bar.
44. ASTM B193—Standard Test Method for Resistivity of Electrical Conductor Materials.
45. ASTM B371/B371M—Standard Specification for Copper-Zinc-Silicon Alloy Rod.
46. ASTM B427—Standard Specification for Gear Bronze Alloy Castings.
47. ASTM B443—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip.
48. ASTM B446—Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar.
49. ASTM B462—Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
50. ASTM B463—Standard Specification for UNS N08020 Alloy Plate, Sheet, and Strip.

51. ASTM B472—Standard Specification for Nickel Alloy Billets and Bars for Reforging.
52. ASTM B584—Standard Specification for Copper Alloy Sand Castings for General Applications.
53. ASTM B763/B763M—Standard Specification for Copper Alloy Sand Castings for Valve Applications.
54. ASTM D1248—Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
55. ASTM D1784—Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
56. ASTM D1785—Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
57. ASTM F441/F441M—Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
58. ASTM F467—Standard Specification for Non-Ferrous Nuts for General Use.
59. ASTM F468—Standard Specification for Non-Ferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.

B. American Society of Mechanical Engineers (ASME)

1. ASME B1.20.1—Pipe Threads, General Purpose (Inch).
2. ASME B1.20.7—Hose Coupling Screw Threads (Inch).
3. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
4. ASME B16.5—Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24 Metric/Inch Standard.
5. ASME B16.10—Face-to-Face and End-to-End Dimensions of Valves.
6. ASME B16.11—Forged Fittings, Socket-Welding and Threaded.
7. ASME B16.18—Cast Copper Alloy Solder Joint Pressure Fittings.
8. ASME B16.24—Cast Copper Alloy Pipe Flanges and Flanged Fittings Classes 150, 300, 400, 600, 900, 1500, and 2500.
9. ASME B16.34—Valves – Flanged, Threaded, and Welding End.
10. ASME B16.42—Ductile Iron Pipe Flanges and Flanged Fittings Classes 150 and 300.
11. ASME Section VIII, Pressure Relief Devices.

C. American Society of Safety Engineers (ASSE)

1. ASSE 1011—Performance Requirements for Hose Connection Vacuum Breakers.

D. American Water Works Association (AWWA)

1. AWWA C110/A21.10—Ductile-Iron and Gray-Iron Fittings.
2. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
3. AWWA C115/A21.15—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
4. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).
5. AWWA C500—Metal-Seated Gate Valves for Water Supply Service.
6. AWWA C508—Swing-Check Valves for Waterworks Service, 2-Inch (50 mm) through 24-Inch (600 mm).
7. AWWA C509—Resilient-Seated Gate Valves for Water-Supply Service.
8. AWWA C512—Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service.
9. AWWA C550—Protective Interior Coatings for Valves and Hydrants.
10. AWWA C800—Underground Service Line Valves and Fittings.

E. Fluid Controls Institute (FCI)

1. FCI 70-2—Control Valve Seat Leakage.

F. Manufacturers Standardization Society (MSS)

1. MSS SP-61—Pressure Testing of Valves.
2. MSS SP-108—Resilient-Seated Cast Iron Eccentric Plug Valves.

G. NSF International (NSF)

1. NSF 61—Drinking Water System Components – Health Effects.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storing and protecting the items specified in this Section.
- B. All valves, unless otherwise directed, shall be loaded and unloaded by lifting, and under no circumstances shall valves be dropped, skidded, or rolled. Valves shall not be stacked or placed under pipe, fittings, or other valves in such a manner that damage could result.
- C. Slings, hooks, or tongs used for lifting shall be padded in such a manner as to prevent damage to exterior surface or interior linings and valve components. If

any part of the coating, lining, or components is damaged, the repairs or replacement shall be made by the Contractor at his expense and in a manner satisfactory to the Engineer before attempting to install such valves.

- D. Only new valves will be allowed for installation and shall be stored in a manner to prevent damage and be kept free of dirt, mud, or other debris.

1.05 QUALIFICATIONS

- A. All of the valves shall be products of well-established firms which are fully experienced, reputable, have been selling this product for a minimum of 10 years, and are qualified in the manufacture of the particular product furnished. The valves shall be designed, constructed, and installed in accordance with the requirements and procedures of applicable AWWA standards and shall comply with these Specifications as applicable.

1.06 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

1.07 VALVE TYPE CLASSIFICATIONS

- A. Air Valves (Type 100 series)
 - 1. Type 100: Air-Release Valves for Leachate Services.
- B. Ball Valves (Type 200 series)
 - 1. Type 200: Threaded Bronze Ball Valves, 2 Inches and Smaller.
 - 2. Type 210: Double-Union PVC Ball Valves, 3 Inches and Smaller.
- C. Check Valves (Type 400 series)
 - 1. Type 420: Cast-Iron Swing Check Valves with Outside Lever and Weight, 4 Inches and Larger.
- D. Plug Valves (Type 900 series)
 - 1. Type 902: Eccentric Plug Valves, 4 Inches through 12 Inches.

PART 2 PRODUCTS

2.01 GENERAL

- A. All valves shall be complete with all necessary geared actuators, handwheels, levers, valve bonnets, valve boxes, extension stems, operating nuts, and T-handle wrenches, which are required for proper valve operating and completing of the work included under this Section. Renewable parts including discs, packing, and seats shall be of types specified in this Section and acceptable by valve manufacturer for the intended service. All units shall have the name of the manufacturer and the size of the valve cast on the body or bonnet or shown on a permanently attached stainless-steel plate in raised embossed letters.
- B. Valves and valve operators shall be factory prepared and primed and field finish coated in accordance with Section 09900, Painting and Coating.

2.02 VALVE ACTUATORS

- A. The valve actuator shall be an integral part of a valve. The valve actuator shall be provided, installed, and adjusted by the valve manufacturer. Actuator mounting arrangements shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by the Engineer.
- B. All valves shall open counter-clockwise as viewed from the top. Unless otherwise required by the Engineer, the direction of rotation of the wheel or wrench nut to open each valve shall be to the left (counter-clockwise). Each valve body or actuator shall have the word "Open" cast on it and an arrow indicating the direction to open.
- C. Actuators shall clearly indicate valve position and an adjustable stop shall be provided to set closing torque. All exposed nuts, bolts, and washers shall be AISI Type 304 stainless steel. Unless noted otherwise, valves shall be equipped with the following manual actuators:
 - 1. Exposed Valves 2 to 6 inches: handwheel actuators.
 - 2. Buried Valves 6 inches and smaller: 2-inch-square operating nuts (with valve bonnets, valve boxes, and extension stems as required) and T-handle wrench.
- D. For buried service, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

- E. All buried valves shall have non-rising stems. All buried valves 3 feet below grade or deeper as measured at the valve centerline shall be furnished with an operator stem extension to extend the operating nut within 6 inches from the top of the valve box cover.

2.03 VALVE END CONNECTIONS

- A. Provide valve end connections conforming to connected piping and as shown in the Drawings.
- B. Comply with the following standards:
 - 1. Threaded: ASME B1.20.1.
 - 2. Flanged: ASME B16.1 Class 125 unless other noted or AWWA C207.
 - 3. Mechanical (gland) Type: AWWA C111/A21.11.
- C. Nuts, Bolts, and Washers: Wetted or internal to be bronze or stainless-steel. Exposed to be zinc or cadmium-plated.
- D. Epoxy Interior Coating: Provide epoxy coating for all interiors of ferrous valve body surfaces in accordance with AWWA C550. Coatings shall be NSF-approved for valves in all potable water piping services. Coatings shall not be required for stainless-steel valve interiors.

2.04 VALVE BOXES

- A. All buried valves 2-inch size and larger shall be equipped with a standard cast-iron roadway valve box. Valve boxes shall be of the slip or sliding type with a round lid marked "Leachate". The box shall be designed to prevent transfer of the surface loads directly to the valve or piping. Valve boxes must have a minimum adjustable range of 12 inches and a minimum inner diameter of 6 inches. All valve boxes and lids shall be produced from grey cast-iron conforming to the latest revision of specification for grey iron castings, ASTM A48/A48M, Class 20A-25A. All castings shall be true and free of holes and shall be cleaned in accordance with good foundry practice, chipped and ground as needed to remove fins and rough places on castings. Valve boxes have to be rated to sustain FDOT H-20 loadings and have a minimum depth of 8 inches. The valve box lid shall fit flush in the top of the box without forcing and shall not rock, tip, or rattle.
- B. Provide debris cap.
- C. Valve boxes shall be as manufactured by Tyler Pipe, Geneco, Star Pipe Products, or equal.

2.05 EXTENSION STEMS (NOT USED)

2.06 BOLTS, NUTS, AND GASKETS FOR FLANGED VALVES

- A. Bolts, nuts, and gaskets for flanged valves shall be as described in Section 15055, Piping Systems—General.

2.07 PAINTING AND COATING

- A. Coat metal valves located aboveground or in vaults and as specified in Section 09900, Painting and Coating, System No. 10. Apply the specified prime and finish coat at the place of manufacture. The finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.
- B. Coat buried metal valves at the place of manufacture as specified in Section 09900, Painting and Coating, System No. 21.
- C. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless-steel pieces, as specified in Section 09900, Painting and Coating, System No. 7. Apply lining at the place of manufacture.
- D. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.
- E. Measure the thickness of the valve interior linings as specified in Section 09900, Painting and Coating. Repair areas having insufficient film thickness as specified in Section 09900, Painting and Coating.

2.08 AIR RELEASE VALVES (TYPE 100 SERIES)

- A. General Description
 - 1. All valves shall meet or exceed all applicable provisions of the latest revision of AWWA C512. Design pressure is 150 psig. Valves shall be operable for water temperatures of above freezing to 125°F.
 - 2. All valves shall consist of a float or a float assembly. Valves shall be identified properly in plates attached permanently on the valve body. The body and cover shall be cast-iron ASTM A126, Class B, or ASTM A48/A48M, Class 35. Valves 3 inches and smaller shall have threaded ends. Valves 4 inches and larger shall have flanged ends. Threaded ends shall comply with ASME B1.20.1. Flanges shall comply with ASME B16.1, Class 125. All flanges shall be flat faced.

3. The float shall be Type 304 or 316 Stainless-Steel. For valves with inlet sizes less than 4 inches, the float shall be able to withstand a collapse pressure of 1,000 psig. For inlet sizes 4 inches and larger, the float shall be capable of withstanding collapse pressures of 750 psig. Trim shall be Type 304 or 316 Stainless-Steel. The valve seat shall be of EPDM or other rubber materials applicable to leachate. The valve seat shall be easily removed and replaced in the field.
4. Drain/test ports on all valves with inlet size 1 inch or larger shall have two 1/2-inch NPT minimum plugged ports, one near the bottom of the valve body and the other near the top of the valve. The plug shall be of bronze, ASTM B584, Alloy C83600.

B. Type 100—Air Release Valves for Leachate Services

1. Air valves for leachate service shall have elongated cylindrical chambers. The body shall be ASTM A351 Grade CF8M stainless steel. All valves shall provide the following: 1/2-inch clearance around the float in the chamber, minimum size 1/2-inch isolation valve and quick-disconnect couplings at the valve venting for back-flushing; blowoff port and valve at the bottom of the chamber; and inlet valve at the valve inlet. A back-flushing assembly shall be provided for all valves. The back-flushing assembly shall consist of an inlet shutoff valve, a flush valve, a clear water inlet valve, rubber supply hose, and quick-disconnect couplings. Type 140 valves shall be air-release valves. Valves shall be APCO 450 Series, Val-Matic Model 49ABW, or equal.

2.09 BALL VALVES (TYPE 200 SERIES)

A. Type 200—Threaded Bronze Ball Valves, 2 Inches and Smaller

1. Ball valves 2 inches and smaller shall have bronze (ASTM B62 or ASTM B584, Alloy C83600 or C84400) body and plug ball retainer. Ball and stem shall be Type 316 stainless-steel. Valves shall have screwed ends (ASME B1.20.1), non-blowout stems, reinforced PTFE seats, and have plastic-coated lever operators. Valves shall have a pressure rating of at least 600 psi WOG at a temperature of 150°F. Valves shall be Stockham T-285 Series, Nibco T-585-70 Series, Apollo 70-100 Series.

B. Type 210—Double-Union PVC Ball Valves, 3 Inches and Smaller

1. Unless noted otherwise, ball valves installed in PVC piping systems 3 inches and smaller shall be constructed from polyvinyl chloride (PVC) ASTM D1784, rated to 150 psi minimum from 30° to 120°F, double-union design with two-way blocking capability, socket end connection except

where threaded or flanged-end valves are specifically shown in the Drawings, double EPDM O-ring seals and EPDM backing cushions, PTFE seals, ABS handle, NSF 61 certified. Valves shall be as manufactured by Asahi/America Inc., Quarter-Bloc Ball Valve Series, or approved equal.

2.10 CHECK VALVES (TYPE 400 SERIES)

- A. Type 420—Cast-Iron Swing Check Valves with Outside Lever and Weight, 4 Inches and larger
 - 1. Check valves shall be swing-check type with outside lever and weight and shall permit free flow of sewage forward and provide a positive check against backflow. Check valves shall be designed for a minimum working pressure of 150 psi. The manufacturer's name, initials, or trademark and also the size of the valve, working pressure, and direction of flow shall be directly cast on the body. Swing check valves shall exceed the minimum requirements of AWWA C508 with a heavy-duty body of cast-iron conforming to ASTM A126 Class B with integral flanges, faced and drilled in accordance with ASME B16.1 Class 125. Bolts, nuts, washers, etc., shall be Type 316 stainless-steel. The valve body shall be the full waterway type, designed to provide a net flow not less than the nominal inlet pipe size when swung open no more than 25°. The valve shall have a replaceable stainless-steel body seat and a cast-iron disc faced with a renewable resilient seat ring of rubber and held in place by stainless-steel screws. The disk arm shall be ductile-iron or steel, suspended from and keyed to a stainless-steel shaft, which is completely above the waterway and supported at each end by heavy bronze bushings. The shaft shall rotate freely without the need for external lubrication. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing. Simple O-ring shaft seals are not acceptable. The valve interior shall be painted with epoxy coating by the valve manufacturer in accordance with AWWA C550. The check valve shall be GA Industries, Inc., Figure 220 Lever and Weight or approved equal.

2.11 PLUG VALVES (TYPE 900 SERIES)

- A. Rubber compounds shall have less than 2% volume increase when tested in accordance with ASTM D471 after being immersed in distilled water at a temperature of 73.4°F ±2°F for 70 hours.
- B. Type 902—Eccentric Plug Valves, 4 Inches through 12 Inches
 - 1. Eccentric plug valves 4 inches through 12 inches shall be non-lubricated type. Minimum pressure rating shall be 175 psi. Bodies shall be cast-iron

in accordance with ASTM A126, Class B. Ends shall be flanged, Class 125 in accordance with ASME B16.1. Plugs shall be stainless-steel, cast-iron (ASTM A126, Class B), or ductile-iron (ASTM A536, Grade 65-45-12) with Buna-N facing. Valve body seats shall be Type 304 or 316 stainless-steel or have a raised welded-in overlay at least 1/8-inch thick of not less than 90% nickel. Body cap screws and bolts and nuts shall be Type 316 stainless-steel. Packing shall be butadiene-filled Teflon or approved equal.

2. Manual valves exposed aboveground shall have handwheel operators with the packing gland and shall include a friction collar and memory stop. Buried valves shall have 2-inch square nuts. All eccentric plug valves shall be Clow F-5412 flanged, Val-Matic, or approved equal.

PART 3 EXECUTION

3.01 JOINTS

- A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.
- C. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

3.02 INSTALLING EXPOSED VALVES

- A. Unless otherwise indicated in the Drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical.
- B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.03 INSTALLING BURIED VALVES

- A. Connect the valve, coat the flanges, apply tape wrapping or polyethylene encasement and place and compact the backfill to the height of the valve stem.
- B. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.
- C. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.
- D. Install debris cap as close as possible under the cast-iron cover without interfering with the cover operation. Trim flexible skirt to provide a smooth contact with the interior or the extension pipe.

3.04 FIELD COATING BURIED VALVES

- A. Coat flanges of buried valves and the flanges of the adjacent piping and the bolts and nuts of flanges and mechanical joints, as specified in Section 09900, Painting and Coating, System No. 24.
- B. All buried ductile iron fittings, and valves shall have the appropriate finish applied and be bagged before backfilling. Polyethylene bagging for buried ductile iron fittings, and valves shall be 8 mils thickness minimum polyethylene, manufactured in accordance with ASTM D1238, Type I, Class C, Grade E1.

3.05 VALVE LEAKAGE AND FIELD TESTING

- A. Test valves for leakage at the same time that the connecting pipelines are tested. See Section 15144, Pressure Testing of Piping, for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.
- B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

END OF SECTION

SECTION 15144
PRESSURE TESTING OF PIPING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the hydrostatic, pneumatic, and leakage testing of pressure piping including leachate force mains and pump stations.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. Six copies of the test records to the Engineer upon completion of the testing.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Water Works Association (AWWA)
 - 1. AWWA C600—Installation of Ductile Iron Mains and Their Appurtenances.
 - 2. AWWA C605—Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

1.04 TEST PRESSURES

- A. At a minimum the Contractor shall perform pressure and leakage test at 1.5 times the maximum system pressure or 100 pounds per square inch (psi), whichever is greater (based on the elevation or the lowest point of the section under test and corrected for gauge location).

1.05 TESTING RECORDS

- A. The Contractor shall provide records of each piping installation during the testing. These records shall include the following information:
 - 1. Date and times of test.
 - 2. Identification of process, pipeline, or pipeline section tested or retested.
 - 3. Identification of pipeline material.
 - 4. Identification of pipe specification.
 - 5. Test fluid.
 - 6. Test duration.
- B. Test pressure at low point in process, pipeline, or pipeline section.
- C. Remarks: Leaks identified (type and location), types of repairs, or corrections made.
- D. Certification by Contractor that the leakage rate measured conformed to the Specifications.

1.06 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

PART 2 PRODUCTS

2.01 VENTS AND DRAINS FOR ABOVEGROUND PIPING

- A. The Contractor shall install vents on the high points of aboveground piping, whether shown in the Drawings or not. Provide a valve at each vent or drain point. Valves shall be 3/4 inch for piping 3 inches. Valves shall be ball or gate valves unless otherwise shown on the Drawings. Valves shall be rated for the pressure of the adjacent piping and shall be suitable for use with the adjacent pipe material.

2.02 MANUAL AIR-RELEASE VALVES FOR BURIED PIPING

- A. The Contractor shall provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and, after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

2.03 TEST BULKHEADS

- A. The Contractor shall design and fabricate test bulkheads in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of the code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

2.04 TESTING FLUID

- A. The line shall be slowly filled with water and the specified test pressure shall be maintained in the pipe for the entire test period by means of a pump furnished by the Contractor. Provide accurate means for measuring the quantity of water required to maintain this pressure. The amount of water required is a measure of the leakage.
- B. The Contractor shall be responsible for all costs associated with supplying and disposing of the test water.
- C. The Contractor shall provide back flow prevention control for temporary connections to existing water mains.

2.05 TESTING EQUIPMENT

- A. The Contractor shall provide calibrated pressure gauges, pipes, bulkheads, and pumps to perform the hydrostatic testing. The Contractor shall provide any necessary assistance required for testing.

PART 3 EXECUTION

3.01 TESTING PREPARATION

- A. Pipes shall be in place, backfilled, and anchored before beginning pressure testing.
- B. The Contractor shall conduct pressure tests on exposed and aboveground piping after the piping has been installed and attached to the pipe supports, anchors, expansion joints, valves, and meters.
- C. For buried piping, the pipe may be partially backfilled and the joints left exposed for inspection during an initial leakage test. However, perform the final pressure test after completely backfilling and compacting the trench.

- D. Provide any temporary piping needed to carry the test fluid to the piping that is to be tested. After the test has been completed and demonstrated to comply with the Specifications, disconnect and remove temporary piping. Do not remove exposed vent and drain valves at the high and low points in the tested piping; remove any temporary buried valves and cap the associated outlets. Plug taps or connections to the existing piping from which the test fluid was obtained.
- E. Provide temporary drain lines needed to carry testing fluid away from the pipe being tested. Remove such temporary drain lines after completing the pressure testing.
- F. Before starting the test, the Contractor shall notify the Engineer.

3.02 LENGTH OF TEST SECTION FOR BURIED PIPING

- A. The maximum length of test section for buried pipe of 12 inches or smaller in diameter is 1,000 feet. Provide intermediate test bulkheads where the pipeline length exceeds these limits.

3.03 INITIAL PIPELINE FILLING FOR HYDROSTATIC TESTING

- A. The maximum rate of filling shall not cause the water velocity in the pipeline to exceed 1 foot per second (fps). Filling may be facilitated by removing automatic air valves and releasing air manually.

3.04 TESTING NEW PIPE WHICH CONNECTS TO EXISTING PIPE

- A. Before testing new pipelines that are to be connected to existing pipelines, the Contractor shall isolate the new line from the existing line by test bulkheads, spectacle flanges, or blind flanges. After the new line has been successfully tested, remove test bulkheads or flanges and connect to the existing piping.

3.05 HYDROSTATIC TESTING OF ABOVEGROUND OR EXPOSED PIPING

- A. Open vents at high points of the piping system to purge air while the pipe is being filled with water. Venting during system filling may also be provided by temporarily loosening flanges.
- B. Maintain the test pressure for a minimum of 2 hours. Examine joints, fittings, valves, and connections for leaks. The piping system shall show zero leakage or weeping. Correct leaks and retest until zero leakage is obtained.

3.06 HYDROSTATIC TESTING OF BURIED PIPING

- A. Where any section of the piping contains concrete thrust blocks or encasement, the Contractor shall not make the pressure test until at least 10 days after the concrete has been placed.
- B. Apply and maintain the test pressure by a positive displacement hydraulic force pump.
- C. Maintain the test pressure for the 2 hours by restoring the pressure whenever it decreases by 5 psi.
- D. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage volume for HDPE Pipe is as specified in Article 3.05 of Section 15146, High-Density Polyethylene (HDPE) Pipe.
- E. The leakage test shall be a separate test following the pressure test and shall not be less than 2 hours long. All leaks evident at the surface shall be repaired and leakage eliminated regardless of the total leakage as shown by test. Lines that fail to meet tests shall be repaired and retested as necessary until test requirements are complied with. Defective materials, pipes, valves, and accessories shall be removed and replaced.
- F. Submit plan for testing to the Engineer for review at least 10 days before starting the test.
- G. Any leakage in welded pipes shall be repaired by appropriate welding techniques.
- H. Repair and retest any pipes showing leakage rates greater than that allowed in the criteria above.

3.07 REPETITION OF TEST

- A. If the actual leakage exceeds the allowable leakage, locate and correct the faulty work and repeat the test. Restore the work and all damage resulting from the leak and its repair. Eliminate visible leakage.

3.08 BULKHEAD AND TEST FACILITY REMOVAL

- A. After a satisfactory test, the Contractor shall remove the testing fluid, remove test bulkheads and other test facilities, and restore the pipe coatings/linings.

END OF SECTION

SECTION 15146
HIGH-DENSITY POLYETHYLENE (HDPE) PIPE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. Description: The Contractor shall provide all materials and incidentals, including piping, molded and ductile iron fittings, flanged adapters, flanged joints, mechanical joint adapters, hardware, and appurtenances for the HDPE piping systems shown on the Drawings and the Drawing Process Flow Identification.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance, and Section 15055, Piping Systems—General.

- A. In general, shop drawings and related manufacturer's product certification shall be made in accordance with the General and Special Conditions of the Contract for approval before the manufacturer constructs or fabricates the material. The following items, which require shop drawings, are brought to the Contractor's attention. The list may not include all items for which shop drawing submittals are required to meet the requirements of the project.
1. Detail drawings of all classes of pipe, joints, and fittings.
 2. Detail Drawings of all joints, including manufacturer's certified factory and/or laboratory test reports to confirm thrust-restraint capacities and restraining mechanism application.
 3. Existing piping connection details.
 4. Adapters for connection to mechanical joint valves and ductile iron pipe fittings.
- B. Certification and test reports for the materials, manufacturing, and testing of the types of pipe supplied shall be furnished by the HDPE pipe manufacturer for the manufacturer's own products in accordance with the latest standards of the industry as described in this Section.
- C. Provide a statement in writing from the HDPE pipe manufacturer that the manufacturer is listed with the Plastic Pipe Institute as a qualified extruder for the polyethylene resin to be used in the manufacture of the pipe for this project.
- D. All persons making heat fusion joints shall receive training in the manufacturer's recommended procedures. The Contractor shall maintain records of trained

personnel and certify that training was received not more than 12 months before construction began. Additionally, the Contractor shall have worked on one or more projects involving combined installation of at least 10,000 feet of HDPE butt-fusion-welded pipe and shall provide the Engineer with a written list of HDPE pipeline installation experience, including project location, date, Owner, and personnel assigned and installing on this project.

- E. The pipe manufacturer shall certify in writing that the Contractor is qualified to join, lay, and pull the pipe or representative of the pipe manufacturer shall be onsite to oversee all pipe joining. All costs for the manufacturer's representative shall be paid for by the Contractor.
- F. The Contractor shall provide qualifications of the proposed firm to be used to clean, inspect, and videotape HDPE piping for record purposes. The Contractor shall submit a video record on DVD when the system is complete. The DVD shall be clearly labeled with the video inspection date, pipe starting and ending point, name, address, and phone number of firm performing the videotaping. Each section of pipe that is video inspected shall have a complete dialogue dubbed onto the video recording that at a minimum describes the length of pipe videotaped, the location of pipe videotaped, all welds, any deflections, and other features of interest.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
 - 2. ASTM D3261—Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
 - 3. ASTM D3350—Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 - 4. ASTM D4976—Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
 - 5. ASTM F714—Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter.

B. American Water Works Association (AWWA)

1. AWWA C151/A21.51—Ductile Iron Pipe, Centrifugally Cast, for Water.
2. AWWA C901—Polyethylene (PE) Pressure Pipe and Tubing, 1/2-inch (13 mm) through 3-Inch (76 mm), for Water Service.
3. AWWA C906—Polyethylene (PE) Pressure Pipe and Fittings, 4-Inch through 65-Inch (100 mm Through 1,650 mm), for Waterworks.

C. International Organization for Standardization (ISO)

1. ISO 9001—Quality Management Systems – Requirements.

1.04 QUALITY ASSURANCE

- A. The pipe and fitting manufacturer(s) shall have an established quality-control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rated, and contamination. The cell classification properties of the material shall be certified by the supplier and verified by the manufacturer's quality control.

1.05 TESTING REQUIREMENTS

- A. See Section 15144, Pressure Testing of Piping.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. General

1. All HDPE shall be DriscoPlex PE 3408 HDPE; or approved equal.
2. All HDPE pipe 4 inches in diameter or greater shall have a Ductile Iron Pipe outside diameter, and HDPE pipe 3 inches in diameter and smaller shall be IPS unless otherwise specified or shown in the Drawings.
3. All HDPE piping system components shall be the products of one manufacturer.
4. Pipe and fittings shall be manufactured by an ISO 9001-certified manufacturer.

B. HDPE Pipe

1. HDPE pipe 4 inches in diameter and larger shall conform to material standard ASTM D3350 345434 E cell classification rated as PE 3408 by the Plastics Pipe Institute. Minimum pressure rating shall be in accordance

with Piping Schedule Drawing or as specified in this Section. Minimum pressure rating shall be 100 psi SDR 17 (Standard Dimension Ratio) for pipe sizes greater than 4 inches in diameter. For pipe sizes 3 inches and smaller in diameter, the minimum pressure rating shall be 200 psi SDR 9.

2. The polyethylene compound shall be suitably protected against degradation by ultraviolet light.
3. The maximum allowable hoop stress shall be 800 psi at 73.4°F.
4. The pipe manufacturer shall be listed with the Plastic Pipe Institute as meeting the requirements of the resin manufacturer to manufacture pipe from the resin used.

C. Perforated HDPE Pipe for Leachate Collection and Leak Detection Systems

1. Perforated HDPE pipe shall conform to the requirements specified for HDPE pipe.
2. Perforations shall be drilled into the pipe at the pipe extrusion plant or fabrication shop. Any burrs remaining after drilling shall be removed. Perforations shall be drilled and deburred before the pipe is delivered to the job site. Job site perforation or perforation by the Contractor shall not be permitted.
3. Number of perforations: Pipe perforations shall be 3/8-inch diameter ($\pm 1/16$ inch) with locations and spacings as indicated on the Drawings.

D. Fittings

1. The pipe manufacturer shall mold or fabricate the polyethylene fittings. Butt fusion outlets shall be made to the same outside diameter, wall thickness, and tolerances as the mating pipe. All fittings and custom fabrications shall be fully rated for the same internal pressure as the mating pipe.
 - a. Molded Fittings: Molded fittings shall be manufactured in accordance with ASTM D3261 and shall be so marked. Each production lot of molded fittings shall be subjected to the test required under ASTM D3261. The manufacturer shall submit samples from each molded fitting production lot to x-ray inspection for voids and shall certify that voids were not found.
 - (1) Polyethylene Flange Adapters: Flange adapter shall be made with sufficient throughbore length to be clamped in a butt fusion joining machine without the use of a subend holder. The sealing surface of the flange adapter shall be machined with a series of small V-shaped grooves to restrain the gasket against blow-out. Flange adapters shall

be fitted with ductile-iron backup rings pressure rated equal to or greater than the mating pipe. The Contractor shall provide flat ring-type EPDM gaskets with gasket thickness and hardness as recommended by the pipe manufacturer for use with HDPE flanged joints. Provide carbon steel hardware (bolts, nuts, washers, etc.) conforming to ASTM A307, Grade B for use with the flange adapters assemblies in accordance with the pipe manufacturer's recommendations. Gaskets shall be made from material suitable for exposure to the liquid within the pipe.

- b. Fabricated Fittings: Fabricated fittings shall be made by heat fusion joining specially machined shapes cut from pipe, polyethylene sheet stock, or molded fittings. Fabricated fittings shall be rated for internal pressure service equivalent to the full-service pressure rating of the mating pipe. Pressure de-rated fittings are not acceptable. Directional fittings 16 inches IPS and larger, such as elbows, tees, crosses, etc., shall have a plain end inlet for butt fusion and flanged directional outlets.

2. D.I./HDPE Mechanical Joint Adapters:

- a. The manufacturer of the HDPE pipe shall supply all D.I./HDPE mechanical joint adapters and accessories required to connect plain-end HDPE piping to mechanical joint fittings, valves, and appurtenances.
- b. The D.I./HDPE mechanical joint adapter shall consist of:
 - (1) A molded or fabricated HDPE mechanical joint transition fitting.
 - (2) A Buna-N gasket for a D.I. mechanical joint.
 - (3) A ductile iron mechanical joint backup drive ring.
 - (4) Cor-Ten mechanical joint tee bolts.
 - (5) A stainless-steel sleeve stiffener molded or fabricated within the MJ end of the HDPE mechanical joint adapter fitting.
- c. The D.I./HDPE mechanical joint adapter shall be connected to the HDPE pipe by a heat-fused joint on one end and connected to a ductile iron pipe valve, fitting, or appurtenance with the internally stiffened mechanical joint end.

- d. The tee bolts and backup drive ring shall act as a joint restraint for connections to mechanical joints.
 - e. The HDPE mechanical joint adapter fitting shall be molded or fabricated by the manufacturer of the HDPE pipe. All molded fittings shall be fully pressure rated to match the SDR pipe pressure rating. Fabricated fittings shall be rated for internal pressure service equivalent to the full pressure rating of the mated IPS pipe.
 - f. If rework compounds are required, only those generated in the manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.
 - g. Solvent epoxy cementing and mechanical joining with bolt on wrap-around clamps shall not be used.
3. Ductile-iron fittings connected to SDR 17 HDPE pipe (4 inches and larger) shall be as specified in Section 15155, Ductile Iron Pipe and Fittings.

E. HDPE Pipe Jointing Method

- 1. HDPE pipe shall be jointed by butt fusion in accordance with the pipe manufacturer's directions and only for pipe within one SDR ratio of each other.
- 2. For SDR ratios that are two or more apart (i.e., SDR 21 to SDR 11), the joint shall be made using restrained joints. Same-diameter pipe may be joined by using HDPE flange adapters and backup rings bolted to each other.
- 3. All HDPE pipe joined by butt fusion shall be made from the same class and type of raw material made by the same raw material supplier.
- 4. *Butt fusion* means the butt joining of the pipe by heat fusion aligned faces of the pipe ends (butts) in a suitable apparatus and joining under controlled pressure and alignment.
- 5. The external bead resulting from the butt-fusion process shall be visible and examined for complete butt-fusion 360° around the pipe exterior.
- 6. Short spools of pipe between valves and fittings shall be ductile iron pipe, with all joints restrained for sizes 4 inches and larger. For 2-inch, the spool shall be Schedule 40 Type 304 stainless steel piping or Schedule 80 PVC piping with IP threads stainless steel or PVC fittings and all joints restrained.
- 7. Where approved by the Engineer, the HDPE pipe and fittings may be fused with Electrofusion Couplings, as manufactured by Central Plastics

Company, or approved equal. Technical information must be provided to demonstrate that the fused coupling will not compromise the structural integrity of the HDPE pipe.

2.02 LOCATOR WIRE

- A. All HDPE piping shall be installed with detectable pipeline marking tape for location purposes as specified in Section 15055, Piping Systems—General.

PART 3 EXECUTION

3.01 GENERAL

- A. All polyethylene pipe shall be cut, fabricated, joined, and installed in strict conformance with the pipe manufacturer's recommendations. Joining, laying, and pulling of polyethylene pipe shall be accomplished by personnel experienced in working with HDPE pipe.

3.02 LAYING PIPE

A. Joints

1. All HDPE to HDPE pipe joints shall be joined by heat fusion that produces homogeneous, sealed, leak-tight joints.
2. Restrained mechanical joint adapters shall be provided at tie-ins with valves, ductile iron fittings, and other pipe materials.

B. Butt Fusion Testing

1. The Contractor shall test the first fusion of each day.
2. In testing, the fusion shall be allowed to cool completely and then fusion test straps shall be cut out. The test shall be a minimum of 12 inches or 30 times the wall thickness in length with the fusion in the center and a minimum of 1 inch or 1.5 times the wall thickness in width. Bend the test strap until the ends of the strap touch. The Contractor shall not begin until a fusion test has passed the bent strap test.

C. Pipe Deflection

1. When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the amount of deflection shall not exceed 75% of that recommended by the manufacturer.

D. Pipe Cutting

1. Cutting HDPE butt fusion connections to HDPE pipe, valves, fittings, or closure pieces shall be done in a neat, workmanlike manner without damaging the pipe. Ends shall be cut square and perpendicular to the pipe axis.

3.03 PERFORATED HDPE PIPING INSTALLATION

- A. All sections of perforated HDPE pipe shall be thoroughly cleaned and deburred after perforating and before welding or delivery to the job site to ensure all drill cuttings are removed from the pipe.
- B. Pipe and fittings shall be joined using butt heat-fusion techniques in accordance with the pipe manufacturer's recommendations unless otherwise noted on the Drawings. Heat-fusion weld beads projecting into the interior of the piping on all solid wall and perforated gravity drain HDPE pipe shall be removed so that the internal weld is flush with the interior of the pipe. The joint must be completely cooled before bead removal. The internal bead shall be removed before making the next butt fusion.
- C. Pipe shall be installed in gravel fill as specified in Section 02301, Earthwork for Landfill Construction.
- D. Perforated pipe shall be installed in accordance with Drawing details and as specified for HDPE pipe.
- E. Before final acceptance, completely flush and clean all parts of the system. Flushing water shall be disposed of properly. Flushing water shall not be discharged to the leachate storage tanks. The leachate collection and leak detection pumps shall not be used to handle water resulting from flushing operations. Remove all accumulated construction debris, rocks, sand, gravel, and other foreign material.

3.04 FLUSHING AND CLEANING

- A. Flushing and Cleaning shall be as specified in Section 15144, Pressure Testing of Piping.

3.05 TESTING AND LEAKAGE

A. Hydrostatic Tests—General

1. All testing shall comply with Section 15144, Pressure Testing of Piping, except as specified in this Section.
2. All field tests shall be made in the presence of the Owner or Engineer. Except as otherwise directed, all pipelines shall be tested. All piping to operate under liquid pressure shall be tested in sections of approved length, typically from valve to valve and in no case longer than 1,000 feet.
3. Hydrostatic testing shall consist of a combined pressure test and leakage test. The field test pressure shall be in accordance with Section 15144, Pressure Testing of Piping, Article 1.06, measured at the lowest point of the section being tested. The pressure shall be applied by a pump connected to the pipe in a manner satisfactory to the Engineer. The pump, pipe connection, and all necessary apparatus shall be furnished by the Contractor and shall be subject to the satisfaction of the Engineer.
4. The maximum duration for any test, including initial pressurization, initial expansion, and time at test pressure, must not exceed 8 hours. If the test is not completed due to leakage, equipment failure, etc., depressurize the test section and allow it to “relax” for at least 8 hours before bringing the test section up to test pressure again.
5. Monitored Make-Up Water Test: The test procedure consists of initial expansion and test phases.
 - a. During the initial expansion phase, the test section is filled with water. Once the line is filled, make-up water is added at hourly intervals as required to maintain the test pressure for 3 hours.
 - b. At the end of the initial expansion period, the addition of make-up water will cease. During the test phase the pipe will not have any water added to it for the following 2 hours. The 2 hours will be the actual leakage test. At the end of the 2-hour period, measured make-up water will be added to the pipe to return it to the original test pressure.
 - c. If the amount of make-up water added is greater than calculated using the numbers listed below, the section being tested will be considered to have a leak. The leak shall be found and fixed at the Contractor’s expense and that section of the line retested before continuing with subsequent leakage tests. Testing and repairs shall be repeated at the Contractor’s expense until the amount of make-

up water is less than the amount calculated using the numbers listed below.

ALLOWABLE FOR EXPANSION UNDER TEST PRESSURE*
POLYETHYLENE PIPE

Nominal Pipe Size (in.)	Allowances for Expansion (US Gal/100 Feet of Pipe)		
	1-Hour Test	2-Hour Test	3-Hour Test
2	0.08	0.12	0.15
3	0.10	0.15	0.25
4	0.13	0.25	0.40
6	0.30	0.60	0.90
8	0.50	1.0	1.5
10	0.75	1.3	2.1
12	1.1	2.3	3.4
14	1.4	2.8	4.2
16	1.7	3.3	5.0
18	2.2	4.3	6.5
24	4.5	8.9	13.3
30	6.2	12.6	19.1
36	9.0	18.0	27.0
42	12.0	24.0	36.0
48	15.0	27.0	43.0

*These allowances only apply to the test phase and not to the initial expansion phase.

B. Video Inspection

1. All HDPE gravity piping (solid wall and perforated) shall be jet cleaned and then video inspected before final inspection. The Contractor shall provide all equipment and labor for such cleaning and inspection. Any Subcontractor must be approved by the Owner before work can begin.
2. Video inspection shall be performed after cleaning and pressure testing (when pressure testing is required) the pipe. If cleaning and video inspection of each pipe run from its respective cleanout is not possible, the Contractor shall correct installation deficiencies to allow cleaning and video inspection of the entire length.
3. Digital video recordings shall be taken of all inspections. The Contractor shall prepare a DVD video record of the inspection for submission as detailed in Paragraph 1.02F. The DVD shall be accompanied by an inspection log in addition to a summary report.

END OF SECTION

SECTION 15155
DUCTILE IRON PIPE AND FITTINGS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall provide all materials and incidentals, including piping, fittings, flanged joints, mechanical joints, retainer glands, polyethylene bagging for buried ductile iron piping, fittings, valves, and appurtenances for the ductile iron piping systems required for the work shown on the Drawings and described in Section 15060, Pipe Supports.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. All ductile iron pipe and fittings to be installed under this Contract shall be inspected and tested at the foundry where the material for this project is manufactured. The Contractor shall submit sworn certificates of such tests and their results.
- B. Shop Drawings, including layout drawings, shall be submitted as specified in Section 15055, Piping Systems—General.
- C. The Contractor shall submit the pipe manufacturer's certification of compliance with the applicable Sections of the Specifications.

1.03 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

2. ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
3. ASTM A307—Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
4. ASTM A536—Standard Specification for Ductile Iron Castings.
5. ASTM A563—Standard Specification for Carbon and Alloy Steel Nuts.
6. ASTM B117—Standard Practice for Operating Salt Spray (Fog) Apparatus.
7. ASTM C150/C150M—Standard Specification for Portland Cement.
8. ASTM C283—Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
9. ASTM D714—Standard Test Method for Evaluating Degree of Blistering of Paints.
10. ASTM D792—Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
11. ASTM D1238—Standard Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer.
12. ASTM E96—Standard Test Methods for Water Vapor Transmission of Materials.
13. ASTM G95—Standard Test Method for Cathodic Disbondment Test of Pipeline Coatings (Attached Cell Method).

B. American Society of Mechanical Engineers (ASME)

1. ASME B1.1—Unified Inch Screw Threads (UN and UNR Thread Form).
2. ASME B16.1—Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
3. ASME B16.21—Nonmetallic Flat Gaskets for Pipe Flanges.

C. American Water Works Association (AWWA)

1. AWWA C104/A21.4—Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
2. AWWA C110/A21.10—Ductile-Iron and Gray-Iron Fittings.
3. AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
4. AWWA C115/A21.15—Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
5. AWWA C150/A21.50—Thickness Design of Ductile-Iron Pipe.
6. AWWA C151/A21.51—Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153/A21.53—Ductile-Iron Compact Fittings.
8. AWWA C207—Steel Pipe Flanges for Waterworks Service, Sizes 4-Inch through 144-Inch (100 mm through 3,600 mm).

9. AWWA C600—Installation of Ductile-Iron Mains and their Appurtenances.
 10. AWWA C651—Disinfecting Water Mains.
- D. International Organization for Standardization (ISO)
1. ISO-9001—Quality Management Systems – Requirements.
- E. NSF International (NSF)
1. NSF 61—Drinking Water System Components – Health Effects.

1.04 QUALITY ASSURANCE

- A. Source Quality Control:
1. The ductile iron pipe manufacturer shall submit certification that the pipe and fitting products meet all tests required by AWWA C151/A21.51.
 2. All materials shall be new and have a manufacturer's certificate verifying compliance to all tests and inspections as required in this Section. The weight, class, and casting period shall be shown on each piece of pipe. The manufacturer's "mark," the year produced, and the word "Ductile" or the letters "DI" shall be cast or stamped on all pipe.

1.05 TESTING REQUIREMENTS

- A. See Section 15144, Pressure Testing of Piping, for testing requirements.

1.06 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.

PART 2 PRODUCTS

2.01 GENERAL

- A. All ductile iron piping shall be designed and manufactured in accordance with AWWA C150/A21.50 and AWWA C151/A21.51 for the following minimum operating conditions:
1. The minimum internal design pressure shall be 150 psi with a 100-psi surge allowance, with a safety factor of 2, for a total internal design pressure of 500 psi.

2. The external loads design criteria shall be for the minimum cover indicated on the Drawings at 120 lb per cubic feet soil weight and live load based on one AASHTO H-20 truck load. The thickness design of ductile iron pipe shall be in accordance with AWWA C150/A21.50.
3. Pressure Class: All ductile iron piping shall meet the following minimum working pressure classes:
 - a. 4 inches through 12 inches: 350 psi.

2.02 JOINTS

- A. Ductile iron fittings shall be furnished with mechanical joints and flanged joint ends as shown on the Drawings and specified in this Section:
 1. Mechanical Joints: All buried ductile iron fittings shall be furnished with mechanical joint ends unless noted otherwise. Mechanical joints shall conform to AWWA C111/A21.11. Glands shall be constructed of ductile iron.
 2. Flanged Joints: Pipe for threaded flange fabrication shall be Special Thickness Class 53 in accordance with AWWA C110/A21.10, AWWA C111/A21.11, and AWWA C115/A21.15. Bolt circle and bolt holes shall match those of ASME B16.1 Class 125 flanges. The flanges shall be rated for a maximum working pressure of 250 psi. Threaded flanges shall be individually fitted and machine tightened on the pipe ends. Flange facing shall be smooth or with shallow serrations in accordance with AWWA C115/A21.15.

2.03 FITTINGS

- A. General: Ductile iron pipe fittings shall be the compact type meeting the requirements of AWWA C110/A21.10 and AWWA C153/A21.53 where applicable. Fittings shall be manufactured in accordance with AWWA C110/A21.10. Where taps are shown on fittings, tapping bosses shall be provided. At a minimum, fittings shall have the same pressure rating as the connecting pipe.
 1. Flanged Joint: AWWA C110/21.10 and ASME B16.1, faced and drilled 125-pound ANSI standard.

- 2. Mechanical Joint: AWWA C110/A21.10
 - a. Provide mechanical joint fittings for all buried fittings as shown in the Drawings, unless noted otherwise.
 - b. Provide specified gaskets.

2.04 LINING AND COATING

- A. The Contractor shall provide ceramic epoxy-lined ductile-iron piping, valves, and fittings. The Contractor shall perform all field measurements confirming the accuracy of the piping sizes and lengths shown on the Drawings. The Contractor shall notify the Engineer immediately before deviating from or altering the lining of ductile-iron piping.
- B. Ceramic Epoxy Lined Pipe, Valves, and Fittings: The Contractor shall notify the Engineer immediately before cutting epoxy-lined ductile iron pipe in the field. The Contractor shall repair the cut end in accordance with the pipe manufacturer's written procedures.
 - 1. General: The lining shall be an amine-cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The lining material shall be Protecto 401 Ceramic Epoxy as manufactured by Induron Protective Coatings, Inc. The lining shall be applied by a competent pipe lining specialty firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.
 - 2. Lining Materials: Lining material shall meet the following requirements and properties:
 - a. A permeability rating of 0.00 when tested according to Method A of ASTM E96, Procedure A with a test duration of 30 days.
 - b. The following test shall be run on coupons from lined ductile pipe:

Test Parameter	ASTM Test Method	Typical Value
Salt Spray	B117	0.0 undercutting after 2 years
Cathodic disbondment 1.5 volts @ 77° F	G95	No more than 0.5 mm undercutting after 30 days

Test Parameter	ASTM Test Method	Typical Value
Immersion	D714	No effect after 2 years for 20% sulfuric acid, 140°F 25% sodium hydroxide, 160°F distilled water
Immersion	D714	0.0 undercutting after 2 years for 120°F tap water

3. Application: The lining applicator shall apply lining according to the requirements of the Protecto 401 Specification and application methods and procedures.

2.05 MANUFACTURERS

- A. Acceptable ductile iron pipe manufacturers include US Pipe, American Ductile Pipe, Griffin Pipe, or approved equal.

2.06 BOLTS

- A. General: The Contractor shall provide carbon steel, ASTM A307, Grade A hex head bolts and ASTM A563, Grade A hex head nuts. Threads shall be as specified in ASME B1.1 coarse thread series, Class 2A external and Class 2B internal. Nuts, bolts, and gaskets for flanged fittings and blind flanges shall be designed to withstand the design and test pressure ratings for the pipe.

2.07 GASKETS

- A. Gaskets for mechanical joints shall be compatible with Class I landfill leachate pipe service. See Section 15055, Piping System—General, for gasket requirements.
- B. Gaskets for flanged joints shall be EPDM and in accordance with AWWA C207 material shall be compatible with Class I landfill leachate. Gaskets shall be full-face type for 125-pound flanges.

2.08 RETAINER GLANDS

- A. Retainer glands shall be provided for all buried ductile-iron mechanical joints, fitting, and ductile-iron pipe connections to buried valves. Retainer glands shall be designed for joint retaining through the use of a follower gland and set screw-anchoring devices that impart multiple wedging action against the pipe. The

mechanical joint-restraint device shall be UL listed and shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

1. Gland: Manufactured of ductile iron conforming to ASTM A536. Gland dimensions shall match AWWA C111/A21.11 and AWWA C153/A21.53.
2. Restraining Devices: Manufactured of ductile iron heat treated to a minimum hardness of 370 BHN. Restraining devices shall incorporate a set screw/twist-off nut bolt to ensure the proper actuating of the restraining device. The twist-off nut shall be designed to come off at the torque limit desired to anchor the restraining device in place on the pipe.
3. Joint Deflection: Retainer gland joint deflection shall be limited to manufacturer's recommended maximum deflection angle. Joint deflection shall be applied before the set screws are torqued.
4. Acceptable Manufacturers:
 - a. EBAA Iron, Inc. – Megalug 1100 Series.
 - b. Or approved equal.

2.09 EXTERNAL PIPE RESTRAINTS

- A. Ductile iron pipe push-on (bell and spigot) joint restraint shall be provided by a restraining harness consisting of a restraint ring, connecting tie-rods, and split-ring assembly installed at all push-on joints. The restraint ring shall consist of wedging components made from 60-42-12 ductile iron conforming to ASTM A536 and wedges heat treated to minimum 370 BHN. Torque limiting twist-off nuts shall be provided on each wedge to ensure proper applied installation torque. The split ring shall be made from 60-42-12 ductile iron conforming to ASTM A536. The connecting rods shall be made of steel conforming to AWWA C111/A12.11. Sizes 4- to 16-inch-diameter restraining harnesses shall have 350-psi maximum working pressure rating and 18- to 36-inch-diameter restraining harnesses shall have 250-psi maximum working pressure rating. All harnesses shall be designed with a 2-to-1 safety factor applied to the maximum working pressure rating.
- B. Acceptable Manufacturers
 1. EBAA Iron, Inc. – Series 1700.
 2. Or approved equal.

2.10 INTERNAL PIPE RESTRAINT (NOT USED)

2.11 POLYETHYLENE BAGGING

- A. All buried ductile iron pipe, fittings, and valves shall have the appropriate finish applied and be bagged before backfilling. Polyethylene bagging for buried ductile iron pipe, fittings, and valves shall be 8 mils thickness minimum polyethylene, manufactured in accordance with ASTM D1238, Type I, Class C, Grade E1.

2.12 COLOR CODING OR MARKING (NOT USED)

PART 3 EXECUTION

3.01 HANDLING PIPE AND FITTINGS

- A. Care shall be taken in loading, transporting, and unloading to prevent injury to the pipe, fitting, lining, and coating. Pipe and fittings shall not be dropped. All pipe and fittings shall be examined before installation, and no piece that the Engineer finds defective shall be installed. The Contractor shall repair any damage to the pipe and fittings coating and/or lining as directed by the Engineer. If the Engineer determines that the coating and/or lining cannot be repaired, the Contractor shall replace the damaged pipe and fittings at no additional compensation.
- B. All pipe and fittings shall be subjected to a careful inspection immediately before installation.
- C. If any defective pipe is discovered after it has been installed, the Contractor shall remove and replace it with a pipe in satisfactory condition at no additional expense to the Owner.
- D. Ceramic epoxy pipe and fittings shall be handled only from the outside of the pipe and fittings. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

3.02 PIPE INSTALLATION

- A. The Contractor shall provide and use proper implements, tools, and facilities for the safe and convenient performance of the work. All pipe, fittings, valves, and appurtenances shall be lowered carefully into the trench and at above-grade locations to prevent damage to the pipe, protective coating, lining, and polyethylene bagging. Under no circumstances shall pipeline materials be dropped off or dumped. A trench shall be dewatered before the pipe is installed.
- B. The Contractor shall carefully examine all pipe fittings, valves, and other appurtenances for damage and other defects immediately before installation and before bagging buried ductile-iron pipe. The Contractor shall mark and hold

defective materials for inspection by the Engineer, who may prescribe corrective repairs or reject the materials.

- C. The Contractor shall remove all lumps, blisters, and excess coating from the socket and plain ends of push-on joint pipe for buried service. The outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt, sand, grit, or any foreign material before the pipe is laid in trench.
- D. The Contractor shall prevent foreign material from entering the pipe while the pipe is being placed in the trench. During installation, no debris, tools, clothing, or other materials shall be placed in the pipe.
- E. As each length of buried pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be secured in place with approved backfill material.
- F. When pipe is not being laid, the open ends of pipe shall be closed by a watertight plug or other means approved by the Engineer. When practical, the plug shall remain in place until the trench is pumped completely dry. Care shall be taken to prevent pipe flotation should the trench fill with water.
- G. Trench width at the top of pipe, bedding conditions, and backfill placement and compaction shall be such that design loadings on the pipe will not be exceeded.
- H. Joint Assembly: Pipe joints shall be assembled in accordance with the manufacturer's instructions and the requirements of AWWA C600.
 - 1. Flanged Joint: Before connecting flanged pipe, the Contractor shall thoroughly clean all faces of the flanges of all oil, grease, and foreign material. The gaskets shall be checked for proper fit and thoroughly cleaned. Care shall be taken to ensure proper sealing of the flange gasket. Bolts shall be tightened so that the pressure on the gasket is uniform. Torque-limiting wrenches shall be used to ensure uniform bearing insofar as possible. If joints leak when the hydrostatic test is applied, the gaskets shall be removed and reset and bolts retightened.
 - 2. Push-On, Restrained Joint, or Mechanical Joint: The Contractor shall joint piping in accordance with the manufacturer's recommendations. Provide all special tools and devices, such as special jacks, chokers, and similar items required for proper installation. Lubricant for the pipe gaskets shall be furnished by the pipe manufacturer, and no substitutes will be permitted under any circumstance.
- I. Pipe Deflection: When it is necessary to deflect pipe from a straight line in either the vertical or horizontal plane or where long radius curves are permitted, the

amount of deflection shall not exceed that shown in ANSI/AWWA C600 and that recommended by the retainer gland manufacturer for mechanical joint pipe and fittings.

- J. Pipe Cutting: For inserting valves, fittings, or closure pieces pipe shall be cut in a neat, workmanlike manner without damaging the pipe or lining. Ductile cast iron may be cut using an abrasive pipe saw, rotary wheel cutter, guillotine pipe saw, milling wheel saw, or oxyacetylene torch. Cut ends and rough edges shall be ground smooth, and for push-on joint connections the cut end shall be beveled.

3.03 ABOVE-GROUND PIPE INSTALLATION

- A. The Contractor shall install pipe in horizontal or vertical planes, parallel or perpendicular to concrete pad edges unless otherwise shown. Support pipe and fittings to prevent strain on joints, valves, and equipment. Install flanged joints so that contact faces bear uniformly on the gasket. Tighten bolts in accordance with the pipe manufacturer's recommendations.

3.04 SURFACE PREPARATION AND PAINTING

- A. All exposed pipe and fittings shall be painted as specified in Section 09900, Painting and Coating.
- B. All buried steel (excluding stainless steel) bolts, nuts, washers, rods, harnesses, clamps, sleeves, and appurtenances shall be coated with System No. 24 as specified in Section 09900, Painting and Coating.

3.05 INSPECTION AND TESTING

- A. See Section 15055, Piping Systems—General, and Section 15144, Pressure Testing of Piping.

END OF SECTION

DIVISION 16
ELECTRICAL

SECTION 16401
LOW-VOLTAGE ELECTRICAL WORK—GENERAL REQUIREMENTS

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals necessary for a complete corrosion-resistant working system, including all ancillary items that may be required for the equipment provided and not specifically identified herein, fees, charges, and permits necessary. Work of this Section includes electrical installation requirements for equipment of other Sections. This Section is general and does not purport to show or identify all required components for a complete and working system. This Section may include specifications for materials and equipment not contained within the scope of this project.
- B. The Contractor shall provide temporary and permanent electrical services of proper voltage and phase as required for the Project. All single-phase temporary receptacle outlets shall be provided with ground fault protection in accordance with NEC 590.6 and installed in accordance with NEC 406.8.
- C. The Contractor shall coordinate the work of this Section with others involved in the construction of the project.
- D. The Contractor shall coordinate with the local power company to schedule and arrange for connection of the proposed electrical systems to the electrical distribution system.

1.02 SUBMITTALS

The Contractor shall submit shop drawings in accordance with Section 01330, Submittals and Acceptance:

- A. The Contractor shall submit a complete list of materials and equipment to be incorporated in the work to the Owner for review within 30 days after the Award of Contract.
- B. The list shall include catalog numbers, cut sheets, diagrams, and other descriptive data required to demonstrate conformance with the Specifications. Partial lists will not be acceptable.

- C. The basis of acceptance shall be the manufacturer's published ratings for the equipment. The manufacturer shall be regularly engaged in the manufacture of products specified.
- D. Shop drawings shall be submitted for the following items of equipment:
 - 1. Wiring Devices.
 - 2. Safety Switches.
 - 3. Circuit Breakers.
 - 4. Motors.
 - 5. Motor Starters.
 - 6. Outdoor Electrical Equipment Housing.
 - 7. Relays.
 - 8. Control Devices.
 - 9. Transformers.
 - 10. Lighting Fixtures.
 - 11. Concrete Posts/Poles.
 - 12. Surge Protection Device.
- E. Contents of the shop drawings shall include the following:
 - 1. Details of construction, outline and assembly drawings.
 - 2. Dimensions.
 - 3. Materials.
 - 4. Finish.
 - 5. Ratings.
 - 6. Accessories.
 - 7. Trim.
 - 8. Engineering data.
 - 9. Ladder-type schematic control diagrams and wiring diagrams.
 - 10. Calculations for harmonic current and voltage distortion.
 - 11. Test Equipment datasheets and proposed test procedures for testing the grounding system.
- F. The Contractor shall submit the manufacturer's literature for the equipment listed in Paragraph 1.02.D above to the Owner for review, including the following:
 - 1. Written description of equipment function, normal operating characteristics and limiting conditions.
 - 2. Recommended assembly, installation, alignment, adjustment, and calibration instructions.
 - 3. Operating instructions.
 - 4. Guide to troubleshooting.

5. Maintenance instructions and timetables.
 6. Parts List and an assembly drawing with the parts identified.
- G. Surge protection device submittals shall include the following:
1. UL 1449 peak let-through voltage documentation.
 2. Category C3 peak let-through voltage test results.

1.03 REFERENCES

Reference standards and recommended practices referred to in this Section shall be the latest revision of any such document in effect at the bid time. The following documents are a part of this Section. Where this Section differs from these documents, the requirements of this Section shall apply.

- A. American National Standards Institute (ANSI)
1. ANSI C12.20—Electricity Meters 0.1, 0.2, and 0.5 Accuracy Classes.
 2. ANSI C80.1—Electrical Rigid Steel Conduit.
- B. American Society for Testing and Materials (ASTM)
1. ASTM A36/A36M—Standard Specification for Carbon Structural Steel.
 2. ASTM A48/A48M—Standard Specification for Gray Iron Castings.
 3. ASTM A153/A153M—Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 4. ASTM B8—Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- C. American Bearing Manufacturers Association (ABMA)
1. ABMA Std 20—Radial Bearings of Ball, Cylindrical Roller, and Spherical Roller Types, Metric Design.
- D. Federal Specifications and Standards (FSS)
1. FSS A-A-50552—Fittings for Cable, Power, Electrical and Conduit, Metal, Flexible.
 2. FSS A-A-50553B—Fittings for Conduit, Metal (Thick-Wall (Rigid) and Thin-Wall (EMT) Type).
 3. FSS A-A-50563B—Conduit Outlet Boxes, Bodies and Entrance Caps, Electrical: Cast Metal.
 4. FSS A-A-55809B—Insulation Tape, Electrical, 600V, Polyvinyl Chloride, Pressure-Sensitive Adhesive.

5. FSS A-A-55810A—Conduit, Metal, Flexible.
6. FSS A-A-59213A—Splice Connectors.
7. FSS A-A-59544A—Cable and Wire, Electrical (Power, Fixed Installation).
8. FSS W-C-375E—Circuit Breakers, Molded Case: Branch Circuit and Service.
9. FSS W-C-596H—Connector, Electrical Power (General Specification).
10. FSS W-P-115C—Panel, Power Distribution.
11. FSS W-S-896G—Switches, Toggle (Toggle and Lock), Flush-Mounted (General Specification).

E. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE 112—Standard Test Procedure for Polyphase Induction Motors and Generators.
2. IEEE 117—Standard Test Procedure for Thermal Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery.
3. IEEE 519—Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
4. IEEE C2—National Electrical Safety Code (NESC).
5. IEEE C62.41.1—Guide on the Surges Environmental in Low-Voltage (1,000 V and Less) AC Power Circuits.
6. IEEE C62.45—Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 V and Less) AC Power Circuits.

F. National Electrical Manufacturers Association (NEMA)

1. NEMA ICS 1—Industrial Control and Systems: General Requirements.
2. NEMA ICS 6—Industrial Control and Systems: Enclosures.
3. NEMA MG 1—Motors and Generators.
4. NEMA PB 1—Panelboards.
5. NEMA ST 20—Dry Type Transformers for General Applications.
6. NEMA TC 2—Electric Polyvinyl Chloride (PVC) Conduit.
7. NEMA TC 3—Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
8. NEMA WD 1—General Color Requirements for Wiring Devices.

G. National Fire Protection Association (NFPA)

1. NFPA 70—National Electrical Code (NEC).
2. NFPA 101—Life Safety Code.

H. Underwriters Laboratories, Inc. (UL)

1. UL 6A—Electrical Rigid Metal Conduit – Aluminum.
2. UL 50—Enclosures for Electrical Equipment, Non-Environmental Considerations.
3. UL 67—Standard for Panelboards.
4. UL 83—Thermoplastic-Insulated Wires and Cables.
5. UL 360—Standard for Liquid-Tight Flexible Metal Conduit.
6. UL 467—Grounding and Bonding Equipment.
7. UL 489—Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
8. UL 498—Standard for Attachment Plugs and Receptacles.
9. UL 508—Standard for Industrial Control Equipment.
10. UL 510—Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
11. UL 514A—Metallic Outlet Boxes.
12. UL 514B—Conduit, Tubing, and Cable Fittings.
13. UL 514C—Standard for Nonmetallic Outlet Boxes, Flush-Devices Boxes, and Covers.
14. UL 651—Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
15. UL 797—Electrical Metallic Tubing - Steel.
16. UL 1029—Standard for High-Intensity-Discharge Lamp Ballasts.
17. UL 1449—Standard for Surge Protective Devices.
18. UL 1660—Liquid-Tight Flexible Nonmetallic Conduit.

I. Intertek

1. ETL-PVC-001—Independent third-party testing standard to signify compliance to coating adhesion performance.

1.04 QUALITY ASSURANCE

- A. PVC-coated metal conduit must comply with UL 6A for safety and ETL PVC-001 for performance.

1.05 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Section 01780, Warranties and Bonds.
- B. All equipment and materials supplied shall be warranted against defective design, materials, and workmanship for a minimum of 1 year, or as specified in this Section, against normal use. The warranty period shall begin once the total project

is accepted by the Owner and shall cover replacement of equipment and/or repair, including labor, travel time, and miscellaneous expenses at no cost to the Owner for the full warranty period.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor shall adhere to the requirements specified in Section 01650, Delivery, Storage, and Handling, for storage and protection of the items specified in this Section.
- B. The Contractor shall deliver materials with manufacturer's tags and labels and UL labels intact. Packaged material shall be delivered in the manufacturer's original, unopened containers bearing the manufacturer's name, brand, and UL label. Materials and equipment shall be stored in a dry, clean location. Handle and store so as to avoid damage. Items delivered in broken, damaged, rusted, or unlabeled condition shall be removed from the project site immediately and replaced with acceptable items. The Contractor shall provide suitable protection of materials and equipment from dust and moisture. The Contractor shall be responsible for the condition of materials and equipment until they are accepted by the Owner.

1.07 OPERATIONS AND MAINTENANCE (O&M) MANUALS

- A. O&M Manuals shall be in accordance with General Conditions, Supplementary Conditions, and Section 01830, Operations and Maintenance Manuals.
- B. Before final acceptance of this project, an O&M Manual shall be submitted to the Owner. The manual shall include manufacturer's literature as outlined in Paragraph 1.02.F above, drawings corrected in accordance with shop drawing review comments and including all modifications, and lists of suppliers and/or service shops that can provide parts and accessories and equipment repair for the items of equipment listed in Paragraph 1.02.D above. The lists shall include a contact name, telephone number, and address.
- C. A test report detailing the results of the grounding system test shall be provided with the O&M Manual.

1.08 CODES, INSPECTIONS, AND FEES

- A. The Contractor shall obtain all necessary permits and inspections required for the work of this Section and pay all charges incidental to this work. The Contractor shall deliver to the Owner all certificates of inspection issued by authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS AND EQUIPMENT

- A. All material and equipment shall be new and listed or labeled for use within the United States by a Nationally Recognized Testing Laboratory (NRTL). Equipment shall be provided with a specific listing, such as UL, when indicated in this Section or in other portions of the Contract Documents. Only products by manufacturers regularly engaged in the production of specified units will be acceptable.
- B. Where two or more units which perform the same function or are of the same class of equipment or materials are required, provide all units from a single manufacturer.
- C. Provide materials and equipment of suitable composition to perform satisfactorily when exposed to corrosive conditions of the project site.
 - 1. Provide breather and drain fittings in all raceways and enclosures where necessary to prevent condensation or trapping of moisture.
 - 2. Provide heaters in all control panels to prevent condensation.

2.02 CONDUIT

- A. Rigid Metal Conduit: Rigid metal conduit shall be galvanized and shall conform to UL 6A.
 - 1. PVC-coated rigid steel conduit, elbows, and fittings shall be coated with a bonded polyvinylchloride which is permanently fused on at the factory.
 - a. Must meet UL 6A safety standards and carry the ETL-PVC-001 verified label.
 - b. Aboveground conduit system PVC coating shall have a minimum thickness of 40 mils. Couplings and condulets shall have overlapping pressure sealing sleeves.
 - c. Below-ground conduit system PVC coating shall have a minimum thickness of 40 mils.
 - d. Below-ground conduit system PVC coating for extreme corrosive conditions shall have a minimum thickness of 40 mils and shall have external and internal bonded coatings.
- B. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be polyvinyl chloride compound and shall conform to NEMA TC-2 and UL 651. Conduit shall be sunlight resistant, rated for use with 90 °C conductors. Fittings shall be of the

same polyvinyl chloride compound and from the same manufacture as the conduit and shall conform to NEMA TC-3 and UL 514B. Conduit and fittings shall be joined by a solvent cement. The type of cement and the procedure for application shall be as recommended by the conduit manufacturer. The conduit shall be Carlon Plus 80, or equal.

- C. Liquidtight Flexible Metal Conduit: Liquidtight flexible metal conduit shall be made with galvanized steel flexible conduit covered with an extruded PVC jacket. Fittings shall be compression type specifically designed for use with flexible conduit and shall form watertight connections. Box connectors shall have an “O” ring between the fitting body and the enclosure.

2.03 BOXES

- A. General: Boxes shall be sized as recommended by the NEC or as shown on the Drawings.
 - 1. Boxes shall be stainless steel, or cast metal, as specified or shown on the Drawings.
 - 2. Cast metal boxes shall be of the type indicated on the Drawings.
- B. Outlet Boxes: Outlet boxes shall be sheet steel, cast metal, or nonmetallic.
 - 1. Sheet steel boxes shall be cadmium-coated or zinc-coated.
 - 2. Cast metal boxes shall conform to FSS A-A-50563B.
 - 3. Non-metallic boxes shall conform to UL 514C.
 - 4. Fixture outlet boxes and junction boxes shall be 4-inch, octagonal.
 - 5. Switch and receptacle outlet boxes shall be 2 inches wide by 4 inches high by 2 inches deep.
 - 6. Junction box extensions and covers shall conform to UL 514A.
 - 7. Boxes installed in wet locations or on exterior surfaces shall be cast metal with gasketed covers.

2.04 WIRING DEVICES

- A. Toggle Switches: Toggle switches shall be specification grade and shall conform to FSS W-S-896G and shall be totally enclosed with bodies of molded compound and a mounting strap.
 - 1. Handles shall be ivory.
 - 2. Wiring terminals shall be screw-type, back- or side-wired.

3. Switches shall be rated, quiet type, 20 amperes, 277 volts.
4. Switches shall be suitable for control of tungsten filament lamp loads with "T" marking of UL.
5. No more than one switch is allowed in a single gang position of a switch box.

B. Receptacles: Receptacles shall be specification grade and shall conform to NEMA WD-1 and UL 498.

1. Single and duplex receptacles for general-purpose use shall be heavy-duty specification-grade, 20 amperes, 125 volts, three-wire grounding, NEMA configuration 5-20R.
2. Special purpose single receptacles shall be heavy-duty specification grade, 20 amperes, 250 volts, three-wire grounding, NEMA configuration 6-20R, unless indicated otherwise on the Drawings.
3. Ground fault circuit interrupter receptacles shall be duplex, 20 amperes, 125 volts, three-wire grounding, NEMA configuration 5-20R.
 - a. Receptacles shall have a nominal sensitivity to ground leakage current of 4 to 6 milliamps and shall interrupt the current supply for any value of ground leakage current exceeding the trip level of 4 to 6 milliamps on the load side of the receptacle with a maximum tripping time of 1/30th of a second.
 - b. Receptacles shall provide protection for any device connected to the circuit beyond the receptacle.
 - c. Receptacles shall have test and reset buttons accessible on the face of the receptacle.
4. Receptacles shall be suitable for mounting in a standard outlet box and shall have a high-impact nylon face.
5. Wiring terminals shall be screw-type, back- or side-wired.
6. Color of device face shall be ivory.
7. Receptacles shall be Leviton, Hubbell, Pass & Seymour or approved equal.

2.05 DEVICE PLATES

- A. Cover Plates: Cover plates shall conform to UL 514A.
1. Furnish one-piece type to suit devices installed, with round or beveled edges.
 2. Weatherproof switch cover plates shall be spring-loaded gasketed type with individual cover for each switch. Receptacle covers shall be weatherproof with or without the attachment plug cap inserted.
 3. Waterproof receptacle cover plates shall have screw cap for each outlet. The plug shall have a matching screw attachment to maintain the rating when the plug is attached. The screw cap shall be permanently attached to the cover plate by a chain. A matching plug shall be provided for each cover plate.
 4. Zinc-coated steel or cast-metal plates shall be used on unfinished walls.
 5. Satin-finish stainless steel plates shall be used on finished walls.
 6. The Contractor shall provide metal screws with countersunk heads and finish to match the finish of the plate.

2.06 WIRE AND CABLE

- A. Conductors: All conductors shall be annealed soft drawn copper, conforming to ASTM B8, UL 83, and the latest requirements of the NEC. All conductors shall have THW or THWN type insulation, rated at 600 volts, unless specifically noted otherwise.
1. Other types of insulation may be used as permitted by the NEC. The Contractor shall be responsible for change in conduit size and conductor size to maintain the ampacity of the circuit.
 2. Wire #8 AWG and larger shall be stranded concentric lay. Wire sizes #14, #12, and #10 AWG shall be stranded for control and motor power and solid for light and receptacle circuits.
 3. Conductors shall be as manufactured by General Cable Corp., BICC Cables Corp., ESSEX International, Inc., Southwire Company, Pirelli Cable Corp., or equal.
 4. Conductors installed between Adjustable Speed Drives (ASD) and motors shall be shielded ASD cables for conductor sizes AWG 4/0 and below. ASD cables shall be rated for up to 1000V and have cross-linked polyethylene (XLPE) Type XHHW-2 insulation on current-carrying conductors. ASD cables with current-carrying conductors of size No 2 and smaller shall have an insulated grounding conductor. Larger cables may have insulated or bare grounding conductors. ASD cables shall have a braided or tape shield. The outer jacket shall be black sunlight and oil-resistant PVC. ASD cables shall be rated for 90°C in wet or dry locations

and shall be suitable for direct burial. ASD cables shall be designed specifically for use in ASD applications. The Contractor shall install the ASD cables in accordance with the cable manufacturer's and the ASD manufacturer's recommendations. ASD cables shall be manufactured by Belden, or approved equal.

- B. Conductor splices shall not be allowed on any conductor unless approved by the engineer and, if approved, shall conform to FSS A-A-59213A. Acceptable: Scotchcast Splicing Kit, 3M Company. Plastic tape shall conform to FSS A-A-55809B.

2.07 SAFETY SWITCHES

- A. Safety switches shall be NEMA heavy-duty type and UL listed. Switches shall be rated as indicated on the Drawings.
 - 1. All switches shall have switch blades which are fully visible in the OFF position when the door is open. Switches shall have permanently attached arc suppressors, hinged or otherwise attached to permit easy access to line-side lugs without removal of the arc suppressor. Lugs shall be UL listed for copper and aluminum cables and front removable. All current-carrying parts shall be plated by electrolytic processes.
 - 2. Switches shall have a quick-make and quick-break operating handle and mechanism which shall be an integral part of the box, not the cover. Padlocking provisions shall be provided for padlocking in the OFF position only, with at least three padlocks. Switches shall have a dual-cover interlock to prevent unauthorized opening of the switch door in the ON position or closing of the switch mechanism with the door open.
- B. Enclosures: Switches installed indoors shall be furnished in NEMA 1 general-purpose enclosure with knockouts, unless otherwise specified. Switches located outdoors shall be furnished in NEMA 3R or NEMA 4X stainless steel enclosures as indicated on the Drawings.
 - 1. Covers on NEMA 1 enclosures shall be attached with butt-type pin hinges.
 - 2. NEMA 3R switches through 200 amperes shall be provided with closing caps and/or interchangeable hubs as required. Rain-tight covers shall be securable in the open position.
 - 3. NEMA 4X switches shall be furnished in stainless steel enclosures without knockouts. The means of sealing the cover shall be positive, with 30-through 200-ampere switches having quick release latches with pin type hinges and gaskets. Enclosures shall be of Code-gauge stainless steel.

- C. The switch jaws shall be multi-spring type for positive grip of the switch blades. The fuse clips shall be spring-reinforced, positive-pressure type, or electrolytic copper.
- D. Switches shall be as manufactured by Square D, General Electric, Cutler-Hammer, or Siemens. All switches shall be by the same manufacturer.

2.08 CIRCUIT BREAKERS

- A. The Contractor shall provide molded-case thermal magnetic circuit breakers of the type, size, and electrical characteristics specified or indicated on the Drawings. Circuit breakers used as service entrance disconnects shall be suitable and rated as service entrance equipment.
- B. Circuit breakers shall be of single-unit construction, and multi-pole circuit breakers shall have trip elements in each pole with common trip bar. Frame size 200 amperes or larger shall have adjustable magnetic instantaneous trip and shall have interchangeable thermal magnetic trip units.
- C. Shunt trip shall be installed in circuit breakers where required by the Drawings or Specifications.
- D. Circuit breaker interrupting ratings shall be equal to the available short circuit current at the point of installation with the minimum ratings as follows:

<u>Frame Size</u>	<u>240 V</u>	<u>480 V</u>
100 A	18,000	14,000
200 A	25,000	22,000
400 A	42,000	30,000
800 A	42,000	30,000
1,200 A	42,000	30,000

- E. Provide NEMA Type 1 enclosures for general duty indoor use. Enclosures shall be NEMA 4X stainless steel for exterior locations unless indicated otherwise.
- F. Circuit breakers shall be as manufactured by General Electric, Siemens, Square D, or Cutler-Hammer.

2.09 MOTORS

- A. Motors shall be provided with the equipment driven by the motor, unless otherwise indicated or specified, and shall conform to the latest requirements of

NEMA, IEEE, ANSI, NEC, and American Bearing Manufacturer's Association (ABMA) standards, where applicable.

1. Motors shall be of sufficient capacity to operate the driven equipment, under all load and operating conditions, without exceeding 100% of the motor's nameplate horsepower rating, excluding the service factor, and without exceeding the motor's rated temperature limits.
 2. Motors shall be furnished with permanent, highly visible stainless steel nameplates. Nameplates shall include all motor ratings, accessories, and special features.
- B. Motors may be single speed or variable speed as required for the application.
1. Motors for variable-speed applications shall be designed for operation at the rated maximum speed and at reduced speed throughout the variable-speed range without overloading. Motors for variable-speed operation shall be inverter duty rated and compatible with the associated variable-speed control equipment and operating conditions, including the effects of harmonic current and voltage distortion. Motors for variable-speed operation shall be equipped with a normally closed automatic reset winding thermostat in addition to all accessory equipment recommended by the variable-speed equipment manufacturer. Thermostat leads shall be brought to the motor connection box.
- C. Motors shall be NEMA Design B, unless otherwise indicated or specified, and shall be suitable for continuous duty operation. Motor currents and torque shall be in accordance with NEMA MG1-12.34 and MG1-12.37.
1. Three-phase, single-speed, squirrel-cage induction motors less than 50 HP shall be rated 208-230/460 volt for use on 208-, 240-, or 480-volt, three-phase, 60-Hz systems.
 2. Multi-speed motors and motors 50 HP and larger may be single voltage as required for the particular voltage.
- D. Motors shall be provided with Class F non-hygroscopic insulation system using materials and an insulation system evaluated in accordance with IEEE 117 classification tests. Temperature rise shall be limited to a maximum of 80° C, by resistance, at a service factor of 1.0 in an ambient temperature of 40° C. Motors shall have multiple dips and bakes of varnish treatment for additional protection.
- E. Motors larger than 5 HP shall be provided with locked-rotor current not exceeding NEMA Code letter "G."
- F. Motors shall be furnished with a minimum service factor of 1.15.

- G. Motors shall be suitable for full voltage across-the-line-type starting, unless otherwise specified or indicated on the Drawings.
- H. Motors shall be equipped with ball, open, single-row, deep-groove Conrad-type bearings conforming to the ABMA Std 20. Drive end bearings may be cylindrical roller type for belted drives.
 - 1. Bearing life shall be 17,500 hours minimum for belted applications and 100,000 hours minimum for flexible direct-coupled applications.
 - 2. The bearing identification number shall be stamped on the motor nameplate.
 - 3. The lubrication system shall consist of a capped grease fitting inlet, a relief plug 180 degrees from inlet, and a grease reservoir in bracket and cast inner cap.
 - 4. Bearings shall be greased by the manufacturer with a premium moisture-resistant polyuria-thickened grease containing rust inhibitors and suitable for operation over a temperature range of -25° C to 120° C.
- I. The motor enclosure, including frame with integrally cast feet and/or vertical P-base mounting, end brackets, bearing inner caps, fan guards, and conduit box and cover shall be ASTM Type A48/A48M, Class 25 cast iron or better.
 - 1. Conduit boxes shall be provided with the number and size of conduit connections, as shown on the Drawings. The conduit box shall allow rotation to accommodate conduit connection. Provision for grounding shall be made using a mounted clamp-type lug in the conduit box.
 - 2. Motors shall be equipped with lifting lugs. Motor enclosures shall be equipped with stainless-steel screens for all openings in accordance with NEMA MG 1 for guarded machines.
 - 3. Vertical hollow-shaft motors shall be equipped with non-reverse ratchets to prevent backspin.
 - 4. Motors shall be NEMA MG 1 open drip-proof, weather-protected Type I, totally enclosed fan-cooled, or explosion-proof as specified in other Sections of the Specifications or indicated on the Drawings.
- J. Submersible motors shall be explosion-proof and NRTL listed for Class 1, Division 1, Group C & D hazardous locations as defined by the NEC.
 - 1. All electrical components shall be housed in an air-filled or oil-filled cast-iron, watertight enclosure which is sealed by the use of O-rings. Joints shall be rabbeted with extra-large overlaps.
 - 2. Automatic reset, normally closed, thermal overloads shall be imbedded in the motor winding to provide overheating protection.

3. Moisture-detection probes shall be incorporated to detect moisture in either the seal or stator cavity by measuring resistivity between the probes. Float-type devices or single probe-to-ground moisture detectors are not acceptable.
 4. Submersible motors shall have power and control conductors housed in multi-conductor cables of sufficient length to reach the control panel or junction box as indicated on the Drawings. Cable leads shall allow cable-to-motor connections to be accomplished in the field without soldering. Cable entrance to the motor shall be sealed.
 5. Submersible motors shall be designed to allow either fully submerged or completely dry operation.
- K. Polyphase motors shall be of an energy-efficient design having a minimum efficiency rating as listed in NEMA MG 1-12.55, Table 12-6C.
1. Motor efficiency shall be determined in accordance with NEMA MG 1-12.54.1 and IEEE 112, Method B.
 2. Efficiency rating shall be labeled on the motor nameplate in compliance with NEMA MG 1-12.54.2.
- L. Motors shall be capable of the following starts per hour, unless otherwise specified, without overheating or causing damage to the motor.
1. Submersible motors, 10 starts per hour.

2.10 MOTOR STARTERS

- A. Manual Motor Starters: Manual motor starters shall be toggle, key, or pushbutton type and shall be equipped with melting alloy overload protection on each pole.
1. Fractional horsepower manual motor starters shall be Square D Class 2510 Type F (or equal) single-unit with handle guard/lock-off feature. The handle shall be toggle-type unless otherwise specified or indicated on the Drawings.
 2. Integral horsepower manual motor starters shall be Square D Class 2510 Type M or T (or equal) rated 600 VAC/250 VDC, with lock-off feature and auxiliary contact. Auxiliary contact shall be normally open unless otherwise indicated. Control shall be pushbutton or toggle as indicated on the Drawings.

3. Manual motor starters shall be provided in surface-mounted enclosures unless otherwise indicated.
 - a. Type F units mounted outdoors shall be in NEMA 4 cast-metal enclosures.
 - b. Type M or T units mounted outdoors shall be in NEMA 4 stainless-steel or cast-metal enclosures.
 - c. Manual motor starters in hazardous locations shall be Class 2510 NEMA 7 and 9, by Square D or equal.
- B. Magnetic Motor Starters: Magnetic motor starters shall be rated in accordance with NEMA standards, sizes, and horsepower ratings. Starters shall be sized for the horsepower ratings as indicated on the Drawings or required by the driven equipment. Minimum sizes and type of starter shall be as indicated on the Drawings and shall have the following features:
 1. Magnetic starters shall be equipped with double-break silver-alloy contacts. All contacts shall be replaceable without removing power wiring or removing the starter from the panel or enclosure.
 2. Coils shall be of molded construction. All coils shall be replaceable from the front without removing the starter from the panel or enclosure.
 3. Overload relays shall be the melting-alloy type with a replaceable control module. Thermal units shall be of one-piece construction and interchangeable. The starter shall be inoperative if the thermal unit is removed. Three-phase starters shall have overload relays in all three phases. Reset button shall be accessible without opening the door or panel. Visible trip indication for overload phase indication shall be provided. The relay shall have a Form C contact, which operates when the overload relay trips; the contact shall be wired to terminal blocks for remote use. Solid-state overload (SSOL) relays shall be used for projects that include renovations or upgrades to existing facilities that use SSOL relays for motor protection. SSOL shall be Square D Micrologic or equal. Provide SSOL relays with the following features:
 - a. Phase loss protection; trips within 3 seconds.
 - b. Phase unbalance protection.
 - c. Ground fault trip when selected.
 - d. Selectable trip Class 5, 10, 20, or 30.

- e. Reset trip with selected Auto/Manual.
 - f. Dip-switch selectable with the following features:
 - (1) Set Phase Unbalanced ON or OFF.
 - (2) Set Phase Loss ON or OFF.
 - (3) Set Reset to Manual or Automatic.
 - (4) Set Ground Fault ON or OFF.
 - g. Overload shall be self-powered with no need for external power source.
- 4. A phase-failure relay shall be provided for all motor starters and shall have solid-state sensing circuitry monitoring all three phases. The relay shall have isolated DPDT contacts and shall protect the motor against the loss of one of the three phases: voltage unbalance in excess of 10% rated voltage, phase reversal, and undervoltage. Undervoltage shall be adjustable to 75% of rated voltage. The relay shall be Square D Company Class 8430 or approved equal.
 - 5. All motor starters shall have their own control power transformer for individual starter control voltage, except where installed in control panels in which a common control power transformer may be incorporated. Control voltage shall be 120 VAC. Control power transformers shall be sized to include motor space heater load, starter or contactor coil, timers, relays, and other devices as indicated or specified. Primary inputs and the ungrounded secondary output of the control power transformer shall be fused.
 - 6. Starters shall be suitable for adding at least four external electrical interlocks of any arrangement, normally open or normally closed. Starters shall be supplied with a minimum of two interlock contacts.
 - 7. All magnetic starters shall be provided with terminal blocks for wiring devices external to the starter enclosure. The starter shall be supplied in a NEMA 1 enclosure unless otherwise indicated or specified.
 - 8. The starter shall be capable of starting the motor the number of times per hour stated for motors or as required by the pumping sequence, without causing damage to the starter.
 - 9. Panel-mounted elapsed-time meters shall have six register wheels indicating up to 99,999.9 hours, without a reset knob, and be rated at 115 VAC, 60-Hz. The panel manufacturer shall provide one meter for

each motor installed and connect the meter so that the meter will record the time that the motor is energized.

10. Equip all magnetic controllers and/or starters, unless otherwise noted, with a three-position selector switch labeled “Hand-Off-Automatic” or as indicated. Switch in Hand position shall start motor.
11. Equip all magnetic controllers and/or starters with indicating lights as follows: green-power on, red-running.
12. A list of overload relay heater elements installed in each starter shall be included in the Operation and Maintenance Manual. The list shall identify the starter by name of equipment and show the type, size, and model number of the heater element.

C. Full-Voltage Non-reversing (FVNR) Starters: FVNR motor starters shall be designed for across-the-line full-voltage starting and stopping of squirrel-cage motors and shall be the combination type with motor circuit protector unless otherwise indicated.

1. The starters shall be rated 600 VAC, 60-Hz.

D. Combination Starters

1. All motor starters shall be combination type unless noted otherwise.
2. Combination starters shall be manufactured in accordance with the latest published NEMA Standards. Combination starters shall consist of circuit breaker, a fused disconnect, or a motor circuit protector, as indicated on the Drawings, and a magnetic motor starter as specified above. Combination starters shall have an interrupting rating sufficient for the short circuit current available at the line terminals with a minimum rating of 14,000 RMS symmetrical amperes at 480 volts. All combination starters shall be mounted in a NEMA 1, General Purpose enclosure, unless otherwise indicated on the Contract Drawings.
3. The operator and operator arm shall be permanently attached to the handle of the breaker with positive indication of switch position with door either open or closed. The door and switch shall be interlocked to prevent closing the switch when the door is open.
4. The door latch shall be tamper-proof with a coin-proof slot in the door handle latch. The door handle shall have double safety interlocking of the operator and door handle to prevent opening of the door when the breaker is in the “ON” position. An interlock bypass shall be provided to allow access to authorized personnel. All exposed parts shall be dead when the switch is in the “OFF” position.

5. Padlocking facilities shall be provided to positively lock the disconnect in either the “ON” or “OFF” position with from one to three padlocks with the door open or closed.
6. Combination starters shall be Allen-Bradley, Cutler-Hammer, Square D, or approved equal.

E. Control Devices

1. Pushbutton control, when indicated on the Drawings, shall be non-illuminated, momentary contact (unless otherwise indicated), oil-tight, pushbutton with no guard. Pushbutton controls shall be Square D Type “K” or approved equal.
2. Selector switch operators, when indicated on the Drawings, shall be two- or three-position, non-illuminated, oil-tight switches with normal return to all positions. Selector switch operators shall be Square D Type “K” or approved equal.
3. Pilot lights shall be 120-volt LED push-to-test type.
4. Control relays shall be double-pole, double throw sealed, plug-in type relays with din rail or panel mount base, rated for 10A current at 120 VAC, with internal LED pilot light to indicate relay coil is energized.
5. Provide time delay relays in all motor starters larger than 5 HP to provide a sequenced start-up of motors upon energization. Sequence shall start with largest motor, next largest, etc. The timer shall have a range of 5 to 180 seconds.

2.11 DRY-TYPE TRANSFORMERS

- A. Dry-type transformers for power and lighting shall be self-cooled with ratings as indicated on the Drawings. Transformers 25 kVA and larger shall have a minimum of four 2-1/2% full-capacity primary taps, two above and two below the rated voltage. Transformers shall be UL listed.
- B. The core shall be constructed of high-grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. The core lamination shall be clamped together with structural steel angles. The core and coil assembly shall be mounted to the enclosure by neoprene rubber vibration-absorbing mounts. The neoprene rubber mounts shall eliminate metal-to-metal contact between the enclosure and the core and coil assembly.
- C. Insulating material shall be in accordance with NEMA ST-20 for a 220°C component recognized insulation system. A temperature rise above 40°C ambient shall be 150°C for transformers 15 kVA and above, and 115°C for transformers below 15 kVA, with maximum temperature of the top of the enclosure not exceeding a 50°C rise above a 40°C ambient.

- D. Coils shall be continuous-wound construction and shall be impregnated with a non-hygroscopic thermosetting varnish.
- E. Transformers shall be mounted in drip-proof and rodent-proof heavy-gauge steel enclosures, ventilated according to current manufacturing standards. Outdoor units shall be weatherproof.
- F. Transformer enclosures shall be painted with a gray baked-enamel finish applied after the unit has been degreased, cleaned, phosphate, and primed. Enclosures may be designed for floor or wall mounting. Floor mounting units shall be mounted on a 3-1/2-inch raised concrete pad.
- G. Transformers shall be as manufactured by Square D, General Electric, Cutler-Hammer/Westinghouse, Siemens, or approved equal.

2.12 LIGHTING FIXTURES AND COMPONENTS

- A. Lighting fixtures similar and equal to the types indicated on the Drawings shall be furnished and installed complete with all ballasts, lamps, starters, lenses, accessory hardware, and associated equipment to provide a complete and working lighting system. Each fixture furnished shall be designed for the wattage and lamp type indicated on the Drawings and/or specified in this Section.

2.13 SURGE PROTECTION DEVICE

- A. Primary surge protection device (SPD) shall be installed at the main service on the load side of the main breaker or automatic transfer switch as indicated on the Drawings.
 - 1. Primary service SPD shall be listed in accordance with UL 1449-3RD Edition and shall be tested to Category C3 (20 kV, 10 kA, 8/20 μ sec. Waveform) in accordance with IEEE C62.41.1 and IEEE C62.45. Suppressors shall meet or exceed the following criteria:
 - a. Single impulse current rating of 160,000 amperes per phase (8/20 μ sec. waveform).
 - b. Pulse life rating of 1,000 occurrences with no clamping drift for Category C (8/20 μ sec. waveform).

- c. UL 1449 peak let-through voltage shall not exceed the following:

<u>Voltage</u>	<u>L-N</u>	<u>N-G</u>
120/208 or 120/240	500	500
277/480	800	800

- d. The test for Category C3 peak let-through voltage IEEE C.62.41.1 (20 kV-1.2/50 μ s) shall be conducted by an independent testing laboratory. Documentation of the test shall be submitted with the shop drawings.
- e. Peak let-through voltage measured in UL and ANSI/IEEE testing shall include the effect of 6-inch leads connected to the complete unit.
- f. Turn-on and turn-off times shall be less than 1.0 nanosecond.

B. Secondary surge protection device (SPD) shall be installed on the secondary side of step-down transformers or at the associated panelboards, at control panels, and at motor disconnects or junction boxes as indicated on the Drawings. Suppressors at panelboards shall be connected to a 30-amp multi-pole breaker. All other suppressors shall be fused.

1. Secondary SPD shall be listed in accordance with UL 1449-3RD Edition. Suppressors shall meet or exceed the following criteria:

- a. Single impulse current rating of 80,000 amperes per phase (8/20 μ sec. waveform).
- b. Pulse life rating of 1,000 occurrences with no clamping drift for Category C (8/20 μ sec. waveform).
- c. UL 1449 peak let-through voltage shall not exceed the following:

<u>Voltage</u>	<u>L-N</u>	<u>N-G</u>
120/208 or 120/240	500	500
277/480	800	800

- d. The test for Category C3 peak let-through voltage IEEE C.62.41.1 (20 kV-1.2/50 μ s) shall be conducted by an independent testing laboratory. Documentation of the test shall be submitted with the shop drawings.

- e. Peak let-through voltage measured in UL and ANSI/IEEE testing shall include the effect of 6-inch leads connected to the complete unit.
- f. Turn-on and turn-off times shall be less than 1.0 nanosecond.

C. Minimum Requirements for Surge Suppressors

- 1. Provide suppression elements between each phase or leg and the system neutral and between the neutral conductor and ground.
- 2. Each module of modular type suppressors shall be externally fused. The status of each module shall be monitored on the front of the enclosure and on each module.
- 3. The suppressor failure mode shall be of a “fail-short” design.
- 4. Visible indication of proper connection and operation shall be provided.
- 5. Modular-type suppressors shall have an internal disconnect and current limiting fuses. Encapsulated suppressors shall have external fuse or circuit breaker protection.
- 6. Terminals shall be provided for all necessary power and ground connections and shall accommodate #10 to #1 AWG wire sizes.
- 7. Suppressors shall be of solid-state componentry and shall operate bidirectionally.
- 8. Suppressors shall have a warranty guarantee period of at least 5 years.

D. All surge protection devices shall be of the same manufacture and shall be installed in accordance with the manufacturer’s installation instructions. The mounting position shall be selected to provide the shortest lead possible between the suppressor and the point of connection.

E. Surge protection devices shall be as manufactured by Advanced Protection Technologies, Inc., PQ Protection, LEA or approved equal.

2.14 GROUNDING

- A. Ground rods shall be copper-clad steel, 3/4-inch-x-10-foot sectional type, with couplings and driving studs for installation.
- B. The conductor shall be bare, stranded copper, complying with ASTM B8, for main power ground and instrument ground, unless otherwise indicated. Grounding conductors run in conduit shall have green insulation.
- C. Connection to the ground rod shall be made with exothermic welding kits by Cadweld or approved equal. “Acorn” type clamps are not acceptable. Ground

connections to equipment frames, building steel, etc., shall be made with equipment grounding lugs or clamps intended for grounding purposes.

2.15 PLASTIC CAUTION TAPE

- A. The Contractor shall provide a continuous non-metallic caution tape, 12 inches below finished grade, above each duct or conduit run. The tape shall be 6 inches wide, imprinted to indicate underground electric utilities, as manufactured by Griffolyn, Terra-Tape, or equal.

2.16 PRECAST PRODUCTS

- A. Concrete Handholes: Concrete handholes shall conform to the dimensions shown on the Drawings, shall be designed to AASHTO H-20 loading, and shall be constructed of 4,000-psi (minimum) reinforced concrete.
 - 1. Handholes shall have full-size aluminum (T6061-T6) diamond plate pedestrian covers with reinforcing angles, rated for 300 pounds per square foot unless otherwise indicated. Covers shall be removable and shall be provided with lifting holes (four per cover). Covers larger than 4-foot-x-4-foot nominal shall be of sectional construction. Aluminum angles with flat bars shall be set into the inside of walls flush with the top to match covers.
 - 2. Handholes shall be open bottom unless otherwise indicated or specified.
 - 3. Handholes shall have pulling eyes cast in the wall opposite duct entry. The conduit shall be terminated in a handhole with end bells grouted in entrance windows with non-shrink grout.
 - 4. Power and/or signal cables shall be supported on heavy-duty non-metallic cable racks with adjustable arms and be held in place with non-metallic tie wraps. Racks shall be maximum 3 feet apart with a minimum of one per wall of handhole. Racks shall be attached to handhole walls in accordance with the rack manufacturer's recommendation with a minimum of three anchors per rack. An anchor shall be located in holes immediately above each adjustable arm.
 - 5. Handholes shall be installed on a 6-inch-thick bed of gravel. The gravel shall be compacted before casting or setting handholes. Handholes shall protrude 2 inches minimum above surrounding grade.
- B. Concrete Pull Box: The pull box shall be constructed of reinforced concrete or polymer concrete and shall be Brooks Products, Inc., Quazite, or equal. Covers shall be provided with lifting slot, bolts, and "ELECTRIC" logo.

PART 3 EXECUTION

3.01 LAYOUT OF CONDUIT AND WIRING SYSTEMS

- A. The Contractor shall lay out the work and shall be responsible for all necessary lines, levels, elevations, and measurements. The Drawings indicate the extent and general arrangement of the components. The Contractor shall become familiar with the work of other trades engaged in the construction. The exact routing of raceways and locations of equipment may be governed by structural conditions and obstructions. The Contractor shall coordinate with the details of equipment shop drawings for power and control connections to equipment furnished by others. This is not to be construed as permitting redesigning systems.
- B. Submit all requests for changes in the proposed layout due to structural features, equipment locations, and similar conditions to the Owner, with the following provisions:
 - 1. Detail the reasons for the changes.
 - 2. Submit requests within 30 days after award of Contract.
 - 3. Make no changes without written approval of the Owner.
- C. Examine areas scheduled to receive electrical equipment and material for conditions which will adversely affect the execution, permanence, or quality of the work. Determine field conditions by actual measurement. Do not proceed with installation until defects have been corrected.

3.02 INSTALLATION

- A. General: Comply with NEC, NESC, local codes, and rules and regulations of local agencies having jurisdiction. Coordinate electrical installation of systems and packaged equipment items specified in other Sections of these Specifications.
 - 1. Conductors, circuit breakers, motor controllers, and protective devices indicated or specified shall be sized to serve the electrical equipment furnished and shall meet all requirements of the NEC. Voltage drop shall be limited to 3%, including main service, feeder, and branch circuit.
 - 2. Coordinate protective, control, and signaling devices.
- B. Grounding and Bonding: The Contractor shall establish a grounding and bonding system that electrically connects metal structural materials, equipment enclosures, conduits, outlet boxes, cabinets, motor frames, fixtures, devices, transformer cases, switchgear enclosures, incoming service neutral conductor, and the earth. The common point of attachment for the grounding and bonding system shall be at the main service disconnect unless otherwise indicate in this Section or in the

Drawings. The grounding and bonding system shall be properly bonded and sized in accordance with NEC. Solidly bond all non-current-conducting metal parts to the electrical installation grounding bus. A green insulated grounding conductor shall be carried with each circuit.

1. Provide common grounds throughout the system.
2. Provide a ground grid consisting of driven copper-clad steel ground rods connected by bare copper conductor at the service entrance and/or as shown on the Drawings. Resistance to remote earth shall be 10 ohms or less before connection to the system.

C. Identification: Equipment such as but not limited to disconnect switches, motor starters, control panels, etc., shall be clearly marked.

1. Identify all devices operating at more than 250 VAC phase-to-phase or 125 VAC phase-to-ground with red enamel letters or numerals of appropriate height applied with a stencil.
2. Except as otherwise noted, all equipment shall be marked with engraved nameplates of laminated two-color phenolic plastic having white letters. Attach each nameplate with stainless steel screws. Align nameplates on equipment being marked in the center near the top.
3. Panelboards and control panels shall have designation in 1/2-inch-high letters and voltage in 1/4-inch-high letters centered above the door on exterior trim.
4. Mark equipment mounted remotely from the source of power (such as pumps and fans) with equipment number, source of power, and starter location. Where starters are remotely mounted, marking shall include equipment name, number, and location.
5. Conductors shall be identified at each termination, pull box, junction box, handhole, point of entry to or exit from wireways, panelboards, control panels, and other points of access. Tags or labels shall be securely affixed to the conductor in visible locations. Tags shall be durable plastic with the designation stamped on one side with suitable dies. Labels shall be permanent with legible black characters on white heat-shrink tubing or equivalent identification acceptable to the Owner.
 - a. Power conductors shall be color-coded to identify phases, neutral and switch legs, using plastic, self-sealing tape. Tags or labels shall identify the switchboard, MCC, panel, etc., it is served from and the circuit number.

- b. The control conductor (including monitor and instrumentation conductors) shall be identified by color coding and tag or label as to wire number (corresponding to the manufacturer's wiring diagram) and equipment name.
 - c. Power wiring and control wiring shall be identified in all handholes with a waterproof permanent tag attached to the cable with plastic cable ties.
- D. Equipment Connections: Provide complete system with all power and control connections required for proper operation.
- E. Conduit
 - 1. Rigid galvanized steel (RGS) conduit may be used as follows:
 - a. Exposed in buildings.
 - b. Exposed with PVC coating.
 - c. Concealed in poured concrete.
 - d. Below grade with PVC coating.
 - 2. Rigid non-metallic (PVC) conduit may be used as follows:
 - a. Concealed in walls and floors, Schedule 80.
 - b. Below-grade direct burial, Schedule 80.
 - 3. Burial depth of conduit shall be measured from the top of the conduit to the top surface of finished grade, pavement, concrete, or similar cover as follows:
 - a. 36 inches (minimum) below unpaved areas,
 - b. 36 inches (minimum) below stabilized subbase in paved areas.
 - 4. For concrete slabs on grade and foundations, conduit burial depth shall be measured from the bottom of the concrete slab or foundation as follows:
 - a. 12 inches (minimum) below concrete slabs on grade or foundations.
 - 5. It shall be the responsibility of the Electrical Contractor to coordinate the location and depths of all electrical conduits to be installed under this Contract with other trades. Particular attention shall be given to all locations where conduits enter a structure or building from underground. Proper clearances from the top of the conduits to the bottom of slabs and foundations shall be maintained.

6. Where conduits rise through slabs on grade, curved portion of bends shall not be visible above the finished slab.
7. Conduit stub-up to above grade and conduit stub-up out of or from below floor slab shall be PVC-coated aluminum from and including the last 90° bend.
8. Stub-ups through concrete slabs for connection of future equipment or conduits runs shall be provided with couplings threaded inside for plugs and shall be set flush with the finished floor or slab. Install screwdriver-operated threaded flush plugs in couplings. Provide pull wire in all empty conduit runs.
9. Avoid bends and offsets, where possible. Make bends and offsets with an approved hickey or conduit-bending machine. Install plastic (PVC) coated conduit and fittings in accordance with the manufacturer's installation manual using tools designed for installing plastic (PVC) coated conduit and fittings. Touch up any and all damaged areas with manufacturer-recommended coating compound. Do not install crushed or deformed conduit. Use expansion fittings or other approved devices where conduit or tubing crosses expansion joints. Prevent dirt or trash from lodging in conduits, boxes, and fittings. Free clogged conduit of all obstructions or replace conduit.
10. Installers of PVC coated metal conduit shall be certified by the manufacturer and be able to present a valid, unexpired, certified installer card before starting installation.
11. Supports:
 - a. Pipe straps, wall brackets, hangers, or ceiling trapeze.
 - b. Use wood screws or screw-type nails for fastening to wood. Use toggle bolts for fastening to hollow masonry units. Use concrete inserts or expansion anchors for fastening to concrete. Use machine screws, welded threaded studs, or spring-tension clamps for fastening to steel work.
 - c. Power-driven threaded studs may be used in lieu of expansion bolts or machine or wood screws where acceptable to the Owner.
 - d. Use threaded C-clamps on rigid steel conduit only.
 - e. Do not weld conduit or pipe straps to steel structures.
 - f. Non-metallic conduit through 1-inch size shall use one-hole snap-strap clamps and 1-1/4-inch through 2-inch shall use two-hole snap-strap clamps, with maximum spacing between supports as

outlined in the NEC based on 50°C conductor temperature. Clamps shall be manufactured from a nylon compound.

12. Expansion couplings shall be used in all straight lengths of non-metallic conduit in exposed applications. Maximum spacing between expansion couplings shall be 100 feet.
13. Connections: All conduits, where they enter sheet metal enclosures such as panelboards, pull boxes or outlet boxes, shall be secured in place by galvanized locknuts and bushings, one locknut inside of box with bushing on conduit end and one locknut outside of box for rigid conduit. The locknuts shall be tightened against the box without deforming the box.
 - a. Conduit connections shall use fittings to maintain NEMA rating of enclosures.
 - b. All bushings and conduit box connectors shall have the insulating material permanently fastened to the fittings.
 - c. Grounding bushings shall be used in switchgear and motor control centers.
 - d. Conduit connections exposed in wet locations shall be by watertight threaded hub. Metallic conduit box connections may use a two-piece hub with built-in recessed neoprene gasket such as Appleton Uni-Seal. Non-metallic conduit box connectors may use a neoprene flat washer or “O” ring placed over threads of the fitting between the shoulder of the fitting and the box.

F. Boxes

1. The Contractor shall provide outlet, pull, junction, or terminal boxes in wiring or conduit systems wherever required for pulling wires, making connections, and mounting devices or fixtures.
 - a. Indicated locations are approximate only. Coordinate actual location with all work to be performed in the space or area and for the equipment to be served.
 - b. Locate outlets so that fixtures and other items will be symmetrically located according to the space or area layout.
 - c. Outdoor switch and receptacle outlets shall use non-metallic boxes and covers.
2. Outlet boxes in exposed work or wet locations shall be cast metal. Sheet metal boxes shall be concealed in walls or ceiling. Non-metallic boxes shall be used with non-metallic conduit.

3. Supports:

- a. In open overhead spaces, cast boxes threaded to rigid metallic conduit need not be separately supported unless used for fixture support.
- b. Use wood screws or screw-type nails for fastening to wood. Use toggle bolts for fastening to hollow masonry units. Use concrete inserts or expansion anchors for fastening to concrete. Use machine screws or welded, threaded studs for fastening to steel work.
- c. Power-driven threaded studs may be used in lieu of expansion bolts or machine or wood screws where acceptable to the Engineer and the Owner.

G. Wiring Devices: Receptacles installed outdoors shall be the ground-fault circuit-interrupter type.

H. Wiring

- 1. The Contractor shall provide a complete system of conductors as indicated.
- 2. Size shall be as required by the NEC and shall be #12 AWG minimum for power and lighting circuits and #14 AWG minimum for control and alarm circuits.
- 3. Crimp-on insulated wire terminals shall be used on stranded wire for terminations.
- 4. Splices shall be in accessible locations only and shall be insulated-pressure type for #10 AWG and smaller wires. For #8 AWG and larger, use solderless connectors covered with an insulation material equivalent to the conductor insulation.

I. Lighting Fixtures: All fixtures and supports shall be carefully laid out and equipped with suitable swivel hangers, canopies, and/or other auxiliaries as required to ensure that fixtures are plumb without bending or offsetting stems, rods, or supports and properly aligned both lengthwise and crosswise except that where obstructions or conflicts are encountered the fixtures shall be relocated as directed by the Engineer or the Owner and installed in such a manner as to provide a finished, neat, and workmanlike installation.

J. Appearance: All items shall be cleaned or touched up as necessary to ensure first-class condition.

3.03 FIELD TESTS AND OBSERVATION

- A. General: Do not enclose or cover any work until it has been observed, tested, and accepted.
 - 1. Provide all personnel, equipment, and instruments required for observation and testing.
 - 2. Demonstrate that all circuits and devices are in operating condition. Tests shall include the following:
 - a. Megger all motor windings before operation for insulation resistance and, if found low, dry out windings to secure acceptable insulation resistance.
 - b. Check control center components, buses, starters, breakers, relays, alarms, interlocks, etc., and place in service in accordance with the manufacturer's instructions. Inspect and adjust electrical equipment before energization.
 - c. Megger all power cables and wiring for insulation resistance and record.
 - d. Check all motors for correct lubrication and lubricate, if required, in accordance with the manufacturer's instructions.
 - e. Check direction of rotation of all motors and reverse, if necessary.
 - 3. Assemble in binders and turn over to the Owner all instruction bulletins, lubrication schedules, operating instructions, pamphlets, parts lists, prints, etc., accompanying or attached to apparatus and equipment.
 - 4. Notify the Engineer and the Owner 1 week before test date.
- B. Ground Rod Test: Before any wire is connected to ground rods, test each rod for resistance to ground.
 - 1. The testing instrument shall be a direct reading, single test, portable ground testing megger.
 - 2. The test procedure shall be as recommended by the manufacturer of the test instrument used.
 - 3. The make and model of the test instrument and a copy of the test procedure shall be submitted to the Owner before the test is conducted.
 - 4. Do not conduct tests within 48 hours after rainfall or during foggy weather.
 - 5. If ground resistance exceeds 10 ohms, additional grounds shall be driven.
 - 6. The grounding test shall be witnessed by the Engineer or other representative of the Owner. A copy of the test results and method shall be

included in the maintenance manual. Deliver one copy of the test results to the Engineer and the Owner within 1 week after the test.

3.04 ADJUST AND CLEAN

- A. The Contractor shall remove excess and waste materials from the project site.
- B. Remove defective work and replace with material that meets Specification requirements or repair to the satisfaction of the Owner.
- C. Touch up scratches, abrasions, voids and other defects in factory- or shop-finished surfaces.

END OF SECTION

**TECHNICAL SPECIFICATIONS
FOR THE
2024 GAS COLLECTION AND CONTROL SYSTEM**

Lee/Hendry Regional Solid Waste Disposal Facility 2024 Gas Collection and Control System

Technical Specifications

Lee-Hendry County Landfill
5500 Church Rd.
Felda, Florida 33930

SCS ENGINEERS

09223126.00 | April, 2024

3922 Coconut Palm Dr, Ste 102
Tampa, FL 33619
813-621-0080

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SECTION 01 10 00

SUMMARY OF WORK

PART 1 – GENERAL

1.01 PROJECT DESCRIPTION

- A. The project work to be performed by the Contractor consists of furnishing all labor, materials, equipment, tools, transportation, services, incidentals, and performing all work necessary to complete the project, in place and ready for service in accordance with the Plans and Specifications prepared therefore and entitled “Lee/Hendry Regional Solid Waste Disposal Facility (Facility) Gas Collection and Control System (GCCS)”. The work generally includes but is not limited to the following items:
1. Construction staking/system layout/surveying prior to construction.
 2. Installing below grade high-density polyethylene (HDPE) landfill gas (LFG) extraction wells and horizontal collectors with sumps at the low points.
 3. Installing below grade high-density polyethylene (HDPE) LFG laterals and header, air supply line, and dewatering discharge line. Header appurtenances also to be installed include, but are not limited to, sumps, isolation valves, access risers, and blind flanges.
 4. Installing header isolation valve, airline isolation valves, and liquid conveyance line isolation valves, cleanouts, and air release valves.
 5. Contractor is responsible for procurement and cost of clean soil backfill.
 6. Installing gas wellheads, including fittings, valves, tubing, hoses, clamps, regulators and filters, and related appurtenances.
 7. Interconnection of electrical service and installation of new control/disconnect panels to ensure new flare and existing appurtenances have the necessary electrical required.
 8. Installation of the new compressed air system including all electrical wiring and conduit required to power proposed and existing entities as outlined in the drawings.
 9. Offloading and installation of new 2,500 scfm flare station skid. Installing all electrical wiring and conduit required to power proposed entities as outlined in the drawings.

10. Pouring and testing of concrete pads for Blower/flare, air compressor and propane tank and future generator.
11. Connection of all electrical wiring to new flare skid.
12. Install condensate management piping to remove condensate from proposed flare skid as shown in drawings.
13. Install lift station with submersible pump to discharge to the ponds as shown in the drawings.
14. Fencing to house flare, blower, and air compressor station with structure.
15. System start-up and testing of new system once installation has been completed by electrical and mechanical contractors including verification and technical assistance with electrical wiring and conduit required to power and operate all proposed entities as outlined in the drawings.
16. Repairing access road in areas impacted by construction activities.
17. Conformance surveying
18. Providing as-built documentation (record drawings)

1.02 WORK SEQUENCE

Construction work is to be sequenced to accommodate work with any other contractors on site or County forces.

1.03 CONTRACTOR USE OF PREMISES

- A. The land available for the Contractor's use during the performance of the project will be limited to the area as shown on the Contract Drawings and identified as "Contractors Storage/Laydown Area." The exact area will be determined during the pre-construction meeting with the coordination of the County and Contractor.
- B. Work Days: Allowable work times shall be Monday through Friday 7:00 a.m. to 4:00 p.m. and Saturday 7:00 a.m. to 12 p.m., excluding Sundays and County observed Holidays. Contractor shall request in writing to the County 48 hours' prior to Sunday or County observed Holiday to work.
- C. Access: No later than 10 days after notice to proceed, the Contractor shall arrange with the County a sequence of procedures, means of access, space for storage of materials and equipment, and use of approaches and roadways. Contractor's use of the premises shall be confined to the areas approved by the County.
- D. Smoking: Smoking is prohibited at the Landfill.

- E. Contractor shall not dispose any refuse on site without approval of the County and in accordance with Section 02 41 16, Refuse Handling, Storage, and Disposal.
- F. Areas outside the limits of construction that have been disturbed by the Contractor shall be returned to its original condition, or better, upon completion of the work at no additional cost to the County.
- G. Contractor shall coordinate with the County for available area to locate Contractor's trailer. Non-potable water and electrical services are already available. If using the electrical service, the Contractor is responsible for coordinating with the electric company for any connections and pay for electrical services at no additional cost to the County.

1.04 WORK HOURS

- A. Regular working hours are defined as Monday through Friday 7:00 a.m. to 4:00 p.m. and Saturday 7:00 a.m. to 12 p.m., excluding Sundays and County observed Holidays. Contractor shall request in writing to the County 48 hours' prior to Sunday or County observed Holiday to work.
- B. Construction Quality Assurance (CQA) shall be the responsibility of the County and CQA Consultant who will act as the County's representative. The CQA Consultant is a party independent of the Contractor and is responsible for field-testing, observing, and documenting activities related to the construction and/or permit documents and the CQA Plan. The CQA Consultant will provide a full-time Construction Quality Assurance Representative (CQAR) who will observe construction activities.
- C. Requests for approval by the County to work other than regular working hours must be submitted to the County at least 48 hours prior to any proposed weekend work or extended workweek hours.
- D. Periodic unscheduled work hours on weekdays will be permitted provided that 24 hours notice is provided to the County. Maintenance and cleanup may be performed during hours other than regular working hours.

1.05 COUNTY OCCUPANCY AND LANDFILL OPERATIONS

The Contractor shall cooperate with the County during construction operations to minimize conflicts with County work and facilitate County usage. The Contractor shall perform the work so as not to interfere with the County's operations, maintenance, environmental monitoring, and other County activities at the site.

1.06 SITE CONDITIONS

- A. Existing Grades: The existing grades may vary from those indicated on the Plans due to landfill settlement and ongoing filling operations.

- B. Existing Features: The Contract Documents require the Contractor to field verify the location of existing features. Existing features include but may not be limited to the following: stormwater drainage structures and underground pipes, stormwater terraces and swales, leachate collection system cleanouts, sumps, pump stations, electrical panels, forcemain, utilities, roads, guardrails, drainage culverts, monitoring wells and piezometers, fences, and buildings.
- C. Preconstruction Survey - The Contract Documents require the Contractor to prepare a preconstruction survey prior to beginning work. Refer to Section 01 50 00 Site Conditions Surveys for requirements.
- D. The Contractor shall enforce safety procedures to minimize hazards to workers, the public, and the environment.

1.07 LINES AND GRADE

- A. All work shall be done to the lines, grades, and elevations shown on the Contract Drawings.
- B. Topographic survey information (north, the grid, and the coordinates shown) is referenced to the East Zone of the Florida State Plane Coordinate System. Basic horizontal and vertical control points have been established. These points shall be used as datum for the work. All additional survey, layout, and measurement work shall be performed by the Contractor as a part of the work.
- C. The Contractor shall provide experienced instrument personnel, competent assistants, and such instruments, tools, stakes, and other materials required to complete the survey, layout, and measurement work. In addition, the Contractor shall furnish, without additional cost to the County, competent personnel from its force and such tools, stakes, and other materials as the Engineer may require in establishing or designating control points, checking survey, layout, and measurement of work performed by the Contractor.

1.08 ERRORS AND/OR OMISSIONS IN PLANS AND SPECIFICATIONS

The intent of the Specifications is to outline or indicate the items of work, or both, which cannot be readily shown on the Drawings and, further to indicate the types and qualities of materials. Drawings and specifications shall be considered as being complimentary and items or work mentioned or indicated in one and not in the other shall be included as if mentioned in both. Should Drawings disagree in themselves or with the Specifications the better quality or greater quantity of work or materials shall be estimated upon, and shall be provided.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 20 00

MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The Contractor shall receive and accept the compensation provided in the Contract as full payment for furnishing all labor, equipment, and materials and for performing all construction/operations necessary to complete the work as described in the Contract, and in full payment for all losses or damages incurred during the work, for any discrepancies between actual and estimated quantities, or from any unanticipated difficulties which may arise during the work until final acceptance by the County.
- B. Payment for the various items on the Contractor's Bid Form, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles and for all labor, operations, supervision, overhead, and profit, and incidentals appurtenant to the items of work being described as necessary to complete the various items of the work all in accordance with the requirements of the Contract Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor.
- C. No separate payment will be made for any item that is not specifically set forth on the Contractor's Bid Form and all costs therefore shall be included in the prices named on the Contractor's Bid Form for the various appurtenant items of work. Payment for complying with the safety requirements for construction on the work site shall be included in the contract unit price paid for the various items of work wherein it is required, and no separate payment will be made therefore.
- D. The total Bid Amount shall cover all work required by the Contract Documents. All costs in connection with the proper and successful completion of the work, including furnishing all materials, equipment, supplies, and appurtenances; providing all construction equipment and tools; including all costs and expenses for taxes, commissions, transportation charges and expenses, permit fees, patent fees, royalties, handling and tests; and performing all necessary labor and supervision to fully complete the work shall be included in the Bid. All work not specifically set forth as a pay item on the Contractor's Bid Form shall be considered a subsidiary obligation of Contractor and all costs in connection therewith shall be included in the unit prices Bid and/or the lump sum prices.

- E. The quotations for the various items of work are intended to establish a total price for completing the work in its entirety. Should the Contractor feel that the cost for any item of work has not been established by the Contractor's Form, Contractor shall include the cost for that work in some other applicable Bid Item, so that his Bid for the project does reflect his total price for completing the work in its entirety.
- F. All estimated quantities stipulated on the Contractor's Bid Form are approximate and are to be used only (a) as a basis for estimating the probable cost of the work and (b) for the purpose of comparing the Bids submitted for the work. The actual amounts of work done and materials under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished unless it exceeds the estimated quantities in which case a change order must be approved prior to payment for quantities exceeding the estimated quantity.
- G. The Contractor shall field verify all quantities and dimensions shown on the Drawings or contained in the Contract Specifications.
- H. The Contractor shall be responsible for establishing contracts with its subcontractors, which have a measurement and payment in accordance with this Section. If the Contractor establishes a contract with its subcontractors, which is in conflict with this Section, any additional cost incurred will be borne by the Contractor.
- I. Restoration is not a separate pay item but is considered to be an integral part of the work under the contract, and all contract Bid prices include the cost of restoration necessitated by the work related to that Bid item. Restoration includes existing structure and property, paving, stabilized roads, drainage piping and ditches, catch basins, head walls, yard culverts, driveways, lawns and ground areas, walkways, and irrigation systems, which are altered, removed or damaged during construction. Cleanup is an integral part of restoration.

1.02 COMPUTATION OF QUANTITIES

- A. Measurement of quantities expressed as area shall be based upon a horizontal, planimetric projection to the work limits as determined by survey record drawings prepared by a surveyor licensed in the State of Florida. Cost of surveying shall be paid by Contractor, and incorporated into Bid Items, as appropriate.
- B. Measurement of linear Items will be for quantities actually field installed to the specified work limits, based upon surveyed stations recorded along the straight or curved centerline of each respective Item. Measurement conducted by survey is to be conducted by the Contractor's approved surveyor licensed in the State of Florida.

- C. Payment will be made to the limits as specified in the Contract Documents. If the constructed limits are less than the specified limit, payment will be made to the actual limits of construction as shown on the Record Drawings. Payment for quantities that exceed the specified contract limits will only be made with the approval of the County with acceptable supporting documentation from the Contractor. Payment for quantities that exceed the Contract quantities can only be obtained through an approved Change Order.
- D. No partial payments shall be made for the installation of items which have not been tested and approved by the Engineer.
- E. Payment will be made monthly until completion of each unit price item based on quantity completed by Contractor, and verified by the Engineer. Final payment will be based on quantity calculated from Record Drawings prepared by a surveyor licensed in the State of Florida and confirmed by field measurement by the Engineer.
- F. Payment for Lump Sum items will be made as described for each individual lump sum Bid Item. The Contractor shall not rely on the estimated quantities given, but shall instead estimate all quantities for the item independently for the basis of their Bid. No claim shall be made by the Contractor for deviations between the Contractor's estimated quantity and the Engineer's estimated quantity including the quantity required to complete the Work. The Contractor shall base their Bid solely on the Contractor's independently estimated quantity.

1.03 VARIATIONS IN ESTIMATED QUANTITIES

- A. The quantities given in the Contract Documents are approximate only, and are given as a basis for the uniform comparison of Bids. The County does not expressly, or by implication, agree that the actual amount of work will correspond therewith.
- B. The Contractor must provide, for unit price work, a proposed contract price determined on the basis of estimated quantities required for each item. The estimated quantities of items are not guaranteed and are solely for the purpose of comparing Bids. Each such unit will be deemed to include an amount for overhead, profit and indirect costs for each separately defined item.

1.04 BID FORM

- A. The Bid Form for the items contained within this Section can be found in the contract documents.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 MEASUREMENT AND PAYMENT - REQUIRED

A. Item No. 001 – Mobilization / Demobilization (Lump Sum)

Measurement. Measurement for this item shall be on a lump sum basis based on percentage of work completed. Mobilization and Demobilization should not exceed 5% of the total contract value.

Payment. Payment for this item shall be on a lump sum basis as described below. No price adjustments will be made for this item due to changes in the work. Item includes, but not limited to, performance of preparatory paperwork and construction operations, movement of personnel and equipment to the project site, safety equipment, furnishing, and installing at the beginning of the project, as well as removing and disposing at the conclusion of the project, required facilities to begin work on a substantial phase of the Contract.

The Contract Price for mobilization/demobilization shall be subject to the following provisions:

- a. Partial payments for mobilization/demobilization will be made in accordance with the following schedule.

Condition or Percent of Total Contract Amount Earned	Allowable Percent of the Lump Sum Price for the Item
Submittal/completion of items listed in Section 013010 prior to construction	25
10 percent total contract amount earned	40
25 percent total contract amount earned	60
50 percent total contract amount earned	80
100 percent total contract amount earned	100

The final payment for mobilization/demobilization will not be made until all temporary facilities, excess materials, temporary erosion and sedimentation controls, equipment, and appurtenances used to perform the Work and all remaining construction debris have been removed from the site. Additionally, this shall include the submittal of all final record drawings, record survey project photos, release of liens, warranties, and other incidentals as specified as requirements of project close-out.

B. Item No. 002 – Project Survey (Lump Sum)

Measurement. Measurement for the Work specified in this item shall be based on the schedule below for payment and all Items related to survey the Work shall be included in the Lump Sum price. Project Survey shall not exceed 3% of the total contract value.

Payment. Payment for this item shall be on a lump sum basis as described below. No price adjustments will be made for this item due to changes in the work. This item will consist of all surveying and control required by the Contract Documents. Surveying shall be performed as described in the technical specifications. This work includes establishment of appropriate local site benchmarks, baseline surveys, location of utilities, stakeout of elevation and positional information required to complete the construction, progress payment surveys, and obtaining all survey information required to compile Record (As-Built) Drawings as required by the Contract Documents. As-built drawings must be signed and sealed by a surveyor licensed in the State of Florida.

The Contract Price for Project Survey shall be subject to the following provisions:

- a. Partial payments for surveying will be made in accordance with the following schedule.

Condition or Percent of Total Contract Amount Earned	Allowable Percent of the Lump Sum Price for the Item
Preconstruction Survey	25
LFG System Survey	50
Final Survey - Record Drawings and As-Built signed and sealed survey as required	100

The following defines complete documents for the surveys notated above:

Preconstruction Survey: The preconstruction survey shall include a survey of the existing conditions within the limits of construction of the Gas Collection and Control System (GCCS). The survey shall note all above grade structures, piping, and features which may or will be impacted by the work. The preconstruction survey shall include proposed location of landfill gas header and lateral pipes, stub out locations for future construction, vertical wells, remote wells, access riser points, isolation valves, air release valves, sumps, road crossings, connection points to existing GCCS, sections to be abandoned and removed, and any other improvement as part of the GCCS construction. Vertical well locations to include Northing, Easting, ground surface elevation to determine any adjustments prior to drilling.

LFG System Survey: The LFG system survey shall include survey locations of the landfill gas header and lateral pipes, stub out locations for future construction, vertical wells, remote wells, access riser points, isolation valves, air release valves, sumps, road crossings, bollards, and any other improvement as part of the GCCS construction.

Final Survey - Record Drawings and As-Built: Following completion of the LFG Survey, the final survey will include all features of the project installed as part of the construction project and all existing features within the limits of construction. The final survey shall include, but not limited to, GCCS components, all above grade structures, piping, sod limits, roadways, stormwater down chutes, and features that were impacted by the work.

The Contractor shall, throughout the project, maintain a redline set of construction drawings noting deviations or actual installed conditions for the GCCS construction. As part of Final Completion, the Contractor must submit a complete set of final Record Drawings based on the redlines maintained throughout the project which identify the actual constructed conditions. These record drawings shall use the construction drawings as a base and show changes by cloud and strikethrough in electronic format (AutoCAD 2018 or newer). The record drawings shall incorporate the surveys listed above and any other changes made to the components of the GCCS into the set so to create a single Record Drawing Set for the project. A draft Record Drawing set, in both hardcopy and AutoCAD 2018 (or newer) format in accordance with the specifications, must be submitted to the County and Engineer for review in order to grant Substantial Completion. Final completion cannot be granted until certified Record Drawings (hardcopy and AutoCAD) signed and sealed by a Florida licensed Professional Engineer or Land Surveyor and the Project Record Documentation package is submitted to and approved by the County and Engineer. The Record Drawings are critical to the County and must be accurate to receive approval by the Florida Department of Environmental Protection (FDEP) for operation of the facility.

Partial Surveys of Work: It is understood that the Contractor may elect to survey each section of the GCCS system separately. Partial surveys must be submitted to the Engineer to determine that the section the Contractor is requesting to continue working in meets the design requirements. The Contractor may not continue work until the partial survey is approved. Partial surveys are not required to be signed and sealed at the time of submittal, however, the partial surveys used to compile the complete survey for each of the surveys listed above, must not deviate from the partial survey submitted and the complete survey must be certified for submittal. Payment for surveys will not be made until the complete, certified survey is submitted and approved. However, partial surveys may be used for payment of work items such as soil and piping upon review, agreement, and approval by the County, Engineer, and CQA Representative.

- C. Item No. 003 – 36-inch Diameter Bore with 8-inch Diameter HDPE SDR 11 Casing (Vertical Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified landfill gas wells from existing ground surface to the bottom of the well bore as measured in the field by the Engineer.

Payment. Payment for this item will be at the contract unit price per linear foot installed. Payment will include all boring, stone, soil, bentonite, geotextile, well bore reinforcement grate, backfilling, waste relocation to working face, health and safety requirements, HDPE piping (solid and perforated), connections, fittings, and shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents. Price shall include the above-grade riser pipe at each well.

- D. Item No. 004 – Boring Refusal (Vertical Foot)

Measurement. Wells that must be abandoned due to insufficient depth resulting from boring refusal shall be paid on a linear foot basis as measured in the field by the Engineer from existing ground surface to the bottom of the well bore. No boring may be abandoned without approval of the Engineer. Proper backfill of abandoned boreholes will include clean soil to surface. This item shall include all material, labor, equipment, waste relocation to working face, backfill transportation, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

Payment. Payment for this item will be at the contract unit price per linear foot of boring, and includes boring, and backfilling with clean soil.

- E. Item No. 005 – 18-inch HDPE SDR 17 Landfill Gas Header Pipe (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item shall be at the contract unit price per horizontal linear foot of installed 18-inch HDPE SDR 17 header piping. Payment includes trench excavation, loading, hauling, and unloading of excavated waste from GCCS trenches and disposing of at the active face; loading, hauling, and unloading of clean soil from adjacent borrow area and placed into GCCS trenches; placing pipe bedding, clean soil backfill, soil compaction, fittings, piping, connections, cutting and capping of pipes to be abandoned in place, pipe location markings, quality control surveying, pressure testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- F. Item No. 006 – 8-inch HDPE SDR 17 Landfill Gas Lateral Pipe (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item shall be at the contract unit price per horizontal linear foot of installed 8-inch HDPE SDR 17 lateral piping. Payment includes trench excavation (5 ft deep or less), loading, hauling, and unloading of excavated waste from GCCS trenches and disposing of at the active face; loading, hauling, and unloading of clean soil from adjacent borrow area and placed into GCCS trenches; placing pipe bedding, clean soil backfill, soil compaction, fittings, piping, connections, cutting and capping of pipes to be abandoned in place, pipe location markings, quality control surveying, pressure testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

G. Item No. 007 – 6-inch HDPE SDR 17 Landfill Gas Lateral Pipe (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item shall be at the contract unit price per horizontal linear foot of installed 6-inch HDPE SDR 17 lateral piping. Payment includes trench excavation (5 ft deep or less), loading, hauling, and unloading of excavated waste from GCCS trenches and disposing of at the active face; loading, hauling, and unloading of clean soil from adjacent borrow area and placed into GCCS trenches; placing pipe bedding, clean soil backfill, soil compaction, fittings, piping, connections, stub-ups for connections at wellheads, pipe location markings, quality control surveying, pressure testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

H. Item No. 008 – 8-inch Solid Wall HDPE SDR 11 Horizontal Collector Pipe (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe wherein measurement will be made in plan view from the LFG System Survey.

Payment. Payment for this item shall be at the contract unit price per horizontal linear foot. Payment includes excavation, transportation of excavated refuse to the working face, backfill material, bentonite, backfilling, soil compaction, restoration of cover soils, fittings, piping, connections, risers for connection to wellheads, pipe location markings, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work

incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- I. Item No. 009 – 8-inch Perforated Wall HDPE SDR 11 Horizontal Collector Pipe (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe wherein measurement will be made in plan view from the LFG System Survey.

Payment. Payment for this item shall be at the contract unit price per horizontal linear foot. Payment includes excavation, transportation of excavated refuse to the working face, backfill material, tire chips provided by the County, geotextile, bentonite, backfilling, soil compaction, restoration of cover soils, fittings, piping, connections, risers for connection to wellheads, pipe location markings, quality control surveying, testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- J. Item No. 010 – 30-inch CMP Casing for Road Crossing (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item will be at the contract unit price per linear foot installed, including excavation, backfilling, solid corrugated drainage piping installation and connections, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- K. Item No. 011 – 18-inch CMP Casing for Road Crossing (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item will be at the contract unit price per linear foot installed, including excavation, backfilling, solid corrugated drainage piping installation and connections, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- L. Item No. 012 – 3-inch HDPE SDR 11 Pipe in Separate Trench (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item will be at the contract unit price per horizontal linear foot of installed 3-inch HDPE SDR 11 Pipe in a separate trench from LS-01 to the tie-in location at the existing Class III pond. Payment includes fittings, piping, connections, blind flange for future connection, concrete pad at the pond inlet, pipe supports, pipe location markings, quality control surveying, pressure testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- M. Item No. 013 – 3-inch HDPE SDR 11 Condensate Discharge Line in Common Trench (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item shall be at the contract unit price per horizontal linear foot of installed 3-inch HDPE SDR 11 Condensate Discharge Line in a common trench with the air supply line and header or lateral pipe. Payment includes fittings, piping, connections, stub-ups for connection at wellheads and isolation valves, cutting and capping of pipes to be abandoned in place, pipe location markings, quality control surveying, pressure testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- N. Item No. 014 – 2-inch HDPE SDR 9 Air Supply Line in Common Trench (Linear Foot)

Measurement. Measurement for this item shall be on an installed linear foot basis per specified pipe size wherein measurement will be made in the plan view from the LFG System Survey.

Payment. Payment for this item shall be at the contract unit price per horizontal linear foot of installed 2-inch HDPE SDR 9 Air Supply Line with the liquid conveyance line and header or lateral pipe. Payment includes fittings, piping, connections, stub-ups for connections at wellheads and isolation valves, pipe location markings, quality control surveying, pressure testing, and incidentals. Payment shall constitute full compensation for all material, labor, equipment and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- O. Item No. 015 – 24-inch HDPE SDR 17 Condensate Sump with Pump (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed condensate sump with pneumatic pump, including excavation, stone base support, backfilling, clean soil backfill material, concrete ballast, dewatering efforts, fittings, sump and piping installation and connections, monitoring ports, supplied pump, placement and testing of the pump, pump data modules, pump air and discharge hoses, check and ball valves, connectors for air and condensate discharge line, sump flanged lid, testing, connection to header pipe, and any other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- P. Item No. 016 – 18-inch HDPE SDR 17 Horizontal Collector Sump with Pump (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed condensate sump with pneumatic pump, including excavation, stone base support, backfilling, clean soil backfill material, fittings, sump and piping installation and connections, monitoring ports, supplied pump, placement and testing of the pump, pump air and discharge hoses, connections to air and condensate discharge stub-ups, sump flanged lid, testing, connection to horizontal collector piping, and any other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- Q. Item No. 017 – 18-inch Header Isolation Valves (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, backfilling, flanges, valves, valve stem extension controls, fittings, spacers, piping installation and connections, flexible hoses, and related component, testing, plastic wrapping and coating, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

- R. Item No. 018 – 3-inch Condensate Discharge Isolation Valve with Vault Box (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, backfilling, valve with vault box, fittings, spacers, piping installation and connections, pipe supports, related component, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

S. Item No. 019 – 2-inch Air Supply Line Isolation Valves (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, backfilling, valves, fittings, spacers, piping installation and connections, pipe supports and related component, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

T. Item No. 020 – 3-inch Condensate Discharge Stub-up with Valve Fittings (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis. This item is for the pump discharge manifold at stub-ups at a new gas well and horizontal collector.

Payment. Payment for this item will be at the contract unit price per supplied unit, including valves, fittings, spacers, installation and connections, testing, and other incidentals. Contractor is to install stub-ups, valves, and valve fittings. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

U. Item No. 021 – 2-inch Air Supply Stub-up with Valve Fittings (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis. This item is only for the check and ball valve at stub-ups at new gas well and horizontal collector.

Payment. Payment for this item will be at the contract unit price per supplied unit, including valves, fittings, spacers, installation and connections, testing, and other incidentals. Contractor is to install stub-ups, valves, and valve fittings. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

V. Item No. 022 – 2-inch Condensate Discharge Line Air Release Valve (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, backfilling, valves, fittings, spacers, piping installation and connections, pipe supports and related component, flanges, pressure testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

W. Item No. 023 – 18-inch HDPE SDR 17 Header Access Riser (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed vacuum access risers for the 18-inch HDPE SDR 17 header pipe, including completed access riser, fittings, piping, blind flange with neoprene gaskets, connections to header line, monitoring ports, tubing for LFG sampling, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

X. Item No. 024 – 18-inch Header Blind Flange (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis. This item is only for the header blind flanges.

Payment. Payment for this item will be at the contract unit price per supplied unit. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

Y. Item No. 025 – 3-inch Condensate Discharge Dual Cleanout (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed unit, including excavation, backfilling, valves, fittings, spacers, piping installation and connections, testing, and other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

Z. Item No. 026 – Sodding (Square Yard)

Measurement. Measurement for this item shall be on a square yard basis wherein measurement will be made in the plan view from the Final Survey. Areas disturbed

by the Contractor that are not required as part of the performance of the work, as determined by the County and Engineer, will not be included in the quantity of payment.

Payment. Payment for this item shall be on a square yard basis for areas which have been disturbed by the CONTRACTOR estimating a 50-foot wide section following the alignment of the LFG header and lateral pipes along the side slopes as shown on the Contract Drawings and in accordance with the Specifications. The pay item includes addition of topsoil, conditioning the topsoil with fertilizer and/or lime application, soil testing, fine grading, supplying and installing sod, anchoring/netting of sod, watering, mowing, replanting, repair of erosion, maintaining areas sodded through final acceptance of the WORK, and any other work necessary to produce a uniform stand of grass. No payment will be made for sod placed outside of the limits of construction shown on the Contract Drawings without prior approval of the ENGINEER. Payment of sod shall not relieve the CONTRACTOR of the need to maintain sod throughout warranty period.

AA. Item No. 027 – LFG Wellheads – (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item shall be at the contract unit price per supplied unit, including new QED Precision Accu-Flo wellheads with fine tune control valve and all required connections, QED well caps, Solarguard flex hose, steel clamps, fittings, monitoring/sample port covers, high liquid level indicator, and HDPE reducers. Contractor shall also include the material and labor for installing the wellheads on remotes, horizontal collectors and any required transitions and fittings. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

BB. Item No. 028 – Compressed Air System (Lump Sum)

Measurement. Measurement for this item shall be on a completed lump sum basis.

Payment. Payment for this item will be on a lump sum basis for the supply and installation of a new compressor, dryer system, and storage tank including compressor shed enclosure. This pay item shall include grading and compaction of base soils, site work, enclosure, excavation, pipe installation, backfilling, compaction, fittings, supply and installation of the new compressor, dryer, tank, and all mechanical and electrical connections, testing and start-up services. All valves, piping, and related work to provide full functional compressor/dryer system. Payment also includes all materials, equipment, and setup, including the control panel, electrical conduit, wiring, setup of communications system, computer interface setup, and any other work necessary to provide a fully

functional system. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

CC. Item No. 029 – Grading Work for Flare and Blower Skid Area (Lump Sum)

Measurement. Measurement for this item shall be on a completed lump sum basis.

Payment. Payment for this item will be on a lump sum basis for the completed grading work for the flare and blower skid area. This pay item shall include procurement of clean soil, grading and compaction of soils, placement of gravel pads and fencing in the Construction Drawings. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

DD. Item No. 030 – Concrete Pads (Lump Sum)

Measurement. Measurement for the work specified in this item will be based on Lump Sum for the concrete pads installed in accordance with the Contract Documents.

Payment. Payment for this item will be on a Lump Sum basis for a completely supplied, installed and accepted concrete pads for the flare/blower skid, air compressor, future generator and the propane tank. This item shall include full compensation for all costs associated including materials, equipment, transportation, testing and analysis per the Construction Drawings, labor, appurtenances, permits, and all other incidentals necessary to construct concrete pads.

EE. Item No. 031– Flare and Blower Skid Delivery and Installation (Lump Sum)

Measurement. Measurement for the work specified in this Bid Item will be based on Lump Sum for the Flare and Blower Skid installed in accordance with the Contract Documents, Technical Specifications, and accepted by the Engineer.

Payment. Payment for this item will be on a Lump Sum basis for a completely supplied, installed and accepted Flare and Blower Skid. This item shall include full compensation for all costs associated including materials, crane unload of flare, equipment, transportation, labor, appurtenances, permits, and all other incidentals necessary to unload on site a pre-assembled flare and blower skid as indicated in Contract Documents. This work also includes, but is not limited to, unloading and placement of flare, connection of flare to system piping, valves, drain lines, couplings, labor, quality control testing, installation, startup, training, fabrication, shop drawings and all other incidentals associated with the work under this item.

FF. Item No. 032 – Electrical Supply and Grounding (Lump Sum)

Measurement. Measurement for this item shall be on a completed lump sum basis.

Payment. Payment for this item will be on a lump sum basis for the completed electrical work for the project. Procurement and Installation of new panels and complete installation of new facilities as shown on Sheet E-1 through E-5 in the Construction Drawings. This pay item shall include coordination with electric company, grading and compaction of soils after underground electrical install, excavation, electrical wire and conduit installation, backfilling, compaction, fittings, panels, site light, switches, all electrical connections, testing, startup services, and related work to provide a fully functional electrical system powering blower/flare skid, existing pump station, compressor/dryer, and lift station. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

GG. Item No. 033 – 24-inch HDPE SDR 17 Lift Station with Pump (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis.

Payment. Payment for this item will be at the contract unit price per installed lift station with submersible pump, including excavation, stone base support, backfilling, clean soil backfill material, concrete ballast, dewatering efforts, fittings, blind flange for future use, sump and piping installation and connections, monitoring ports, supplied pump, pump connections, placement and testing of the pump, pump control panel and data modules, check and ball valves, flow meter, lift station flanged lid, concrete containment, startup, training by pump manufacturer and any other incidentals. Payment shall constitute full compensation for all material, labor, equipment, and work incidental thereto, necessary to complete this item in accordance with the Contract Documents.

HH. Item No. 034 – LFG Extraction Well Pumps (Each)

Measurement. Measurement for this item shall be on a completed and installed unit basis of a pump at a new gas well.

Payment. Payment for this item will be at the contract unit price per supplied unit, including short body QED bottom loading AP-4 pneumatic pumps, connectors for air and dewatering discharge, well seal cap, fittings, Contractor shall include up to 100 feet of cables and fittings for each of the pumps. The Contractor shall not purchase any pumps without the approval and direction of the County and Engineer. The pumps will be requested from the Contractor on an as needed basis depending on the conditions observed as the vertical gas extraction wells are installed and brought into operation. Pump installation shall require County and Engineer direction for placement and approval. Payment shall constitute full compensation for all material, labor, equipment, and work

incidental thereto, necessary to complete this item in accordance with the Contract Documents.

END OF SECTION

**Lee/Hendry Regional Solid Waste Disposal Facility
2024 Landfill Gas Collection and Control System
BID No.**

The following prices are hereby given by the Bidder for each Item herein below delineated to be used for the dual purpose of: a) arriving at an estimated total Bid Price; and b) establishing price factors to be utilized in adjustments to the estimated total price resulting from change orders issued in accordance with these Contract Documents. Said total price being the County's guide to the qualified low Bidder. An incomplete Bid Form shall be considered non-responsive.

Item No.	Description	Unit	Estimated Quantity	Unit Price (\$)	Amount (\$)
001	Mobilization/Demobilization (Maximum of 5% of Total Bid Price)	LS	1		\$ -
002	Project Survey	LS	1		\$ -
003	36-inch Diameter Bore with 8-inch Diameter HDPE SDR 11 Casing	LF	669		\$ -
004	Boring Refusal	LF	70		\$ -
005	18-inch HDPE SDR 17 LFG Header Pipe	LF	4,800		\$ -
006	8-inch HDPE SDR 17 LFG Lateral Pipe	LF	1,300		\$ -
007	6-inch HDPE SDR 17 LFG Lateral Pipe	LF	2,200		\$ -
008	8-inch Solid Wall HDPE SDR 11 Horizontal Collector Pipe	LF	1,000		\$ -
009	8-inch Perforated HDPE SDR 11 Horizontal Collector Pipe	LF	1,400		\$ -
010	30-inch CMP Casing for Road Crossing	LF	160		\$ -
011	18-inch CMP Casing for Road Crossing	LF	80		\$ -
012	3-inch HDPE SDR 11 Pipe in Separate Trench	LF	1,100		\$ -
013	3-inch HDPE SDR 11 Condensate Discharge Line in Common Trench	LF	8,300		\$ -
014	2-inch HDPE SDR 9 Air Supply Line in Common Trench	LF	8,300		\$ -
015	24-inch HDPE SDR 17 Condensate Sump with Pump	EA	6		\$ -
016	18-inch HDPE SDR 17 Horizontal Collector Sump with Pump	EA	3		\$ -
017	18-inch Header Isolation Valves	EA	5		\$ -
018	3-inch Condensate Discharge Isolation Valve with Vault Box	EA	5		\$ -
019	2-inch Air Supply Line Isolation Valves	EA	5		\$ -
020	3-inch Condensate Discharge Stub-up Valve Fittings	EA	19		\$ -
021	2-inch Air Supply Stub-up Valve Fitting	EA	19		\$ -
022	2-inch Condensate Discharge Line Air Release Valve	EA	4		\$ -
023	18-inch HDPE SDR 17 Header Access Riser	EA	3		\$ -
024	18-inch Header Blind Flange	EA	4		\$ -
025	3-inch Condensate Discharge Dual Cleanout	EA	10		\$ -
026	Sodding	SY	66,000		\$ -
027	LFG Wellheads	EA	19		\$ -
028	Compressed Air System	LS	1		\$ -
029	Grading Work for Flare and Blower Skid Area	LS	1		\$ -
030	Concrete Pads	LS	1		\$ -
031	Flare and Blower Skid Delivery and Installation	LS	1		\$ -
032	Electrical Supply and Grounding	LS	1		\$ -
033	24-inch HDPE SDR 17 Lift Station with Pump	EA	1		\$ -
034	LFG Extraction Well Pumps	EA	8		\$ -
SUBTOTAL BID COST					\$ -
Authorized Contingency (10% of Subtotal Cost)					\$ -
TOTAL BID COST					\$ -

SECTION 01 20 10

PROJECT MEETINGS

PART 1 - GENERAL

1.01 SUMMARY

This Section specifies administrative and procedural requirements for project meetings including but not limited to:

- A. Pre-construction Conference
- B. Progress Meetings
- C. Coordination Meetings

1.02 DESCRIPTION

- A. The County will schedule and administer a preconstruction conference, weekly construction progress meetings, and specially called meetings throughout the progress of work. The Engineer or County will be responsible for preparing the agenda, making arrangements, preparing the meeting summaries, and presiding at these meetings.
- B. Representatives of Contractor, Subcontractor(s), and Suppliers attending these meetings shall be qualified and authorized to act on behalf of the entity each represents.
- C. The Contractor shall attend meetings to ascertain that work is expedited consistent with Contract Documents and construction schedules.

1.03 PRECONSTRUCTION CONFERENCE

After award of the contract, but prior to the notice to proceed, a joint meeting shall be held with representatives of the County, Engineer, Contractor, including the Project Superintendent, and other invited parties which may be affected by the project.

This meeting is intended to introduce the various key personnel from each organization and to discuss the Contract Documents, the start of construction, order of work, labor and legal requirements, names of the major subcontractors, method of payment, shop drawing submittal schedule, protection of existing facilities and other pertinent items associated with the Project. The Contractor shall bring five (5) copies of a construction schedule, schedule of values, and shop drawing submittal log to this meeting.

The suggested agenda for the preconstruction meeting is as follows:

- A. Introduction of key personnel and roles

- B. Overview of project
 - 1. Project summary
 - 2. Contract completion time
 - 3. Liquidated damages
 - 4. Guarantee of work
- C. Project schedule
- D. Critical work sequencing
- E. Labor requirements
- F. Relationship and coordination with:
 - 1. Other Contracts
 - 2. On-going landfill operations
- G. Use of premises
 - 1. Site access and traffic control
 - 2. Office, work and storage areas
 - 3. Temporary facilities/utilities
 - 4. Safety and first aid procedures
 - 5. Security procedures
 - 6. Posting of signs
 - 7. Clean-up procedures
 - 8. Other County requirements
- H. Procedures and processing of:
 - 1. Shop drawings
 - 2. Applications for payment
 - 3. Partial payments
 - 4. Change orders

- 5. Requests for information
- 6. Record documents
- I. Construction facilities controls
- J. Staking of work
- K. Equipment to be used
- L. Material/manufacturers/suppliers to be used
- M. Major equipment/material deliveries
- N. On-site material storage requirements
- O. Project inspections
- P. Record documentation

1.04 PROGRESS MEETINGS

During the course of the Contract, progress meetings will be organized weekly, or as needed, and conducted by the County and/or Engineer to discuss the progress of the Work. Depending on the project progress and schedule, the County reserves the right to request meetings every other week instead of weekly. The Contractor and Project Superintendent shall attend these meetings.

The suggested agenda for these meetings:

- A. Review summary of previous meeting
- B. Work progress
 - 1. Since last meeting
 - 2. Expected progress during next work period
- C. Field observations, problems, conflicts
- D. Construction schedule
 - 1. Problems which impede the construction schedule
 - 2. Revisions to schedule
 - 3. Critical/long-lead items
 - 4. Off-site fabrication and delivery schedules

- E. Coordination of work items with County activities
- F. Shop drawing submittals
 - 1. Status of reviews
 - 2. Submittal requirements
 - 3. Remaining submittals
- G. Record documents
 - 1. Well logs, pipe installation records
 - 2. Photographs
 - 3. Red-line mark-ups
 - 4. Survey Notes
- H. Maintenance of quality standards
- I. Pending changes and substitutions
 - 1. Effect on construction schedule and on completion date
 - 2. Effect on other Contracts of the project
- J. Other Business

1.05 COORDINATION MEETINGS

Coordination meetings will be organized as needed unless the specific subject warrants an immediate meeting and cannot wait to be discussed during the next scheduled progress meeting. The Contractor and Project Superintendent shall attend these meetings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 01 30 10

CONTRACTOR SUBMITTALS

PART 1 - GENERAL

1.01 PRE-CONSTRUCTION MEETING SUBMITTALS

- A. At the pre-construction meeting, the Contractor shall submit the following items to the Engineer for review:
 - 1. A preliminary schedule of Shop Drawings submittals and target dates for the project prior to start of construction.
 - 2. Schedule of values that will be used for payment applications.
 - 3. A list of any and all permits and licenses the Contractor shall obtain indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.
 - 4. Insurance certificates.
 - 5. Health and Safety Plan.

1.02 SHOP DRAWINGS

- A. Wherever called for in the Contract Documents, or where required by the Engineer, the Contractor shall furnish to the Engineer for review, one (1) copy of each submittal. The term "submittal" as used herein shall be understood to include detail design calculations, shop drawings, fabrication and installation drawings, lists, graphs, operating instructions, catalog sheets, data sheets, samples, and similar items. Said submittals shall be submitted to the Engineer, 15 days minimum prior to planned work activity to allow review of same by the Engineer, and to accommodate the rate of construction progress required under the Contract, unless otherwise required and authorized by the Engineer. Should any submittal be a part of any schedule milestone and is considered to be unacceptable by the County, the appropriate milestone shall be considered as not having been met until a complete and properly detailed submittal is received.
- B. The Contract Drawings shall not be traced or reproduced by any method for use as or in lieu of detail shop drawings. Show dimensions and note which are based on field measurement. Identify materials and products in the work shown. Indicate compliance with standards and special coordination requirements.
- C. Attach to the front of each submittal a title sheet stating the pertinent product information submitted and reference the appropriate Specification Section and Paragraph. Apply stamp, signed or initialed, certifying that all quantities, dimensions, field construction criteria, materials, catalog numbers, and specified

performance criteria has been reviewed in accordance with the requirements of the Work and the Contract Documents.

If this information is not provided with each submittal, the submittal shall be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.

- D. All shop drawings or other submittals shall be accompanied by the form mutually agreed upon at the pre-construction meeting. Any submittal not accompanied by the approved form or if all applicable items on the form are not completed, the submittal will be returned to the Contractor without action taken by the Engineer.
- E. Normally, a separate transmittal form shall be used for each specific unrelated item or class of material or equipment for which a submittal is required. Transmittal of a submittal of various items using a single transmittal form will be permitted only when the items taken together constitute a manufacturer's "package" or are so functionally related that this helps speed the review of the group or package as a whole. A multiple-page submittal shall be collated into sets, and each set shall be stapled or bound, as appropriate, prior to transmittal to the Engineer.
- F. Except as may otherwise be provided herein, the Engineer will return prints of each submittal to the Contractor, with comments noted thereon, within 15 calendar days following their receipt by the Engineer. It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer by the second submission of a submittal item. The County reserves the right to withhold monies due the Contractor to cover additional costs of the Engineer's review beyond the second submittal.
- G. If a submittal is returned to the Contractor marked "**NO EXCEPTIONS TAKEN**," formal revision and resubmission of said submittal will not be required.
- H. If a submittal is returned to the Contractor marked "**MAKE CORRECTIONS NOTED**," formal revision and resubmission of said submittal will not be required. However, Contractor shall address the comments/corrections in the final Work. Revisions indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- I. If a submittal is returned to the Contractor marked "**AMEND - RESUBMIT**," the Contractor shall revise said submittal per Engineer's comments and shall resubmit the required number of copies of said revised submittal to the Engineer.
- J. If a submittal is returned to the Contractor marked "**REJECTED - RESUBMIT**," the Contractor shall revise said submittal and shall resubmit the required number of copies of said revised submittal to the Engineer.

- K. Fabrication of an item **shall not** commence before the Engineer has reviewed the pertinent submittals and returned copies to the Contractor marked either “**NO EXCEPTIONS TAKEN**” or “**MAKE CORRECTIONS NOTED.**” Revisions indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as the basis of claims for extra work.
- L. All Contractor submittals shall be carefully reviewed by an authorized representative of the Contractor prior to submission to the Engineer. Each submittal shall be dated, signed, and certified by the Contractor as being correct. Contractor shall use the County-approved shop drawing stamp agreed upon at the pre-construction meeting. No consideration for review by the Engineer of any Contractor submittals will be made for any items which have not been so certified by the Contractor. **All non-certified submittals will be returned to the Contractor without action taken by the Engineer, and any delays caused thereby shall be the total responsibility of the Contractor.**
- M. The Engineer’s review of the Contractor submittals shall not relieve the Contractor of the entire responsibility for the correctness of details and dimensions. The Contractor shall assume all responsibility and risk for any misfits due to any errors in the Contractor submittals. Any fabrication or other work performed in advance of the receipt of approved submittals shall be entirely at the Contractor’s risk and expense. The Contractor shall be responsible for the dimensions and the design of adequate connections and details.
- N. Product Data
1. Product data includes standard printed information (e.g., specifications) on materials, products and systems, not specially prepared for this project, other than the designation of selections from among available choices printed therein. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, reference it to Specification Section and Paragraph number. Show reference standards, performance characteristics, and capacities; dimensions; and required clearances. Said submittals shall be submitted to the Engineer, minimum 15 days prior to obtaining the material to review of same by the Engineer, and to accommodate the rate of construction progress required under the Contract, unless otherwise required and authorized by the Engineer.
 2. Collect required data into one submittal for each unit of work or system, and mark each copy to show which choices and options are applicable to project. Modify manufacturer’s standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the Work. Delete information not applicable.
 3. Failure to follow the guidelines in paragraphs 1 and 2 above shall be grounds for rejection of Contractor submittals.

- O. Contractor shall notify Engineer in writing, at time of submittal, of proposed deviations from requirements of Contract Documents.

1.03 CONTRACTOR'S PROJECT SCHEDULES

- A. The schedule shall be comprehensive, covering both activities at the site of the Work and offsite activities such as design, procurement, and fabrication. The schedule shall be orderly and realistic and shall be revised as necessary to meet this requirement. The Contractor shall promptly advise the County and Engineer of any occurrence that may impact the schedule. No revision to the schedule can be made without approval from the County and Engineer.
- B. The detailed schedule and each revision thereof shall be subject to approval by the County and Engineer for conformity with the requirements of the Contract Documents. The Contractor shall assist the County and/or Engineer in reviewing and evaluating each schedule furnished. Disapproved schedules returned to the Contractor shall be revised to correct the defects noted and shall be resubmitted to the County within five (5) calendar days after receipt.
- C. When required to perform and complete the changed Work in accordance with the revised schedule, the Contractor shall provide additional labor, materials, equipment, or other factors of production in excess of those in use before the changed Work was ordered.

1.04 SAMPLES

- A. Unless otherwise specified, whenever in the Specifications samples are required, the Contractor shall submit one (1) sample of each such item or material to the Engineer for approval at no additional cost to the County.
- B. Samples, as required herein, shall be submitted for approval a minimum of fifteen (15) working days prior to ordering such material for delivery to the job site and shall be submitted in an orderly sequence so that dependent materials or equipment can be assembled and reviewed without causing delays in the Work.
- C. All samples shall be individually and indelibly labeled or tagged, indicating thereon all specified physical characteristics and manufacturer's names for identification and submittal to the Engineer for approval.
- D. Unless otherwise specified, all colors and textures of specified items will be selected by the County from the manufacturer's standard colors and standard product lines.

1.05 RECORD DRAWINGS

- A. Contractor's Record Drawings shall be maintained in accordance with this Section. The Contractor shall keep and maintain at the job site one set of draft Redline Drawings.

1. On these, the Contractor shall mark all project conditions, locations, configurations, and any other changes or deviations which may vary from the details represented on the original Contract Drawings, including buried or concealed construction and utility features which are revealed during the course of construction.
 2. Special attention shall be given to recording the horizontal and vertical location of all buried header, lateral, air supply line, liquid conveyance line and utilities, that differ from the locations indicated or which were not indicated on the Contract Drawings.
 3. Redline Drawings shall be supplemented by any detailed sketches or typewritten changes to the specifications, as necessary or directed, to indicate fully the Work as actually constructed.
 4. These master Redline Drawings shall be the Contractor's representation of as-built conditions, including all revisions made necessary by addenda, change orders, and the like.
 5. Redline Drawings shall be maintained up-to-date during the progress of the Work and available for inspection by the Engineer.
- B. The Contractor shall include a survey site plan and pipe route survey table with the Redline Drawings showing coordinates and elevations of all wells, condensate traps, valves, etc., and piping installed.
1. Piping shall be located every 50 feet and at grade breaks and changes in pipe slope and direction, fittings, tie-ins, appurtenances, etc., as required for the conformance survey.
 2. For pipe runs of 100 feet or less, the pipe shall be located a minimum of every 20 feet.
 3. Coordinates and elevations shall be included in the survey for pipe fittings, changes in pipe slope and direction, valves, buried flanges, appurtenances and other similar connections to the header piping, and the ground surface at each well and appurtenance, and for all pipe location shots.
 4. All locations shall be shown in the coordinate system identical to that used for the Construction Drawings.
 5. A Florida Licensed Professional Surveyor shall certify all survey work pertaining to the Record Drawings.
- C. Redline Drawings shall be accessible to the Engineer at all times during the construction period and shall be delivered to the Engineer upon Substantial Completion of the Work.

- D. Requests for partial payments will not be approved if the Redline Drawings are not kept current and not until the completed Redline Drawings showing all variations between the Work as actually constructed and as originally shown on the Contract Drawings or other Contract Documents have been inspected by the Engineer.
- E. Final payment will not be approved until the Contractor -prepared Record Drawings have been approved by the Engineer.
- F. Upon Substantial Completion of the Work and prior to final acceptance, the Contractor shall complete and deliver a preliminary set of Record Drawings and Pipe Route Survey Table to the Engineer for review, conforming to the construction records of the CONTRACTOR.
 - 1. The Contractor shall take care in reviewing the preliminary Record Drawings and Pipe Route Survey Data Table for accuracy and completeness.
 - 2. If more than one review of the Record Drawings and Pipe Route Survey Data Table is required, the Contractor shall reimburse the County for the time-and-materials cost for the Engineer's subsequent reviews.
 - 3. The Record Drawings shall be generated using AutoCAD 2018 (or newer version) computer software and consist of corrected plans showing the reported location of the Work.
 - 4. Upon the Engineer's acceptance of the Record Drawings, the Contractor shall provide two (2) complete sets of Record Drawings to the Engineer.
 - 5. The information submitted by the Contractor will be assumed to be reliable, and the Engineer will not be responsible for the accuracy of such information, nor for any errors or omissions, which may appear on the Record Drawings as a result.

1.06 PROGRESS REPORTS

- A. A progress report shall be furnished to the County with each application for progress payment. If the Work falls behind schedule, the Contractor shall submit additional progress reports at such intervals as requested.
- B. Each progress report shall include sufficient narrative to describe any current and anticipated delaying factors, their effect on the construction schedule, and proposed corrective actions. Any Work reported complete, but which is not readily apparent to the Engineer, must be substantiated with satisfactory evidence.
- C. Each progress report shall include a list of the activities completed with their actual start and completion dates, a list of the activities currently in progress, and the number of working days required to complete each.

1.07 SURVEY DATA

All field books, notes, as-built pipe slope calculations, photographs, sketches and other data developed by the Contractor in performing the surveys required by the Work shall be available to the Engineer for examination throughout the construction period. All locations and elevations shall be identified by qualified survey crews and tied to the Coordinate System NAD 83 in feet. Survey shall be in accordance with the respective pipeline and well installation Specifications. All such data shall be submitted to the Engineer with documentation required for final acceptance of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 40 00

QUALITY CONTROL

PART 1 - GENERAL

1.01 SITE INVESTIGATION AND CONTROL

- A. Contractor shall verify all dimensions in the field and check field conditions continuously during construction. Contractor shall be solely responsible for any inaccuracies built into the work due to Contractor's failure to comply with this requirement.
- B. CONTRACTOR shall inspect related and appurtenant WORK and report in writing to the County and Engineer any conditions which will prevent proper completion of the work. Failure to report any such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor at Contractor's sole cost and expense.

1.02 INSPECTION OF THE WORK

- A. All work performed by the Contractor shall be inspected by the Contractor and designated County Project Manager and nonconforming work shall be noted and promptly corrected. The Contractor is responsible for the work conforming to the Contract Documents.
- B. The WORK shall be conducted under the general observation of the designated County Project Manager and is subject to inspection by representatives of the County acting on behalf of the County to ensure compliance with the requirements of the Contract Documents. Such inspection may include mill, plant, shop, or field inspection, as required. The Project Manager or any inspector(s) shall be permitted to access all parts of the work, including plants where materials or equipment are manufactured or fabricated.
- C. The presence of the Project Manager or any inspector(s), however, shall not relieve the Contractor of the responsibility for the proper execution of the work in accordance with all requirements of the Contract Documents. Compliance is a duty of the Contractor, and said duty shall not be avoided by any act or omission on the part of the Project Manager or any inspector(s). Inspection of work later determined to be nonconforming shall not be cause or excuse for acceptance of the nonconforming work. The acceptance of nonconforming work shall be approved by the County when adequate compensation is offered and it is in the County's best interest.
- D. All materials and articles furnished by the Contractor shall be subject to inspection, and no materials or articles shall be used in the WORK until they have been inspected and accepted by the Project Manager or other designated

representative. No work shall be backfilled, buried, hidden, or otherwise covered until it has been inspected. Any work so covered in the absence of inspection shall be subject to uncovering at the Contractor's expense. Where uninspected work cannot be uncovered, such as in concrete cast over reinforcing steel, all such work shall be subject to demolition, removal, and reconstruction under proper inspection, and no additional payment will be allowed.

1.03 TIME OF INSPECTION AND TESTS

- A. Any samples and test specimens required under these Specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analyses before said articles or materials are to be used. Contractor shall furnish and prepare all required test specimens at Contractor's own expense. Whenever the Contractor is ready to backfill, bury, hide, or otherwise cover any work under this Contract, the Project Manager shall be notified not less than 24 hours in advance to request inspection before beginning any such work of covering. Failure of the Contractor to notify the Project Manager at least 24 hours in advance of any such inspections shall be reasonable cause for the Project Manager to order a sufficient delay in the Contractor's schedule to allow time for such inspection, any remedial, or corrective work required, and all costs of such delays, including its impact on other portions of the work, shall be borne by the Contractor.

1.04 SAMPLING AND TESTING

- A. When not otherwise specified, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, the County reserves the right to use any generally-accepted system of inspection which, in the opinion of the Engineer, will ensure the County that the quality of the workmanship is in full accord with the Contract Documents.
- B. Any waiver of any specific testing or other quality assurance measures, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the specified testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.
- C. Notwithstanding the existence of such waiver, the Engineer shall reserve the right to make independent investigations and tests as specified in the following paragraph and, upon failure of any portion of the WORK to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the Engineer to require the removal or correction and reconstruction of any such work.

- D. In addition to any other inspection or quality assurance provisions that may be specified, the Engineer shall have the right to independently select, test, and analyze, at the expense of the County (only with prior approval by the County), additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed provided that wherever any portion of the work is discovered, as a result of such independent testing or investigation by the Engineer, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such work shall be borne by the Contractor.

1.05 RIGHT OF REJECTION

- A. The Project Manager or designated representative, acting for the County, shall have the right at all times and places to reject any articles or materials to be furnished hereunder which, in any respect fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the work at the site. If the Project Manager or designated representative, through an oversight or otherwise, has accepted materials or work which is defective or which is contrary to the Contract Documents, such material, no matter in what stage or condition of manufacture, delivery, or erection, may be rejected.
- B. Contractor shall promptly remove or replace rejected articles or materials from the site of the work after notification of rejection.
- C. All costs of removal and replacement of rejected articles or materials, as specified herein, shall be borne by the Contractor.
- D. Failure to promptly remove and replace rejected work shall be considered a breach of this specification and the County may after 7 days notice, terminate the Contractor's right to proceed with the affected work and remove and replace the work and issue a back charge to cover the cost of the work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 00

SITE CONDITIONS SURVEY

PART 1 GENERAL

1.01 SUMMARY

- A. The CONTRACTOR shall perform, or obtain other professional subcontractors to complete surveys that meet the minimum standards of Florida Department of Transportation (FDOT) Survey Codes, to document elevations, grades, locations, maintain survey control during construction, and perform related field engineering as specified in the Contract Documents.
- B. Throughout this Section, all references to “Surveyor” shall mean a professional land surveyor licensed in the State of Florida

1.02 SURVEY REFERENCE POINTS

- A. The Contractor shall locate survey reference points prior to starting work and the Contractor shall protect and preserve all permanent survey reference points during construction.
 - 1. The Contractor shall make no changes or relocate any survey reference point without prior written notice to the Engineer.
 - 2. The Contractor shall report to the Engineer when any survey reference point is lost, destroyed, or requires relocation because of necessary changes in grades or locations.
 - 3. The Contractor, at no additional cost to the owner, shall replace and re-survey reference points that have been lost or destroyed. The replaced survey reference point shall be surveyed by a Surveyor. Replacement will be based on original survey control.
- B. Prior to any work, the Contractor shall immediately notify the Engineer and County of any discrepancies with the survey reference points from the coordinates and elevations provided.

1.03 RECORD DRAWINGS (AS-BUILT DRAWINGS)

- A. All survey record documents, submitted to the Engineer for progress review, do not require the signature of a Surveyor; however, final Record Drawings shall be signed and sealed by a Surveyor.
- B. Submitted record documents shall include the following:

1. As stages of the work are completed, the Contractor will submit surveys, signed and sealed by a Surveyor. The Record Drawings information shall be submitted on 24-inch by 36-inch sheets, as well as AutoCAD Drawing files (compatible with (AutoCAD r18 or later version) on a flash drive. The Contractor will submit 5 original signed and sealed hard copies by a SURVEYOR and 2 flash drives with the AutoCAD drawing files, shall be submitted.
 2. AutoCAD Drawing File Requirements - Contour lines shall be continuous, unbroken polylines with a width of zero and an elevation (z-coordinate) assigned according to the elevation of the contour line. All spot elevations shall have horizontal controls with vertical z-coordinates. Contours shall be at one-foot intervals, with index contours at every fifth interval. Objects in the Record Drawings shall be drawn to scale. Unless otherwise stated, all surveys shall be at a scale of 1" = 50'.
 3. Survey information (north, the grid, and the coordinates) is referenced to the East Zone of the Florida State Plane Coordinate System, NAD 83, 1999 Adjustment. The elevations are to the National Geodetic Vertical Datum of 1929 (NGVD1929).
 4. All Record Drawings shall have survey control monuments shown for the purposes of orientation, both horizontally and vertically.
 5. If multiple sheets are required for the Record Drawings, each sheet shall include match lines as required.
- C. The Contractor understands and agrees that existing elevations and contours shown on the Contract Drawings are solely for the Engineer's information. Actual quantities of soils and other materials required to complete the work are the Contractor's responsibility. The Contractor shall determine existing elevations for the purpose of conducting the work as required by the Contract Documents. The Contractor is responsible to notify the Owner and Engineer in writing of any and all discrepancies prior to beginning work.

1.04 SUBMITTALS

- A. The Contractor shall submit the name and address of the Surveyor to the Engineer prior to any work for record purposes only.
- B. The Contractor shall submit documentation signed by the Surveyor that elevations and locations of improvements are in conformance with the Contract Documents, or if not in conformance, certify as to variances from the Contract Documents.
- C. The Contractor shall provide and submit to the Engineer for approval, signed and sealed drawings representing the horizontal and vertical limits, as follows:

1. Preconstruction Survey - Prior to performing any earthwork, a Preconstruction Survey of the site must be provided to the Engineer for review and approval. The Preconstruction Survey shall include:
 - a. Survey of the existing conditions within the limits of construction of the Project and 50 feet beyond the limits of construction.
 - b. The Preconstruction Survey shall be collected on a 50 foot by 50 foot grid, at a minimum, and note all above grade structures, piping, and stormwater features, which may or will be impacted by the work and shall include the areal extent of existing sod that must be removed in order to enable the work to proceed.
 - c. Location of LFG lateral pipes, stub out locations, new and re-drill wells, isolation valves, air release valves, road crossings, blind flanges, connection points to existing Landfill Gas Collection and Control System (LFGCCS), sections of existing and LFGCCS improvements to be abandoned, and other related LFGCCS improvements.
2. Final Survey - The Final Survey will include, but is not limited to, the following:
 - a. All features of the Project installed and all existing features within the limits of construction.
 - b. Stormwater structures, downchutes, piping, limits of liner, underground piping, access roads, sod and/or seeding limits, and all other features related to the Project.
 - c. Stormwater pipe invert elevations and locations shall be noted, at a minimum, every 50 linear feet along each pipe and at each change in pipe size, type, direction, and elevation.
 - d. Final location of new LFG header and lateral pipes, stub out locations, new and re-drill wells, isolation valves, air release valves, road crossings, connection points to existing LFGCCS, sections of abandoned LFGCCS, flare station improvements, and all other related LFGCCS improvements.
 - e. LFG pipe invert elevations and locations shall be noted, at a minimum, every 10 linear feet along each pipe and at each tie-in location, bend, stub-out, riser, blind flange, change in pipe size, and any grade brakes.
 - f. LFG pipe route survey including coordinates and elevations of surveyed top of LFG pipe, fittings, tie-ins, appurtenances, length of pipe segments, pipe slope between each surveyed station, and

ground surface elevation. Each pipe segment shall be given a unique description. Pipe route survey data shall be provided in tabular format. Example format below.

- g. LFG pipe profiles for header and lateral pipes. Profiles shall include pipe diameter, slope, grade breaks, section view of ground surface along pipe segment, location and description of existing utilities encountered, pipe crossings and vertical and horizontal scale bar.

STATION	GRID COORDINATES		Surveyed Top of Pipe (ft)	Ground Elev. (ft)	Header Depth (ft)	Header Slope	Const. Notes and Fittings	Pipe Info.
	(north)	(east)						
Line F-F 0+00	5078.45	22997.65	1235.58	1239.66	3.8	-2.13%	Sta 0+02 Line E-E' 12"x4" Branch Saddle	31 ft of 4" Dia HDPE at 2.13%
0+04	50704.56	22997.42	1235.74	1240.40	4.47		Begin 8" CMP Road Casing	
0+26	50694.44	22977.80	1235.28	1239.09	3.8		End 8" CMP Road Casing	
0+31	50712.65	22981.02	1235.17	123.54	3.4		Sta 1+28 C-C' 4" Tee and Riser	
Lateral to EW-A								
0+00	50601.26	23272.90	1274.62	1278.90	4.3	2.00%	Sta 2+00 Line A-A' 6"x4" Branch Saddle	5 ft of 4" Dia HDPE at 2.00%
0+05	50606.27	23271.25	1274.72	1278.66	3.9		Well EW-A	
Lateral to EW-B								
0+00	50591.22	23078.87	1264.31	1268.29	4.0	2.00%	Sta 4+00 Line A-A' 6"x4" Branch Saddle	5 ft of 4" Dia HDPE at 2.00%
0+05	50595.82	23081.00	1264.41	1268.86	4.5		Well EW-B	

- D. Record Drawings - The Contractor shall submit to the Engineer, for review and approval, signed and sealed Record Drawings for all work (to include any areas outside the limits of work disturbed by the Contractor) as follows:

1. The Contractor shall, throughout the Project, maintain a redline set of Construction Drawings noting deviations or actual installed conditions for the Project.

2. As part of Final Completion, the Contractor must submit a complete set of 24 inch by 36 inch sheet Record Drawings based on the redlines maintained throughout the Project which identify the actual constructed conditions. Record Drawings shall use the Contract Drawings as a base and show changes by cloud and strikethrough in electronic format (AutoCAD r18 or later version). These drawings shall incorporate the surveys listed above and any other changes made to the Project into the set in order to create a single Record Drawings set for the Project.
 3. The Contractor shall submit 2 draft copies of the completed Record Drawings, in both hardcopy and AutoCAD format, for review at Substantial Completion.
 4. The Contractor shall submit 5 signed and sealed certified sets of final approved by the Engineer Record Drawings and AutoCAD files shall be submitted for final acceptance.
 5. Substantial Completion cannot be granted until a draft set of Record Drawings in both hardcopy and AutoCAD file formats are submitted to the County and Engineer for review.
 6. Final Completion cannot be granted until the Record Drawings signed and sealed by a Surveyor and AutoCAD files are submitted to and approved by the County and Engineer.
- E. Partial Surveys - It is understood the Contractor may elect to construct the Project at different time intervals and survey each section separately. Partial Surveys must be submitted to the Engineer to determine the section the Contractor is requesting to continue working in meets the design requirements. The Contractor may not continue work until the Partial Surveys are approved. Partial Surveys are not required to be signed and sealed at the time of submittal, however, the surveys used to compile the complete survey must not deviate from the Partial Surveys submitted and the complete survey must be certified for submittal. Payment for surveys will not be made until the complete, certified survey is submitted and approved. However, Partial Surveys may be used for payment of work items upon review, agreement, and approval by the County and Engineer.

PART 2 - PRODUCTS

This Section is Not Applicable.

PART 3 - EXECUTION

3.01 CONTRACTOR RESPONSIBILITIES

- A. The Contractor shall retain the services of a Surveyor to identify existing control points and maintain survey control during work.

- B. The Contractor shall identify all survey reference points.
- C. The Contractor shall provide civil, structural, or other professional engineering services specified or required to execute the Contractor's construction methods.
- D. The Contractor shall be responsible for the preservation of all benchmarks, stakes, and marks. If any benchmarks, stakes, or marks are disturbed by the Contractor, the Contractor shall not proceed with any work until such points, marks, lines, and elevations as may be necessary for the work have been established.
- E. The accuracy of any method of staking shall be the responsibility of the Contractor. All engineering for vertical and horizontal control shall be the responsibility of the Contractor.
- F. The surveyors shall maintain a complete, accurate log of all control and survey work as it progresses. This log shall be available for periodic review by the Engineer.
- G. Grades, elevations, and locations will be required periodically during the prosecution of the work. The Contractor's Surveyor will provide as-built notes and Record Drawings when construction is completed.
- H. All topographic surveys shall meet the minimum standards of Chapter 61-G17 of the Florida Administrative Code. Surveys shall include (but are not limited to) grading, elevations, structure locations, pipe inverts, piping, and other permanent structures as needed on a 50 foot by 50 foot grid.
- I. The topographic information collected shall be taken on a grid (or as specified for the identified area), at a minimum, one point directly above the previous as necessary to provide an accurate representation of the contour topography (i.e., spot elevations, grade breaks, ditches, mounds, etc.) and the thickness of the material placement from previous work. For ditches and Leachate Collection and Removal System (LCRS) trenches, spot elevations shall be taken, at a minimum, every 50 linear feet to include, at a minimum, the centerline of the ditch/trench, the toe and top of ditch/trench slopes, and any grade breaks.
- J. The elevation and grades shall be within an accuracy of 0.2 feet vertical and 0.5 feet horizontal as shown in the Contract Documents. Unless otherwise stated, all surveys shall be at a scale of 1" = 50', with contours at one-foot intervals.
- K. For thickness verifications, **NO MINOR TOLERANCES ARE ACCEPTABLE**. The thicknesses indicated on the CONTRACT DRAWINGS are minimum thickness and **CANNOT** be less than the dimensions shown on the Contract Documents.

END OF SECTION

SECTION 01 50 10

TEMPORARY UTILITIES

PART 1 - GENERAL

1.01 THE REQUIREMENT

- A. General. The CONTRACTOR shall provide facilities and equipment that are adequate for the performance of the WORK under this Contract within the time specified. All facilities and equipment shall be kept in satisfactory operating condition, capable of safely and efficiently performing the required WORK, and subject to inspection and approval by the PROJECT MANAGER at any time for the duration of the Contract. All WORK hereunder shall conform to the applicable requirements of the OSHA Standards for Construction.
- B. Separate Contracts. Whenever portions of the WORK hereunder are let under separate contracts, all of the provisions of this Section shall apply to each such prime contractor, including the requirements for separate field offices and communications facilities.

1.02 POWER AND LIGHTING

- A. Power. The CONTRACTOR shall provide, at the CONTRACTOR's own expense, all necessary power required for the CONTRACTOR's operations under the Contract and shall provide and maintain all temporary power lines required to perform the WORK in a safe and satisfactory manner.
- B. Construction Lighting. All WORK conducted at night or under conditions of insufficient day light shall be suitably lighted to ensure proper WORK and to afford adequate facilities for inspection and safe working conditions.
- C. Approval of Electrical Connection. All temporary connections for electricity shall be subject to approval by the PROJECT MANAGER and the power company representative and shall be removed in like manner at the CONTRACTOR's expense prior to final acceptance of the WORK.
- D. Separation of Circuits. Unless otherwise permitted by the PROJECT MANAGER, circuits separate from lighting circuits shall be used for all power purposes.
- E. Construction Wiring. All wiring for temporary electric light and power shall be properly installed and maintained and securely fastened in place. All electrical facilities shall conform to the requirements of Subpart K of the OSHA Standards for Construction and local code.

1.03 WATER SUPPLY

- A. General. The COUNTY will allow use of surface water for general use and drilling activities. Should the surface water on site be determined not to be suitable for other construction purposes, the CONTRACTOR shall provide, at the CONTRACTOR's own expense, an adequate supply of water of a quality suitable for construction purposes.
- B. The CONTRACTOR shall provide and operate all pumping facilities, pipelines, valves, hydrants, storage tanks, and all other equipment necessary for the adequate development and operation of the water supply system that the COUNTY is allowing to access. The CONTRACTOR shall be solely responsible for the adequate functioning of the CONTRACTOR's water supply system and solely liable for any claims arising from the use of same, including discharge or waste of water therefrom.
- C. Potable Water. Drinking water on the site during construction shall be furnished by CONTRACTOR and shall be potable water furnished in approved dispensers. Notices shall be posted conspicuously throughout the site warning the CONTRACTOR's personnel of non-potable water sources.
- D. Water Connections. The CONTRACTOR shall not make connection to or draw water from any fire hydrant or pipeline without first obtaining permission of the authority having jurisdiction over the use of said system. For each such connection made, the CONTRACTOR shall first attach to the fire hydrant or pipeline a valve and a meter, if required by the said authority, of a size and type acceptable to said authority and agency.
- E. Removal of Water Connections. Before final acceptance of the WORK on the project, all temporary connections and piping installed by the CONTRACTOR shall be entirely removed, and all affected improvements shall be restored to their original condition or better and to the satisfaction of the PROJECT MANAGER and the agency owning the affected utility.
- F. Fire Protection. The construction area and all other parts of the WORK shall be connected with the CONTRACTOR's water supply system and shall be adequately protected against damage by fire. Hose connections and hose, water casks, chemical equipment, or other sufficient means shall be provided for fighting fires in the temporary structures and other portions of the WORK, and responsible persons shall be designated and instructed in the operation of such fire apparatus so as to prevent or minimize the hazard of fire. The CONTRACTOR's fire protection program shall conform to the requirements of Subpart F of the OSHA Standards of Construction.

1.04 SANITATION

- A. Toilet Facilities. Fixed or portable chemical toilets shall be provided by the CONTRACTOR for the use of the CONTRACTOR's employees or subcontractors. Toilets at construction job sites shall conform to the requirements of Subpart D, Section 1926.51 of the OSHA Standards for Construction.
- B. Sanitary and Other Organic Wastes. The CONTRACTOR shall establish a regular daily collection of all sanitary and organic wastes. All wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of in accordance with all laws and regulations pertaining thereto. Disposal of landfill refuse from excavation associated with the work shall be handled in accordance with Section 02 41 16.
- C. Waste Disposal. Disposal of all such wastes not covered in Section B above shall be at the CONTRACTOR's expense. The CONTRACTOR shall open an account with the Lee-Hendry County disposal facility for the disposal of wastes generated by the CONTRACTOR that are not associated with excavation activities. The CONTRACTOR shall take all waste except that which is generated by excavation activities across the scales at the landfill and follow landfill directions for final disposal.

1.05 COMMUNICATIONS

- A. Telephone Services. The CONTRACTOR shall provide and maintain at all times during the progress of the WORK, at the CONTRACTOR's own expense, not less than one cell phone that can be provided to County for project communications.

1.06 SAFETY

- A. General. Jobsite safety is the CONTRACTOR's responsibility. Appropriate first aid facilities and supplies shall be kept and maintained by the CONTRACTOR at the site of the WORK. All persons within the construction area shall be required to wear protective helmets and green/yellow safety vests. In addition, all employees of the CONTRACTOR and his subcontractors shall be provided with, and required to use, personal protective and life saving equipment as set forth in Subpart E of the OSHA Standards for Construction (29 CFR 1926) and shall comply with the "A Compilation of Landfill Gas Field Practices, and Procedures" dated August 2011 by the Solid Waste Association of North America (SWANA), and will coordinate with the local fire department.
- B. Public Safety. During the performance of the WORK, CONTRACTOR shall erect and maintain temporary fences, bridges, railings, and barriers and take all other necessary precautions and place proper guards and warning signs for the prevention of accidents. CONTRACTOR shall erect and maintain suitable and sufficient lights and other signals.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 50 30

PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 GENERAL

- A. CONTRACTOR shall protect all existing utilities and improvements not designated for removal and restore damaged or temporarily relocated utilities and improvements to a condition equal to or better than they were prior to such damage or temporary relocation, all in accordance with requirements specified herein, and in accordance with the requirements of the Contract Documents.
- B. CONTRACTOR shall determine the exact locations and depths of all utilities indicated on the drawings which affect the WORK. In addition to those indicated, CONTRACTOR shall make exploratory excavations of all utilities. All such exploratory excavations shall be performed as soon as practicable after award of Contract and, in any event, a sufficient time in advance of construction to avoid possible delays to CONTRACTOR's WORK. When such exploratory excavations show the utility location as indicated on the drawings to be in error, CONTRACTOR shall so notify PROJECT MANAGER.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and depth of the utility.

1.02 RIGHTS-OF-WAY

- A. CONTRACTOR shall not do any work that would affect any oil, gas, sewer, or water pipeline; any fiber, telephone, telegraph, or electric transmission line; any fence; or any other structure, nor shall CONTRACTOR enter upon the rights-of-way involved until notified by the PROJECT MANAGER that the COUNTY has secured authority from the property owner. After authority has been obtained, CONTRACTOR shall give said owner due notice of CONTRACTOR intention to begin WORK, and shall give said owner convenient access and every facility for removing, shoring, supporting, or otherwise protecting such pipeline, transmission line, ditch, fence, or structure and for replacing same. When two (2) or more Contracts are being executed at one time on the same or adjacent land in such manner that WORK on one Contract may interfere with that on another, the COUNTY shall decide which CONTRACTOR shall have priority to perform and in what manner. When the territory of one Contract is the necessary or convenient means of access for the execution of another Contract, such privilege of access or any other reasonable privilege may be granted by the COUNTY to the CONTRACTOR so desiring, to the extent, amount, manner, and times permitted. No such decision regarding the method or time of conducting the work or the use of territory shall be made the basis of any

claim for delay or damage, except as provided for temporary suspension of the WORK in the General Conditions of the Contract.

1.03 EXISTING UTILITIES AND IMPROVEMENTS

- A. General. CONTRACTOR shall protect all utilities and other improvements which may be impaired during construction operations. It shall be CONTRACTOR's responsibility to ascertain the location of all possible existing utilities and other improvements indicated on the drawings or otherwise that will be encountered in the construction operations, and to see that such utilities or other improvements are adequately protected from damage due to such operations. The CONTRACTOR shall contact the COUNTY immediately upon discovery of additional utilities in the area prior to starting and during the performance of the work. CONTRACTOR shall take all possible precautions for the protection of unforeseen utility lines for uninterrupted service and such special protection as may be directed by the PROJECT MANAGER.
- B. Utilities to Be Moved. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon proper application by the CONTRACTOR, be notified by the PROJECT MANAGER to move such property within a specified reasonable time. CONTRACTOR shall not interfere with said property until after the expiration of the time stipulated.
- C. County's Right of Access. The right is reserved to the COUNTY and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the WORK of this Contract.
- D. Known Utilities. Existing utility lines that are shown on the drawings or the locations of which are made known to the CONTRACTOR prior to excavation that are to be retained and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired by CONTRACTOR at CONTRACTOR's expense.
- E. Unknown Utilities. If CONTRACTOR damages any existing utility lines that are not shown on the drawings or the locations of which are not made known to CONTRACTOR prior to excavation, or were, or could not have been verified or located by the CONTRACTOR prior to starting work, a written report thereof shall be made immediately to the PROJECT MANAGER. If directed by the PROJECT MANAGER, repairs shall be made by CONTRACTOR under the provisions for changes and extra work contained in the General Conditions.
- F. Utilities to Be Removed. When utility lines that are to be removed are encountered within the area of operations, CONTRACTOR shall notify the

PROJECT MANAGER a sufficient time in advance for the necessary measures to be taken to prevent interruptions of the service.

- G. Approval of Repairs. All repairs to a damaged improvement shall be inspected and approved by an authorized representative of the improvement before being concealed by backfill or other work.
- H. Relocation of Utilities. Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is shown on the drawings, CONTRACTOR shall at CONTRACTOR's own expense, remove and, without unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the PROJECT MANAGER and the OWNER of the facility. In all cases of temporary removal or relocation, restoration to former location shall be accomplished by CONTRACTOR in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.
- I. Maintaining in Service. All oil and gasoline pipelines, power, telephone, or other communication cable ducts, gas and water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the WORK shall be maintained continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the PROJECT MANAGER are made with the OWNER of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, wire, or cable. CONTRACTOR shall be responsible for and shall make good all damage due to CONTRACTOR's operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

1.04 SUBSURFACE OBSTRUCTIONS

- A. CONTRACTOR shall field determine, before pipeline trenching and associated excavations are begun, the depth and location of existing utilities. Utility locations indicated on the plans were obtained from the records available, but have not been field verified, nor have depths been measured or observed. CONTRACTOR shall submit descriptions, depths, and locations of subsurface obstructions to the PROJECT MANAGER for review.
- B. In excavation, backfilling, and laying pipe, care shall be taken not to remove, disturb, or injure existing pipes, conduits, or structures. If necessary, CONTRACTOR at own expense shall sling, shore-up, and maintain such structures in operation.
- C. CONTRACTOR shall obtain the permission of and give sufficient notice to the proper authorities of CONTRACTOR's intention to remove or disturb any pipe, conduit, etc., and shall abide by their regulations governing such work.

- D. In the event subsurface structures are broken or damaged in the execution of the WORK, CONTRACTOR shall immediately notify the proper authorities and repair the damage at once at own expense. Repairs shall be made to the satisfaction of the PROJECT MANAGER. CONTRACTOR shall be responsible for any damage to persons or property caused by such breaks or due to own neglect in reporting and/or repairing such damages.
- E. COUNTY or PROJECT MANAGER will not be liable for any claims made by the CONTRACTOR based on underground obstructions that could have been reasonably identified as being different than that indicated on the plans. CONTRACTOR shall uncover subsurface obstructions in advance of construction so that the method of avoiding same may be determined before the work reaches the obstruction.

1.05 CONFLICTS WITH OTHER UTILITIES

- A. CONTRACTOR shall coordinate and cooperate with the COUNTY to ensure that no damages to existing utilities occur.
- B. All temporary support or minor adjustment which does not require replacement or direct bypass connections to these existing services (such as all direct-buried telephone cables or two-inch and smaller gas lines) will be the responsibility of the CONTRACTOR.
- C. COUNTY will not be responsible for any delay or inconvenience to the CONTRACTOR resulting from the existence, removal, or adjustment of any public or private utility that could have been reasonably identified. Additional costs incurred as a result thereof shall be borne by the CONTRACTOR and considered as included in the Contract Price.

1.06 EXISTING FENCE LINES

- A. Any fence removed or temporarily relocated shall be restored to its original condition and location.
- B. All cost for such temporary removal or replacement shall be included as indicated in the unit prices proposal. No direct payment will be made for fence replacement unless specifically noted otherwise.

1.07 UTILITY INVESTIGATION

- A. Prior to commencing with trench or other excavations required for the performance of the WORK, CONTRACTOR shall conduct a field investigation for the purpose of determining existing locations of all underground utilities and facilities which are shown on the drawings. The investigation shall be made by hand or machine excavation. All such excavations shall include removal of surface material and obstructions required to perform the excavations. CONTRACTOR shall provide sheeting, shoring, and bracing, as required, to

minimize the required size of the excavation and support adjacent ground, structures, roadways, and utilities. After the data is obtained at each excavation site, CONTRACTOR shall immediately backfill each excavation site. Backfill shall be compacted clean soil for the full depth. The surface shall be returned to its original grade and condition except that paved areas may be temporarily surfaced and maintained where excavations required for the performance of the WORK coincide with the location of the investigative location. CONTRACTOR shall be responsible for all costs associated with repair of roadways, paving, structures, underground and above ground utilities and facilities damaged in conducting the investigations.

- B. Findings of the investigation shall be reported to the PROJECT MANAGER. The PROJECT MANAGER shall furnish two sets of full size blue line drawings for CONTRACTOR's field use in recording the findings of the investigation and for CONTRACTOR's office use in transcribing the field investigation information onto same for submission to the PROJECT MANAGER. CONTRACTOR shall clearly designate all found utilities and facilities discovered whether or not shown on the Contract Drawings. CONTRACTOR shall provide written detailed description of any underground utility or facility conflicting with the elevation or alignment of the WORK.
- C. CONTRACTOR shall describe size, material, and location of existing underground utilities and facilities. Locations and elevations shall be referenced to project stationing, distance from base line, and project bench marks.

1.08 PROTECTION OF EXISTING LANDFILL

- A. The CONTRACTOR shall use extreme care during construction activities on or near the landfill to not damage unnecessarily any existing features.
- B. The CONTRACTOR shall use low ground pressure equipment on final geomembrane cover areas so as to not disturb the certified final cover.
- C. Assistance will be given to the CONTRACTOR in determining the toe of the landfill as needed to avoid damage to the liner and existing features. This assistance shall in no way relieve the CONTRACTOR from responsibility and liability in maintaining site conditions.
- D. Any damage resulting from the CONTRACTOR's operations shall be repaired by the CONTRACTOR to original conditions or replaced with new materials at no additional cost to the COUNTY. Repairs shall be as directed by the PROJECT MANAGER with approved materials.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 70 10

START-UP

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Startup certifications are required for the condensate sumps, dewatering pumps, and air compressors. Certifications include the Manufacturer's Check-Out Certification and the Demonstration Certification. The CONTRACTOR shall satisfy the requirements of these certifications as specified herein.
- B. Related Work Described Elsewhere:
 - 1. Section 33 21 70-1: LFG Extraction Wells and Wellheads
 - 2. Section 44 11 20: LFG Blower/Flare System

PART 2 – PRODUCTS

2.01 INSTALLATION, OPERATION, AND MAINTENANCE MANUALS

- A. The CONTRACTOR shall supply an electronic copy of installation, operation, and maintenance manuals for the following equipment:
 - 1. Pneumatic pumps and data module
 - 2. LFG wellheads (Manufacturer's Check-Out Certification)
 - 3. 2,500 scfm Flare and all associated equipment on skid
 - 4. Air Compressor
- B. Manuals for each piece of equipment shall include the following:
 - 1. Manufacturer's recommended installation procedures
 - 2. Parts list and diagrams
 - 3. Maintenance procedures and frequency
 - 4. Method of operation
 - 5. Safety precautions
 - 6. Troubleshooting guide
 - 7. Contact information for customer service and support

8. Name, address, phone and fax numbers for supplier of equipment

PART 3 - EXECUTION

3.01 PRELIMINARY MATTERS

- A. Startup Certification: Prior to system startup, successfully complete all testing required of the individual components. Complete and submit an electronic copy of the attached "Manufacturer's Check-Out Certification" form for the pumps and LFG wellheads. The submitted copies shall have signatures of the General CONTRACTOR, the Subcontractor (if involved), and the Manufacturer's representative. All copies shall be provided with the respective Operation and Maintenance (O&M) Manual. This form and the O&M Manual shall be submitted prior to providing operational training to the COUNTY and prior to conducting the Substantial Completion inspection.
- B. Demonstrate to the ENGINEER all temporary jumpers and/or bypasses have been removed and that all components are operating under their own controls as designated.
- C. Coordinate startup activities with the PROJECT MANAGER and with the ENGINEER at least one week prior to commencing system start-up.

3.02 START-UP OF PNEUMATIC VALVE

- A. Confirm that all equipment is properly energized and that all switches are set to their normal operating condition.
- B. Initiate start-up in accordance with the start-up sequence. This start-up sequence shall follow, exactly, the sequence in the submitted O&M manuals.
- C. Observe individual component operations and make adjustments as necessary to demonstrate performance of the valve.
- D. Coordinate with the ENGINEER before performing any adjustments that may disturb other landfill operations.

3.03 START-UP OF BLOWER/FLARE STATION

- A. Confirm that all equipment is properly energized and that all switches are set to their normal operating condition.
- B. Initiate start-up in accordance with the start-up sequence. This start-up sequence shall follow, exactly, the sequence in the submitted O&M manuals.
- C. Observe individual component operations and make adjustments as necessary to optimize the performance of the blower/flare station and control panel.

1. Follow start-up sequence for flare.
 2. Perform automatic and manual restarts.
 3. Observe and document proper operation of flow meter, chart recorder, displays, gauges, valves, and warning light.
 4. Perform shutdown sequence.
- D. Coordinate with the ENGINEER before performing any adjustments that may disturb other landfill operations.

3.04 DEMONSTRATION AND TESTING

- A. After all work components have been constructed, field tested, and started-up in accordance with the individual specifications and manufacturer requirements, perform the demonstration and testing in the presence of the ENGINEER and the PROJECT MANAGER. The demonstration shall be held upon completion of all systems concurrent with the Substantial Completion inspection. Prior to the demonstration, the CONTRACTOR shall indicate in writing to the ENGINEER that the WORK is complete, has been tested by the CONTRACTOR, and is ready for demonstration.
- B. The demonstration and testing shall be conducted for five consecutive days. The WORK must operate successfully throughout the five-day testing period in the manner intended. If the WORK does not operate successfully, the problems shall be corrected, and the five-day test shall be restarted to Day 1. If more than five days are needed for the demonstration test, the CONTRACTOR shall reimburse the COUNTY for the cost of the additional costs for the ENGINEER.
- C. Acceptability of the WORK's performance will be based on the WORK performing as specified in the Contract Documents, either under actual or simulated operating conditions as approved by the ENGINEER. The intent of the demonstration and testing is for the CONTRACTOR to demonstrate to the PROJECT MANAGER and the ENGINEER that the WORK will function as a completed and operable system under normal operating conditions and is ready for acceptance.
- D. In conjunction with the demonstration and testing, the CONTRACTOR shall provide a training session or sessions for a minimum of 4 hours to adequately instruct designated OWNER personnel on system start-up, operations, maintenance, shutdown, and other essential features of the system equipment.
1. The training shall detail the function of the various systems and system components and their relationships to each other.

2. System operations under typical and alarm conditions shall be demonstrated; some of these alarm conditions may be simulated (e.g., via electrical jumpers) for training purposes.
 3. Prior to Substantial Completion, the CONTRACTOR shall submit for approval, a detailed agenda for the training sessions and the experience of the person(s) conducting the training.
 4. Training shall be conducted during the Substantial Completion inspection, following the completion of the start-up testing.
- E. Demonstration Certification: Complete and submit one electronic of the attached “Demonstration Certification” form. The submitted copies shall have signatures of the General CONTRACTOR, the Subcontractor (if involved), and the Manufacturer’s representative (if involved). All copies shall be provided with the respective O&M Manual.

END OF SECTION

MANUFACTURER'S CHECK-OUT CERTIFICATION

____ CLIENT: _____
____ ENGINEER: _____ Check-out
____ CONTRACTOR: _____ Memo No. _____

PROJECT DATA

NAME: Lee/Hendry County
Landfill Gas Collection and Control
System Project

LOCATION: Felda, Florida

CLIENT: Solid Waste Disposal Facility

CONTRACT DATA

NUMBER: _____
DATE: _____
DRAWING # _____
SPECIFICATION _____
SECTION: _____

Name of equipment checked: _____

Name of manufacturer of equipment: _____

1. The equipment furnished by us has been checked on the job by us. We have reviewed (where applicable) the performance verification information submitted to us by the Contractor.
2. The equipment is properly installed, except for items noted below.*
3. The equipment is operating satisfactorily, except for items noted below.*
4. The written operating and maintenance information (where applicable) has been presented to the Contractor, and gone over with him in detail. At least four (4) copies of all applicable operating and maintenance information and parts lists have been furnished to the Contractor for insertion in each of the Equipment Brochures.

Checked By:

Name of Manufacturer's Rep.

Name of General Contractor

Address and Phone No. Of Rep.

Authorized Signature/Title/Date

Signature/Title/Person Making Check

Name of Subcontractor

Date Checked

Authorized Signature/Title/Date

* Manufacturer's Representative Notations - Exceptions noted at time of check were:

Manufacturer's Representative to note adequacy of related equipment that directly affects operation, performance or function of equipment checked. (No comment presented herein will indicate adequacy of related systems or equipment):

DEMONSTRATION CERTIFICATION

____ CLIENT: _____
____ ENGINEER: _____ Check-out
____ CONTRACTOR: _____ Memo No. _____

PROJECT DATA

NAME: Lee/Hendry County
Landfill Gas Collection and Control
System Project

LOCATION: Felda, Florida

CLIENT: Solid Waste Disposal Facility

CONTRACT DATA

NUMBER: _____
DATE: _____
DRAWING # _____
SPECIFICATION _____
SECTION: _____

NOTE TO CONTRACTOR:

Submit one electronic and four (4) copies of all information listed below under (a) and (b) for review at least one week before scheduled demonstration of the Work. After all information has been approved by the ENGINEER, give the COUNTY a Demonstration of Completed Systems as specified and have the COUNTY sign four (4) copies of this form. After this has been done, a written request for a final inspection of the system shall be made by the CONTRACTOR.

MEMORANDUM:

Approval of this certificate indicates that the COUNTY has been given a Demonstration of Completed Systems on the Work covered under this Specification Section. Operation of the overall system and of major equipment items were described and demonstrated. The following items were given to the COUNTY:

- (a) COUNTY's four (4) copies of Operation and Maintenance Manuals for equipment or systems specified under this section containing approved submittal sheets on all items, including the following:
 - (1) Maintenance information published by manufacturer on equipment items.
 - (2) Printed warranties by manufacturers on equipment items.
 - (3) Check-Out Certification on equipment signed by manufacturer's representative.
 - (4) Written operating instructions on any specialized items.
 - (5) Explanation of guarantees and warranties on the system.

- (b) Record documentation showing as-built conditions.
- (c) A demonstration/training session presenting system operation and maintenance procedures.

(Name of Contractor)

By: _____
(Authorized Signature, Title & Date)

(Name of Subcontractor)

By: _____
(Authorized Signature, Title & Date)

Received the following: Operations and Maintenance manual, as-built documentation,
demonstration and instructions on system operation

(Solid Waste Disposal Facility)

By: _____
(Authorized Signature, Title & Date)

SECTION 01 70 30

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. The Contractor shall maintain at the site one hard copy record set of:
1. Drawings
 2. Project Manual
 3. Addenda
 4. Change orders and other modifications to Contract
 5. Project Manager field orders, written instructions or clarifications
 6. Approved submittals
 7. Field test records
 8. Daily logs
 9. Survey notes and calculations
 10. Construction photographs
 11. Associated permits
 12. Certificates of inspection and approvals

1.02 SUBMITTALS

- A. Upon Substantial Completion the Contractor shall:
- Deliver two identical, complete review sets of Record Documents within 14 calendar days after Substantial Completion to the Engineer. Each set of Record Documents shall consist of: one set of 22 x 34-inch redline drawings and one copy of record documentation and vendor and material supply information. The Engineer shall comment and return one set to the Contractor. The final Record Drawings shall be generated using computer software as specified in Part 3.03 F of this Section.
- B. Accompany the submittals with a transmittal letter containing the following:
1. Date
 2. County project title and number
 3. Contractor's name and address
 4. Title of record document
 5. Signature of Contractor or authorized representative
- C. At County's acceptance:
- Upon receipt of the Engineer's comments, Contractor shall deliver within 14 days to the Engineer four (4) complete sets of Record Drawings incorporating the

Engineer's comments. Record Drawings submitted by the Contractor shall be sealed by a Florida Licensed Professional Land Surveyor. If the second submittal of the Record Documents is deemed incomplete or does not address all of the Engineer's comments, the submittal shall be returned to the Contractor. The Contractor shall reimburse the County for the Engineer's expense for the additional reviews.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS AND SAMPLES

- A. Contractor shall store documents and samples in Contractor's field office apart from documents used for construction.
 - 1. Provide files and racks for storage of documents.
 - 2. Provide secure storage space for storage of samples.
- B. Maintain documents in clean, dry, legible condition and in good order. Record Documents shall not be used for construction purposes.
- C. Make documents and samples available at all times for inspection by Engineer.
- D. Failure to properly maintain Record Documents as stated herein may be reason to delay a portion of progress payments until the requirements of this Section are satisfied.

3.02 CONSTRUCTION PHOTOGRAPHS

- A. Progress Photos: The Contractor shall provide a photographic record of construction progress every other week to the County. For each submittal, at a minimum, the photographic record shall consist of an electronic set of 12 digital color photographs, each formatted to 4 inches by 6 inches. The Engineer shall reserve the right to select the views to be photographed. The photographs shall be of good quality as determined by the Engineer, and date stamped. Each photograph will be captioned with the following items identified:
 - County project name and number
 - Date photograph was taken
 - Detailed description identifying location and name of feature photographed
 - Name of Contractor
- B. Photographs shall be taken weekly or during execution of individual work items, whichever is more frequent, beginning prior to the start of construction and continuing through the completion of all construction.

- C. Photographs shall be taken to document each major work item, including:
1. Pre-construction conditions.
 2. Mobilization and storage of materials. Materials photographed shall include the pipe, sumps, and fittings to be used in the work.
 3. Installation of landfill gas extraction wells and horizontal collectors.
 4. Installation of the gas lateral and header piping, including pipe fusion.
 5. Road crossing and casing.
 6. Connection of gas lateral piping to header.
 7. Installation of air supply line and condensate discharge line in trench, including cross-over of pipes and appurtenances.
 8. Backfilling of installed pipe, including placement of warning tape and compaction.
 9. Ditch crossings and stormwater swale crossings.
 10. Installation of pneumatic pumps in sumps.
 11. Buried blind flanges.
 12. Tie-in of each condensate discharge line to traps and leachate collection risers.
 13. Installation of header, lateral, air supply, and condensate discharge line isolation valves.
 14. Pressure testing.
 15. Flare installation including all electrical components.
 16. Flare pad installation and testing.
 17. Connection of condensate discharge line to existing ponds.
 18. Site cleaning and demobilization.

3.03 RECORD DOCUMENTS

- A. Label each document "RECORD DOCUMENTS" in large printed letters.
- B. Maintain redline set of Drawings and specifications legibly annotated to show all changes made during construction.

1. Graphically depict changes by modifying or adding to plans, details, sections, elevations, or schedules.
 2. Make changes on each sheet affected by changes.
- C. Record information concurrently with construction progress.
- D. Record Drawings shall include the following:
1. Title Sheet (includes County project name and number, site location map, site address and phone number, and names, addresses and phone numbers of design engineer and Contractor).
 2. Header and Lateral Layout (as-built and drawn using surveyed horizontal and vertical coordinates) shown with most recent site topography. Site plan layout shall include existing and new features, identification of pipe locations and sizes, and callouts of all surveyed points (well locations, pipe tie-ins, fittings, appurtenances, road crossings, changes in pipe direction and slope, etc.). The header and lateral layout site plan shall be at a scale providing appropriate clarity to the drawing as approved by the Engineer.
 3. Record Construction Pipe Route Survey Table showing coordinates and elevations of surveyed top of pipe, fittings, tie-ins, sumps, and appurtenances, length of pipe segments, pipe slope between each surveyed station, and ground surface elevation. Each pipe segment shall be given a unique description as approved in advance by the Engineer. Pipe Route Survey data shall be provided in a tabular format, which shall be approved by the Engineer. An example format is provided below.

STATION	GRID COORDINATES		Header Invert Elev. (ft)	Ground Elev. (ft)	Header Depth (ft)	Header Slope	Const. Notes and Fittings	Pipe Info.
	(north)	(east)						
Line F-F 0+00	5078.45	22997.65	1235.58	1239.66	3.8	-2.13%	Sta 0+02 Line E-E' 12"x4" tie-in	31 ft of 4" Dia HDPE at 2.13%
0+04	50704.56	22997.42	1235.74	1240.40	4.47		Begin 8" CMP Road Casing	
0+26	50694.44	22977.80	1235.28	1239.09	3.8		End 8" CMP Road Casing	
0+31	50712.65	22981.02	1235.17	123.54	3.4		Sta 1+28 C-C' 4" Tee and Riser	
Lateral to EW-A								
0+00	50601.26	23272.90	1274.62	1278.90	4.3	2.00%	Sta 2+00 Line A-A' 6"x4" Branch Saddle	5 ft of 4" Dia HDPE at 2.00%
0+05	50606.27	23271.25	1274.72	1278.66	3.9		Well GEW-A	
Lateral to EW-B								
0+00	50591.22	23078.87	1264.31	1268.29	4.0	2.00%	Sta 4+00 Line A-A' 6"x4" Branch Saddle	5 ft of 4" Dia HDPE at 2.00%
0+05	50595.82	23081.00	1264.41	1268.86	4.5		Well GEW-B	

4. As-Built Typical Details.

5. Pipe profiles of all header and lateral pipes. Profiles shall include pipe diameter, slope, grade breaks, section view of ground surface along pipe segment, location and description of existing utilities encountered, pipe crossings and vertical and horizontal scale bar.

E. Project Documentation Manual:

1. Each copy of the Project Manual shall be bound, consist of clean legible copies or originals, and at the minimum consist of the following information:
 - a. Cover Sheet
 - b. Table of Contents
 - c. List of Addenda
 - d. Project Contact List - includes the names, phone numbers and address of the following:

Project Manager
Site Representative
Drilling Contractor
Pipe Contractor
Surveyor
Record Documenter

- e. Project Vendor List including list of materials provided by each vendor, and address, phone, fax number of each vendor.
 - f. Project Record Drawing Summary
 - g. Route Survey Data Table - referencing pipeline station with appropriate grid coordinates, ground surface elevation, depth of cover soil, top of pipe elevation at a minimum of every 50-feet, slope at all major line, angle and grade change points, valves, tees, and other appurtenances, and connection locations.
 - h. Pressure Test Reports
 - i. Contractor's Daily Work Logs
 - j. Construction Meeting Notes/Status Reports
2. Project Document appendices shall include:
- a. HDPE/PVC pipe specifications
 - Pipe Installation Manual
 - Engineering Characteristics Manual
 - Pipe Material Data Sheet
 - Manufacturer quality assurance certificates
 - Fabricated fittings specification sheets
 - b. Valve specifications
 - Isolation valves (stem extension)
 - Check valves
 - Ball valves
 - c. Photographs

F. General File Requirements:

- 1. Drawings shall be generated using AutoCAD Release 2018 software or newer. The Record Drawings shall be drawn to include the following:
 - a. 3-dimensional, 1:1 format.
 - b. Existing survey reference points.
 - c. Breaklines that define all surface features.
 - d. Contours and spot elevations must be at correct elevation.
- 2. Electronic copies of the Contract Documents drawings will only be available to the Contractor in AutoCAD Release 2018 or newer format. Neither the County nor Engineer shall be responsible for conversion of files to other file formats.

3. Use Electronic drive or CD-ROM for submittal of electronic files. Two complete copies of the Record Document electronic files shall be supplied along with each set of Record Documents.
4. Label each disk/drive with County project name and number, Contractor's name, address and phone number, date of submittal, and file reference names.

END OF SECTION

SECTION 02 41 16

REFUSE HANDLING, STORAGE, AND DISPOSAL

PART 1 - GENERAL

1.01 NOTIFICATION

- A. The Contractor shall notify the County in advance of planned unloading of excavated waste at the active face.
- B. No excavated materials shall be removed from the site or disposed of by the Contractor except as specified below and approved by the County.

1.02 SUBMITTALS

- A. The Contractor shall submit refuse disposal log to the County representative on a weekly basis during construction.

PART 2 - REFUSE HANDLING AND DISPOSAL

2.01 REQUIREMENT

- A. Excavated waste shall be loaded onto dump truck or other vehicle provided by the Contractor and moved to working face designated by the County as soon as possible after excavation for disposal.
- B. In the event that waste is excavated and cannot be immediately taken to the working face the waste may be stored adjacent to the excavation until it can be taken to the working face before the end of the same working day. Waste shall remain within close proximity to the location from which it was removed. All excavated waste must be removed from all locations at the end of each working day.
- C. In the event asbestos containing waste is encountered in the excavated waste, the Contractor shall notify the County immediately. Asbestos containing waste shall be maintained in a moist condition during the removal and transfer process to prevent and/or minimize emissions. Disturbed refuse (including any suspect asbestos-containing material) shall be transported to the working face of the Facility immediately for disposal and shall be buried with a minimum of six (6) inches of soil cover.

2.02 DISPOSAL OF REFUSE DAILY

- A. All excavated waste shall be hauled to the working face at least 30 minutes prior to the end of daily landfill operations.

- B. Excavated refuse is to be loaded and hauled by the Contractor to the working face of the landfill for disposal by the County. Contractor shall keep record of the quantity (number of loads) of refuse hauled to the working face of the landfill and provide a disposal log to the County representative on a weekly basis.

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 31 20 00

EXCAVATING, TRENCHING, BACKFILLING, AND GRADING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope: Contractor shall provide all labor, materials, and incidentals to excavate and trench designated areas, install pipe and appurtenances, haul (on-site) and install bedding and backfill material (to be supplied by **Contractor**), compact backfill, and regrade disturbed areas as shown on the Drawings, and described in this Section.
- B. The work specified in this Section includes the trenching and trench backfilling activities associated with installation of the LFG lateral and header pipe, air supply pipe, dewatering discharge line, tie-ins, condensate sumps, and any other work requiring drilling, excavation, trenching, trench backfilling, or grading.
- C. Work under this Section includes trenching and grading activities inside of municipal solid waste (MSW) landfill areas.
- D. No classification of type of excavated materials will be made. Excavation includes all soil and refuse materials regardless of type, character, composition, moisture, or condition thereof.
- E. Any damage to existing features shall be repaired as directed by the Engineer, at the Contractor's expense.

1.02 PROJECT CONDITIONS

- A. Existing project conditions are shown on the Drawings or otherwise described herein.
- B. Site information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the Contractor. The Contractor shall explore ahead of the required excavation to determine the exact location of all structures, utilities, etc.
- C. Structures shall be supported and protected from damage by the Contractor. If structures are broken or damaged, Contractor shall restore structures, utilities, etc. to their original condition at no additional cost to the County as soon as possible. Any expected delay in the repair of damaged features or structures shall be notified to the County. Repair of damaged features or structures shall be approved by the Engineer and County.

1.03 SITE ACCESS

Work shall be performed so as to not block or hinder site access, except as authorized by the County.

1.04 SAFETY

- A. All work shall be performed in strict accordance with the Health and Safety requirements set forth in the General Conditions of the Contract Documents.
- B. All work shall be performed in strict accordance with all local, State, U.S. Occupational Safety and Health Administration (OSHA) and other applicable Federal regulations regarding trenching operations and trench safety.
- C. Excavation may be made without sheeting and bracing within the limitations and requirements of the governmental agencies having jurisdiction. Failure of the Engineer to order the use of bracing or sheeting and shoring or direct changes to systems in place, shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of excavations or of his obligations under the Contract. The Contractor shall be responsible for the condition of all excavations. All slides and caves shall be removed without extra compensation, at whatever time and under whatever circumstances that they may occur.
- D. All excavation shall comply with the applicable requirements as stated in the following:
 - 1. OSHA excavation safety standards 29 CFR, 1926 subpart P.
 - 2. Trench safety guidelines as specified by the Landfill Gas Division of the Solid Waste Association of North America (SWANA).
- E. The Contractor shall include for any excavation, temporary controls for stormwater runoff and erosion control in full conformance with all existing facility permits and/or applicable regulations. Facility's current permits will be supplied at pre-construction meeting.

1.05 SUBMITTALS

- A. Health and Safety Plan.
- B. Results of sieve analysis and calcium carbonate test for stone backfill.
- C. Pipe slope calculations and survey notes for pre-construction layout, including lateral route, and air supply/dewatering discharge lines.
- D. Pipe survey notes for installed pipe pursuant to Part 3.06 of this Section.

- E. Proposed stationing and pipeline identification procedures. Prior to the start of any pipe installation, Contractor shall supply an example layout drawing showing how the header and laterals will be marked with stations for the conformance surveys. The example layout drawing and stations must be consistent with the requirements of Sections 01 30 10, 01 70 30, and 33 51 10 of the Contract Documents.
- F. Contractor daily logs detailing length of trench excavated and backfilled, with reference to pipe stationing and details sufficient to properly describe the work completed to date.
- G. Clean soil backfill will be the responsibility of the **Contractor**: procurement, transportation and cost.
- H. The Contractor shall notify the Engineer in writing of the material source for each of the soils specified within Part 2 of this Section at least 14 calendar days prior to the date of anticipated use of such material. Notification shall include:
 - 1. Supplier's name.
 - 2. Borrow location.
 - 3. Documentation confirming adequate quantities are available to complete the work.
 - 4. Soil field-moisture, laboratory proctor-density tests, and field compaction test results as required within Part 2 of this Section.
 - 5. Certification that the soil is not petroleum-contaminated or contaminated with other chemicals or compounds that may be deemed hazardous or harmful to human health and the environment.

PART 2 - PRODUCTS

2.01 CLEAN BACKFILL MATERIALS

- A. Soil material may be reused for clean soil backfill provided it is free of sticks, roots, organic matter, MSW, and stones larger than 1-inch in any dimension. Remove any material that cannot be made to compact readily and replace with suitable material. If new material must be imported for use as clean soil backfill it must meet the criteria of this Specification and the testing requirements below and is the responsibility of the **Contractor** to provide clean soil backfill during construction.
- B. Material shall be well-graded (SW) or poorly graded (SP) clayey sands (SC) as classified by the Unified Soil Classification System (USCS), or other soil as approved by the Engineer.

- C. Clean backfill material (to be provided by **Contractor**) shall be used in the following areas of work and as shown on the Drawings, unless specified otherwise:
1. Pipe Bedding
 2. Trench Backfill
 3. Backfill in well borehole
 4. Above the final cover system to ground surface in all trenches
 5. Any location on Drawings that calls for “general fill” or “clean soil backfill” if excavated material is waste or is otherwise not suitable for reuse.

2.02 SUBGRADE SOIL MATERIALS

- A. Subgrade soils are natural, in-place materials. Soils shall be well-drained and reasonably free of sticks, roots, debris, organic matter, and MSW. Contractor shall remove material that cannot be made to compact readily and replace with Engineer-approved soil.
- B. Soils which yield or exhibit pumping due to excessive moisture shall be excavated and replaced with general fill or materials as approved by the Engineer.

2.03 NON-CALCAREOUS STONE

- A. Stone backfill shall be hard, durable non-calcareous rock. Stone shall be washed as a component of the manufacturing process and be free of organics, lumps or balls of clay, and other deleterious materials.

Stone shall be FDOT No. 4 and conform to the following gradation requirements:

Sieve Size	% Passing (by weight)
2 - inch	100
1 ½ - inch	90
1 -inch	35
¾ - inch	5
⅜ - inch	0

2.04 TOPSOIL

- A. Material shall be fertile, natural soil, typical of the locality, free from MSW, stones (exceeding 2-inch in any dimension), roots or sticks (exceeding 1-inch diameter), clay, and weeds, and obtained from naturally well drained areas. It shall not be excessively acid or alkaline nor contain material harmful to plant growth. The material shall comply with the requirements of FDOT’s Standard

Specifications for Road and Bridge Construction (2017), Section 987, prepared soil layer materials.

- B. Topsoil will be used as part of the restoration operations to reestablish vegetation. The Contractor shall place a minimum of four (4) inches of topsoil over all graded earthen areas and over any other areas to be seeded. Sources of topsoil shall be approved by the Soils Engineer prior to disturbance.
- C. Topsoil shall be natural topsoil without admixture of subsoil material, and shall be classifiable as loam, silt loam, clay loam, sandy loam, or a combination thereof. The pH shall range from 5.5 to 7.0. Topsoil shall contain not less than five (5) percent or more than 20 percent, by weight, of organic matter as determined by loss on ignition of oven-dried samples to 65°C.

PART 3 – EXECUTION

3.01 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities from damage.
- C. Protect benchmarks, survey control points, monitoring wells, existing structures, and fences from excavating equipment and vehicular traffic.

3.02 PRE-CONSTRUCTION LAYOUT

- A. Prior to trenching and pipe installation, Contractor and Contractor's surveyor shall stake out the entire proposed trench alignment. The proposed alignment must be approved by the Engineer prior to beginning excavation activities. This pipeline route staking for both header and lateral pipes must meet the minimum pipe slopes listed in this Section and on the Drawings.
- B. Survey notes with proposed pipe slope calculations shall be submitted to the Engineer for approval prior to pipe installation. Notes of pre-construction survey shall identify conflicts between the proposed work and existing features.

3.03 EXCAVATION

- A. Refuse materials shall be handled as directed in Section 02 41 16, Refuse Handling, Storage, and Disposal.
- B. Excavate to lines, grades, and dimensions necessary to complete the work.

- C. Trenching Tolerances:
1. Excavate to install pipes in straight runs at a uniform grade, without sags or humps, between vertical and horizontal control points in accordance with the Contract Drawings.
 2. Minimum trench width shall be as shown on the Drawings.
 3. Maintain thickness of soil cover over the top of the pipe, as shown on the Drawings, or approved by the Engineer.
- D. Contractor shall not excavate trench more than it can be completely backfilled after installation of the pipe on the same day. Excavations shall not be left open overnight. In the event that a trench must be left open overnight the Contractor must get permission from the County to leave trench open and trench must be encircled in safety/warning tape attached to stakes placed along the perimeter on all edges of the trench. In the event that the trench has exposed refuse, all refuse must be covered with a tarp, or other cover material as approved by the County, which is secured on all corners and along its perimeter.
- E. Contractor shall use appropriate survey/level instrumentation during excavation to ensure proper trench slope. Verification of installed pipe slope shall be as specified in Part 3.06.
- F. Minimum trench slopes shall be at least 5 percent (within waste limits) as shown on the Drawings or approved by the Engineer.

3.04 DEWATERING

- A. Water that enters excavations into refuse shall be considered landfill leachate and shall not be discharged to the ground or other means that are typical for stormwater. Water in trench excavations into refuse shall be pumped into sealed tanks, hauled to the leachate tanks. The Contractor must notify the County prior to discharging into leachate tanks.
- B. The Contractor shall at all times during construction provide and maintain proper equipment and facilities to remove water entering excavations. Contractor shall keep such excavations dry so as to obtain a satisfactory foundation condition for all work.
- C. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottom and soil changes detrimental to stability of subgrades and foundations. Subgrade soils that become soft, loose, "quick", or otherwise unsatisfactory for support of structure as a result of inadequate dewatering or other construction methods shall be removed and replaced by crushed stone or gravel as required by the Engineer at the Contractor's expense. The bottom of excavations shall be firm and without standing water before placing structures or pipes. Provide and maintain pumps, well points, sumps,

suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

D. Disposal of Water Removed by Dewatering System:

1. Water conveyed away from excavations which has not contacted refuse materials shall be discharged to areas approved by the Engineer.
2. Dispose of water by procedures approved by the Engineer in such a manner as to cause no inconvenience to the County or others involved in work about the site.
3. Water conveyed away from excavations which has contacted refuse materials shall be pumped into spill-proof containers and discharged into the leachate tanks as directed by the County.

E. If pipe trench becomes watered-in after placement of pipe, but before backfilling, Contractor shall dewater the trench, demonstrate that the pipe bedding and pipe slope remain satisfactory, and upon approval by the Engineer, backfill the pipe with clean dry soil in accordance with Part 2.01 of this Section.

3.05 ROAD CROSSINGS

- A. Contractor shall schedule and coordinate all road crossings with the County to minimize disruption of the County's operations.
- A. HDPE pipes shall be encased in a larger diameter Corrugate Metal Pipe (CMP) casing for protection. The inner diameter of the casing shall be a minimum of five (5) inches larger than the cumulative outside diameters of the HDPE pipes encased. The CMP shall conform to AASHTO M36.

3.06 PIPE SURVEY

- A. Contractor shall verify that pipe slope meets the requirements specified in this Section and on the Drawings at 10-foot intervals along LFG laterals and header and record such information in the project notes. Station numbering shall be used and marked on the pipe, as approved by the Engineer.
1. Contractor shall measure each length of installed pipe and mark the 10-foot stations. Stationing of laterals shall begin with 0+00 at the header, ending at the riser for the well.
 2. Stationing of the header shall begin with 0+00 at a location approved by the Engineer. Station numbering for pipe installed each day shall be consecutive with pipe installed on previous days. The Contractor shall not restart station numbering at 0+00 for any header segment without advance approval from the Engineer.

3. Survey equipment shall be used to measure the change in relative elevation between each 10-foot station prior to burial of any pipe.
 4. The surveyed elevations and calculated change in elevation and slope for each 10-foot section shall be recorded in the Contractor's project notes.
 5. A trench laser will not be considered acceptable survey equipment for the purpose of verifying pipe slope.
- B. The project notes detailing the required pipe slope confirmation shall be provided daily to the Engineer.
- C. An as-built survey shall be conducted on all installed pipe prior to backfilling the trench.
1. The survey shall document the horizontal and vertical location of the top of the landfill gas laterals, air supply lines, condensate discharge line and drain line pipes at minimum 50-foot intervals and at each change in pipe direction, ground surface grade break, change in pipe grade, fitting; included but not limited to; valves, cleanouts, access risers, elbows, tees, etc., connection, pipe crossover, and tie-in along the entire pipeline routes.
 2. If a run of pipe is 100 feet or less in length, Contractor shall provide survey shots at a 20-foot interval or less. For a run of pipe of 50 feet or less, Contractor shall provide survey shots at a 10-foot interval or less to document the pipe as-built conditions.
 3. The survey shall also document the type of pipe, location (horizontal and vertical coordinate) of structures and appurtenances such as, but not limited to road crossing casing, pipe crossing, and tie-ins.
 4. This surveying shall be sealed by a Florida Licensed Land Surveyor as described in Section 01 70 30, Project Record Documents.

3.07 BACKFILLING

- A. Backfill materials shall be as described in Part 2 of this Section.
- B. Contractor shall notify the Engineer prior to beginning backfilling. The Engineer shall inspect all pipe, fittings, and connections prior to approving backfilling. If Contractor backfills pipe without inspection of the pipe while pipe is installed in the open trench, Contractor shall uncover all uninspected buried pipe so that it may be properly inspected. This shall be done at no additional cost to the County.
- C. Place bedding material in trench to the lines and grades shown on the Drawings.
- D. Bedding material (clean soil) shall be placed in the trench ensuring material is placed under the haunch of the pipe. The bedding shall be poured into place, not

pushed, and shall be raked by hand or machine to level it before placement of pipe.

- E. Backfilling procedures shall be modified as necessary as approved by the Engineer in order to not displace (either horizontally or vertically) piping installed in the trench during backfill or bedding placement.
- F. Contractor shall compact the areas under all fitting(s) (i.e. tees, wyes, ninety, etc.), valve(s), sump(s), flange(s) prior to installing them in the trench. Contractor shall notify the Engineer after compacting the area and prior to placing the items listed above.
- G. Place soil backfill in maximum 6 inch lifts above pipe bedding to the existing grade. Contractor shall compact soil backfill in 6 inch lifts with mechanical compaction such as a walk-behind vibratory compactor or excavator bucket. Compaction shall be to a density where subsequent passes with the mechanical compaction device will not reduce the surface elevation of the bedding material by more than three-quarters of an inch.

3.08 REFUSE DISPOSAL

The Contractor shall be responsible for loading and transporting refuse to the working face as specified in Section 02 41 16. No excavated waste shall be left overnight at any excavation at any time.

3.09 GRADING DISTURBED AREAS

Contractor shall regrade and return to their original condition, as determined by the Engineer, all areas disturbed by Contractor's work. This includes, but is not limited to ruts caused by construction equipment, soil stockpile areas, and landfill benches and terraces used for access.

3.10 TESTING REQUIREMENTS DURING PLACEMENT

- A. The Contractor shall place backfill and fill materials to achieve an equal or "higher" degree of compaction than undisturbed materials adjacent to the work; however, in no case shall the degree of compaction fall below minimum compaction specified in this Section.
- B. Where laboratory or field testing is specified herein to verify that the constructed, in-place work meets the specifications and quality control requirements herein, the Contractor shall employ and bear the expense for an independent testing laboratory to conduct such tests. The Contractor shall pay for the costs of all retests required due to the initial testing not passing the requirements herein. Selected laboratory shall be approved by the County and the Engineer.

Where laboratory testing is specified to verify that any individual material of construction or product meets certain quality control requirements (i.e. size,

gradation, mix formula, hardness, shape, inherent strength, etc.), the Contractor shall employ and bear all expenses for an independent testing laboratory to sample the material or product and to conduct such tests and retests if necessary or required by the County.

END OF SECTION

SECTION 32 90 00

SEEDING AND SODDING

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all work and services for completion of all sodding and seeding, which will occur in all Contractor disturbed areas as shown on the drawings and as specified, in accordance with provisions of the Contract Documents. Sodding is required on all disturbed areas on a side slope and staging/laydown area located on the top slope and seeding is required on other disturbed top slope.
- B. The work shall include, but not necessarily be limited to soil preparation, liming, fertilizing, seeding and mulching, sodding and maintenance of all areas as shown on the drawings and as specified herein, including all areas disturbed by the Contractor.
- C. Construct grassing operations in strict conformity with the drawings and specifications and in accordance with the Florida Department of Transportation (FDOT) Standard Specifications Sections 570 and 981.
- D. Do not incorporate materials in construction until approved by the Engineer.

1.02 Submittals

- A. Seed: Signed copies of vendor's statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed. Statement shall certify that each container of seed delivered is fully labeled in accord with Federal Seed Act and equals or exceeds Specification requirements.
- B. Sod: Prior to placing sod out, notify the Engineer of source and permit the Engineer to inspect. Submit documentation from supplier regarding species and percentages of purity.
- C. Fertilizer: Furnish duplicate copies of invoices for all fertilizer used on project, along with certification of quality and warranty.
- D. Guarantee. Furnish copies of manufacturer/supplier warranties or guarantees for all products provided under this Specification.

PART 2 - PRODUCTS

2.01 TOPSOIL

- A. Refer to Section 31 20 00, Excavating, Trenching, Backfilling, and Grading.

2.02 SOD

- A. Sod shall be provided as required in accordance with FDOT Specifications sections 575 and 981. The Contractor shall furnish sod equal to and similar in type as that disturbed. Placement and watering requirements shall be in accordance with FDOT Specifications section 575.

2.03 SEED

- A. All grassing (seeding) shall be completed in conformance with FDOT Specifications section 570 and 981. The grassed (seeded) areas shall be mulched and fertilized in accordance with FDOT Specifications.
- B. Ensure each bag of seed is tagged with an analysis tag showing the results of a test made within 9 months of planting. Wet, moldy, or otherwise damaged seed shall not be used.

2.04 MULCH

- A. The mulch material shall be compost meeting the requirements of FDOT Specifications section 987, hardwood barks, shavings or chips; or inorganic mulch materials as approved by the Engineer; or hydraulically applied wood fiber mulch or bonded fiber matrix (BFM).
- B. Do not use mulch that contains an excessive quantity of matured seeds of noxious weeds, or other species that will grow or provide a menace to surrounding land. Do not use mulch material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.

2.05 MULCH BINDER

- A. Mulch on slopes exceeding 3:1 ratio shall be held in place by the use of an approved mulch binder. The mulch binder shall be nontoxic to plant life.

2.06 INOCULANT FOR LEGUMES

- A. All leguminous seed shall be inoculated prior to seeding with a standard culture of nitrogen-fixing bacteria that is adapted to the particular seed involved.

2.07 FERTILIZER

- A. Fertilize as necessary based on soil testing performed in accordance with FDOT Specifications section 162. Refer to FDOT Specifications section 982 for fertilizer rates.

2.08 LIMESTONE

- A. All limestone for agricultural liming purposes shall be crushed or ground to such a degree of fineness that 90 percent of the material will pass through a 10 {2.00 mm} mesh screen and not less than 50 percent of the material will pass through a 60 {250 µm} mesh screen. All such limestone shall also have a neutralizing value of 90 percent calcium carbonate or better.

2.09 WATER

- A. The water used in the seeding and sodding operations may be obtained from any approved spring, pond, lake, stream or municipal water system. The water shall be free of excess and harmful chemicals, acids, alkalis, or any substance which might be harmful to plant growth or obnoxious to traffic. Salt water shall not be used.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Topsoil shall be placed to achieve a depth of 6 inches in all areas indicated to be sodded on the Contract Drawings and as specified herein.
- B. Mulch material shall be applied uniformly over all seeded areas indicated on the Contract Drawings and as specified herein.
- C. All areas within the limits of the work and all areas disturbed by the Contractor's operations, with the exception of stockpile and borrow areas, shall be sodded or seeded unless otherwise indicated on the Contract Drawings.
- D. The period of sod establishment shall begin immediately after completion of sodding in an area and shall continue for a period of 1 year after the completion of sodding on the entire project unless the desired cover is established in a shorter period of time and shortening of the sod-establishment period is authorized by the Engineer.
- E. Unless otherwise shown on the drawings, sod shall be placed on top of backfill material in all disturbed areas along the side slopes, and seed along the top slope. Staging/laydown area located on top slope will require sod. It has been estimated that the disturbed area will be 30 feet wide and the length of all installed piping plus the tie-in areas.

3.02 SECURING AND SOIL PREPARATION

- A. Topsoil shall be secured from areas from which topsoil has not been previously removed, either by erosion or mechanical methods. Topsoil shall not be removed to a depth in excess of the depth approved by a soils engineer.
- B. The area or areas from which topsoil is secured shall possess such uniformity of soil depth, color, texture, drainage, and other characteristics as to offer assurance that, when removed, the product will be homogeneous in nature and will conform to the requirements of these Specifications.
- C. All areas from which topsoil is to be secured shall be cleaned of all sticks, boards, stones, lime, cement, ashes, cinders, slag, concrete, bitumen or its residue, and any other refuse which will hinder or prevent growth.
- D. In securing topsoil from a designated pit, or elsewhere, should strata or seams of material occur which do not come under the requirements for topsoil, such material shall be removed from the topsoil, or if required by a soils engineer, the pit shall be abandoned
- E. The Contractor shall, by a qualified laboratory, conduct laboratory analysis on 5 representative samples to determine pH content and nutrient levels. The rate for adding sulfur or lime shall be based upon recommendation by the laboratory.
- F. All areas to receive topsoil, seed and/or sod shall be raked, and all rubbish, sticks, roots and stones larger than 1 inch shall be removed. Loosen subgrade surface immediately prior to being covered with topsoil. Subgrade shall be inspected and approved by the Engineer before topsoil is placed.
- G. Topsoil shall be placed over approved areas to a depth sufficiently greater than required so that after natural settlement and light rolling the complete work will conform to the lines, grades, and elevations as indicated on the Contract Drawings. No topsoil shall be spread in water or while excessively wet.
- H. Loosen topsoil surface to a minimum depth of 2 inches. Remove stones over 1 inch in any dimension and sticks, roots, rubbish and other extraneous matter.

3.03 APPLICATION OF LIMESTONE, SULFUR AND FERTILIZER

- A. Sulfur and Limestone: If laboratory results indicate the addition of sulfur or lime is necessary, spread uniformly over designated areas to be seeded or sodded at the rate recommended. Thoroughly mix through upper 2 inches of topsoil.
- B. After application of sulfur or lime, and prior to applying fertilizer, loosen areas to be seeded or sodded with a suitable device if soil has become hard or compacted. Correct any surface irregularities in order to prevent pockets or low areas, which will allow water to stand.

- C. Fertilizing: Distribute fertilizer uniformly with a suitable distributor over areas to be seeded or sodded at a rate of 30 pounds per 1,000 square feet.
- D. Incorporate fertilizer into topsoil to depth of at least 2 inches by disk harrowing or other approved methods. Clean surface of stones or other substances, which will interfere with, turf development or subsequent mowing operations.
- E. Grade areas for seed or sod to a smooth, even surface with a loose, uniformly fine texture. Roll and rake, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas, which can be seeded or sodded soon after preparation.
- F. Fertilizer need not be incorporated in the soil when mixed with seed in water and applied with power sprayer equipment. The seed shall not remain in water containing fertilizer for more than thirty (30) minutes when a hydraulic seeder is used.
- G. Limestone shall be thoroughly mixed into the soil in accordance with the soil pH. Contractor shall notify the soil pH result to the Engineer and get approval for the lime application rate.
- H. It is the responsibility of the Contractor to make one (1) application of maintenance fertilizer at one-half the rates and should be applied in early spring following initial establishment of cover.

3.04 SEEDING OPERATIONS

- A. All disturbed areas that will not be reworked or sodded within 14 days maximum shall be temporarily seeded and mulched. Disturbed areas outside the "Limits of Construction" as shown on the Contract Drawings shall be sodded at no additional cost to the County.
- B. Seeding shall be in accordance with FDOT Standard Specifications. Steep slope seeding shall be in accordance with FDOT Standard Specifications. Seed shall be sown as soon as preparation of the seedbed has been completed. No seed shall be sown during high winds, nor until the surface is suitable for working and is in a proper condition. Seed mixtures may be sown together provided they are kept in a thoroughly mixed condition during the seeding operation.
- C. Seeds shall be uniformly sown by any approved mechanical method to suit the slope and size of the areas to be seeded, preferably with a broadcast type seeder, windmill hand seeder, or approved mechanical power drawn seed drills. Hydroseeding and hydromulching may be used on steep embankments, provided full coverage is obtained. Care shall be taken to adjust the seeder for seedings at the proper rate before seeding operations are started and to maintain their adjustment during seeding. Seed in hoppers shall be agitated to prevent segregation of the various seeds in a seeding mixture.

- D. Immediately after sowing, the seeds shall be covered and compacted to a depth of 1/8 to 3/8 inch by a cultipacker or suitable roller.
- E. Plant establishment including watering shall be in accordance with FDOT Standard Specifications, section 575 and 981.
- F. Protect seeded slopes against erosion with erosion control matting or other methods approved by ENGINEER.

3.05 MULCHING OPERATIONS

- A. Mulching shall be in accordance with FDOT Standard Specifications, section 580.
- B. Apply mulch immediately after seeding. Mulch shall be applied evenly between 3/4 inch and 1-1/2 inch deep, according to the texture and moisture content of the mulch material.
- C. Apply mulch with tackifier regardless of whether using ground or hydroseeding equipment for seeding. Apply enough tackifier to the mulch to hold it in place. Do not apply mulch on windy days. Immediately replace mulch that blows away.
- D. Apply walked-in-mulch on slopes ranging in steepness from 5:1 to 2:1. Immediately walk it into the soil with a cleated track dozer. Make dozer passes vertically up and down the slope.

3.06 SODDING OPERATIONS

- A. The setting of sod pieces shall be staggered in such a manner as to avoid continuous seams where possible.
- B. Sod shall be carefully placed by hand, edge to edge, in rows at right angles to the slope.
- C. Sodding shall be in accordance with FDOT Specification section 575 and 981.

3.07 WATERING

- A. The Contractor shall be responsible for maintaining the proper moisture content of the soil to insure adequate plant growth until a satisfactory stand is obtained. If necessary, watering shall be performed to maintain an adequate water content in the soil.
- B. Watering shall be accomplished by hoses, tank truck, or sprinklers in such a way to prevent erosion, excessive runoff, and overwatered spots.

3.08 MAINTENANCE

- A. The Contractor shall keep all seeded and sodded areas watered and in good condition until final acceptance.

- B. The repair of any erosion or sod relocation necessary prior to the sod becoming firmly rooted to the existing soil will be the responsibility of the Contractor.
- C. Begin maintenance of sodded areas immediately after each portion is planted and continue until final acceptance.
- D. Maintenance shall be at a minimum, all temporary and final seeded and sodded areas, watered twice per week with a minimum of 1/4 inch water applied per watering event.
- E. Upon completion of seeding operations, the Contractor shall clear the area of all equipment, debris, and excess material and the premises shall be left in a neat and orderly condition.
- F. The Contractor shall maintain all seeded and sodded areas without additional payment until final acceptance of the Work by the Owner, and any regrading, refertilizing, reliming, reseeding, or remulching shall be done, at Contractor's own expense. Seeding work shall be repeated on defective areas until a satisfactory uniform standard is accomplished. Damage resulting from erosion, gullies, washouts, or other causes, shall be repaired by filling with topsoil, compacting, and repeating the seeding work at Contractor's expense.
- G. Engineer may require the use of Bermuda sod in areas where Bermuda sod has been disturbed during construction. Additional seeding may be required until Bermuda grass growing season is established.

3.09 FINAL ACCEPTANCE

- A. All seeded and sodded area shall have a satisfactory growth and coverage at the final acceptance of the Work by the Owner. The vegetation growth will be considered satisfactory that has no bare spots larger than 1 ft² and bare spots comprise of no more than 1 percent of any given area.
- B. Sodded areas will be acceptable provided all requirements, including maintenance, have been complied with, and a healthy, uniform, close stand of specified grass is established, free of weeds, bare or dead spots and surface irregularities.
- C. The Contractor shall maintain the sodded areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary. If the planted areas must be resodded, reshaped, or otherwise repaired, regardless of cause, the Contractor shall perform such work at the Contractor's expense. The Engineer, at any time may require replanting of any areas in which the establishment of the grass stand does not appear to be developing satisfactory at no additional cost to County.

- D. The period of establishment for areas that are reseeded or resodded shall extend to 1 year after the completion of reseeding or resodding unless otherwise authorized by the Owner or ENGINEER.

END OF SECTION

SECTION 32 90 20

ENVIRONMENTAL ASSESSMENT

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall evaluate the existing site environmental conditions and adjacent areas prior to commencement of work

1.02 LANDSCAPING AND VEGETATION

- A. Existing landscaping and other vegetation that is to remain in place shall be protected against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, excess foot or vehicular traffic, or improper parking of vehicles on vegetation. Temporary fences, barricades or guards shall be used to protect vegetation to be left standing.
- B. Any vegetation to remain within limits of contract work shall be watered as required to maintain their health during course of construction operations.
- C. The CONTRACTOR shall repair or replace vegetation that will remain, which are damaged by construction operations, in a manner acceptable to the COUNTY at the CONTRACTOR's expense when deemed necessary.

1.03 PROPERTY RESTORATION

- A. All landscaping and/or irrigation systems affected by work shall be restored to original condition at the CONTRACTOR's expense.
- B. The CONTRACTOR shall assume all responsibility and liability for property damages, bodily injury, or financial losses and interruptions of service that may result from the construction activities which affect structures, facilities, water lines, gas lines, power lines, electric conduits, sewer lines, telephone lines, cable TV lines, cable internet lines, and all service facilities connected thereto.
- C. The CONTRACTOR shall be responsible for relocation, repairing, reconstruction, and re-installation of damaged or disturbed items due to the construction activities.
- D. Damaged or disturbed items shall be re-installed or restored to their original condition as soon as possible and prior to completion of work at the CONTRACTOR's expense. Restoration shall be approved by the authority having jurisdiction over the disturbed items. There shall be no extra cost to the COUNTY.

- E. Items not specifically stated in the Specifications that are removed, damaged, destroyed, or defaced due to neglect or carelessness on the part of the CONTRACTOR shall be repaired or replaced by the CONTRACTOR if determined so by the COUNTY.

END OF SECTION

SECTION 33 21 70

LFG EXTRACTION WELLS AND WELLHEADS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The Contractor shall provide all labor, equipment, materials, and appurtenances necessary to drill, install and make ready LFG extraction wells as indicated on the Drawings.
- B. The perforated pipe, gravel stone, geotextile, bentonite, and soil backfill shall be set at depths and thicknesses shown on the Drawings or as designated in the field by the Engineer. It is expected that combustible and asphyxiant gases will be venting from boreholes drilled into waste within the footprint of the landfill. The Contractor's proposal price shall include provision for all equipment and procedures necessary to safely install wells and borings under this condition. All Work shall be performed by qualified workers in accordance with the best standards and practices available.
- C. Upon completion of each new extraction well or boring, Contractor shall dispose of all construction and drilling refuse materials as specified in Section 02 41 16 or as directed by the County.
- D. Related Work Described Elsewhere:
 - 1. Section 02 41 16: Refuse Handling, Storage, and Disposal
 - 2. Section 33 51 10: Pipe and Pipe Fittings
 - 3. Section 33 21 80: Landfill Gas Collection System Appurtenances

1.02 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARD TEST METHODS/PRACTICE

ASTM D 420-98	Standard Guide to Site Characterization for Engineering, Design, and Construction Purposes
ASTM D 422-63	Standard Method for Particle-Size Analysis of Soils
ASTM D 1452-80	Standard Practice for Soil Investigation and Sampling by Auger Borings
ASTM D 2487-00	Standard Classification of Soils for Engineering Purposes (Unified Classification System)

1.03 SUBMITTALS

- A. The Contractor shall prepare and submit to the Engineer, for review and approval, Certificates of Compliance on materials furnished, and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, and inspection of pipe and appurtenances furnished as described in Contractor Submittals.
- B. The Contractor shall prepare and submit to the Engineer for review and approval, Shop Drawings showing dimensions, materials, and manufacturer's information for pipe, pipe perforations, fittings, and bentonite.
- C. One week prior to well drilling, Contractor shall submit an example well boring log and construction log. The example log shall be completed with all of the required descriptions and pertinent information required under Part 3.03 of this Section.
- D. At least two weeks prior to construction, the Contractor shall submit to the Engineer for review and approval, results of the sieve analysis for the soil backfill, samples of all well backfill materials (if requested), the name of the vendor(s), and source of backfill materials furnished.
- E. At the end of each day, Contractor shall provide copies of the handwritten well boring and completion logs for each well drilled on that day. Information to be included on the well logs is listed in Part 3.03 of this Section.
- F. Electronic (typed) copies Final boring logs based on field information shall be submitted with the Record Documents. Description of the boring and excavated material shall be according to the attached well boring log template at the end of this Section.

1.04 QUALITY ASSURANCE

- A. A professional experienced in installation of LFG wells shall be responsible for observing and documenting information related to all boring and installation activities. The OWNER will contract with the quality assurance professional that will oversee and observe the extraction well installation.
- B. Inspect well materials for cleanliness, deformations, and imperfections, and ensure conformance with Specifications prior to use.

PART 2 - PRODUCTS**2.01 CLEAN SOIL BACKFILL**

Clean soil backfill material shall be granular material free of clay, sticks, roots, organic material, MSW, and stones larger than 1-inch in any dimension. Clean soil shall be used in any location on Drawings that calls for “clean soil backfill”.

2.02 STONE

- A. Stone backfill shall be hard, durable non-calcareous rock. Stone shall be washed as a component of the manufacturing process and be free of organics, lumps or balls of clay, and other deleterious materials.

Stone shall be FDOT No. 4 and conform to the following gradation requirements:

Sieve Size	% Passing (by weight)
2 - inch	100
1 ½ - inch	90
1 -inch	35
¾ - inch	5
⅜ - inch	0

2.03 BENTONITE

- A. “Bentonite Plug” as used in the Drawings, shall refer to a well seal comprised of hydrated sodium bentonite pellets or chips of a thickness as indicated on the Drawings. Bentonite material shall consist of clay greater than 85% sodium montmorillonite, without additives.
- B. Bentonite shall be hydrated per manufacturer’s instructions prior to backfilling with soil. Bentonite shall be hydrated in 6-inch lifts as per Paragraph 3.05 B of this Section.
- C. Under no circumstances will the use of granular bentonite be permitted for the vertical extraction wells.

2.04 HDPE PIPE

- A. Pipe for extraction wells shall be 8-inch HDPE SDR11 as shown on the Drawings and conforming to the requirements of Section 33 51 10 Part 2.01.
- B. The perforations in the extraction well piping shall be as specified on the Drawings.

2.05 WELL IDENTIFICATION

- A. Upon completion of well drilling and piping installation, Contractor to install one (1) printed yellow well identification label sticker on each well casing:
- a. Identification labels must be outdoor, UV resistant, waterproof, and permanently adhered around the well casing.

- b. Identification label shall contain the following information: The words Well identification “EW-#” and “Landfill Gas Extraction Well” like the example shown below. Lettering by any other means shall not be permitted.
- c. Identification label shall be 6-inch tall and safety yellow with black lettering. Lettering size (EW-#) to be 2-inch tall. Contractor to provide template before ordering labels.
- d. Identification labels similar to ones found in the following websites:
 - 1. <http://tufflabels.com/outdoor-durable-labels/>
 - 2. <https://www.rippedsheets.com/sheet-labels/102285-outdoor-matte-waterproof-vinyl-super-permanent-labels.html>

2.06 GEOCOMPOSITE “DONUT”

- A. Geocomposite or geotextile ring or donut to be placed between stone and clean soil backfill in well shall be a 36-inch diameter with an 8-inch opening for traditional and 12-inch opening for dewatering LFG extraction wells.

2.07 WELLHEAD

- A. Wellheads shall be QED’s Precision Accu-Flow quick change orifice plate wellheads 2-inch vertical wellheads, or equivalent approved by the County’s Representative, and consistent with the Drawings.

2.08 WELLHOSE

- A. Wellhose shall be QED Solarguard flexible hose or kanaflex flexible hoses with power lock clamps inspected and approved by the County’s Representative and consistent with the Drawings.

PART 3 - EXECUTION

3.01 PRE-CONSTRUCTION SERVICES

- A. The Contractor shall survey and stake the well boring locations prior to drilling. Pre-construction layout surveying shall be done by a Florida Licensed Professional Surveyor.
- B. Contractor shall supply surveyed ground elevations of the proposed new extraction wells to the Engineer so that the design well depths may be confirmed at least one week prior to drilling.

- C. Extraction well and boring locations must be approved and may be adjusted by the ENGINEER prior to beginning drilling.

3.02 DRILLING

- A. Contractor shall stake the extraction wells locations prior to initiating drilling and coordinate the start of drilling with the Engineer.
- B. The Contractor shall provide at all times a thoroughly experienced, competent driller during all operations at the drill site.
- C. The Contractor must use dry drilling equipment.
- D. Wells are to be drilled to the depth vertically straight and the diameter as shown on the Drawings. The boring depths shown on the Drawings may be adjusted in the field by the Engineer. Under no circumstances are the drilling depths from the well schedule on the Drawings to be exceeded unless approved by the Engineer in advance.
- E. At wells located on the sloped ground, Contractor shall install a soil platform using general fill material to level the ground prior to drilling a vertical bore.
- F. If wet boring conditions are observed during drilling, the Contractor shall do the following:
 - 1. The Engineer shall be notified of wet boring conditions.
 - 2. If water is encountered in a boring, the Contractor may be directed by the Engineer to drill beyond the point at which it was encountered. If wet conditions remain, at the direction of the Engineer, the boring may be terminated (after driller has attempted to advance boring for 2 hours) and the length of perforated pipe adjusted by the Engineer. If wet conditions cease (e.g., due to a perched water layer), then drilling will continue to the design depth.
 - 3. If water is encountered in a boring at a shallow depth, the Engineer may decrease the well depth and length of perforated pipe, or relocate the well.
- G. If a bore needs to be abandoned, the contractor shall do the following:
 - 1. If, in the opinion of the Engineer, the borehole has not reached a sufficient depth to function as an effective extraction well, the Contractor shall abandon this borehole by backfilling it with cuttings removed during drilling. Soil shall be backfilled and compacted to ground surface. Contractor shall supply additional soil backfill to refill any settlement within the abandoned borehole, as approved by the Engineer.
 - 2. The Contractor shall make a conscious effort to drill through the obstructions. If a no-progress obstruction is encountered and drilling

through is not possible, the Contractor shall immediately contact the Engineer and as directed install a shorter well, or relocate the well and abandon the drilled hole. If the drill rates drop below two linear feet per hour due to the presence of any obstructions, the Contractor shall immediately contact the Engineer to inform them of the situation. If the Engineer asks the Contractor to continue drilling through the obstruction, the Contractor can charge the County at the hourly drilling rate provided in the Proposal Form until the drilling rate increases above two linear feet per hour or the Engineer instructs the Contractor to stop the drilling.

3. If cuttings are unsuitable as backfill (for example, box springs, tires, etc.) the Contractor shall use soil backfill material.
 4. Compensation for abandoned borings shall be at the unit price for boring refusal.
- H. If asbestos is encountered, the Contractor shall notify the County and the Engineer. The Contractor shall control emissions by covering the asbestos with at least 6 inches of compacted non-asbestos-containing material or with a resinous or petroleum-based dust suppression agent that effectively binds dust and controls wind erosion in accordance with 40 CFR 61.154(c). As needed, the asbestos shall be removed from the excavated area and transported to a designated asbestos disposal area onsite and procedures outlined above and in 40 CFR 61.154(f) shall be performed.
- I. The bore for the well shall be straight and the well pipe shall be installed in the center of the borehole.
1. Following well drilling, a 5-foot by 5-foot well bore reinforcement grate shall be installed over the top of the borehole with opening sizes as shown in the drawing
 2. The Contractor shall take all necessary precautions to maintain the well pipe vertically plumb during the entire backfill operation of the borehole to the satisfaction of the Engineer.
 3. The grate over the borehole that is used to keep the well casing plumb shall not be removed until the borehole is backfilled to within 2 feet of ground surface.
 4. If the pipe is installed out of plumb, as determined by the Engineer, the Contractor, at his own expense, shall correct the alignment.
 5. The well casing shall extend above ground surface as shown on the drawing. No pipe couplings shall be installed above grade or within 10 feet of ground surface below grade

- J. If for any reason the Contractor suspects that drilling may have advanced to or beyond the liner system, the Contractor shall immediately notify the County in verbal and written communication.
- K. Contractor shall leave a solid well casing above the existing landfill grades at the location of the gas extraction wells and horizontal manifold, in accordance with the Drawings.
- L. Contractor shall remove all working platforms constructed for the drill rig after the installation of the well. Hauling, construction, removal, and other work tasks related to well installation shall be carried out with minimal disturbance to the vegetation on the landfill. Any disturbance to the vegetation on the landfill shall be restored to original conditions by the Contractor at his own expense.

3.03 WELL LOGS

- A. Contractor shall keep detailed well logs for all wells drilled. Information recorded on the well logs shall include the following:
 - 1. Total depth of well.
 - 2. Visual description of refuse at 10-foot intervals:
 - a. Type of refuse encountered including the estimated percentage of the following components (by volume) on visual inspection:
 - Paper/Cardboard
 - Plastic
 - Yard refuse
 - Construction debris
 - Textiles
 - Tires
 - Sludge
 - Dirt
 - b. Moisture content (in percentages) based on the guidelines attached to the end of this Section.
 - c. State of decomposition based on the guidelines attached to the end of this Section.
 - d. Temperature of excavated refuse
 - 3. Occurrence, depth, and thickness of water-bearing zones
 - 4. Length of slotted pipe and solid pipe below grade.
 - 5. Thickness, description and depth from ground surface of backfill layers.

6. Length of above ground riser stick-up pipe.
- B. Contractor shall use the well borings description sheet provided at the end of this Section as a guideline for describing excavated materials.
- C. Field copies of the well logs shall be provided to the Engineer at the end of each day.
- D. Typed final copies of the well logs shall be submitted with the Record Drawings. Handwritten logs will not be acceptable for submittal with the Record Drawings.

3.04 JOINING OF PIPES

- A. Pipes shall be joined as specified in Section 33 51 10, Pipe and Pipe Fittings, Section 3.04 Part B.
 1. Heat fusion joints shall be made in accordance with manufacturer's step-by-step procedures and recommendations.
 2. Mechanical joining shall be accomplished with HDPE flange adapters, neoprene gaskets, and ductile iron back-up flanges, and shall be used only where shown on the Drawings.
- B. At the end of each day, Contractor shall cap the ends of all joined pipes longer than 20 feet to prevent entry by animals and debris.

3.05 BACKFILLING

- A. Backfilling of the well shall commence immediately after well drilling is completed and the well piping has been installed in the borehole.
 1. Backfill materials shall be placed carefully within the wells to the dimensions shown on the Drawings and as approved by the Engineer.
 2. Tire chip and soil backfill containing foreign material may be rejected by the Engineer on the basis of a visual examination.
 3. Both well piping and backfill shall be installed with a reinforcement grate installed over the boring. The reinforcement grate shall remain in place until backfill is within 2 feet of existing ground surface.
- B. Gravel pack shall be bucket-poured through the reinforcement grate at a rate that shall not endanger the integrity of the well casing. Care shall be taken during backfilling to prevent bridging. Contractor shall keep record of number of bucket fills at each well.
- C. Bentonite Plug shall be backfilled and hydrated in 6-inch lifts. The Contractor shall soak each lift according to the manufacturer's instructions prior to filling the

next one. A minimum of 6 bags of bentonite shall be poured into the center of the borehole per 6-inch lift.

- D. Soil backfill shall be rodded in the boring to provide even distribution and compaction.
- E. All material layer thicknesses shall be verified by taking measurements before, during, and after installation of each layer.

3.06 REFUSE DISPOSAL

The Contractor shall dispose of excavated refuse as specified in Section 02 41 16-Refuse Handling, Storage, and Disposal.

3.07 TEMPORARY CAP

The Contractor shall temporarily cap the riser pipe of the vertical extraction well immediately after well pipe installation to prevent venting of LFG into the atmosphere. The Contractor or County shall remove this cap during the installation of the wellheads. Lag screws may be necessary due to the internal gas pressure within the well.

3.08 WELLHEAD INSTALLATION

- A. Vertical extraction well and horizontal collector wellheads to be installed in accordance with manufacturer's recommendations. All pipe sections of the wellhead shall be air-tight. Any leaks shall be repaired by Contractor at no additional cost to the County. Refer to measurement and payment specification for applicable requirements for LFG Wellheads prior to purchasing and installing wellheads.
- B. Install QED Solarguard flex hose on all wells. Hose should not have any sags, as shown on the Drawings. However, flexible hose shall not be taut. Provide enough slack to accommodate minor pipe settlement, as approved by the Engineer.

3.09 PNEUMATIC PUMPS

- A. The pneumatic pumps shall be QED AutoPump bottom inlet Model Short AP4⁺B or equivalent. Additional details for pneumatic pumps are in Section 33 21 80 - Landfill Gas Collection System Appurtenances.
- B. Prior to procuring pumps, the Contractor shall contact County's representative for the approval to purchase and install.

ATTACHMENT 33 21 70 - 2 Landfill Borehole and Well Logging Guidance

ATTACHMENT 33 21 70 - 3 Well Boring Log Template

END OF SECTION

SECTION 33 21 70 - 2

LANDFILL BOREHOLE AND WELL LOGGING GUIDANCE

Moisture Content Scale

15% Dry Refuse	20-25% Normal	25-35% Damp	35-50% Wet	50% Saturated
Rock, dirt, etc; no trace of moisture paper will be fuzzed up	Newspaper, etc; still not noticeably wet but normal moisture	Paper shows dampness lawn clippings, tree branches, stiff & hold together	Paper saturated but no free water, just getting sloppy; water emanates when squeezed	Mud or free water present

Decomposition Scale

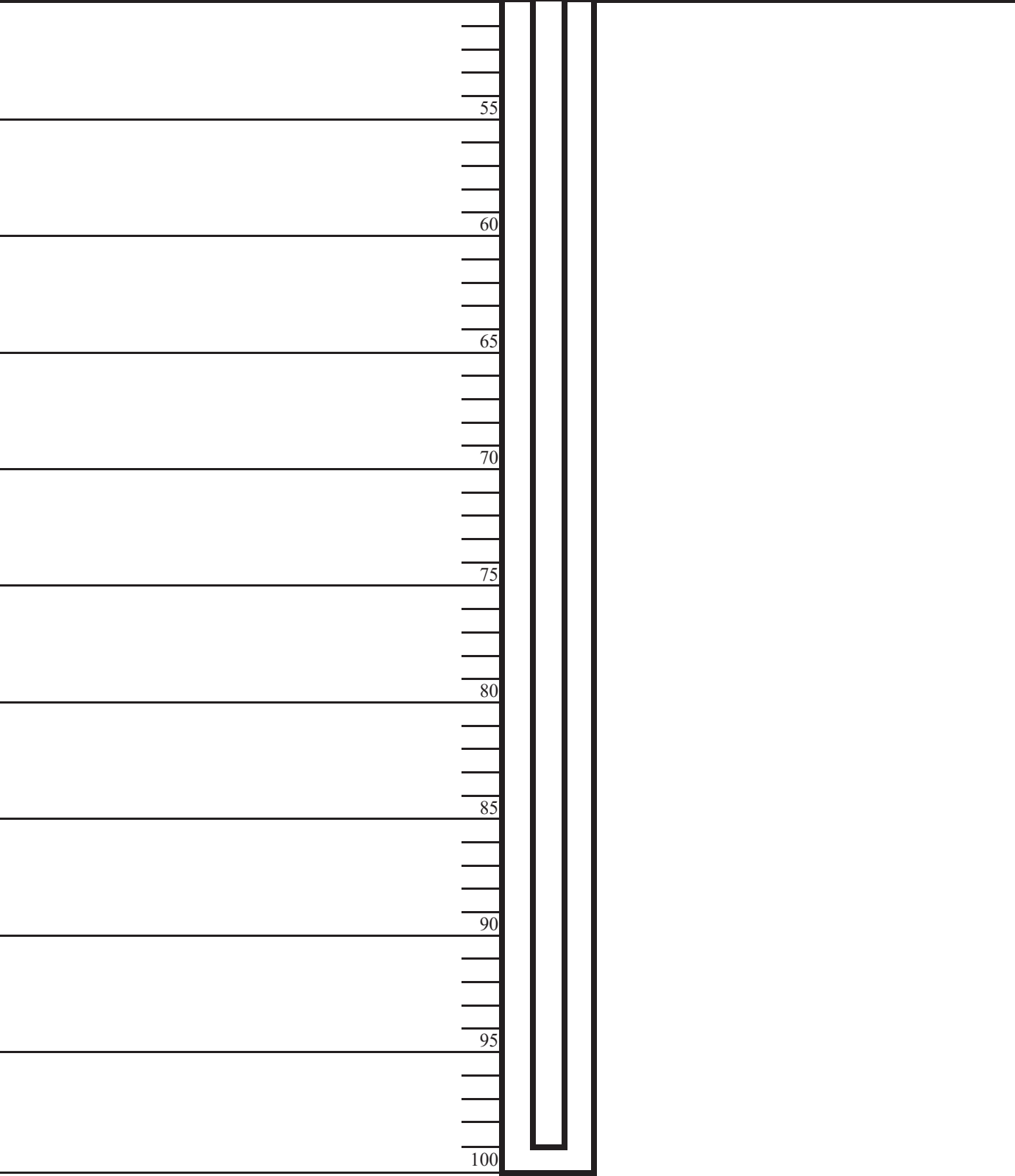
Little	Some	Moderate	Much	Severe
Newspaper readable; refuse looks new		Newspaper not legible; branches intact		Newspaper not legible; crumble; black/brown mucky material

Log the following (in 10-foot intervals):

- Note apparent Intermediate cover thickness and presence of intermediate cell cover
- Ratio of refuse to cover soil
- Degree of compaction (i.e., loose, moderate, tight)
- Composition description (i.e., household, garden, commercial, demolition, sludge, medical, or other)
- Percent of refuse components (plastic, metal, yard waste, etc.)
- Note color and unusual odors or appearances
- Degree of decomposition
- Percent of moisture
- Approximate dates of refuse as an indicator (only) of dates of placement (i.e., newspaper, etc.)
- Refuse temperature
- Gas presence and relative pressure and temperature
- Presence of perched or free liquid
- Note elevations and observations of changes in refuse/soil/liquid conditions

ATTACHMENT 33 21 70 - 3
Well Log - SCS Engineers

Site Name:	Well Number:
Project #:	Coordinates:
Start Date:	Surface Elevation:
Completed:	Top of Casing Elevation:
Contractor:	Boring Diameter:
Inspector:	Pipe Material Diameter
Driller:	Total Depth Drilled:
Completion:	



Well Log - SCS Engineers

Site Name:

Well Number:

Project #:

Coordinates:

Start Date:

Surface Elevation:

Completed:

Top of Casing Elevation:

Contractor:

Boring Diameter:

Inspector:

Pipe Material Diameter

Driller:

Total Depth Drilled:

Completion:

[illegible]

COMPLETION LOG	
RISER STICK UP	
RISER BELOW	
PERF. PIPE	
BACKFILL	
BENTONITE #1	
SILICA SAND 20/30	
BENTONITE #2	
BACKFILL	
GRAVEL PACK	
BACKFILL LOG	
Stone	
Structural fill	
Bentonite fill	
MATERIALS LIST	
TOP CAP	
SOLID PIPE	
PERF PIPE	
BOTTOM CAP	
BENTONITE	
BACKFILL	
STONE	

SECTION 33 21 80

LANDFILL GAS COLLECTION SYSTEM APPURTENANCES

PART 1 - GENERAL

1.01 GENERAL

- A. The Contractor shall furnish all labor, materials, equipment and incidentals necessary to perform all work and services for complete installation of the landfill gas (LFG) collection system appurtenances as shown on the Drawings and as specified, in accordance with provisions of the Contract Documents.
- B. The work shall include, but not necessarily be limited to valves, access risers, blind flanges, installation of pipe, fittings, and connections, abandonment of gas extraction wells and piping, as specified and as shown on the Drawings.
- C. Materials shall not be incorporated in construction until approved by the Engineer.

1.02 SUBMITTALS

- A. The Contractor shall notify the County of the source of all materials and shall furnish a representative sample for approval, at least 15 calendar days prior to the date of anticipated use of such material.
- B. Warranty package will be submitted to County and Engineer for review and approval. All equipment specified in this Section shall be warranted by Manufacturer for a period of not less than one year from the date of acceptance.

PART 2 - PRODUCTS

2.01 PNEUMATIC PUMPS

- A. Pumps shall be air displacement pumps, internally controlled and designed for leachate and condensate systems. Pumps shall be bottom loading with inlet screen.
- B. The pneumatic pumps shall be QED AutoPump bottom inlet model Short AP4⁺B. The pump shall have screens, casings and fittings, and a hose and hardware package with 1-inch discharge hoses and ¾ inch air hoses.

C. Performance and Configuration Requirements:

1. Leachate and Condensate Pumps:

- a. Design Condition: Minimum of 5 gpm at 140 FT Total Dynamic Head (TDH).
- b. Intake Configuration: Bottom loading, screened intake.

D. Accessories:

1. Pipe/tubing: Provide supply air and liquid discharge tubing of sufficient size, strength, and capacity for the pump.
2. Fittings: Provide stainless steel fittings appropriate for tubing connections.
3. All necessary fittings, flanges, etc., to connect pump(s) gas extraction wells, including the discharge of liquids removed into the liquid conveyance line.
4. Air and liquid conveyance hose lengths outside the gas extraction wells shall be field determined and approved by the Engineer.
5. Air intake kit/Assembly: Air filter regulator, Air inlet supply pressure gauge, Pump cycle counter.

2.02 WELL CAPS

- A. The well caps shall be QED 8-inch well diameter wellheads and caps as specified in the Drawings.

2.03 SOURCE QUALITY CONTROL

- A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
 1. Check for compliance with Specification.
 2. Test pump operation.
- B. Factory test of head (FT) versus flow (gpm)

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install pump in gas wells as specified by the Engineer and in accordance with pump manufacturer's recommendations. All pump installations shall be

completed only after CONTRACTOR provides measurement of liquid level in the well and getting approval from the ENGINEER for the depth of the pump.

- B. Connect to air supply line with pressure regulator.
- C. Connect discharge to condensate forcemain line.

3.02 FIELD QUALITY CONTROL

- A. Provide services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by these Specifications.
 - 2. Supervise pre-start adjustment and installation checks.
 - 3. Conduct initial startup of equipment and perform operational checks.
 - 4. Provide a written statement from manufacturer stating that manufacturer's equipment has been installed properly, started up and is ready for Operation by Owner's personnel.

END OF SECTION

SECTION 33 51 10

PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The Contractor shall supply all materials, equipment, and labor needed to install complete and make ready for use all pipe, pipe fittings, and valves as specified herein and as indicated on the Drawings.
- B. Related Work Described Elsewhere
 - 1. Section 31 20 00 - Excavating, Trenching, Backfilling and Grading
 - 2. Section 33 21 70 – LFG Extraction Wells and Wellheads
 - 3. Section 33 21 80 – LFG Collection System Appurtenances
 - 4. Section 33 51 30 – LFG Condensate Management System

1.02 SUBMITTALS

- A. Prior to commencement of construction, the Contractor shall prepare and submit to the Engineer, for review and approval, all manufacturer quality assurance certificates, and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, inspection, maintenance, and repair of each type of pipe, pipe fitting, and valve furnished.
- B. The Contractor shall prepare and submit Shop Drawings to the Engineer for review and approval. The Shop Drawings shall show the following:
 - 1. All dimensions, slopes, and invert elevations at connections to existing pipes.
 - 2. All tie-ins to the existing leachate collection system shall be field-verified and shown on the Shop Drawings. This shall include pipe size and burial depth at a minimum.
 - 3. Pipe Dimensions for each pipe size used:
 - a. Average outside diameter.
 - b. Average inside diameter.
 - c. Minimum average wall thickness.
 - 4. Each pipe and fitting size to be used.
- C. The Contractor shall submit all field pressure testing results to the Engineer for approval.

1.03 MANUFACTURER'S QUALITY ASSURANCE

- A. The pipe and fittings manufacturer shall have an established quality assurance program responsible for inspecting incoming and outgoing materials and assuring the long-term performance of materials and products.
- B. The pipe and fitting manufacturer shall maintain permanent quality control and quality assurance records.

1.04 REFERENCE

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Use of the most recent version is required.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1248	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other gravity-flow applications.
ASTM D 2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2467	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2513	Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping

ASTM D 2855	Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets
ASTM D3035	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3350	Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F2620-19	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI B 31.8 Code for Pressure Piping, Appendix N

PART 2 - PRODUCTS

2.01 FLEXIBLE PVC PIPE ON WELLHEADS

- A. Flexible PVC pipe shall be UV-Resistant Solarguard™ Flexible Hose supplied by QED Environmental.
- B. Fasteners for flexible PVC pipe shall be high strength stainless steel banding kits supplied by QED Environmental.

2.02 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- A. General:
 - 1. All PVC pipe and fittings as indicated on the Drawings shall be Schedule 80 Polyvinyl Chloride conforming to ASTM D 1784, ASTM D 1785 (for pipe), and ASTM D 2467 (for fittings). All pipe and fittings shall be provided by one manufacturer. Acceptable manufacturers include Plastinetics, Inc. Chemtrol, ASAHI/America, or approved equal.
 - 2. PVC pipe and pipe fittings shall be manufactured from a compound which meets the requirements of Type 1, Grade 1, Polyvinyl Chloride PVC 1120, Class 12454-B, as outlined in ASTM D 1784. A Type 1, Grade 1 compound is characterized as having the highest requirements for mechanical properties and chemical resistance.

- a. Compound from which pipe is produced shall have a design stress rating of 13,800 kPa at 23 degrees C, listed by the Plastic Piping Institute.
 - b. Materials from which pipe and pipe fittings are manufactured shall have been tested and approved by NSF International.
 - c. Pipe shall conform to the requirements of ASTM D 2241. Pipe shall be homogenous throughout and shall be free from cracks, holes, foreign inclusions, and other defects.
- B. PVC Pipe Storage: PVC pipe shall be stored or stacked so as to prevent damage by marring, crushing, or piercing. Maximum stacking height shall be limited to 6 feet. At the end of each day, all open ends of joined pipe shall be capped or otherwise covered to prevent entry by animals or debris. For storage over 5 days, a location shall be chosen out of direct sunlight or the piping and fittings will be covered.
- C. All pipe and fittings must be supplied by the same manufacturer.

2.03 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. General:
 - 1. All High-density polyethylene (HDPE) pipe and fittings 6-inch diameter and greater as indicated on the Drawings shall be Standard Dimension Ratio (SDR) 17 using a 4710 type resin or equal.
 - 2. Condensate discharge pipes and fittings shall be 2-inch or 3-inch diameter HDPE SDR 11 as specified in the CONTRACT DRAWINGS.
 - 3. Air supply pipes and fittings shall be 2-inch diameter SDR 9 with yellow striping.
 - 4. Pipe shall be extruded from a Type III, Class C, Category 5, Grade P36 compound as described in ASTM D 1248. It shall be classified as cell 445574C according to ASTM D 3350 and have the material designation of PE 4710. Pipes utilized for gas flow shall be manufactured to meet the requirements of ASTM D 2513. Pipes utilized for liquid flow shall conform to ASTM F714 or ASTM D3035. Manufacturer's literature shall be adhered to when "manufacturer's recommendations" are specified. All pipe and fittings shall be provided by one manufacturer. Acceptable manufacturers include Performance Pipe (800-527-0662), or equal.
 - 5. The nominal inside diameter of the pipe shall be true to the specified pipe size. Standard laying lengths shall be 40 feet $\pm$ 2 inches. Exceptions may be made for 2-inch diameter pipes in coils if suitable strengthening devices are used.
- B. HDPE Fittings

1. Fittings such as couplings, flanges, wyes, tees, etc. shall be manufactured from polyethylene compound having cell classification equal to or exceeding the compound used in the pipe.
 2. All fittings 12 inches and smaller shall be molded, unless approved by the Engineer.
- C. All pipe and fittings must be supplied by the same manufacturer from identical materials, unless approved by the Engineer. The pipe and fittings shall be homogenous throughout and free from visible cracks, holes, foreign inclusions or other injurious defects. The pipe shall be as uniform as commercially practical in color, opacity, density and other physical properties.

2.04 FLANGES FOR HDPE PIPE

- A. Flanges for HDPE pipe shall be convoluted ductile iron back-up rings with a minimum thickness of 1-inch, as manufactured by Improved Piping Products, Inc. (800) 969-0962, of Orinda, California or equal. Hardware and fittings shall be stainless hot-dipped galvanized, finished with blue primer, and epoxy coated.
- B. The studs, nuts, and washers for the flanges shall be hot-dipped galvanized. All below grade studs, nuts, and washers shall be thoroughly coated with Polyken Technologies 1027 Primer, or rubberized emulsion undercoating spray, or equal substitute, with no gaps in coverage. Below grade flanges shall be wrapped in 5-mil polyethylene sheeting just after installation and prior to backfilling to help prevent corrosion.
- C. Flange gaskets shall be full-face Neoprene.

2.05 PIPE MARKINGS

All PVC and HDPE pipe shall be stamped by the manufacturer with the following information at five foot intervals:

- A. Manufacturer name or trademark
- B. Nominal pipe size and sizing system
- C. Standard dimension ration (SDR) or Schedule (SCH) value
- D. Type of plastic (e.g., PE 4710)
- E. Production code
- F. Manufacturing date
- G. ASTM designations (i.e., ASTM D 2513)

2.06 VALVES

- A. All valves shall be complete with all necessary operators and other accessories or appurtenances which are required for the proper completion of the Work. Operators and other accessories shall be sized and furnished by the valve supplier and factory mounted.

- B. Valves and operators shall be suitable for the exposure they are subject to, e.g., buried and landfill gas. Valves shall have all safety features required by OSHA.
- C. Unless otherwise shown, valves shall be the same size as the adjoining pipe.
- D. Valve position indicators shall be installed correctly to properly identify the valve position.
- E. Valve spacers shall be used for all valves 6 inches and larger.

2.07 PIPELINE LOCATOR/WARNING TAPE

- A. For LFG header and laterals as shown on the Drawings, tape shall be a standard locator/warning tape imprinted with the words "Caution Gas Line Buried Below," as supplied by Reef Industries, Inc. (800-231-6074), or equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Pipe shall be stored or stacked so as to prevent damage by marring, crushing, or piercing. Maximum stacking height shall be limited to 6 feet.
- B. Pipe and pipe fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists and lowered on skidways in such a manner as to avoid shock. Derricks, ropes, or other suitable equipment shall be used for lowering the pipe into the extraction well borings. Pipe and pipe fittings shall not be dropped or dumped.

3.02 FIELD QUALITY CONTROL

- A. Pipe may be rejected for failure to conform to the Specifications or for the following reasons:
 - 1. Fractures or cracks passing through pipe wall, except single crack not exceeding 2 inches in length at either end of the pipe which could be cut off and discarded. Pipes within one shipment shall be rejected if defects exist in more than five percent of shipment or delivery.
 - 2. Cracks sufficient to impair strength, durability or serviceability of pipe.
 - 3. Defects indicating improper proportioning, mixing, or molding.
 - 4. Damaged ends, where such damage prevents making a satisfactory joint.
 - 5. Scratches or gouges of depth greater than 10 percent of pipe wall thickness.

- B. Acceptance of fittings, stubs, or other specially fabricated pipe sections shall be based on visual inspection at job site and documentation of conformance to these Specifications.
- C. The Engineer shall be notified by Contractor prior to burial of pipe.
- D. The County designated Project Manager and Engineer reserve the right to require destructive testing of any fusion weld on HDPE pipe.

3.03 PVC PIPE INSTALLATION

- A. PVC pipe installation shall conform to these Specifications, the manufacturer's recommendations, and as outlined in ASTM D 2774.
- B. Field perforations are not authorized.
- C. Pipe shavings from perforations shall be removed from the inside of all pipes using a method approved by and to the satisfaction of the Engineer.

3.04 JOINING OF PVC PIPE

- A. Joining of pipe shall be in accordance with ASTM D 2855.
- B. Preparation:
 - 1. All pipe shall be inspected for cuts, scratches, or other damage prior to installation. Pipe with imperfections shall not be used. All burrs, chips, etc. shall be removed from pipe interior and exterior.
 - 2. The interior of the pipe shall be cleared of foreign matter; e.g., loose dirt, tape, pipe shavings, and paper. All loose dirt and moisture shall be wiped from the interior and exterior of the pipe end and the interior of the fitting.
 - 3. All pipe cuts shall be square, perpendicular to the center line of pipe. Pipe ends shall be beveled prior to applying primer and solvent cement so that the cement is not wiped off during insertion into the fitting socket.
- C. Solvent Welding:

A coating of primer as recommended by pipe supplier shall be applied to the entire interior surface of the fitting socket and to an equivalent area on the exterior of the pipe prior to applying solvent cement. The solvent cement shall comply with the requirements of ASTM D 2564 and shall be applied in strict accordance with manufacturer's specifications. Pipe shall not be primed or solvent welded during precipitation or when atmospheric temperature is below 40 degrees F or above 90 degrees F.
- D. Curing:

After solvent welding, the pipe shall remain undisturbed until cement has thoroughly set. As a guideline for joint setting time, use 1 hour for ambient temperatures 60-90 degrees F, or 2 hours when ambient temperature is 40-60 degrees F.

E. Alignment:

Pipe and pipe fittings shall be selected so as to minimize the linear deviation at the joints, and so that inverts present a smooth surface. Pipe and fittings which do not fit together to form a tight fitting will be rejected.

3.05 FLEXIBLE PVC PIPE CONNECTIONS

Connections to pipe shall be made with clamps in accordance with manufacturer's step-by-step procedures and recommendations, and as approved by the Engineer.

3.06 HDPE PIPE HANDLING

A. HDPE pipe shall not be bent more than the minimum radius recommended by the manufacturer for type, grade, and SDR. Care shall be taken to avoid imposing strains that will overstress or buckle the HDPE piping or impose excessive stress on the joints.

B. Joining HDPE Pipe:

1. Only two methods shall be utilized to join HDPE pipe: heat fusion and mechanical joining.

a. Mechanical Joining shall be accomplished with HDPE flange adapters, neoprene gaskets, and ductile iron back-up flanges, and shall be used only where shown on the Drawings. Refer also to Part 3.11.

b. Heat Fusion joints shall be made in accordance with manufacturer's step-by-step procedures and recommendations.

1) Fusion equipment and a trained operator shall be provided by the Contractor. Pipe fusion equipment shall be of the size and nature to adequately weld all pipe sizes and fittings necessary to complete the project.

2) Branch saddle fusions shall be made in accordance with manufacturer's recommendations and step-by-step procedures. Branch saddle fusion equipment shall be of the size to facilitate saddle fusion within the pipe trench.

- 3) Heat fusion shall be performed outside of the trench whenever practical.
 - 4) Before heat fusing pipe, each length shall be inspected for the presence of dirt, sand, mud, shavings, and other debris, and any foreign material shall be completely removed.
 - 5) At the end of each day, all open ends of fused pipe shall be capped or otherwise covered to prevent entry by animals or debris.
- c. As per the manufacturer's instructions, no fusion shall be performed in precipitation unless a shelter is provided.

3.07 HDPE PIPE INSTALLATION

- A. Pipe installation shall comply with the requirements of ASTM D 2321, PPI TR-31/9-79, and the manufacturer's recommendations.
- B. Lengths of fused pipe to be handled as one segment shall not exceed 500 feet.
- C. Inside of pipe shall be free of debris such as shavings and dirt.
- D. The Engineer shall be notified prior to any pipe being installed in the trench in order to have an opportunity to inspect the following items:
 1. All butt and saddle fusions.
 2. Pipe integrity.
 3. Trench excavation and bedding material for rocks and foreign material.
 4. Proper trench slope.
 5. Trench contour to ensure the pipe will have uniform and continuous support.
 6. Proposed backfill sand and soil.
- E. Any irregularities found by the Engineer during this inspection must be corrected before lowering the pipe into the trench. Pipe shall be allowed sufficient time to adjust to trench temperature prior to any testing, segment tie-ins, and/or backfilling.
- F. Tie-ins shall be made out of the trench whenever possible. When tie-ins are to be made in a trench, a bell hole shall be excavated large enough to ensure an adequate and safe work area.
- G. Below grade piping shall be marked with warning tape to be buried in the trench above the pipe as indicated on the Drawings.

- H. Contractor shall collect all pipe shavings and discard in a trash receptacle. Shavings shall not be left on the ground.
- I. All installed HDPE pipe shall be marked in 10-foot intervals corresponding to the stationing required for slope confirmation and conformance surveying. For main pipeline, station numbering shall be continuous and sequential. Station numbering shall be referenced in daily logs to document pipe installation progress.

3.08 FLANGED CONNECTIONS

- A. For flanged connections in virgin soil, the Contractor shall wrap and tape the flanges and bolts in 5-mil polyethylene sheeting prior to backfilling to help protect the assembly from corrosion.
- B. Flanges shall be joined with stainless hot-dipped galvanized studs and nuts. Stud lengths shall accommodate the required distance between flanges including valve spacers, if necessary.
- C. For flanged connections within the limits of refuse, all below grade back-up rings, studs, nuts and washers shall be thoroughly coated with Polyken Technologies 1027 Primer, or rubberized emulsion undercoating spray, or equal substitute.
- D. The Contractor shall wrap and tape the flanges and bolts in 5-mil polyethylene sheeting prior to backfilling.

3.09 PIPE SUPPORTS

All piping and valves shall be supported in such a manner as to prevent any stress being transmitted between sections and connected equipment and appurtenances.

3.10 SEGMENT TESTING (AIR PRESSURE)

- A. The HDPE laterals and connections to LFG header, air supply lines, and condensate discharge line pipelines (both carrier and containment pipes in case of dual contained pipes) shall be subjected to pressure tests as described herein to detect any leaks in the piping. Testing shall be performed below grade (inside the trench). The Contractor shall accept the responsibility for locating, uncovering (if previously backfilled), and repairing any leaks detected during testing.
- B. Polyethylene piping shall be butt welded together into testing segments. Segments shall be connected to a testing apparatus on one end and fitted with fusion-welded caps on all openings.
- C. The segment to be tested shall be allowed time to reach constant and/or ambient temperature before initiating the test.
- D. The test must be performed during a period when the pipe segment will be out of direct sunlight; i.e., early morning, late evening, or cloudy days. This will

minimize the pressure changes which will occur during temperature fluctuations. No testing will be allowed during the middle of the day or when pipe segments are exposed to sunlight.

- E. The test pressure for LFG laterals, header, containment pipes of dual contained pipes, and condensate sumps shall be 4 psig. The test pressure for air supply and liquid conveyance pipes shall be 100 psig.
- F. Pressure drop during the test shall not exceed 1 (one) percent of the testing gauge pressure over a period of one hour. (See Section 3.11 for test failures). The Engineer shall sign off on a test form to indicate test compliance.
- G. The Engineer and CQA Consultant shall be notified prior to commencement of the testing procedure and shall be present during the test.
- H. All equipment for this testing procedure, including an adequately sized air compressor, fittings, caps/pipe plugs, etc., shall be furnished by the Contractor. Other necessary equipment includes a flange adaptor with a steel or brass blind flange. Tapped and threaded into the blind flange will be a temperature gauge with a scale of 0 to 100 degrees C with 1-deg. intervals, a pressure gauge with a scale that spans the test pressure range with increments equal to 0.1 percent of the test pressure, an appropriate valve to facilitate an air compressor hose, and a ball valve to release pipe pressure at completion of test. Pipe reducers shall be utilized to adapt test flange to size of pipe being tested.

3.11 TEST FAILURE

- A. The following steps shall be performed when a pipe segment fails the one percent/one-hour test described in Part 3.10 F, above.
 - 1. The pipe and all fusions shall be inspected for cracks, pinholes, or perforations.
 - 2. All blocked risers and capped ends shall be inspected for leaks.
 - 3. Leaks shall be located and/or verified by applying a soapy water solution and observing soap bubble formation.
- B. All pipe and fused joint leaks shall be repaired by cutting out the leaking area and refusing the pipe.
- C. After all leaks are repaired, a retest shall be performed in accordance with Part 3.10.

3.12 TEST REPORTING

- A. Each test (pass or failure) shall be reported in writing on the attached pipe testing form or another form approved by the Engineer.

B. If failure occurs, Contractor shall note the following:

1. Location of failure segment.
2. Nature of leaks.
3. Repairs performed.
4. Results of test.

ATTACHMENT 33 51 20 - 2 HDPE Pipe Pressure Protocol

END OF SECTION

**PIPE AND PIPE
FITTINGS**

HDPE PIPE PRESSURE TEST PROCEDURE

This protocol describes the method for testing the installation of HDPE pipelines and components using a low-pressure air test.

PROCEDURE

1. Isolate the section of HDPE pipe to be tested using fusion welded caps. Cap the ends of all branches, laterals, tees, wyes, and stubs included in the test to prevent air leakage. All caps shall be securely braced to prevent blowout.
2. Contractor shall install a temperature gauge, pressure gauge and fittings for connection of an air compressor hose and a ball valve to release the pressure at the completion of the test.
 - Temperature gauge shall have a range of 0 to 100 °C.
 - Pressure gauge shall have increments equal to 1% of the test pressure.

Contractor shall not install new holes in pipeline for the exclusive purpose of performing the air test. However, tapped holes shown on the Plans for items such as header isolation valve monitoring ports may be utilized.

3. Connect the hose to the inlet tap and portable air supply source. Add air slowly to the test section until the pressure inside the pipe reaches the required level as shown below:
 - LFG header, laterals and condensate dewatering discharge lines: 10 psig
 - Air supply line and leachate forcemain: 100 psig
4. Once pressurized and the pressure has stabilized, record the initial temperature (°C) and pressure of the air inside the pipe on the test report form.
5. Begin timing the test. At ten-minute intervals, record the temperature (°C) and pressure of the air inside the pipe on the test report form. Record this data for 6 intervals, until the total time equals 60 minutes.
6. For pipe segments that include an isolation valve, the pressure test must be performed to demonstrate the integrity of the valve. Contractor shall close the valve and perform pressure tests on the header segments on both sides of the valve. This will serve to identify if the valve is airtight.

CALCULATIONS

In order to determine if the section of pipe tested is acceptable, the following calculations must be made.

1. Calculate the final theoretical pressure.

$$P_{\text{final, theoretical}} (\text{psi}) = \frac{[P_{\text{initial}} (\text{psi}) + 14.7] * [T_{\text{final}} (^{\circ}\text{C}) + 273]}{T_{\text{initial}} (^{\circ}\text{C}) + 273}$$

where,

$P_{\text{final, theoretical}} (\text{psi})$ = the theoretical acceptable gauge air pressure in the pipe at the end of the 10 min. interval

$P_{\text{initial}} (\text{psi})$ = the gauge air pressure in the pipe at the start of the 10 min. interval

$T_{\text{initial}} (^{\circ}\text{C})$ = the air temperature in the pipe at the beginning of the 10 min. interval

$T_{\text{final}} (^{\circ}\text{C})$ = the air temperature in the pipe at the end of the 10 min. interval

2. Calculate the gauge pressure (P_c) corrected for the temperature at the end of the 10-minute interval using the following equation and the value for $P_{\text{final, theoretical}}$ calculated above:

$$P_c = P_{\text{final, theol}} (\text{psi}) - 14.7 \text{ psi}$$

3. Calculate the actual Percent Pressure Drop using the following equation:

$$\text{Percent Pressure Drop} = \frac{P_c - P_{\text{f, actual}}}{P_c} * 100\%$$

where,

$P_{\text{f, actual}}$ = the final gauge pressure in the pipe at the end of the interval

4. If the percent pressure drop is less than or equal to 1%, the pipe segment passes for that particular interval. If the percent pressure drop is greater than 1%, then the following steps shall be performed.

- a) All blocked risers and capped ends shall be inspected for leaks.

- b) The pipe and all fusions in the section tested shall be inspected for cracks, pinholes, or perforations.
 - c) Air pressure leaks shall be located and/or verified by applying a soapy water solution and observing soap bubble formation.
 - d) All confirmed pipe and joint leaks shall be repaired by cutting out the leaking area and rewelding the pipe.
 - e) After all leaks are repaired, a retest shall be performed. This process shall be repeated until a successful test is achieved.
5. Each test (passed or failed) shall be reported in writing.
6. For each test failure, Inspector shall note the following:
- a) Location of failure segment
 - b) nature of leaks
 - c) Repairs performed
 - d) Results of test

Upon completion of the test, open the ball valve and allow air to escape. Caps must not be removed until air pressure in all of the test sections has been reduced to atmospheric pressure.

DATA LOG

PROJECT NAME/NO: _____
CONTRACTOR: _____
PERSON PERFORMING TEST: _____
OWNER REPRESENTATIVE: _____

DATE: _____
TIME: _____

DESCRIPTION/LOCATION OF TEST SEGMENT: _____

Interval #	Time (min)	T _{initial} (°C)	T _{final} (°C)	P _{g, initial} (in-H ₂ O)	P _{i, absolute} (in-H ₂ O)	P _{theoretical} * (in-H ₂ O)	P _c * (in-H ₂ O)	P _{f, actual} (in-H ₂ O)	% Pressure Drop*	Retest?
1	10									
2	20									
3	30									
4	40									
5	50									
6	60									

* See equations in procedure

PIPE SIZE: _____
SDR: _____
LENGTH: _____

DESCRIPTION/NATURE OF LEAKS & REPAIRS OF RETEST SEGMENT:

SECTION 33 51 20

LFG HEADER ISOLATION VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Scope of Work: The Contractor shall provide all materials, equipment, and labor needed to install complete and ready-for-use all header isolation valves as specified herein and as indicated on the Plans.
- B. Related Work Described Elsewhere
 - 1. Section 33 51 10: Pipe and Pipe Fittings

1.02 SUBMITTALS

The Contractor shall prepare and submit to the Engineer, for review and approval, certificates of compliance on materials furnished and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, inspection, maintenance, operation, and repair of each type of valve furnished. Shop drawings shall be submitted for butterfly valve assemblies requiring spacers per paragraph 3.01 B of this Section.

PART 2 - MATERIALS

2.01 VALVES

- A. All valves shall be complete with all necessary operators, actuators, handwheels, extension stems, worm gear operators, operating nuts, wrenches, and other accessories or appurtenances which are required for the proper completion of the Work. Operators and other accessories shall be sized and furnished by the valve supplier and factory mounted.
- B. Valves shall be suitable for the intended service. Renewable parts including discs, packing, and seats shall be of types recommended by valve manufacturer for intended service, but not of a lower quality than specified herein.
- C. Valves and operators shall be suitable for burial within a landfill.
- D. Unless otherwise shown, valves shall be the same size as the adjoining pipe.
- E. Header isolation valves shall be butterfly bubble tight, wafer design, with a PVC body, polypropylene disc, nitrile seats and seals, 316 SS valve stem, and compatible with a flat face flange. Valves shall be Asahi-America Type 56 series (12-inch) and Type 57 series (8-inch).

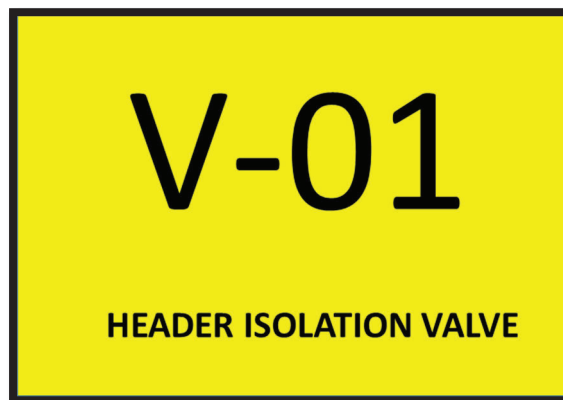
- E. Stem extensions shall be stainless steel in an epoxy coated carbon steel outer housing with a diecast aluminum alloy gear box assembly mounted on top and equipped with a removable manual operating wheel. Height of stem extensions in accordance with the Contract Drawings.

2.02 MONITORING PORTS AT VALVES

Monitoring ports shall be installed at each isolation valve and shall include the following items, or equal substitutes. Monitoring hose shall be stainless steel with outer braid Swagelok (407-894-7191) flexible metal hose, part no. SS-FM4PM4PF4, of adequate length to extend above grade as shown on the Plans. The male NPT end shall be threaded into the top of the header. Sampling end shall be Easy Port™ ¼ inch male NPT screw-capped long barb fittings as supplied by QED Environmental, model no. 40987. The hose shall be secured to the valve stem inner boring by stainless steel brackets.

2.03 IDENTIFICATION TAGS

- A. CONTRACTOR shall supply and affix to each valve an adhesive sticker marked with pre-printed letters designating the valve number (e.g., V-3, V-4, V-5, etc.). Tags shall not be marked with pen or marker.
- B. Tags shall be yellow adhesive sticker with black lettering as shown in the example below. The sticker shall contain the following information: Valve point ID as “V-ID number”, and the text “Header Isolation Valve”.



PART 3 - EXECUTION

3.01 INSTALLATION

- A. Valves shall be installed in accordance with the manufacturer’s recommendations and the following:
 - 1. Butterfly valves shall be installed between two flanges as shown on the Drawings; care shall be taken to avoid stripping studs when tightening.

2. Flanges shall be joined with hot-dipped galvanized studs and nuts, backup rings shall be ductile iron. Stud lengths shall accommodate the required distance between flanges including spacers, if necessary.
 3. All below grade back-up rings, studs, nuts and washers shall be thoroughly coated with Polyken Technologies 1027 Primer (508-261-6200).
 4. The Contractor shall wrap and tape the valve, flanges, and bolts in 5 mil polyethylene sheeting prior to backfilling.
- B. Flanged butterfly valves may require spacers between the flange adapters and the valve body in order to allow full travel of the internal disk. If spacers are necessary for any butterfly valve, the Contractor shall install valve spacers subject to approval by the Engineer.

END OF SECTION

SECTION 33 51 30

LFG CONDENSATE MANAGEMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The CONTRACTOR shall furnish all labor, supervision, administration, management, materials, equipment, and incidentals necessary to install the condensate sumps, pneumatic pumps and related landfill gas (LFG) collection system appurtenances as shown on the CONTRACT DRAWINGS and as specified, in accordance with provisions of the CONTRACT DOCUMENTS, TECHNICAL SPECIFICATIONS conformance with the MANUFACTURER'S recommendations, and with current industry standards.
- B. All materials shall conform to the requirements of this Section and shall be of new stock of the highest grade available, free from defects, and recently manufactured.
- C. All WORK shall be performed in strict accordance with the TECHNICAL SPECIFICATIONS, CONTRACT DRAWINGS, conformance with the MANUFACTURER'S recommendations, and with current industry standards

1.02 REFERENCED DOCUMENTS

- A. Related WORK Described Elsewhere:
 - 1. Section 31 20 00 Excavating, Trenching, Backfilling, and Grading
 - 2. Section 35 51 10 Pipe and Pipe Fittings

1.03 SUBMITTALS

- A. Materials shall not be incorporated in the WORK until approved by the ENGINEER.
- B. The CONTRACTOR shall prepare and submit to the ENGINEER for review and approval MANUFACTURER'S literature, shop drawings, or other information pertaining to the assembly, operation, adjustments, and other maintenance and repairs of equipment to be installed under this Section, together with detailed parts lists, drawings, dimensions, and/or photographs.
- C. At start-up, the CONTRACTOR shall submit Operations and Maintenance (O&M) manuals.

PART 2 - PRODUCTS

2.01 CONDENSATE SUMP

- A. The condensate sump system shall be capable of handling a minimum flow rate of 5 gallons per minute (gpm) with a total dynamic head of 140 feet.
- B. The sump shall be a welded, single walled HDPE assembly as shown on the CONTRACT DRAWINGS. The reservoir shall be fabricated from SDR 17 pipe and designed to withstand

a vacuum of 120 inches-w.c. and a pressure of 5 PSIG at 130 degrees F.

- C. Condensate sump can be tested by MANUFACTURER. The CONTRACTOR to provide leak test report to ENGINEER. Also, the condensate sump will be tested in conjunction with all attached header piping at 4 PSIG for a duration of one hour with no more than 1 percent pressure loss.
- D. The condensate pump shall have level controls. The pump shall pump condensate to a discharge line. Discharge piping from the sump to the condensate discharge line shall be of a size and material recommended by the MANUFACTURER such that the pneumatic pump can deliver the anticipated condensate load.

2.02 ACCESS PORT

- A. Port shall be 1-1/2 - inch diameter black polypropylene quick connect coupling consisting of two parts: a male pipe threaded adapter and cap with steel cam locking levers.

2.03 MONITORING PORT

- A. Monitoring ports shall be QED supplied Easy Port capped long barb fittings, model number 40987.

2.04 PNEUMATIC PUMP

- A. Pump shall be submersible air displacement pump, internally controlled and designed for leachate and condensate systems. Pump shall be bottom-loading with fiberglass body. Major metal components shall be stainless steel, this shall include the pump head assembly, center dip tube, discharge check valve assembly, chain support harness, 3.5-inch extended inlet screen, and bottom check collar. Plastic components shall be PVDF (kynar) or UHMWPE.
- B. The pneumatic pumps shall be QED AutoPump bottom inlet Model Short AP4⁺B.
- C. Pump installed in condensate sump shall include the following components:
 - 1. Air filter/regulator
 - 2. Air inlet supply pressure gauge
 - 3. Pump cycle counter
 - 4. High liquid level indicator
- D. Pump shall have a minimum pumping capacity of 5 gpm with a total dynamic head of 140 feet and an air supply pressure of 60 pounds per square inch, gauge (psig).
- E. Pump accessories to include are 8-inch vacuum fit cap and hose set, including the discharge hose (3/4-inch I.D. Nylon Tube) from the pneumatic pump to the HDPE forcemain and the 150 psig rated, 1/4-inch I.D. air hose to the HDPE air supply line.
- F. Air and discharge hose lengths outside the sump/wells shall be field determined by CONTRACTOR and approved by the ENGINEER.

- G. Each pump will include a 1/2-inch nylon support rope from pump to sealing cap. A stainless steel quick link connector will be used to attach the rope to the pump support harness.

2.05 AIR SUPPLY LINE

- A. The air supply line from the compressor shall be as specified in Section 3.01 below, and as shown on the CONTRACT DRAWINGS.

2.06 CONDENSATE DISCHARGE LINE/DRAINAGE LINE

- A. The condensate discharge line shall be 2-inch or 3-inch diameter HDPE SDR 11 pipe as specified in Section 33 51 10 Pipe and Pipe Fittings and shown on the CONTRACT DRAWINGS.

PART 3 - EXECUTION

3.01 AIR SUPPLY LINE

- A. The air supply line from the compressor to the pneumatic pumps shall be 2-inch diameter SDR 9 HDPE pipe with yellow stripe as specified in Section 33 51 10 LFG Pipe and Pipe Fittings. Air supply line shall be located in the same trench as the header/lateral piping (where possible) at a minimum depth as shown on the CONTRACT DRAWINGS.

3.02 CONDENSATE SUMP INSTALLATION

- A. CONTRACTOR shall install condensate sump in the location and to the lines shown on the CONTRACT DRAWINGS. Sump shall be installed vertically plumb.
- B. HDPE pipe connections in accordance with Section 33 51 10 LFG Pipe and Pipe Fittings.
- C. Caution shall be exercised when backfilling around the sump to prevent damaging air and discharge lines.

3.03 PUMP INSTALLATION

- A. Pump shall be installed in accordance with MANUFACTURER'S recommendations. Pump vent line shall be installed to discharge inside the sump.
- B. Install pump so bottom is suspended off bottom of sump as shown on the CONTRACT DRAWINGS, as recommended by MANUFACTURER and approved by ENGINEER.

3.04 TESTING

- A. Upon completion of the installation, tests shall be performed by the CONTRACTOR with the assistance of the MANUFACTURER'S representative, in the presence of the ENGINEER. These tests shall demonstrate condensate pump, startup, shutdown, operation, and maintenance. Test shall demonstrate the pumping of test water from the sump for the full drawdown of the pump. Equipment and other requirements necessary to perform the tests shall be furnished by the CONTRACTOR.

END OF SECTION

SECTION 44 11 20

LFG BLOWER/FLARE SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope of Work

1. The WORK described in this section consists of furnishing all labor, materials, equipment, and incidentals necessary to furnish, install, and field test a landfill gas blower/flare system, as shown on the CONTRACT DRAWINGS and as specified herein, including all appurtenances to provide a complete system ready for operation.
2. The Landfill Gas Blower/Flare System shall include the following four sub-systems:
 - a. Gas Handling System.
 - b. Interconnecting Piping System.
 - c. Candlestick Flare System.
 - d. Control System.
3. The CONTRACTOR shall be responsible for all electrical wiring connections for operation and control of all equipment related to the Landfill Gas Blower/Flare System.
4. Related Work Described Elsewhere:
Section 33 51 10 – Pipe and Pipe Fittings

1.02 SUBMITTALS

- ###### **A.**
- All equipment and accessories shall have manufacturer's Shop Drawings approved by the ENGINEER prior to shipment and shall be tested for conformance with these Specifications prior to acceptance and final payment by the OWNER. The following materials and shop drawing information shall be submitted:
1. Certified Shop Drawings showing all-important details of the Blower/Flare Skid and Utility flare stack and all dimensions.
 2. Descriptive literature, bulletins, and/or catalogs of the equipment.
 3. A complete bill of materials for all equipment.
 4. The total weight of the equipment, including the weight of the single largest item.

5. Complete performance data that will indicate full compliance with the Specifications; performance curves for flow and pressure/vacuum capacity; calculations showing the equipment gas flow and motor corrections required for operation at the elevation of the job site.
 6. Complete control panel diagrams and elevations showing all components, wires, connections, and numbered terminals.
 7. Complete electrical interconnect diagram showing all wires and terminals between the control panel and external devices.
 8. Exceptions to the applicable requirements, Plans, Specifications, and applicable codes and standards.
 9. Certification that the equipment furnished for this project does not exceed the sound pressure specified herein.
- B. An electronic copy of a draft operation and maintenance manual shall be required four weeks prior to equipment delivery. Two copies of the final manual shall be submitted two weeks after start-up that incorporate comments of the ENGINEER and any revisions made during start-up. The manual shall be prepared specifically for this installation and shall include all required catalog cuts, drawings, equipment list, descriptions, definitions, procedures, and information necessary to instruct operating and maintenance personnel unfamiliar with such equipment. The manual shall include a list of suppliers, with phone numbers and contact, for equipment parts that may need servicing or replacement.
- C. Test Procedures: Detailed outline of functional test procedures shall include a step by step description of the proposed tests, a list of all test equipment including calibration dates, and signoff sheets.
- D. Spare Parts: In addition to the spare parts recommended by this Specification, a list of manufacturer's recommended spare parts shall be submitted.

1.03 QUALIFICATION

- A. The Landfill Gas Blower/Flare System, including all ancillary equipment, shall be furnished by a manufacturer who is fully experienced, reputable, and qualified in the manufacture of the equipment to be furnished. The equipment shall be designed and fabricated in accordance with the best practices and methods. The manufacturer shall have experience in supplying equipment for landfill gas handling systems.
- B. The Landfill Gas Blower/Flare System shall be manufactured by Perennial Energy, Inc., John Zink Company, Parnel Biogas, Inc., or approved equal.

1.04 DESIGN CRITERIA

A. Landfill Gas Blowers:

1. Equipment specified herein is intended to be standard equipment for use in a landfill gas handling system.
2. The blowers shall be designed for continuous operation in an outdoor environment and shall conform to the following, measured at standard 14.7 psia and 68 degrees F condition:

CONDITION	REQUIREMENT
No. of blowers	2
Rated capacity, scfm	1,250 each
Minimum capacity, scfm	250
Site elevation	30 feet above MSL
Landfill gas composition:	
Methane	25-50 percent
Carbon Dioxide	25-50 percent
Oxygen	0-5 percent
Traces gases (e.g., VOCs, H ₂ S)	0-1 percent
Blower inlet vacuum, inches of water	-60
Blower outlet pressure, inches of water	10
Landfill gas inlet pressure:	
Maximum, degrees F	120
Minimum, degrees F	30
Motor:	
Totally enclosed, fan cooled	
Horsepower	50 Min, must meet Vacuum specification
Nominal motor efficiency, percent	50
Minimum motor power factor, percent	72
Motor service factor	1.15
Noise limit	85 dbA at 3 feet
Landfill gas moisture content	100% saturated

3. When rated volumetric capacity is reduced to 40 percent of design, blowers under the specified inlet conditions shall not surge or overload the motor.
4. Each blower equipment rating shall be based upon data previously established by tests in accordance with the ASME Power Test Code for Centrifugal Blowers.

B. Candlestick Flare System:

1. The landfill gas flare system shall be designed to operate continuously at the following service conditions:

CONDITION	REQUIREMENT
Landfill gas flow rate, scfm	250-2,500
Inlet temperature, degrees F	30-120
Landfill gas moisture content	100
Site elevation	30 feet above MSL
Landfill gas composition range:	
Methane	25-50 percent
Carbon Dioxide	25-50 percent
Oxygen	0-5 percent
Traces gases (e.g., VOCs, H ₂ S)	0-1 percent
Control and accessories to include the following:	
Thermocouple for flame temperature confirmation	
Flare and blower control panel	
Pneumatically-operated emergency shut-off valve	
Flow meter	
Digital data recorder	
Flame arrestor	
Auto dialer	
Pilot gas system and thermocouple	

2. At maximum landfill gas flow rate of 2,500 scfm, the flare system shall require a maximum landfill gas pressure of +10 inches water column at the blower outlet.
3. The Landfill Gas (LFG) Blower / Flare System shall be capable of achieving a minimum weighted average destruction efficiency of greater than 98 percent of total non-methane organic compounds and meet the requirements of 40 CFR 60.18.
4. All on-skid flare electrical is to be included with Landfill Gas (LFG) Blower / Flare System and provided by MANUFACTURER.

1.05 APPLICABLE CODES AND STANDARDS

- A. All equipment shall be manufactured in accordance with codes and guidelines as specifically detailed herein and in accordance with applicable portions of the following (latest edition):

1. Local laws and ordinances.
2. State and Federal laws.
3. National Electrical Code. National Electrical Manufacturers Association (NEMA)
4. Underwriters Laboratories (UL).
5. Uniform Building Code (UBC).
6. American National Standards Institute (ANSI).
7. American Society of Mechanical Engineers (ASME).
8. American Gas Association (AGA).
9. Institute of Electrical and Electronic Engineers (IEEE).
10. Instrument Society of America (ISA).
11. Industrial Risk Insurance (IRI).
12. Factory Mutual (FM).
13. National Fire Protection Agency (NFPA).
14. Environmental Protection Agency (EPA).
15. Occupational Safety and Health Administration (OSHA).
16. American Society for Testing and Materials (ASTM).

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. The equipment shall be delivered on site as fully assembled as transportation will allow. Factory-assembled parts and components shall not be dismantled for shipment unless approved by the ENGINEER.
- C. Finished surfaces of all exposed openings shall be protected by wooden blanks, strongly built, and securely bolted thereto.
- D. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.07 WARRANTY AND GUARANTEES

- A. The CONTRACTOR shall warrant the units being supplied to the OWNER against defects in workmanship and material for a period of one (1) year from the date of equipment acceptance by the OWNER. In the event that the equipment fails to perform as specified, the equipment manufacturer shall promptly repair or replace the defective equipment without any cost to the OWNER (including handling and shipment costs).

PART 2 – PRODUCTS

2.01 GENERAL

- A. Equipment shall not have been in service, except for shop tests, at any time prior to delivery. The equipment shall be furnished factory assembled to the extent possible and ready for installation.
- B. Equipment shall be designed and proportioned to have liberal strength, stability, and stiffness and shall be especially adapted for the intended service. Ample room and facilities shall be provided for inspection, repairs, and adjustments.
- C. Parts of equipment shall be amply proportioned for all stresses which may occur during operation and for any additional stresses which may occur during fabrication, transportation, handling, and erection.
- D. These Specifications are intended to give a general description of what is required, but do not cover all requirements of the equipment as offered. They are, however, intended to cover the furnishing, delivery, and field testing of all materials, equipment, and apparatus as required. Auxiliary equipment necessary for proper operation of the proposed Landfill Gas Blower/Flare System not mentioned in these Specifications or shown on the Drawings shall be furnished and installed.
- E. At all levels of performance of the gas system, the sound pressure shall not exceed 85 dbA over a frequency range of 37.8 to 9,600 cycles per second. Measurement shall be made a distance of 3 feet from the outer face of the equipment. The manufacturer shall certify that the equipment furnished for this project does not exceed the specified sound pressure. This written certification shall be submitted with the Shop Drawings.
- F. A brass or stainless steel nameplate shall be attached to each piece of equipment in a conspicuous place. The following information shall be plainly marked on the nameplate: name and address of the manufacturer, serial number, model number, pertinent information regarding electrical requirements, size and capacity and any other information necessary for complete identification.
- G. If necessary, modifications shall be made in the manufacturer's standard product to make it conform to the specific requirements of the Specifications and to requirements contained in regulations issued by public agencies. Such modifications shall be noted in Shop Drawing submittals.

2.02 GAS HANDLING SYSTEM

- A. Blower and Motor:
 - 1. Blower. The blower motor assemblies shall be gas inlet driven, direct drive, multistage centrifugal type exhausts. The blowers shall be designed

for and include variable frequency drive (VFD) control. Impellers shall be mounted on one shaft supported on each end by bearings mounted in the outboard bearing housings. The blower shall be built from parts cast in patterns from which previous units have been built and tested. Each blower shall have monitoring ports factory installed in the blower housing leading to the inlet and outlet piping. Blower shall comply with the Design Criteria of Part 1.4 above.

2. Each blower motor assembly shall be plumbed and factory mounted on a steel skid and delivered to the site as a complete unit. Neoprene base pads shall be provided. A total of three blowers shall be installed at the site under this contract.
3. Blower Housings. The housings shall consist of cast iron sections held securely between cast iron inlet and outlet heads with steel tie rods.
 - a. No contact shall be made between the shaft rotor and the housing, other than through the bearings. Stuffing boxes shall be used as seals to ensure no leakage of gas to the atmosphere or air into the landfill gas.
 - b. The inlet and outlet connections shall be drilled and tapped flange pattern per ANSI 1316.1, 125-pound, and shall be an integral part of the heads.
4. Impellers:
 - a. Impellers shall be one piece cast aluminum alloy, keyed to the shaft and held by a locknut. Hubs of the impellers shall butt against each other directly or through one piece metal spacers. There shall be ample clearance and tip speed shall not exceed 375 feet per second.
 - b. Impellers shall be precisely machine balanced. Vibration shall not exceed 2 mils in the vertical plane measured at the blower bearing housings.
5. Diffusers. Diffuser sections which receive the gas from the impeller and guide the gas to the next impeller shall be provided. The diffusing vanes shall be an integral part of the sections.
6. Shaft. Each shaft shall be made of high grade carbon steel of sufficient diameter to operate below first critical speed.
7. Bearing Housings. Each blower shall be provided with two antifriction bearings. It shall be possible to replace bearings without disconnecting piping or disassembling the compressor casing. Both inlet and outlet

bearings shall be designed for a minimum expected life of 10 years of continuous operation.

8. Casing Drains. Each blower stage shall be provided with 3/8-inch diameter casing drains manifolded to a single manual shut-off valve.
9. Internal Lining. The blower internals shall be furnished with a factory applied Bisonite, Kynar, phenolic coating or approved equal, minimum 10 mils thick to provide resistance to corrosion by landfill gas. The coating shall be applied to all parts of the blower (excluding aluminum impellers) which come in contact with the landfill gas stream.
10. Motor. Each blower shall be direct-coupled to a horizontal 480V, 3-phase, 60-hertz motor. The blower manufacturer shall be responsible for selecting the proper motor size to suit this equipment, the performance requirements noted herein, and the site conditions. The motor shall be totally enclosed fan-cooled (TEFC) suitable for Class 1, Division 2, Group D, classified location, and UL-approved. Motor shall be rated at 104 degrees F ambient with not more than 131 degrees F rise. Bearings shall be of the antifriction type with an AFBMA L-10 life rating of not less than 25,000 hours.
11. Flexible Couplings and Drives. The blowers shall be connected to the drivers with a suitable flexible coupling. The CONTRACTOR shall check and adjust the alignment of the couplings and drives in accordance with the instructions of the blowers' manufacturer to a tolerance of plus or minus 2 mils. Couplings shall be covered with base-mounted aluminum or non-sparking metallic guard.
12. Bases. Hot dip galvanized or epoxy-coated steel bedplates of suitable size for mounting blowers and drivers shall be furnished by the blower manufacturer. The blower and motor shall be carefully aligned and then bolted in place. Suitable vibration isolation pads shall be provided under the steel bedplates of the units.
13. Expansion Joints. Expansion joints between the blower inlet and outlet and connected piping shall be flanged concentric reducers sized to match the blower flanges to the connecting piping or valves.
14. Valves:
 - a. Butterfly valves located at the inlet of each blower shall be bubble-tight, cast iron body, wafer-type with 316 stainless steel disc and stem, Acetal stem bushing, and Teflon replaceable resilient seat. Interior of valve body and valve disc except for valve seat and stainless steel valve seat ring shall be coated with a fusion bonded, thermosetting epoxy coating in accordance with AWWA C550, latest revision. Coating shall be uniformly applied with a minimum

thickness of 12 mils. Surfaces shall be clean, dry, and free from rust and grease before coating.

- b. Manual operators shall be gear or lever type. Operators shall have adjustable stop limiting devices to prevent overtravel of disc. Should an adjustment of the disc be required to maintain a bubble-tight seal, this adjustment shall be made externally without removing the operator housing cover.
 - c. Butterfly valves shall be manufactured by Val-Matic, Bray or as approved by ENGINEER as equal.
 - d. Check valves on each blower outlet shall be flanged, aluminum body with aluminum flappers with a springless, seatless design as manufactured by Techno Corp. (814-838-4561) of Erie, PA, or as approved by ENGINEER as equal.
- 15. Variable Frequency Drive. The CONTRACTOR shall supply a VFD for control of each blower/motor assembly. The VFD shall be capable of controlling the blower motor by either a manually selected speed control or a 4-20 mA DC signal provided by the flow rate or vacuum monitoring system. The operator shall be able to select a desired flow rate or vacuum at the operator interface console, and the VFD shall automatically control the blower speed to maintain the selected flow rate or vacuum.
- 16. Blower Controls:
 - a. Blower-motor starters and controls are specified in Part 2.5. Starters and controls shall be commonly available parts. The manufacturer shall provide the OWNER with a list of known suppliers for parts not commonly available that are expected to need servicing or replacement.
- 17. Experience:
 - a. Blowers shall be manufactured in the United States. Blower manufacturers shall have a minimum of 5 years experience in the design and manufacture of this type of equipment and have a minimum of 25 operating installations on landfills in the U.S.
 - b. Acceptable Manufacturers:
 - 1. Gardner Denver, Inc (Lamson Corporation)
Peachtree City, Georgia
(800) 982-3009
 - 2. Lone Star Blower

Houston, Texas 77061
(832) 532-3112

3. Continental Blower
East Syracuse, NY 13057
(315) 451-5410
4. National Turbine Corporation
North Syracuse, NY 13212
(315) 455-5591

B. Moisture Separator Assembly (Knock-Out Pot):

1. The knock-out pot shall be completely fabricated from HDPE/ 304 stainless steel. It shall be of a vertical, cylindrical design with element removal from the top. A 10-inch flanged, covered, inspection port shall be provided in the side near the bottom for manual clean out of accumulated debris. Nozzle flanges shall meet ANSI 125-pound specifications.
2. The demister pad shall be made from non-corrosive mesh and shall be supported on and held down by high open area, stainless steel grid, or equivalent. It shall be mounted flush against the inside of the knock-out pot and have no gaps present. The moisture separator shall be able to remove 100 percent of droplets greater than 6 micron and shall also remove particulates having a density equal to or greater than water which are greater than 6 micron in size.
3. The moisture separator shall have a flow capacity of at least 2,500 scfm. At the design flow rates, temperatures and pressures, the moisture separator shall not have a pressure drop greater than 3 inches water column and shall be capable of withstanding no less than 4.0 pounds per square inch gauge vacuum.
4. Condensate Removal. There shall be a 2-inch IPS pipe coupling in the bottom of the assembly for condensate removal.
5. Pressure Drop Monitoring. There shall be two 1/2-inch NPT ports in the side of the unit, one upstream and one downstream of the demister element material, for the purpose of connecting differential pressure monitoring device(s).
6. High Level Sensor. A high condensate level sensor shall be installed through a 3/4-inch penetration below the inlet pipe. Sensor shall be manufactured by Omega Model LVU-705 or approved equal.
7. Liquid Level Sight Glass. There shall be two (2) 3/4-inch penetrations spaced at 8-inches apart in the side of the unit, below the inlet pipe, for the purpose of installing a liquid level sight glass. Sight glass shall be manufactured by Schott Duran or approved equal.

8. The moisture separator assembly shall be manufactured in the United States. Manufacturers shall have a minimum of 5 years experience in the design and manufacture of this type of equipment, and have a minimum of 10 units operating successfully on similar landfill gas installations in the U.S.
9. The moisture separator assembly shall be located, installed, and preplumbed on the gas handling system skid.

2.03 INTERCONNECTING PIPING SYSTEM

A. Valves:

1. Butterfly Valves:
 - a. All valve shafts shall be connected to operators by use of keys and keyways. The use of compression or friction connection will not be accepted.
 - b. The butterfly valves, for low-pressure/vacuum landfill gas services, shall have cast-iron wafer-style valve body with contoured 316 stainless steel disc, Type 316 stainless steel stem, Acetal stem bushing, and viton replaceable resilient seat. Valves shall be bubble-tight at 150 pounds per square inch differential pressure and shall be suitable for installation between ANSI 125-pound flanges.
 - c. All butterfly valves shall open left or counterclockwise when viewed from the stem. Manual valve operators shall be either worm gear or lever type. Valves installed greater than 6 feet in height from the ground or skid platform shall be provided with chain wheel operators. All operators shall have adjustable mechanical stop limiting devices to prevent overtravel of disc. Should an adjustment of the disc be required to maintain a bubble-tight seal, this adjustment shall be made externally without removing the operator housing cover. The operator shall be designed such that adjustments can be made under pressure and without the possibility of dirt getting into the operator lubricant. Adjustments through the lower shaft will not be acceptable. Operator components shall, at the extreme operator positions, withstand without damage a pull of 200 lb for handwheel or a torque of 300 ft-lb for operating nuts.
 - d. Interior of valve body and valve disc except for valve seat and stainless steel valve seat ring shall be coated with a fusion bonded, thermosetting epoxy coating in accordance with AWWA C550, latest revision. Coating shall be holiday-free with a minimum

thickness of 12 mils. Surfaces shall be clean, dry, and free from rust and grease before coating.

- e. All butterfly valves shall be manufactured by DeZurik, American-Darling Valves, Kennedy Valve Manufacturing Company, Clow Valve Company, ABZ Valves, or approved equal. Replacement parts and valves shall be commonly available.
- f. All exterior surfaces of butterfly valves shall be clean, dry and free from rust and grease before coating. The exterior ferrous parts of all valves shall be shop primed at the factory with one coat, minimum dry film thickness 1.5 mils, of a primer with rust-inhibitive pigments and synthetic resins. Following installation, aboveground valves shall be finish painted. The color of the paint shall be selected by the OWNER.

2. Sampling Ports:

- a. Gas and pressure sampling ports shall be 1/4-inch barbed fittings with rubber dust caps to match the monitoring ports on the wellheads. Parts shall be commonly available. Sampling ports shall be installed in the following locations:
 - 1. Upstream and downstream of the flame arrestor.
 - 2. Upstream and downstream of the moisture separator at the knock-out pot.
 - 3. Inlet and outlet pipe of the knock-out pot.
 - 4. Inlet pipe to blower.
 - 5. Outlet pipe from blower.
 - 6. Upstream of the mass flow meter.

B. Gas Handling Piping:

- 1. Piping on the gas handling system skid shall be appropriate diameter stainless steel or approved equal. The same specification applies to tees, elbows, wyes, flanges, and other pipe fittings. Flanges shall conform to ANSI 125-pound specifications.
- 2. The gaskets shall be full-face rubber, 1/16 inch to 1/8 inch in thickness, and shall meet the requirements of ANSI Specification A21.11.
- 3. Where shown on the CONTRACT DRAWINGS or as required, pipes and fittings shall be drilled and tapped to receive drainage or other piping or plugs. All holes shall be drilled at right angles to the axis of pipes and fittings.

C. Automatic Shut-Off Valve. The valve shall open when prompted by the flare control panel and closed by loss of electrical power, flame failure, or blower

failure. It shall be a pneumatically operated butterfly valve, bubble-tight, wafer-style, equipped with a stainless steel disk and Viton seat. The operator shall have a manual override and be equipped as a spring fail close device. It shall close when directed by the logic in less than 5 seconds. The compressed gas necessary to operate the valve shall be supplied by a nitrogen bottle.

D. Drain Line Piping:

1. The drain lines from the flare, flame arrestor and condensate knockout pot shall be 2-inch HDPE SDR 11.
2. The blower drain lines shall be stainless steel or 2-inch schedule 80 PVC pipe. They will tie-in to a common line and then transition to 2-inch HDPE SDR 11 using a Vanstone flange or transition fitting where it ties-in to the drain line from the flare.

2.04 CANDLESTICK FLARE SYSTEM

- A. The Landfill Gas (LFG) Blower / Flare System shall be a unitized, modular system including all components for a complete and operational system. The flare shall comply with the Design Criteria of Part 1.4 above.
- B. The Landfill Gas (LFG) Blower / Flare System shall be pre-piped and pre-wired to the extent possible, requiring minimal field assembly.
- C. The Landfill Gas (LFG) Blower / Flare System shall include, but not be limited to, the following components:
 1. Flame Arrester
 - a. Flame arrestor shall have 125-pound ANSI flanged connections.
 - b. The housing construction shall be aluminum. The bank assembly shall be all aluminum and shall be arranged for easy removal from the housing to facilitate inspection and cleaning. The net free area through the bank assembly shall not be less than four times that of the corresponding size pipe.
 - c. Maximum head loss through the flame arrestor shall not exceed 5 inches of water column at 2,500 scfm. All grids of the bank shall be arranged for individual removal. The flame arrestor shall be UL-approved and manufactured by Whessoe Varec, Enardo, or approved equal.
 2. Flare Stack. The flare stack shall be constructed from ASTM A53 steel, and shall be of sufficient length to provide an overall flare system height of approximately 25 feet. Flare construction shall consist of welds conforming to AWS D1.1 standards. The top 5 feet of the stack/burner tip shall be constructed of 304 stainless steel.

3. Burner. The burner unit shall be constructed of 304 stainless steel. It shall consist of the burner nozzle, vanes, and impingement assembly. It shall be designed such that the full range of flow rates, as specified herein, shall combust without causing either flame yellowing, flame lift-off, or flashback, and shall perform according to the destruction and reduction efficiency requirements listed earlier in this TECHNICAL SPECIFICATIONS.
4. Windshield. The flare windshield shall be constructed of 310 stainless steel. The windshield shall extend at least 2 feet above landfill gas exit.
5. Propane Pilot System. Removable pilot assembly shall include pressure regulator, pressure indicator, solenoid valve, manual shutoff valve and pilot gas pressure manometer port. CONTRACTOR shall provide connections to existing propane gas system.
6. Electronic Spark Ignition. 5,000 V electronic igniter assembly removable from outside the flare without disconnecting conduit or wiring. Igniter assembly shall be commonly available parts. The MANUFACTURER shall provide a list of parts not commonly available and known suppliers.
7. Flare Mounting System. This system shall be manufactured of ASTM A36 carbon steel members, which shall be welded to the structure using AWS D1.1 methods. Sufficient steel gusset material shall be incorporated in the structure to prevent erratic vertical alignment of the flare pipe. Flare mounting shall provide anchorage to the new foundation to prevent overturning and provide resistance against seismic or wind forces. CONTRACTOR to provide necessary structural design for all required components including the flare stack pad. All structural design shall comply with UBC 125 MPH criteria.
8. Finish. Carbon steel base of the flare stack shall be sand-blast prepared and primed. Sand blasting shall be to SP-6 guidelines. An inorganic zinc primer, solvent or water based, with a minimum of 14 lbs. metallic zinc content per gallon shall be applied. Minimum application will involve 1 coat, 4 MDFT cover. Acceptable coating suppliers include Ameron Protective Coatings (Brea, CA), DuPont Chemical Company (Wilmington, DE), Glidden Company (Cleveland, OH), and Koppers Company (Pittsburgh, PA).
9. Condensate Drains. Drain ports in the flame arrester and flare stack shall be equipped with stainless steel or SCH 80 PVC ball valves and piped to a common drain line that allows condensate to drain to CS-1.

2.05 CONTROL SYSTEM

- A. Control Panel. The CONTRACTOR shall provide all labor, materials and equipment to fabricate and pre-wire the Control Panels. The CONTRACTOR shall be responsible for procuring all instrumentation integral to the construction of the panels and other instrumentation for the system. The Blower Control Panel and Flare Control Panel can be provided either as a common panel or as separate

but integrated panels. The CONTRACTOR shall provide all labor, materials, and equipment to shop test the entire blower/flare station system with control panels connected, before delivery to the site.

B. The control panel for the Landfill Gas Blower/Flare System shall be compliant with NEMA 4 specifications at a minimum. The main control panel shall be sized to accommodate the required controls and shall be provided with a swing out panel, and with a NEMA 4 compliant window in the door through which status annunciators, recorder, controller, etc. may be viewed. The panel shall include, but not be limited to, the following components:

1. Electrical connections and controls for 3 motors, outlets, fixtures, controls, and devices, etc., included with the system. The panels shall be pre-wired to receive incoming power from the electrical service equipment, and with suitable junction boxes for all outgoing conduit and cable to equipment.
2. A control center to receive all the signals from the various safeties, controls and monitoring equipment, and to automatically control all the various components of the system.
3. The control panel shall be sized to accommodate a laptop personal computer.
4. The control panel shall be air conditioned/heated to maintain the internal panel temperature between 55°F to 85°F.
5. Local touch screen, no less than 6" size. Must be Ethernet and USB ready.
6. Control of the flare shall be achieved using a Programmable Logic Controller (PLC).
 - a. Approved PLC manufacturers are:
 1. Koyo/Automation Direct (DL260 only)
 2. AB (SLC505E-Ethernet Enhanced)
 - b. PLC HARDWARE
 1. All control circuits will use 24VDC unless otherwise specified.
 2. Minimum of 2 Racks with 9 slot count.
 3. RACK1 will be used for Analog IO ONLY.
 - c. Minimum 8 channel analog input and output cards are required. Mixed input/output cards will be accepted, but the combined inputs and outputs must be equal to or greater than 10 points.

- d. All analog channels are required to be wired through analog isolators. The only acceptable isolators are Automation Direct part numbers:
 - 1. FC-11
 - 2. FC-33
- e. If the first rack is filled to capacity then the 2nd rack can be used to accommodate the additional analog cards.
 - 1. The inputs cards will be installed before the output cards.
 - 2. RACK2 will be used for Discrete IO ONLY.
Minimum 16 point input and output cards are required.
- f. ZIP link modules will be required for both input and output cards.
- g. All input Cards will be connected to ZIPLINK: ZL-CM16L24
- h. All output cards will be connected to ZIPLINK: ZL-CM16RL24A
- i. The inputs cards will be installed before the output cards.
 - 1. All analog IO will be terminated to terminal blocks.
Minimum of 20% spare slot space will be required.
 - 2. The H2ECOM-100 is the only approved Ethernet card. It will be installed in the last slot of the CPU rack.
 - 3. CPU rack will contain at least 2 empty slots.
 - 4. Remote call-in modem.
 - 5. D2-FILL will be used to fill spare slots.

7. COMMUNICATION PROTOCOL

- a. The PLCs will communicate via the H2ECOM-100 card using ECOM. The contractor will provide windows based drivers by Kepware (KepServer EX) for the Koyo family of PLCs.

8. FUNCTIONALITY

- a. The operator will have remote start/stop and alarm reset ability from 3rd party SCADA via Windows based PC communications driver (XP/2003).
 - 1. The contractor will provide a licensed copy of KepServer EX.

2. The software at a minimum should be capable of providing remote access/control/reset capabilities for all items mention in this section.
- b. The PLC shall be programmed to attempt four (4) restarts before a call out is initiated.
- c. The PLC shall be programmed to allow only 4 hours/day of flare manual mode operation.
- d. The PLC program shall be written to allow the operator to:
 1. Select flow or vacuum control.
 2. The operator shall have the ability to adjust the set points.
 3. System shall monitor all points and provide control as required by the OWNER.
9. All control power shall be 24 VDC. Where applicable, a 24 VDC relay shall be used to interface with other control voltages.
10. An operator control panel to allow either manual or automatic selection for the control of the operating components of the system.
 - a. Flare controls shall include trouble light contacts, automatic start/stop for pilot ignition, controllers, spark plugs, ultraviolet (UV) scanner, flame safeguard controller, thermocouples, timers, and other components necessary for a complete, operational automatic system. Automatic operation shall be achieved through adjustable timers, relays, and switches activated by the thermocouples and UV scanners.
 - b. Blower Controls. The flare manufacturer shall provide the blower controls for three blowers mounted on a common skid with the control panel. Blower controls shall include ITE Type ETI, or as approved by the ENGINEER as equal motor circuit protectors, motor starters, voltage monitors, dual set point ammeter switch gauges with flow indication (obtained from blower manufacturer), running time meters, hand-off-automatic switches, and green push-to-test run lights housed in a NEMA 4 enclosure. A time delay will prevent blower restart until sufficient time has elapsed for the shaft to stop spinning (approximately 8 minutes)
 - c. The blower controls shall provide for 1 or 2 blower operation through a selector switch (Blower 1, Blower 2, or any combination thereof). During automatic startup of more than one blower, a time delay will prevent multiple blowers from starting simultaneously.

11. The control system shall be designed and manufactured as an outdoor system.
12. Safeties. The system shall be equipped with the following safeties as a minimum:
 - a. Blower-motor overcurrent shall cause system shutdown.
 - b. Blower-motor undercurrent (surge) shall cause system shutdown.
 - c. Flame failure shall cause system shutdown.
 - d. High temperature shutdown.
 - e. Low temperature shutdown.
 - f. High temperature flashback shutdown.
 - g. High blower bearing temperature shutdown.
 - h. High liquid level in knock-out pot shutdown.
 - i. Inlet valve failure.
 - j. Low methane content shutdown.
13. Control Panel Face-Mounted Devices. The system shall be equipped with the following control panel face-mounted devices or displays as a minimum:
 - a. Alarm and shutdown indicating lights.
 - b. Blower motor current meter.
 - c. LFG and supplemental fuel flowmeters.
 - d. Hand/off/auto switches for the blowers.
 - e. Hand/off/auto switches for the flare.
 - f. Run indicators for the blower.
 - g. Total elapsed run time for each blower.
 - h. Flame failure indicator for the flare.
 - i. Automatic shut-off valve failure indication.
 - j. Inlet Valve Failure Indication.
 - k. Safety Shutoff Switch.
 - l. Blower Bearing Temperature Gauges.
 - m. Supplemental Gas Flow Indication.
 - n. Paper data chart recorder.
 - o. Digital data recorder.

C. Auxiliary Equipment

1. Local alarm light shall be provided and mounted near the control panel in a location where it is highly visible.
2. Four outdoor receptacles (120V) with ground fault protection shall be provided at the flare/blower control panel rack.
3. Three phase surge suppression system.
4. 3 ea. Appropriate sized motor starters with thermal overloads.

5. 480:240/120 VAC single phase transformer
6. 240/120 VAC single phase protected load center w/distribution breakers.
7. Fully wired control panel system (requires connection to field devices).
8. 120 VAC surge suppression system.
9. 24 VDC surge suppression system.
10. RS-232/Communications surge suppression system.
11. UL panel construction.
12. PLC supervision and logical control system, both digital and analog.
13. “Touch Screen” operator interface system.
14. SCADA system from 3rd Party Vendor.

D. Automatic Telephone Dialer:

1. General. The system shall receive input from the various monitored items in the form of a change in the status of a dry contact. Upon such change, the system shall automatically dial up to sixteen pre-selected phone numbers. When answered, the system shall send voice messages reporting the specific alarm condition. The system shall also be capable of reporting the status of all monitored items upon receipt of an inquiry phone call. The system shall be initially programmed by the CONTRACTOR with the numbers provided by the OWNER.
2. The System shall make provisions for the following input alarms:
 - a. Blower-motor over-current (3).
 - b. Blower-motor undercurrent (surge) (3).
 - c. Flame failure (1).
 - d. High Temperature (1).
 - e. Low Temperature (1).
 - f. High temperature flashback (1).
 - g. High blower bearing temperature (6).
 - h. Inlet valve failure (1).
 - i. High liquid level in the knock-out pot (1).
 - j. Low methane content (1).
 - k. Pilot failure (1).
3. Equipment Description:

- a. The automatic dialer shall be an advanced microprocessor and synthesized voice technology capable of dialing up to 16 phone numbers, 60 digits each, maximum. Phone numbers and standard tone dialing shall be used on standard phone lines.
- b. The unit shall permit the user to program, right from the keyboard or remotely via touch tone telephone, the following functions:
 - 1. Each fault channel to a normally open or closed mode.
 - 2. Alarm response delay: 0.1 to 999.9 seconds, with different delays being assignable to different alarms.
 - 3. Delay between alarm call outs: 0.1 to 99.9 minutes.
 - 4. Alarm reset time: 0.1 to 99 hours, or “No Reset”.
 - 5. Incoming ring response (answer) delay: 1 to 20 rings.
 - 6. Number of message repetitions: 1 to 20 repetitions.
 - 7. Autocall test: allows the unit to place a round of test calls when enabled and also at subsequent intervals until this function is disabled.
 - 8. Remote system microphone activation.
 - 9. Remote arming and disarming of system.
 - 10. Dialing and re-dialing up to sixteen separate pre-determined telephone numbers and delivering a synthesized voice message.
- c. Normal power shall be 105-135 volts AC, 15 watts, nominal. The unit shall contain its own gel cell rechargeable battery which shall automatically be kept charged when AC power is present. The system shall operate on battery power for a minimum of 20 continuous hours in the event of AC power failure.
- d. The unit shall be provided with a NEMA 4 enclosure, which shall be mounted inside the blower/flare main control panel.
- e. Automatic dialer shall be Raco Verbatim Modular Series VSS or approved equal.

E. Pushbutton/Selector Switches, Control Units, and Panel Lights.

- 1. Manufacturers:
 - Square D
 - a. Cutler-Hammer
 - b. Allen Bradley
 - c. Or equal
- 2. Construction:
 - Heavy Duty
 - a. Oiltight

- b. Base mounted or
 - c. Flush panel mounted
3. Pushbuttons
- Flush head unless otherwise specified elsewhere
- a. Control blocks:
 - 1. Double break silver contacts
 - 2. AC ratings: 7200 va make, 720 va break
 - 3. Single-pole-double-throw or double-pole-double-throw
 - 4. Up to six (6) tandem blocks
 - b. Maintained Contact unless otherwise specified elsewhere
 - c. Non-illuminated
 - d. Legend plates as required for type of operation or as specified elsewhere
4. Selector Switches:
- a. Maintained position unless otherwise specified elsewhere.
 - b. Contact blocks:
 - 1. Double break silver contacts
 - 2. AC ratings: 7200 va make, 720 ma break
 - 3. Single-pole-double-throw or double-pole, single-throw
 - 4. Up to six (6) tandem blocks
 - c. Operators:
 - 1. Number of positions as required or specified elsewhere
 - 2. Standard knob type of operation unless otherwise specified elsewhere
5. Panel lights:
- a. Transformer type
 - b. LED
 - c. Colored lenses as specified elsewhere
 - d. Interchangeable lenses
 - e. Legend plates as required or as specified elsewhere
 - f. Press-to-test feature.
6. Nameplates
- a. Engraved laminated plastic
 - b. Letters 3/16- in. high
 - c. White letters on black background
 - d. Identity per equipment controlled

F. Power Supplies

1. 120 vac 60HZ power input
2. Integral PI filter
3. On/off circuit breaker
4. 0.2% load regulation
5. Short-circuit limit protection
6. Crowbar overvoltage protection

G. Control Relays

1. Manufacturers:
 - a. Potter and Brumfield
 - b. IDEC
 - c. Or equal
2. Operating Data:
 - a. Pickup time: 13 ms maximum
 - b. Dropout time: 10 ms maximum
 - c. Operating Temperature: -45 deg to 70 deg C
3. Contacts:
 - a. Gold flashed fine silver, gold diffused
 - b. Form C
 - c. 110 vac
 - d. Minimum 2 amp rating
4. Rated at 10 million operations
5. Plug-in sockets

H. Programmable Logic Controllers

1. Manufacturers
 - a. General Electric Fanuc 30-70/30-90
 - b. Allen Bradley, any model
 - c. Koyo DL260 only
 - d. Or equal

2.06 IGNITION PROCEDURE

- A. The pilot and main flame shall be controlled by ultraviolet (UV) scanner (optional), thermocouples, solenoids, relays, and timers to perform the following functions:

1. Spark ignition of propane gas creates pilot flame that ignites LFG main flame.
 2. When pilot is successfully ignited, blower(s) and actuator valve on skid inlet are activated.
 3. When main flame is successfully ignited (as detected by a UV scanner or thermocouple), pilot propane gas is shut off.
 4. If pilot is not ignited after three attempts within the pre-selected time interval (as set on the timer), the pilot is shut off, a trouble light is illuminated and alarm sent (via the autodialer).
 5. If main flame is not ignited within the pre-selected time interval, the pilot is shut off, and the trouble light is illuminated and alarm sent.
 6. If the main flame fails, the blower(s) is turned off, and the inlet valve is closed and alarm sent.
 7. In the event of loss of flame, the flare and blower(s) shall automatically restart after an adjustable time delay of 5 to 15 minutes.
 8. In the event of a power failure, the flare and blowers shall automatically restart when power resumes after an adjustable time delay of 5 to 15 minutes.
- B. In the event of a power failure, the flare and blowers shall automatically restart when power resumes after an adjustable time delay of 5 to 15 minutes.

2.07 AUXILIARY EQUIPMENT

A. Gas Mass Flow Meter.

1. Flow Meter. The mass flow meter shall consist of a single point drive system and remote electronics. The method of operation shall utilize a varying delta P signal. The flow meter shall have a digital LCD readout showing instantaneous flow located at the unit and at the flare control panel and provide a record of gas flow to the flare continuously or at maximum intervals of 15 minutes. Flow shall be indicated on the same paper and digital chart recorders as temperature. The unit shall be pressure and temperature corrected. The gas mass flow meter shall be manufactured by: Veris, Inc. or approved equal. The flow meter shall be installed per manufacturer's recommendation with a minimum of 10 diameters of straight piping with no obstructions upstream and 5 diameters downstream. The flow meter shall provide data to a remote recorder.
2. Digital Data Recorder. The digital data recorder shall continuously record temperature, flow and knock-out pot inlet vacuum at a minimum. It shall

have USB flash drive capabilities and a minimum of 6 input channels. The digital recorder shall be manufactured by Yokogawa Model DX Advanced DX 1000. It shall be installed in the control panel unit.

3. A flow totalizer shall be included in the touch screen control panel.

B. Gauges. The system shall be equipped with the following gauges as a minimum:

1. Pressure, Vacuum, and Differential Gauges: Gauges shall be Capsuhelic gauges as manufactured by Dwyer Instruments, Inc., Marietta, Georgia, or equal. Gauges shall read "INCHES OF WATER." Graduations shall be at intervals of 1 inch of water.
 - a. Flame arrester pressure drop indicator. Gauge shall be capable of measuring 0 to 15 in-w.c., differential pressure.
 - b. Moisture separator pressure drop indicator. Gauge shall be capable of measuring 0 to 15 in-w.c., differential pressure.
 - c. Blower vacuum and pressure indicators. Vacuum gauges shall be capable of measuring 0 to 80 in-w.c. Pressure gauges shall be capable of measuring 0 to 30 in-w.c.
 - d. System vacuum indicator. A vacuum gauge shall be mounted upstream of the knock-out pot as indicated on the Plans. It shall be capable of measuring 0 to 80 in-w.c.
 - e. System pressure indicator. A pressure gauge shall be mounted downstream of the blowers' outlet valves as indicated on the Plans. It shall be capable of measuring 0 to 30 in-w.c.
2. Blower inlet and outlet temperature indicators.
 - a. Dial-type temperature gauges shall be provided at the inlet and outlet of each blower. The gauges shall range from 0 to 200 degrees F.

2.08 SPARE PARTS

- A. The Vendor shall provide the following spare parts:
1. 20 ounces of LAMSON No. 5 Grease, if Lamson blower is used, or equal.
 2. One each vacuum, pressure and temperature gauge.
 3. One shaft coupling.
 4. Two thermocouples.
 5. Indicator light package.
 6. 1 ultraviolet scanner.
 7. One set fuses/relays.

8. Two igniter assemblies.
9. One extra bank assembly for the flame arrestor
10. Two Nitrogen Bottles for operation of Automatic Shut-Off Valve.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. The manufacturer/supplier shall install the following items on the main skid:
 1. Blower-Motor Assemblies.
 2. Moisture Separator Assembly (knock-out pot).
 3. Piping and fittings.
 4. Valves.
 5. Control Panels.
- B. The flame arrester shall be installed on the flare inlet pipe and pipe supports shall be used.
- C. All equipment shall be installed in strict accordance with the manufacturer's recommendations and codes and standards.
- D. All skid-mounted equipment shall be installed plumb and perpendicular to piping.
- E. Marred or abraded surfaces of equipment shall be cleaned and refinished to match original finish.
- F. The CONTRACTOR shall coordinate the electrical work with the equipment manufacturer and panel fabricator to provide a complete, integrated, and automatic system.

3.02 START-UP AND TESTING

- A. Factory Test. Prior to shipment, the entire station equipment and all circuits, control systems and devices, including all alarm signals, shall be tested. All apparatus shall be cleaned, adjusted and made ready for shipment after testing. Complete test reports shall be provided to the ENGINEER which show that all system controls operated correctly prior to shipment.
- B. A factory representative with complete knowledge of proper operation and maintenance shall be provided for a minimum of two (2) 8-hour days to instruct representatives of the OWNER and/or the ENGINEER on proper operation and maintenance of the blower/flare system. If there are difficulties in operation of the equipment due to CONTRACTOR's or manufacturer's design or fabrication, additional service shall be provided at no cost to the OWNER.
- C. Functional and Validation Tests. Upon completion of the installation, functional and validation tests shall be performed by the CONTRACTOR with the assistance of the supplier's representative, in the presence of the ENGINEER.

3.03 DEMONSTRATIONS

- A. Demonstrations shall be separate from the installation, startup, and equipment adjustment services described in 3.2 above. System operations under all alarm conditions shall be demonstrated. Some of these alarm conditions may be simulated (e.g., via electrical jumpers) for demonstration purposes.
- B. The Demonstration Test shall demonstrate that all items of these Specifications have been met by the equipment as installed and shall include, but not be limited to, the following tests:
 - 1. That the system has been properly installed and all parts are in correct alignment.
 - 2. That the system performs satisfactorily during continuous operation for at least 3 consecutive days.
 - 3. That there are no mechanical or electrical defects in any of the parts.
 - 4. That the controls perform satisfactorily, including automatic starting and stopping, manual operation, safety shutdowns, call out/notification operation, and under all alarm conditions.

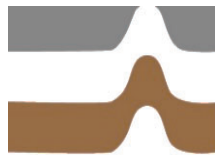
3.04 CLEANING

- A. The CONTRACTOR shall clean exposed surface of all greases, dirt, and other foreign materials.
- B. The CONTRACTOR shall touch up all marred or abraded surfaces as specified herein.

END OF SECTION

ATTACHMENT A
GEOTECHNICAL REPORT

**Subsurface Exploration
Lee/Hendry Class III Landfill Construction
Hendry County, Florida**



Ardaman & Associates, Inc.

CORPORATE HEADQUARTERS

8008 S. Orange Avenue, Orlando, FL 32809 - Phone: (407) 855-3860

Branch Office Locations

Florida: Bartow, Cocoa, Fort Myers, Miami, Orlando, Port St. Lucie, Sarasota, Tallahassee, Tampa, West Palm Beach
Louisiana: Baton Rouge, New Orleans, Shreveport
Houston: Texas

MEMBERS:

ASTM International
Society of American Military Engineers
American Council of Engineering Companies



Ardaman & Associates, Inc.

Geotechnical, Environmental and
Materials Consultants

January 9, 2024
Ardaman File No. 23-23-5241

Jones Edmunds
13545 Progress Boulevard, Suite 100
Alachua, Florida 32615

Attention: Mr. Tobin McKnight, PE

Subject: Subsurface Exploration
Lee/Hendry Class III Landfill Construction
Hendry County, Florida
Jones Edmunds Project No. 12345-026-01

Dear Mr. McKnight:

As requested and authorized, we have completed a subsurface exploration for the subject project. The purposes of performing this exploration were to provide soil stratigraphy data, groundwater level data, and laboratory test data to be used by the client in the design of the landfill improvements. This report documents our field exploration program and our findings.

SITE LOCATION AND DESCRIPTION

The project site is located on the north portion of the Lee/Hendry Class III Landfill facility in Felda, Hendry County, Florida (Section 16, Township 45 South, Range 28 East). The general site location is shown superimposed on the Alva SE, Florida U.S.G.S. quadrangle map presented on Figure 1.

The two areas where our field exploration was performed are low, grassed areas. Standing water was present throughout the south exploration area during our field program. Portions of the existing landfill facility and a large stormwater detention pond are located in close proximity to the areas where our field exploration was performed.

REVIEW OF SOIL SURVEY MAPS

Based on information obtained online from the Web Soil Survey as operated by the U.S. Department of Agriculture Natural Resources Conservation Services, the site is located in an area mapped primarily as the as the “Immokalee sand, 0 to 2 percent slopes” soil series. Additionally, a smaller area of the “Malabar fine sand, high, 0 to 2 percent slopes” soil series was mapped on the southeast portion of the project site. A description of these soil types, as obtained from the Web Soil Survey, is presented below.

Immokalee sand, 0 to 2 percent slopes (#7):

“Immokalee sand, 0 to 2 percent slopes” is a nearly level poorly drained soil found in flatwoods on marine terraces. A representative soil profile consists of sand to a depth of 80 inches. The depth to groundwater is approximately 6 to 18 inches according to the Web Soil Survey.

Malabar fine sand, high, 0 to 2 percent slopes (#51):

“Malabar fine sand, high, 0 to 2 percent slopes” is a nearly level poorly drained soil found in flatwoods on marine terraces. A representative soil profile consists of fine sand to a depth of 42 inches, underlain by fine sandy loam and loamy fine sand to 80 inches. The depth to groundwater is approximately 6 to 18 inches according to the Web Soil Survey.

FIELD EXPLORATION PROGRAM

SPT Borings

The field exploration program included performing 19 Standard Penetration Test (SPT) borings at locations selected by a client representative within the proposed landfill construction areas. The SPT borings were advanced to depths of 30 and 75 feet below the existing ground surface generally using the methodology outlined in ASTM D-1586. A summary of this field procedure is included in Appendix I.

Soil samples recovered during performance of the borings were visually classified in the field and representative portions of the samples were transported to our laboratory in sealed sample jars.

The groundwater level at each of the boring locations was measured during drilling. The borings were backfilled with cement grout upon completion.

Undisturbed Shelby Tube Samples

After completion of the SPT Borings, wash borings were conducted adjacent to Borings TH-23-7, TH-23-14, and TH-23-15 for the purpose of collecting relatively undisturbed Shelby tube samples of clay soils. A total of three Shelby tube samples were collected. A summary of the Shelby tube samples collected at the site is presented in the following table.

Boring Location	Shelby Tube Sample ID	Shelby Tube Sample Depth (ft)
TH-23-7	US-1	35.5 to 38
TH-23-14	US-2	19.5 to 22
TH-23-15	US-3	40.5 to 43

The Shelby tube samples were returned to our laboratory for observation and testing.

Test Locations

The approximate locations of the borings are schematically illustrated on a site plan shown on Figure 2. These boring locations were staked by the project surveyor prior to initiation of our field exploration program.

LABORATORY PROGRAM

Visual Examination and Classification Testing

Representative soil samples obtained during our field sampling operation were packaged and transferred to our laboratory for further visual examination and classification. The soil samples were classified using visual-manual procedures in general accordance with the Unified Soil Classification System (ASTM D-2488). The resulting soil descriptions are shown on the soil boring profiles presented in Appendix II.

In addition, we conducted natural moisture content tests (ASTM D2216), percent fines analyses (ASTM D1140), and Atterberg limits tests (ASTM D4318) on selected soil samples obtained from the borings. The results of these tests are presented adjacent to the sample depth on the boring profiles in Appendix II.

Consolidation Testing

The Shelby tube samples obtained from Borings TH-23-7 and TH-23-14 at the project site were extruded in our laboratory. No testing was performed on the Shelby tube sample collected from Boring TH-23-15. Sub-samples of the soil taken from the Shelby tube samples obtained from Boring TH-23-7 (Undisturbed Sample US-1) and Boring TH-23-14 (US-2) were selected for laboratory consolidation testing. The consolidation test sample depths for each boring are presented in the following table.

Sample I.D.	Description	Percent Fines	Sample Depth
			(ft)
TH-23-7	Sandy clay (CH)	54	37 - 38
TH-23-14	Clayey fine sand (SC)	47	20.5 - 21.5

The resulting void ratio versus log pressure curve of each test are included in Appendix III.

Triaxial Compression Strength Testing

A laboratory unconsolidated undrained (UU-type) triaxial compression test was performed on subsamples of clayey soil selected from the Shelby tube samples obtained from Boring TH-23-7 (Undisturbed Sample US-1) and Boring TH-23-14 (US-2). The triaxial compression tests were conducted in general accordance with ASTM Standard D2850 using a constant rate of strain of approximately 1% per minute. The test results are summarized in the following table.

Sample I.D.	Description	Percent Fines	Sample Depth	Results at ($\sigma_1 - \sigma_3$) max	
			(ft)	Compressive Strength (kg/cm ²)	Strain (%)
TH-23-7	Clayey fine sand (SC)	49	36.5 – 37	1.125	7.9
TH-23-14	Sandy clay (CL)	58	20 – 20.5	0.669	6.3
*Testing performed in general accordance with ASTM D2850					

Please refer to Appendix III for additional details relative to the laboratory triaxial tests.

Permeability Testing

Shallow soil samples collected from Borings TH-23-4, TH-23-8, TH-23-13, and TH-23-14 were molded into 3-inch diameter Shelby tubes in our laboratory. Then, a constant-head permeability test was performed on each of the four samples. The sample depths sound and the results of the laboratory permeability tests are presented in the following table.

Sample Location	Sample Depth (feet)	Percent Fines (%)	Measured Permeability (inches/hour)
TH-23-4	6 to 9	0.7	20
TH-23-8	1.5 to 4.5	4	7
TH-23-13	3 to 6	2	12
TH-23-14	7.5 to 10.5	3	8

For the permeability test samples presented in the table above, a transformation ratio of 1 horizontal to 1 vertical is appropriate (i.e., the estimated ratio of horizontal to vertical permeability).

GENERAL SUBSURFACE CONDITIONS

General Soil Profile

The results of the field exploration and laboratory programs are graphically summarized on the soil boring profiles presented in Appendix II. The stratification of the boring profiles represents our interpretation of the field boring logs and the results of laboratory examinations of the recovered samples. The stratification lines represent the approximate boundary between soil types. The actual transitions may be more gradual than implied.

The results of the borings indicate the following general soil profile:

Depth Below Ground Surface (feet)		Description (Unified Soil Classification)
From	To	
0	17.5	Very loose to very dense fine sand (SP), fine sand with silt (SP-SM), silty fine sand (SM), clayey fine sand (SC), and partially cemented sand and shell
17.5	47.5	Very loose to dense fine sand with silt (SP-SM), silty fine sand (SM) and clayey fine sand (SC). Also soft to very stiff clay (CL, CH) and organic clay and inorganic silt (OH, MH).
47.5	57.5	Very loose to very dense silty fine sand (SM), clayey fine sand (SC), and partially cemented sand and shell

Depth Below Ground Surface (feet)		Description (Unified Soil Classification)
From	To	
57.5	75	Dense to very dense fine sand (SP), fine sand with silt (SP-SM), silty fine sand (SM), and clayey fine sand (SC)

The above soil profile is outlined in general terms only. Please refer to Appendix II for soil profile details.

Groundwater Level

It is noted that Borings TH-23-2 through TH-23-18 were all drilled at locations with standing water present. Therefore, measurement of groundwater levels was not possible at these locations. The groundwater level was measured in Borings TH-23-1 and TH-23-19 during drilling. As shown on the boring profiles in Appendix II, groundwater was encountered in these two borings at a depth of approximately 1 foot below the existing ground surface on the date indicated. Fluctuation in groundwater levels should be anticipated throughout the year primarily due to seasonal variations in rainfall and other factors that may vary from the time the borings were conducted.

CLOSURE

The conclusions submitted herein are based on the data obtained from the soil borings presented on Figure 2 and in Appendix II. This report does not reflect any variations which may occur adjacent to or between the borings. The nature and extent of the variations between the borings may not become evident until during additional exploration or construction. If variations then appear evident, it will be necessary to re-evaluate the conclusions presented in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

This study is based on a relatively shallow exploration and is not intended to be an evaluation for sinkhole potential. This study does not include an evaluation of the environmental (ecological or hazardous/toxic material related) condition of the site and subsurface.

This report has been prepared for the exclusive use of Jones Edmunds in accordance with generally accepted geotechnical engineering practices for the purpose of the Lee/Hendry Class III Landfill Construction project. No other warranty, expressed or implied, is made.

We are pleased to be of assistance to you on this phase of the project. When we may be of further service to you or should you have any questions, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.
Florida Registry 5950



Clif D. Leffler
Assistant Project Engineer



Jason P. Manning, P.E.
Branch Manager
Florida License No. 53265



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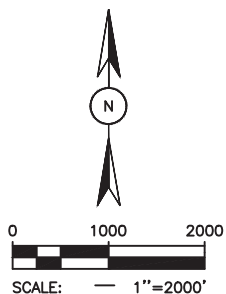
CDL/JPM/DK



APPROXIMATE
SITE LOCATION

SECTION 16
TOWNSHIP 45 SOUTH
RANGE 28 EAST

OBTAINED FROM U.S.G.S. QUAD MAP: ALVA SE, FLORIDA



QUADRANGLE LOCATION

SITE LOCATION MAP

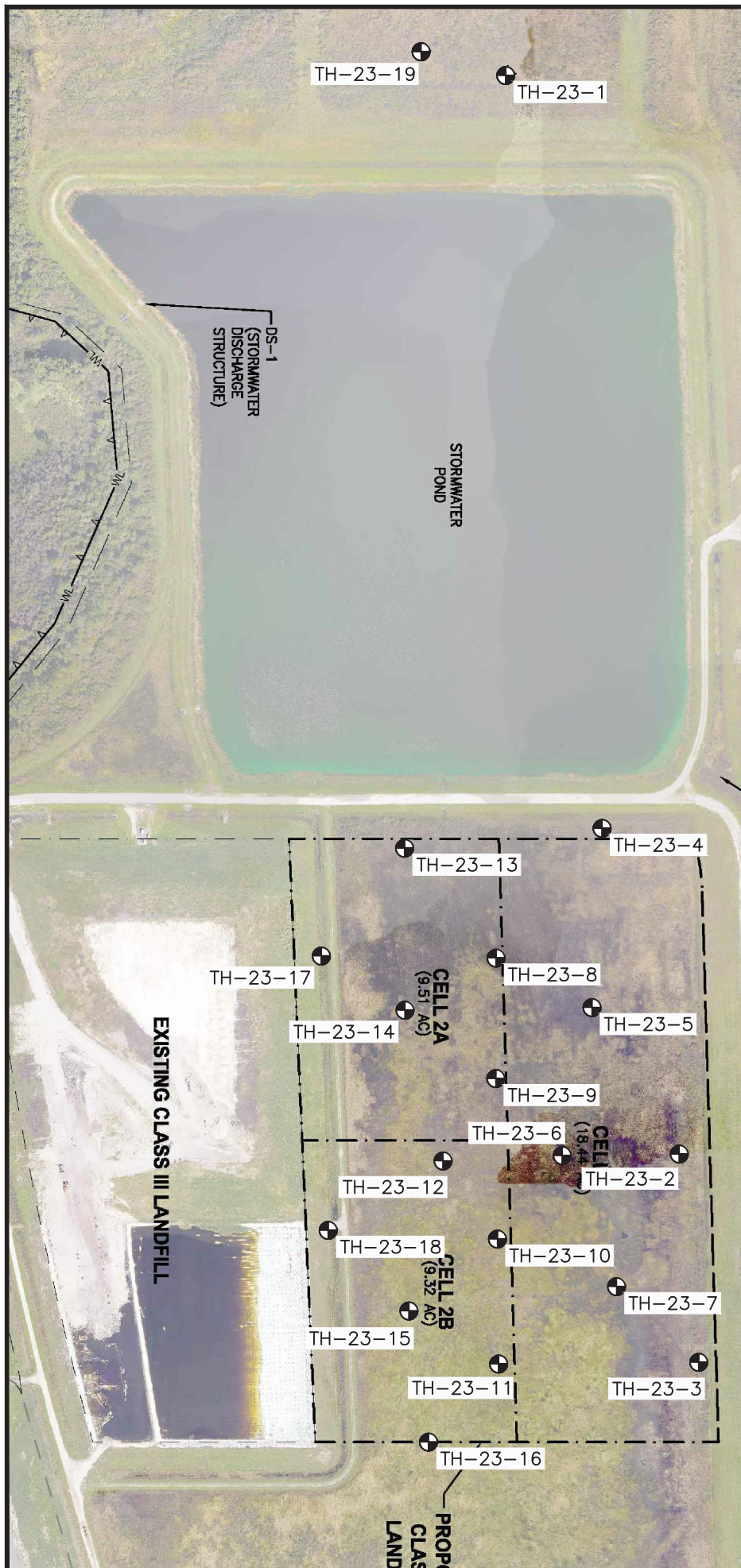


Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

SUBSURFACE EXPLORATION
LEE HENRY CLASS III LANDFILL EXPANSION
LEE COUNTY, FLORIDA

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FILE NO. 23-5241	APPROVED BY:	FIGURE: 1

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LEGEND

- TH STANDARD PENETRATION TEST (SPT) BORING LOCATION

BORING LOCATION PLAN



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LEE HENRY CLASS III LANDFILL EXPANSION
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APPENDIX I

Standard Penetration Test Procedures

STANDARD PENETRATION TEST

The standard penetration test is a widely accepted test method of *in situ* testing of soils (ASTM D 1586), and Ardaman & Associates generally follows this test method. A 2-foot long, 2-inch O.D. split-barrel sampler attached to the end of a string of drilling rods is driven 18 or 24 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each 6 inches of penetration is recorded. The sum of the blows required for penetration of the second and third 6-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties.

The tests are usually performed at 5-foot intervals. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. The circulating fluid, which is a bentonitic drilling mud, is also used to keep the hole open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, flush-coupled casing must be driven to just above the testing depth to keep the hole open and/or prevent the loss of circulating fluid.

Representative split-spoon samples from the soils are brought to our laboratory in air-tight jars for further evaluation and testing, if necessary.

APPENDIX II

Soil Boring Profiles

LEGEND

SOIL DESCRIPTIONS

-  ① FINE SAND (SP)
-  ② FINE SAND WITH SILT (SP-SM)
-  ③ SILTY FINE SAND (SM)
-  ④ CLAYEY FINE SAND (SC)
-  ⑤ CLAY (CL,CH)
-  ⑥ PARTIALLY CEMENTED SAND AND SHELL
-  ⑦ ORGANIC CLAY OR INORGANIC SILT (OH,MH)

COLORS

- Ⓐ LIGHT BROWN TO BROWN
- Ⓑ GRAYISH-BROWN
- Ⓒ LIGHT GRAY TO GRAY
- Ⓓ DARK GRAY OR DARK BROWN
- Ⓔ GREENISH-GRAY

TH STANDARD PENETRATION TEST (SPT) BORING

N STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT

50/5 50 BLOWS FOR 5-INCHES PENETRATION INTO SOIL

WOH SAMPLER ADVANCED BY STATIC WEIGHT OF HAMMER AND RODS ONLY

 GROUNDWATER LEVEL MEASURED ON DATE DRILLED

AOGS GROUNDWATER MEASURED AT OR ABOVE GROUND SURFACE ELEVATION ON DATE DRILLED

US-1  UNDISTURBED SAMPLE OBTAINED WITH A 3-INCH DIA. SHELBY TUBE

NM NATURAL MOISTURE CONTENT IN PERCENT (ASTM D-2216)

-200 PERCENT PASSING NO. 200 SIEVE SIZE (PERCENT FINES)(ASTM D-1140)

LL LIQUID LIMIT IN PERCENT (ASTM D-423)

PI PLASTICITY INDEX IN PERCENT (ASTM D-424)

SP,SP-SM

UNIFIED SOIL CLASSIFICATION SYSTEM

SM,SC,CH

ENGINEERING CLASSIFICATION

I COHESIONLESS SOILS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM	10 TO 30
DENSE	30 TO 50
VERY DENSE	>50

II COHESIVE SOILS

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH, QU, TSF	BLOW COUNT "N"
VERY SOFT	<1/4	0 TO 2
SOFT	1/4 TO 1/2	2 TO 4
MEDIUM	1/2 TO 1	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	>4	>30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLER'S LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER SURFACE DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THESE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE.

SOIL PROFILES LEGEND



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SUBSURFACE EXPLORATION
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HENDRY COUNTY, FLORIDA

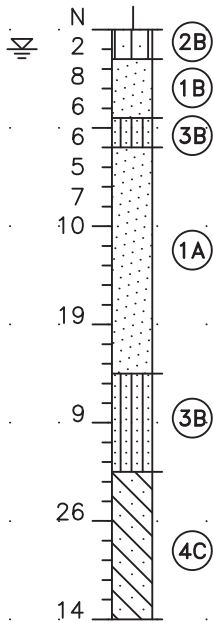
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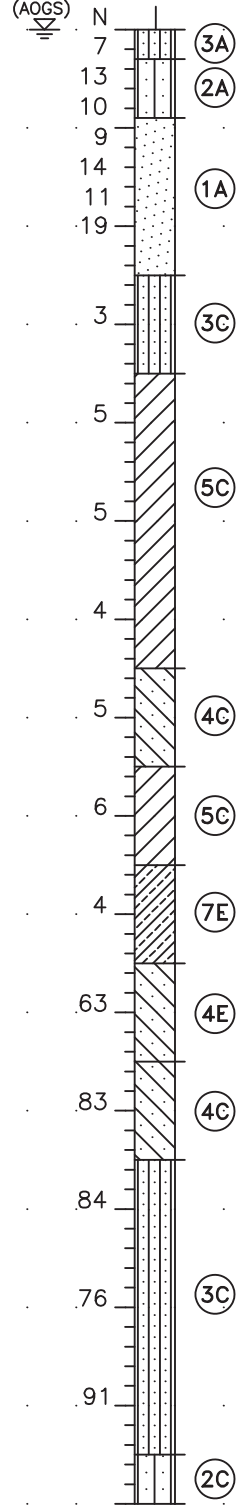
TH-23-1
9/1/23

TH-23-2
9/26/23

FEET
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DEPTH



(AOGS)



FEET
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SOIL BORING PROFILES



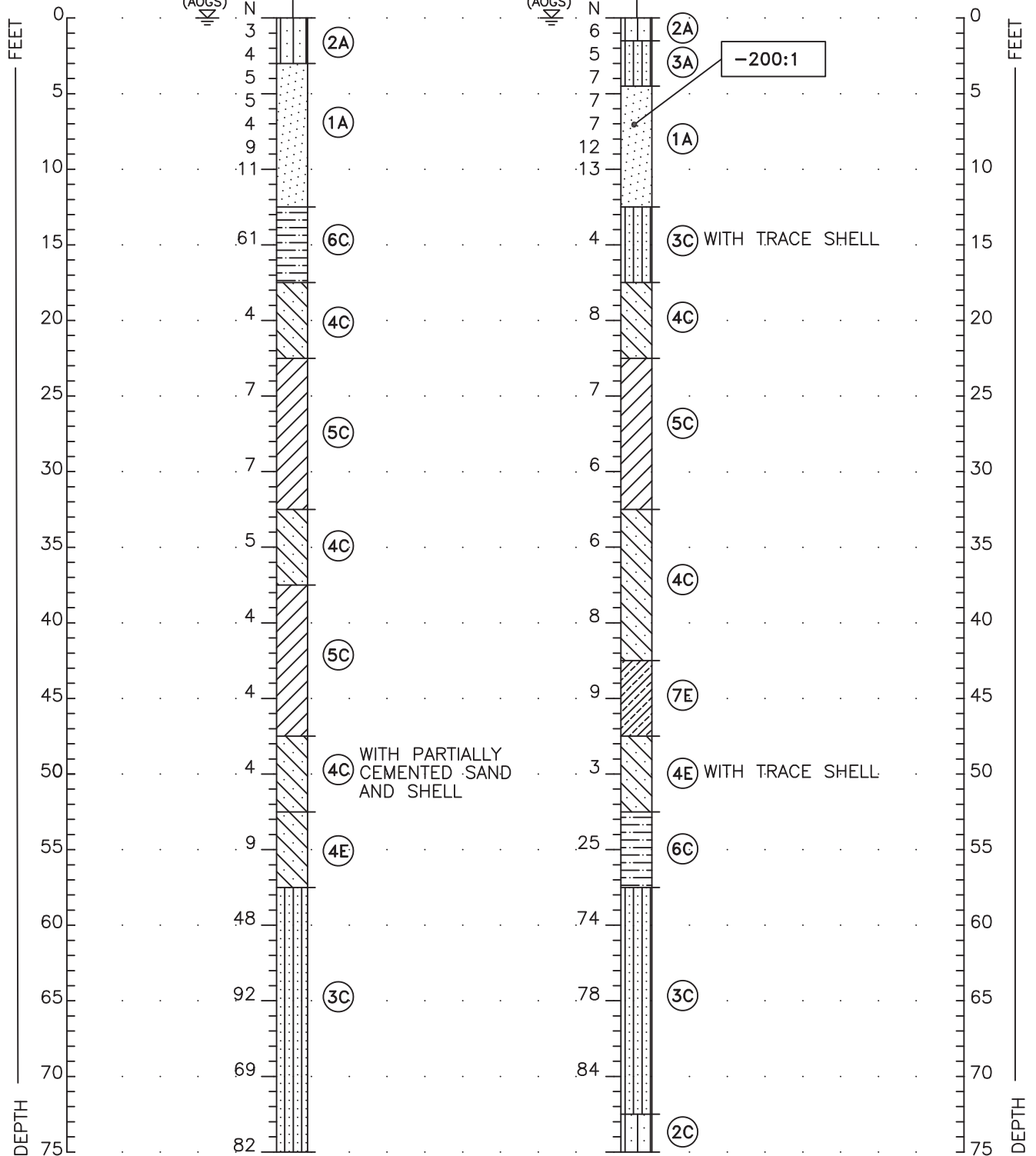
SUBSURFACE EXPLORATION
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TH-23-3
9/5/23

TH-23-4
9/21/23



SOIL BORING PROFILES



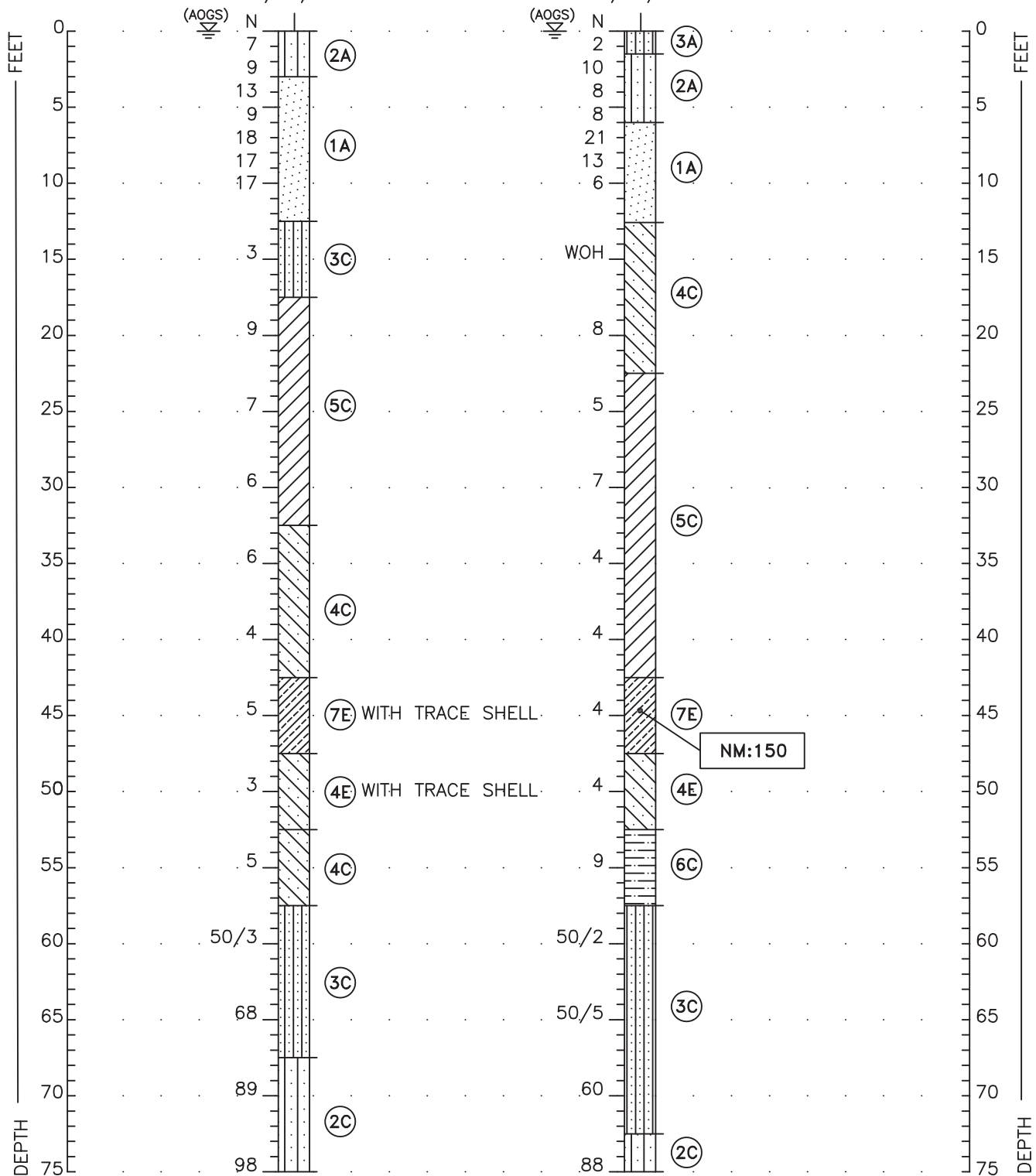
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TH-23-5
9/22/23

TH-23-6
9/26/23



SOIL BORING PROFILES

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SUBSURFACE EXPLORATION
LEE HENDRY CLASS III LANDFILL EXPANSION
HENDRY COUNTY, FLORIDA

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DATE DRILLED:

TH-23-7
9/7/23

TH-23-8
9/28/23

FEET
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DEPTH

(AOGS)

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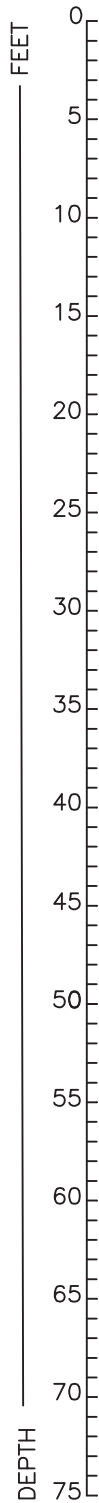
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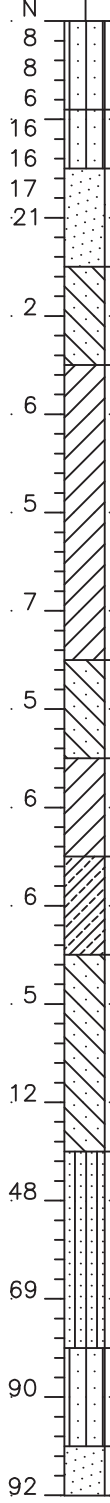
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TH-23-9
9/15/23

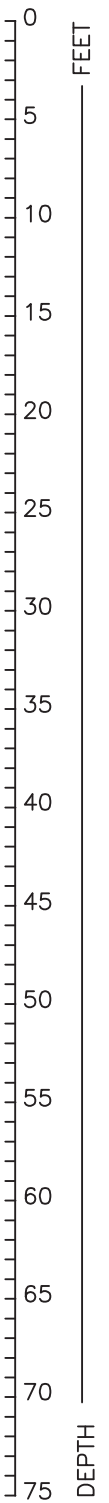
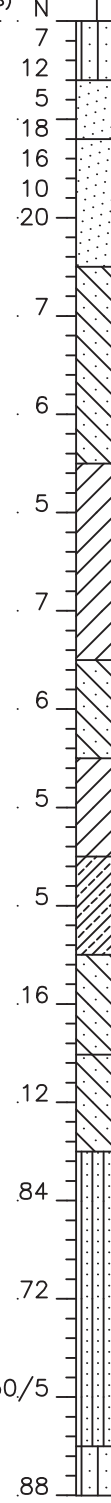
TH-23-10
9/14/23



(AOGS)



(AOGS)



SOIL BORING PROFILES

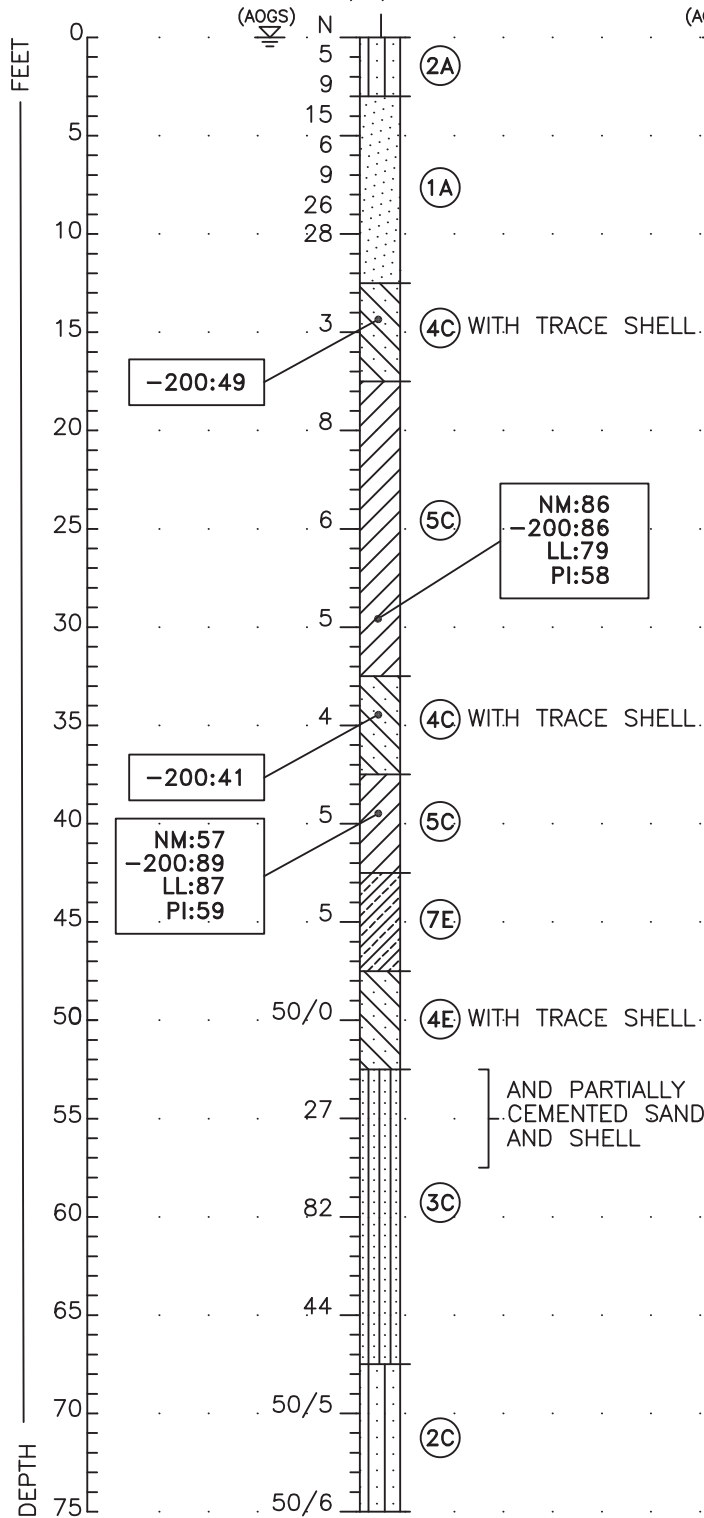


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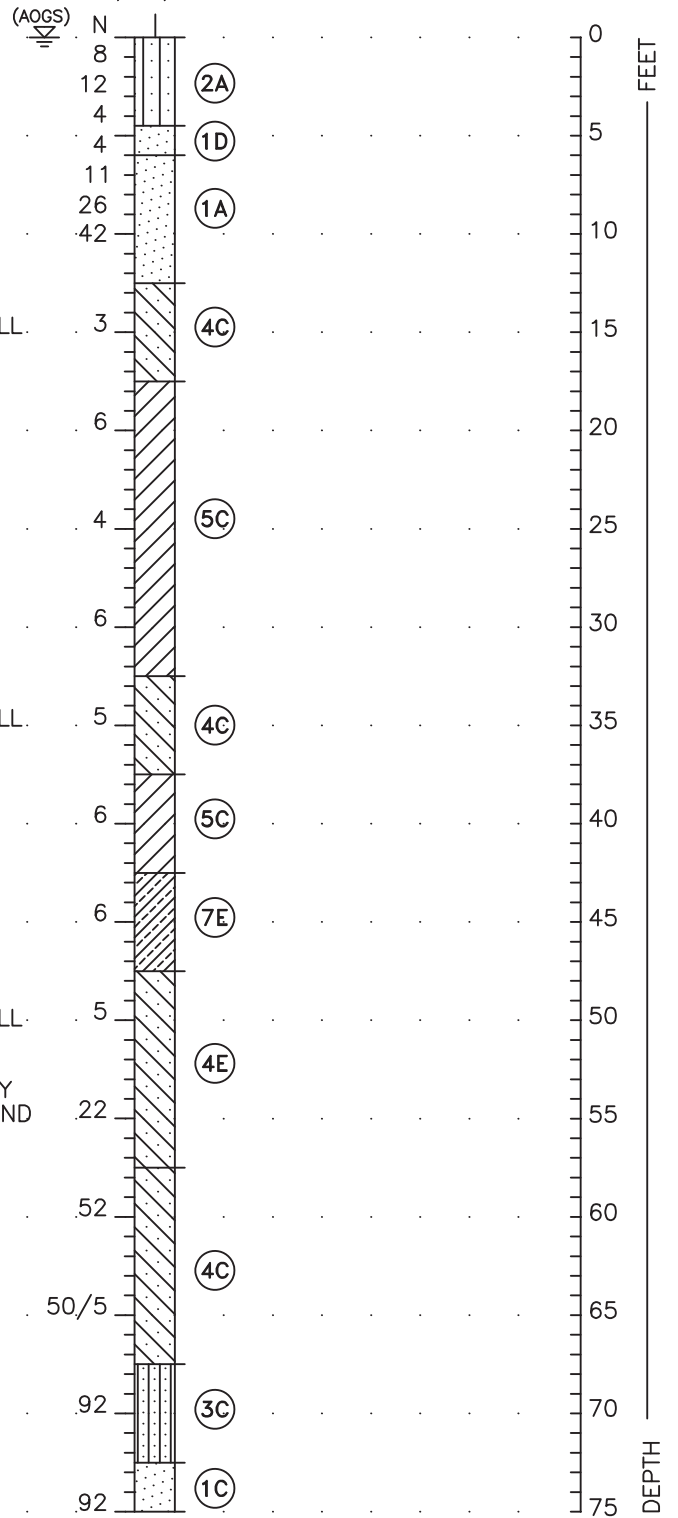
SUBSURFACE EXPLORATION
LEE HENDRY CLASS III LANDFILL EXPANSION
HENDRY COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 10/4/23
FILE NO. 23-5241	APPROVED BY:	FIGURE:

DATE DRILLED: TH-23-11
9/8/23



DATE DRILLED: TH-23-12
9/14/23



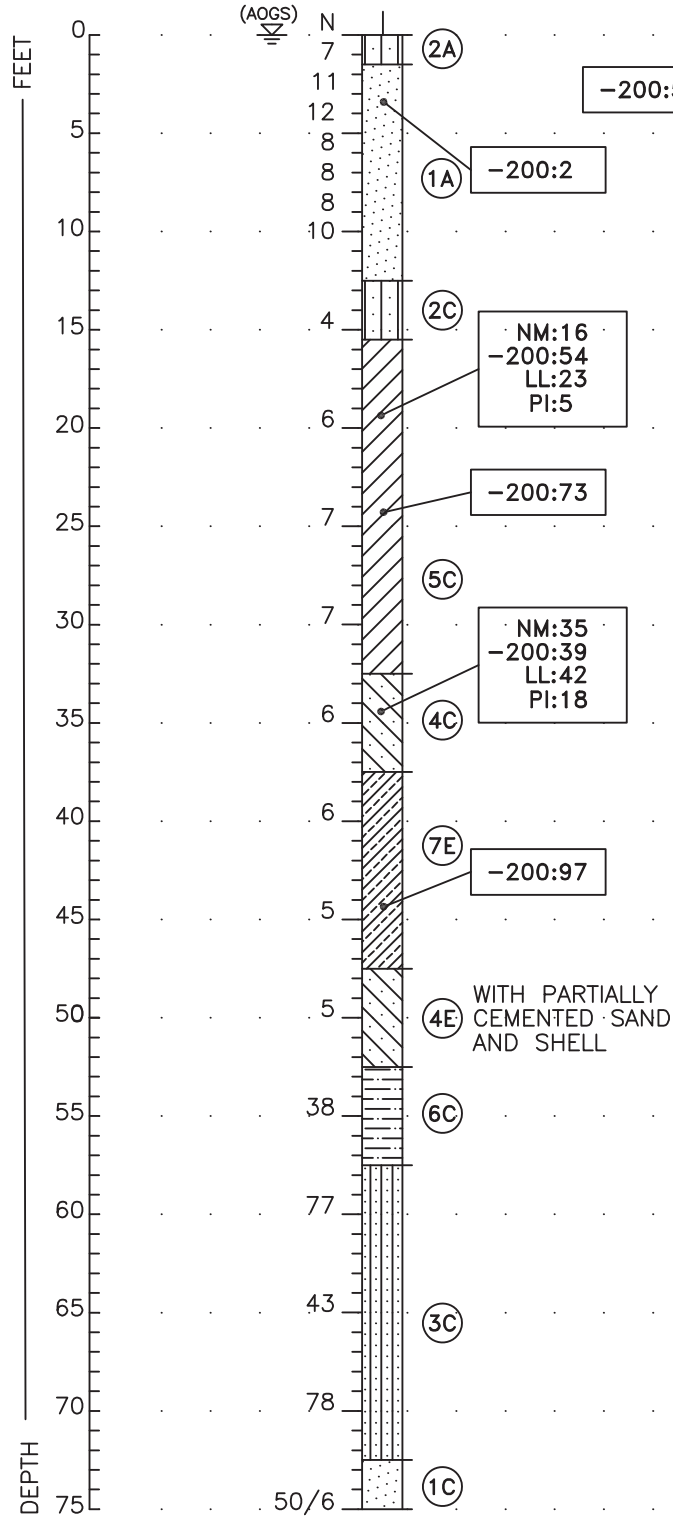
SOIL BORING PROFILES



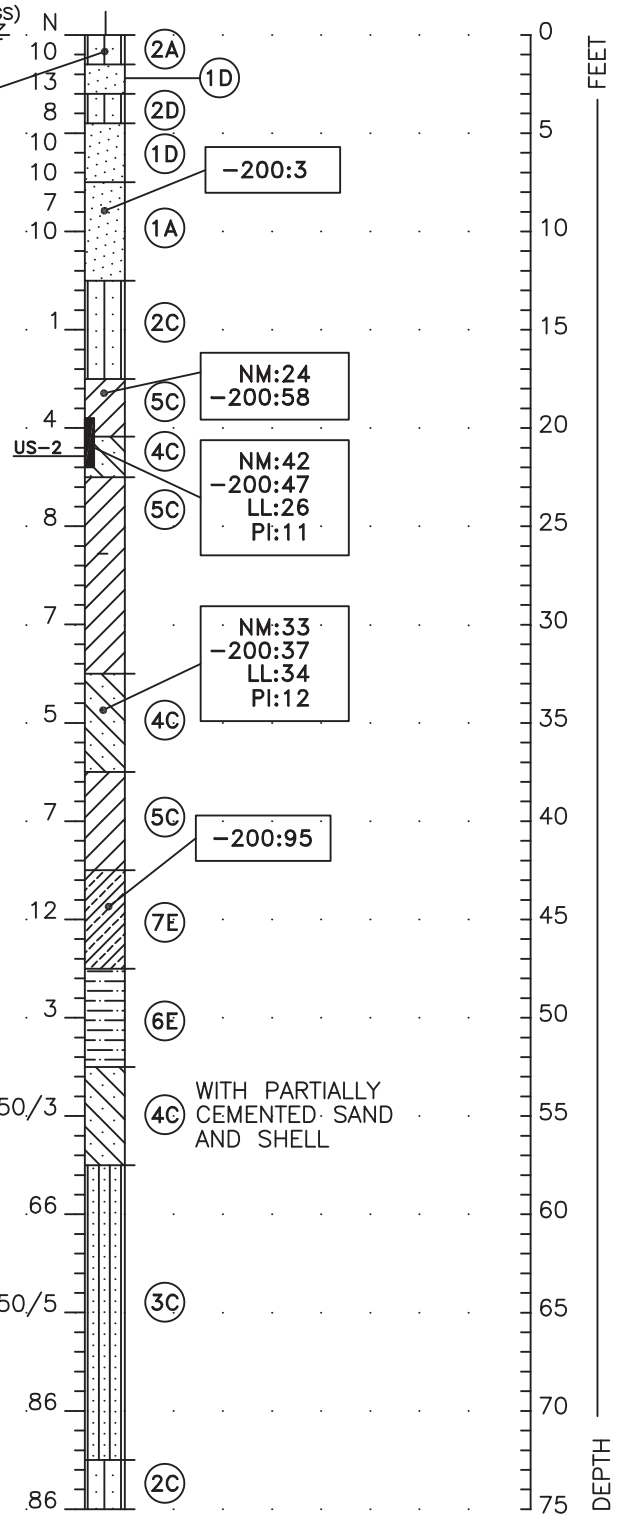
SUBSURFACE EXPLORATION
LEE HENDRY CLASS III LANDFILL EXPANSION
HENDRY COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 10/4/23
FILE NO. 23-5241	APPROVED BY:	FIGURE:

DATE DRILLED: TH-23-13
9/20/23



TH-23-14
9/15/23



SOIL BORING PROFILES

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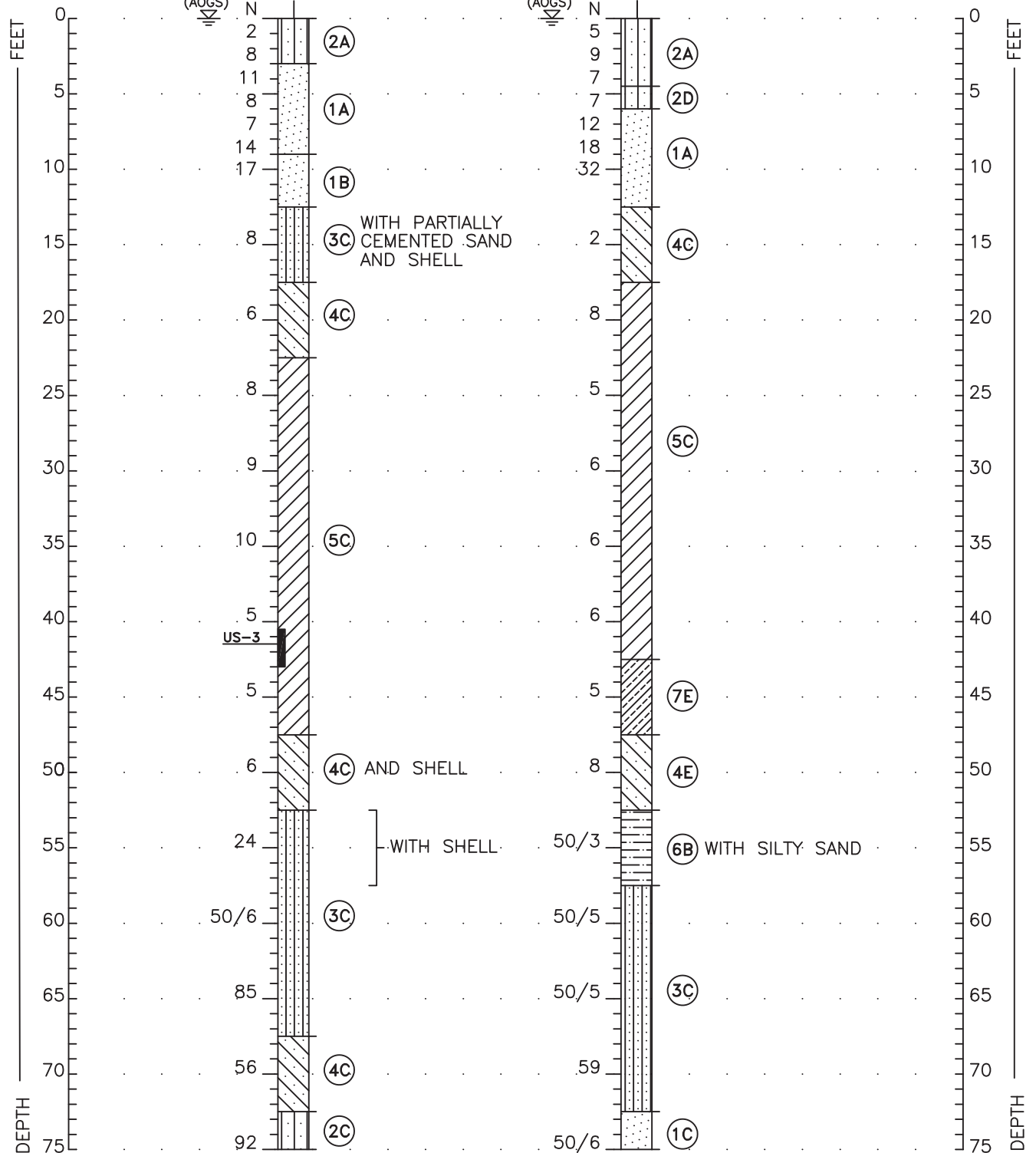
SUBSURFACE EXPLORATION
LEE HENDRY CLASS III LANDFILL EXPANSION
HENDRY COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 10/4/23
FILE NO. 23-5241	APPROVED BY:	FIGURE:

DATE DRILLED:

TH-23-15
9/11/23

TH-23-16
9/11/23



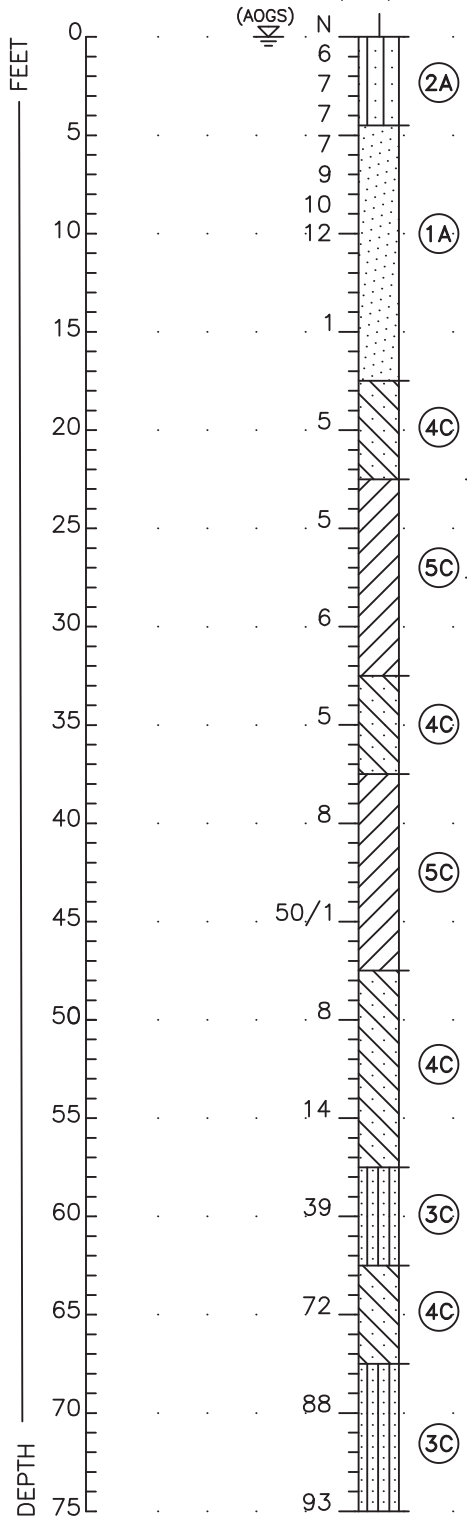
SOIL BORING PROFILES

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Geotechnical, Environmental and
Materials Consultants

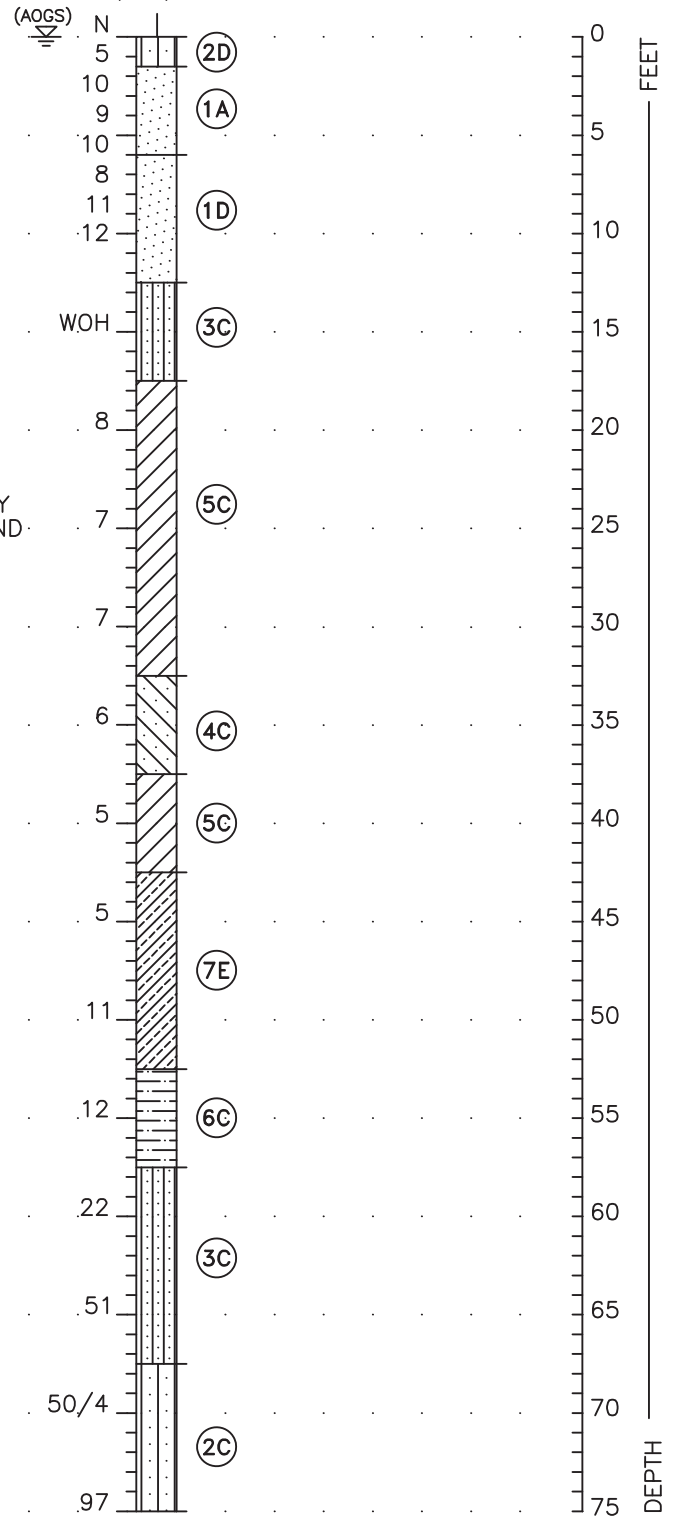
SUBSURFACE EXPLORATION
LEE HENDRY CLASS III LANDFILL EXPANSION
HENDRY COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 10/4/23
FILE NO. 23-5241	APPROVED BY:	FIGURE:

DATE DRILLED: TH-23-17
9/19/23



TH-23-18
9/19/23



SOIL BORING PROFILES

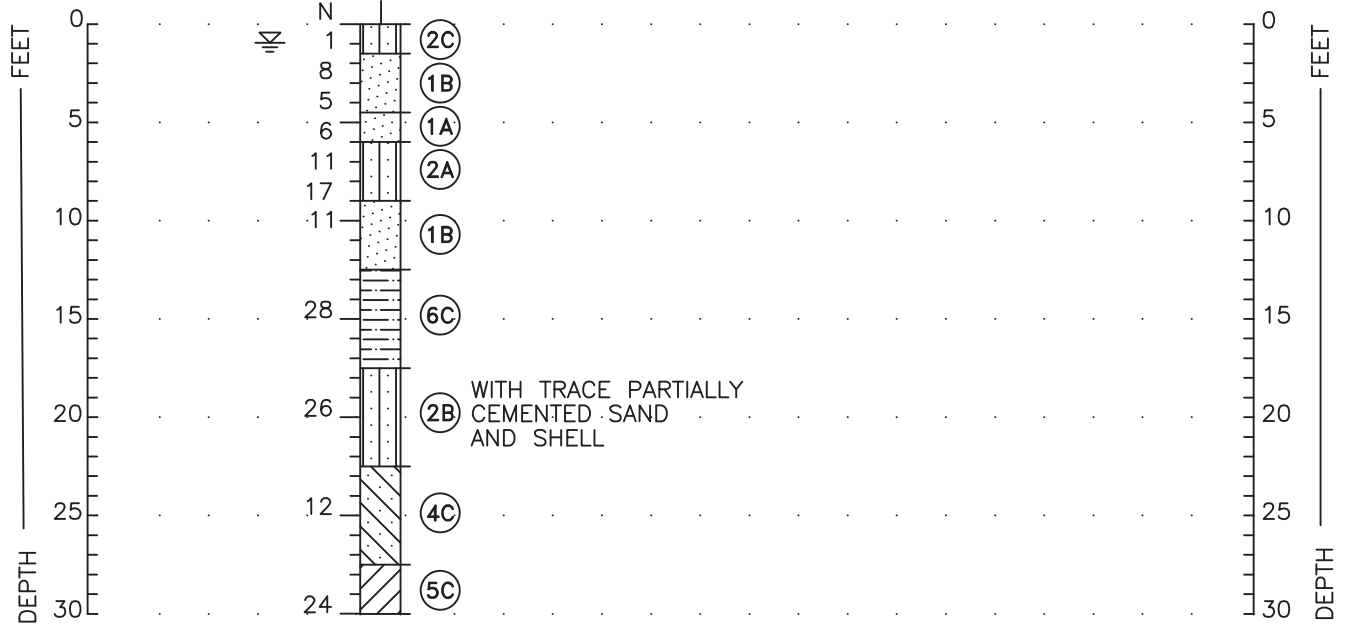
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SUBSURFACE EXPLORATION
LEE HENDRY CLASS III LANDFILL EXPANSION
HENDRY COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 10/4/23
FILE NO. 23-5241	APPROVED BY:	FIGURE:

DATE DRILLED:

TH-23-19
9/11/23



SOIL BORING PROFILES



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SUBSURFACE EXPLORATION
LEE HENDRY CLASS III LANDFILL EXPANSION
HENDRY COUNTY, FLORIDA

DRAWN BY: TAT	CHECKED BY:	DATE: 10/4/23
FILE NO. 23-5241	APPROVED BY:	FIGURE:

APPENDIX III

Consolidation and Triaxial Laboratory Test Results

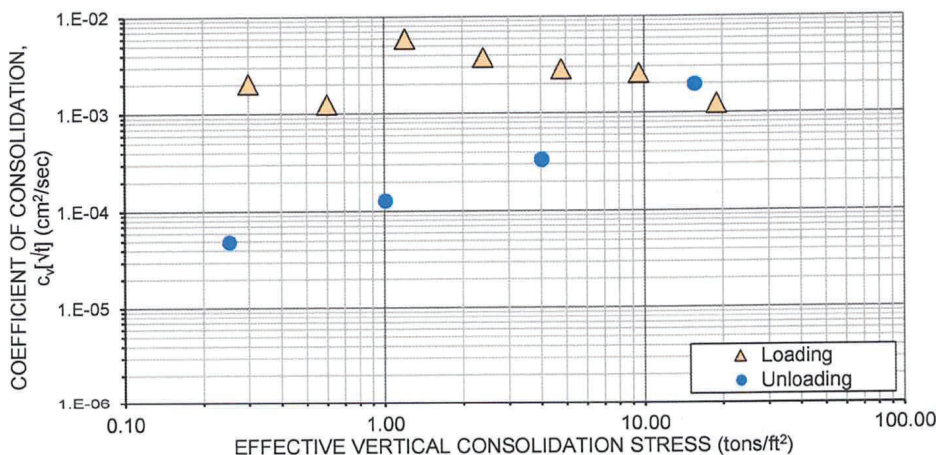
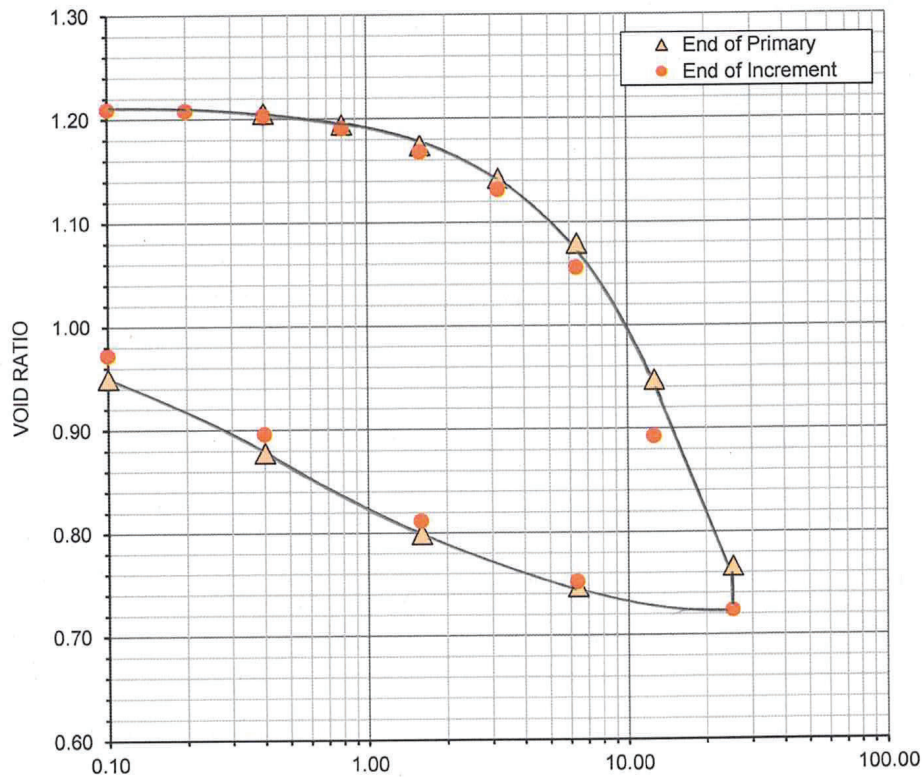
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY

ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: _____
 PROJECT: LEE / HENDRY COUNTY LANDFILL
 FILE NO.: 23-23-5241

RECEIVED: _____
 TEST STARTED: 10/25/23
 REPORTED: 12/27/23

INCOMING SAMPLE NO.: _____
 BORING: TH-23-7 SAMPLE: ---
 DEPTH: 35.0 - 38.0 feet
 LAB IDENTIFICATION NO.: 235214/TH23-7
 SAMPLE DESCRIPTION: GRAY SANDY FAT CLAY



TEST METHOD AND PROCEDURES

ASTM Standard D2435

Method A

Method B ☒

Trimming Method

Cutting Shoe ☒

Other

Initial Sample Diameter (cm): 7.30

TEST CONDITIONS

Tested at As-received Water Content

Tested After Inundating ☒

Stress Inundated (tsf) 0.05

Fluid Tap Water ☒

Other:

SPECIMEN CONDITIONS

Parameter	Initial	Final
Diameter (cm)	5.001	5.001
Height (cm)	1.905	1.702
Water Content (%)	41.1	36.3
Void Ratio	1.211	0.975
Dry Density (lb/ft³)	76.2	85.3
Total Density (lb/ft³)	107.5	116.3
Saturation (%)	92	100

Specific Gravity (ASTM D854) 2.70

Measured ☒

Assumed

Atterberg Limits (ASTM D4318)

Liquid Limit 73

Plastic Limit 14

Plasticity Index 59

Comments:

Particle-Size Distribution

Soil Fraction Passing U.S. Standard Sieve Size (% , dry mass basis)

Dry Mass (grams)		Soil Fraction Passing U.S. Standard Sieve Size (% , dry mass basis)									
45.70		Gravel		Coarse Sand		Medium Sand		Fine Sand			
		3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
Test Method: ASTM D1140		✓									
ASTM D6913											53.7

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TSI
 Date: 12/27/23

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: _____	INCOMING SAMPLE NO.: _____	SAMPLE: _____
PROJECT: LEE / HENDRY COUNTY LANDFILL	BORING: TH-23-7	
FILE NO.: 23-23-5241	DEPTH: 35.0 - 38.0 feet	
	LAB IDENTIFICATION NO.: 235214/TH23-7	
	SAMPLE DESCRIPTION: GRAY SANDY FAT CLAY	
RECEIVED: _____		
TEST STARTED: 10/25/23		
REPORTED: 12/27/23		

Effective Stress (tsf)	Dial Reading (inch)			Time (seconds)		Coefficient of Consolidation, c_v (cm ² /sec)		Increment Average Effective Stress (tsf)	Height (inch)		Void Ratio		Strain (%)		Secondary Compression	
	Initial	End of Primary	End of Increment	t_{90}	t_{50}	c_v [$\sqrt{t}$]	c_v [log t]		End of Primary	End of Increment	End of Primary	End of Increment	End of Primary	End of Increment	C_{α} (%)	$C_{\alpha e}$
0.00	0.0160	0.0160	0.0160	---	---	---	---	---	0.7500	0.7500	1.211	1.211	0.00	0.00	---	---
0.10	0.0160	0.0166	0.0166	---	---	---	---	0.050	0.7494	0.7494	1.209	1.209	0.08	0.08	---	---
0.20	0.0171	0.0175	0.0175	---	---	---	---	0.150	0.7490	0.7490	1.208	1.208	0.13	0.13	---	---
0.40	0.0181	0.0191	0.0197	375	---	2.0E-03	---	0.300	0.7481	0.7474	1.205	1.203	0.26	0.35	0.044	0.0010
0.80	0.0206	0.0237	0.0248	605	---	1.3E-03	---	0.600	0.7443	0.7432	1.194	1.191	0.76	0.91	0.070	0.0015
1.60	0.0260	0.0318	0.0339	126	---	5.9E-03	---	1.200	0.7374	0.7353	1.174	1.168	1.68	1.96	0.120	0.0027
3.20	0.0356	0.0443	0.0478	194	---	3.8E-03	---	2.400	0.7266	0.7231	1.142	1.132	3.12	3.59	0.200	0.0044
6.40	0.0497	0.0675	0.0755	245	---	2.8E-03	---	4.800	0.7053	0.6973	1.079	1.056	5.96	7.03	0.480	0.0106
12.70	0.0781	0.1150	0.1335	246	80	2.6E-03	1.8E-03	9.550	0.6604	0.6419	0.947	0.892	11.95	14.41	0.850	0.0188
25.30	0.1365	0.1794	0.1938	425	97	1.2E-03	1.3E-03	19.000	0.5990	0.5846	0.766	0.723	20.13	22.05	1.010	0.0223
6.40	0.1918	0.1839	0.1822	245	---	1.9E-03	---	15.850	0.5925	0.5942	0.747	0.752	21.00	20.77	---	---
1.60	0.1802	0.1642	0.1600	1,500	345	3.3E-04	4.2E-04	4.000	0.6102	0.6144	0.799	0.811	18.64	18.08	---	---
0.40	0.1586	0.1360	0.1300	4,206	1,300	1.3E-04	9.6E-05	1.000	0.6370	0.6430	0.878	0.896	15.07	14.27	---	---
0.10	0.1295	0.1112	0.1037	12,000	3,660	4.8E-05	3.7E-05	0.250	0.6613	0.6688	0.950	0.972	11.83	10.83	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TSI 
Date: 12/27/23

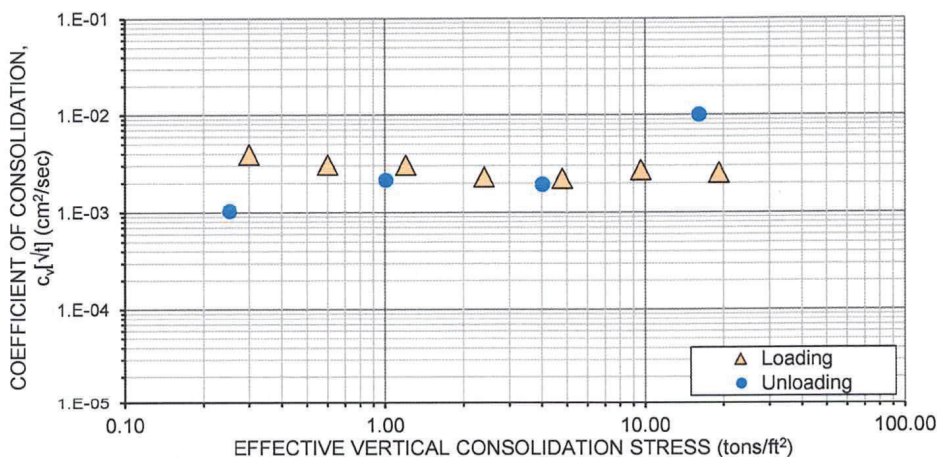
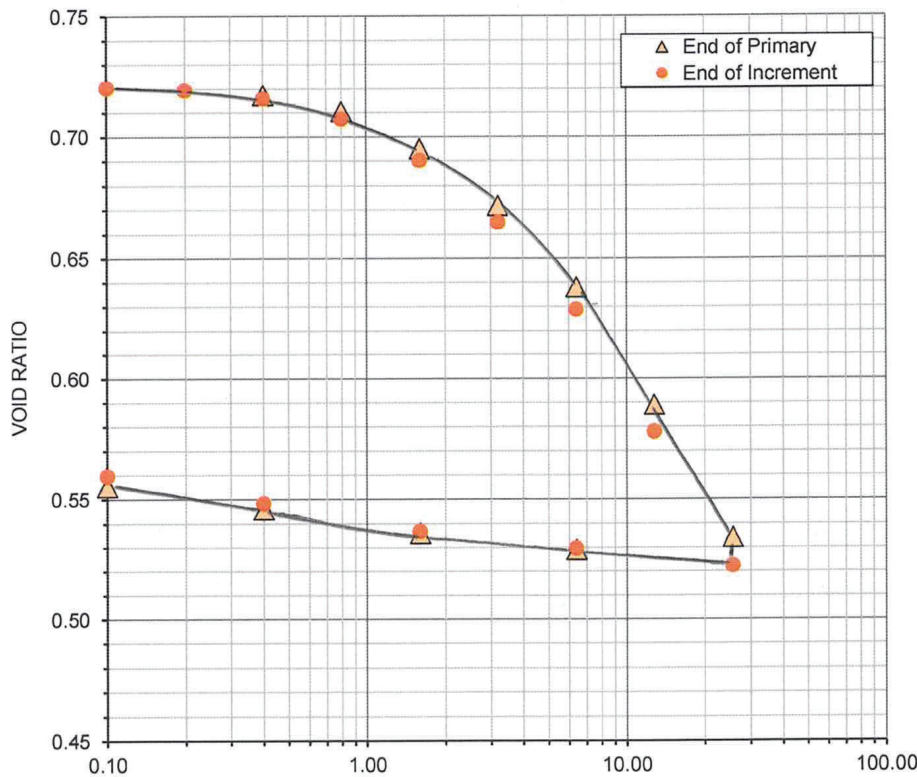
ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY

ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: _____
 PROJECT: LEE / HENDRY COUNTY LANDFILL
 FILE NO.: 23-23-5241

RECEIVED: _____
 TEST STARTED: 10/25/23
 REPORTED: 12/27/23

INCOMING SAMPLE NO.: _____
 BORING: TH-23-14 SAMPLE: _____
 DEPTH: 19.0 - 22.0 feet
 LAB IDENTIFICATION NO.: 235214/TH23-14
 SAMPLE DESCRIPTION: GRAY CLAYEY SAND



TEST METHOD AND PROCEDURES

ASTM Standard D2435
 Method A _____
 Method B ✓
 Trimming Method _____
 Cutting Shoe ✓
 Other _____
 Initial Sample Diameter (cm): 7.30

TEST CONDITIONS

Tested at As-received Water Content _____
 Tested After Inundating ✓
 Stress Inundated (tsf) 0.05
 Fluid Tap Water ✓
 Other: _____

SPECIMEN CONDITIONS

Parameter	Initial	Final
Diameter (cm)	5.001	5.001
Height (cm)	1.905	1.732
Water Content (%)	25.0	20.9
Void Ratio	0.726	0.570
Dry Density (lb/ft³)	98.7	108.6
Total Density (lb/ft³)	123.4	131.2
Saturation (%)	94	100

Specific Gravity (ASTM D854) 2.73
 Measured ✓
 Assumed _____
 Atterberg Limits (ASTM D4318)
 Liquid Limit 26
 Plastic Limit 15
 Plasticity Index 11

Comments: _____

Particle-Size Distribution			Soil Fraction Passing U.S. Standard Sieve Size (% dry mass basis)									
Dry Mass (grams)	59.18		Gravel		Coarse Sand		Medium Sand		Fine Sand			
Test Method:	ASTM D1140	✓	3/4"	3/8"	No. 4	No. 10	No. 20	No. 40	No. 60	No. 100	No. 140	No. 200
	ASTM D6913		----	----	----	----	----	----	----	----	----	47.4

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TSI
 Date: 12/27/23

ARDAMAN & ASSOCIATES, INC. GEOTECHNICAL TESTING LABORATORY
ONE-DIMENSIONAL INCREMENTAL LOADING CONSOLIDATION TEST REPORT

CLIENT: _____ PROJECT: LEE / HENDRY COUNTY LANDFILL FILE NO.: 23-23-5241	INCOMING SAMPLE NO.: _____ BORING: TH-23-14 DEPTH: 19.0 - 22.0 feet LAB IDENTIFICATION NO.: 235214/TH23-14 SAMPLE DESCRIPTION: GRAY CLAYEY SAND	SAMPLE: _____ RECEIVED: _____ TEST STARTED: 10/25/23 REPORTED: 12/27/23

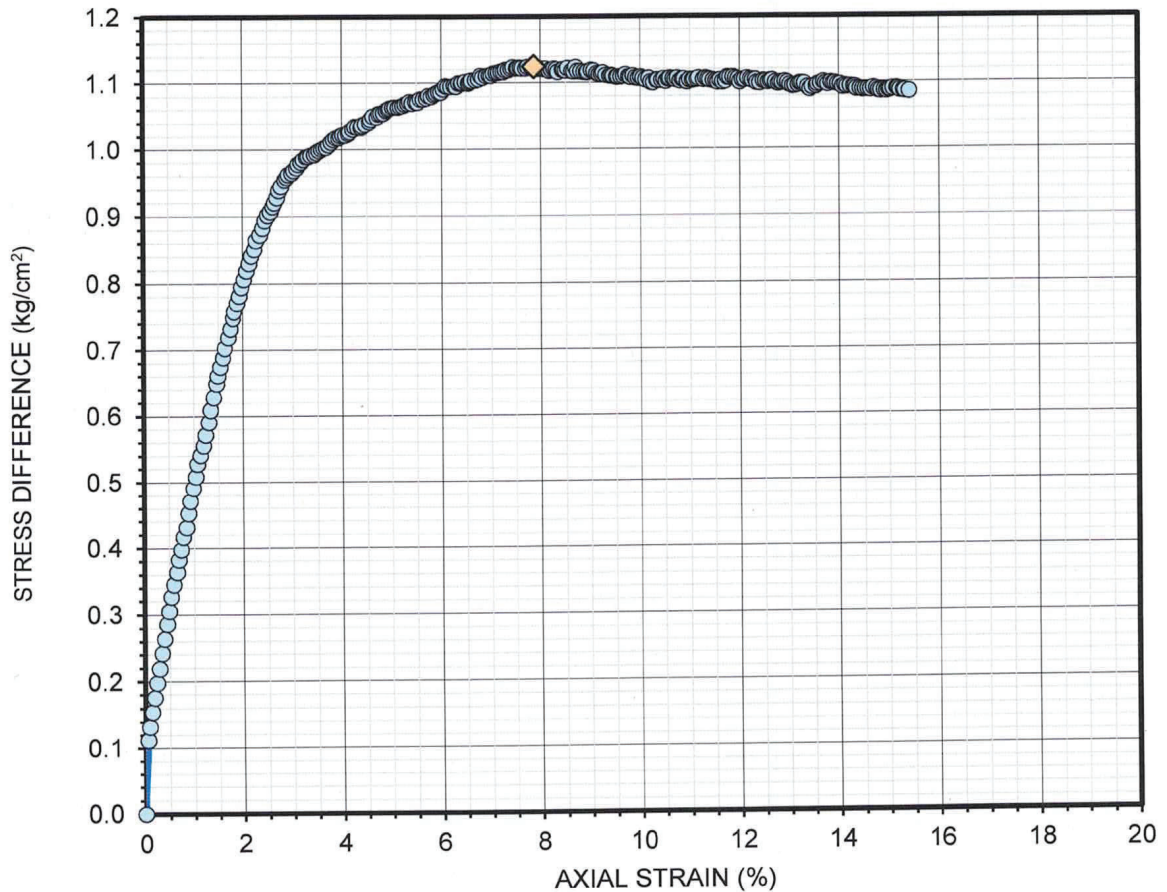
Effective Stress (tsf)	Dial Reading (inch)			Time (seconds)		Coefficient of Consolidation, c_v (cm ² /sec)		Increment Average Effective Stress (tsf)	Height (inch)		Void Ratio		Strain (%)		Secondary Compression	
	Initial	End of Primary	End of Increment	t_{90}	t_{50}	c_v [$\sqrt{t}$]	c_v [log t]		End of Primary	End of Increment	End of Primary	End of Increment	End of Primary	End of Increment	C_{α} (%)	$C_{\alpha e}$
0.00	0.0111	0.0111	0.0111	---	---	---	---	---	0.7500	0.7500	0.726	0.726	0.00	0.00	---	---
0.05	0.0111	0.0121	0.0121	---	---	---	---	0.025	0.7490	0.7490	0.724	0.724	0.13	0.13	---	---
0.10	0.0124	0.0140	0.0140	---	---	---	---	0.075	0.7474	0.7474	0.720	0.720	0.35	0.35	---	---
0.20	0.0145	0.0150	0.0150	---	---	---	---	0.150	0.7469	0.7469	0.719	0.719	0.41	0.41	---	---
0.40	0.0156	0.0164	0.0171	194	---	---	3.9E-03	0.300	0.7461	0.7454	0.717	0.716	0.52	0.61	0.043	0.0007
0.80	0.0180	0.0203	0.0217	245	---	---	3.1E-03	0.600	0.7431	0.7417	0.710	0.707	0.92	1.11	0.093	0.0016
1.60	0.0229	0.0282	0.0303	245	---	---	3.0E-03	1.200	0.7364	0.7343	0.695	0.690	1.81	2.09	0.125	0.0022
3.20	0.0319	0.0399	0.0429	317	---	---	2.3E-03	2.400	0.7263	0.7233	0.672	0.665	3.16	3.56	0.190	0.0033
6.40	0.0448	0.0565	0.0605	317	---	---	2.2E-03	4.800	0.7116	0.7076	0.638	0.629	5.12	5.65	0.210	0.0036
12.80	0.0632	0.0804	0.0853	245	---	---	2.7E-03	9.600	0.6904	0.6855	0.589	0.578	7.95	8.60	0.270	0.0047
25.60	0.0883	0.1072	0.1124	246	---	---	2.5E-03	19.200	0.6666	0.6614	0.534	0.522	11.12	11.81	0.270	0.0047
6.40	0.1104	0.1075	0.1072	60	---	---	1.0E-02	16.000	0.6643	0.6646	0.529	0.530	11.42	11.39	---	---
1.60	0.1052	0.1025	0.1021	317	---	---	1.9E-03	4.000	0.6673	0.6677	0.536	0.537	11.03	10.97	---	---
0.40	0.1007	0.0967	0.0957	290	---	---	2.1E-03	1.000	0.6717	0.6727	0.546	0.548	10.44	10.31	---	---
0.10	0.0946	0.0916	0.0897	606	---	---	1.0E-03	0.250	0.6757	0.6776	0.555	0.560	9.91	9.65	---	---

The test data and all associated project information presented hereon shall be held in confidence and disclosed to other parties only with the authorization of the Client. Physical and electronic records are kept for a minimum of 7 years. Test samples are kept in storage for at least 10 working days after mailing of the test report, prior to being discarded, unless a longer storage period is requested in writing and accepted by Ardaman & Associates, Inc.

Checked By: TSI 
 Date: 12/27/23

Unconsolidated Undrained Triaxial Compression Test

Test Method:	ASTM Standard D2850
Project Name:	LEE-HENDRY COUNTY LF
Project Number:	23-23-5241
Sample Name:	TH-23-7
Depth (feet):	35.0 - 38.0
Confining Stress:	1.856 kg/cm ²
Strain Rate:	1.00 %/minute



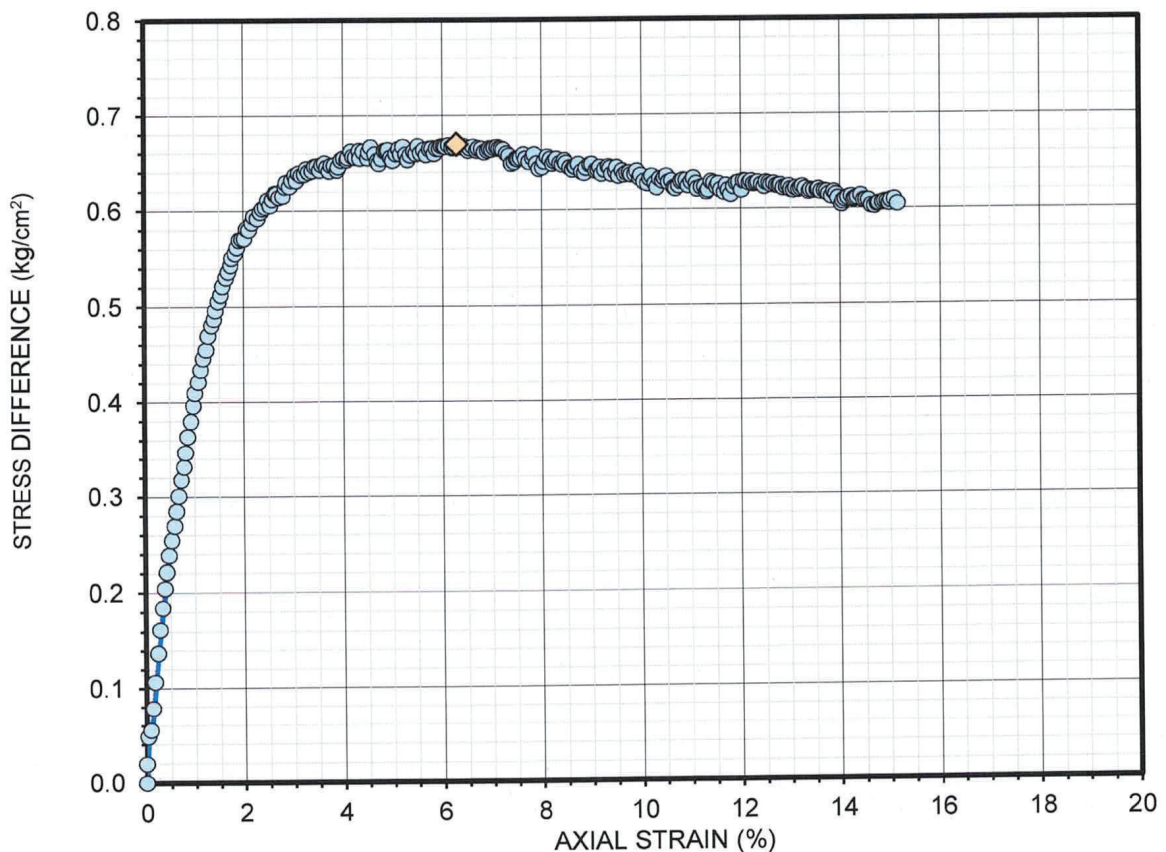
Description:	Light brown clayey sand	
Fines Content, -200 (%):	49.2	
Specific Gravity, G _s :	2.70	
Total Unit Weight (pcf):	110.4	
Dry Density (pcf):	78.9	
Water Content (%):	39.9	
Saturation (%):	95	
($\sigma_1 - \sigma_3$) _{max} (kg/cm ²):	1.125	
Undrained Shear Strength (kg/cm ²):	0.562	
Strain at Failure (%):	7.9	Failure Sketch Diagonal ☐ Bulging ☐ Combination ☒ Other ☐
Checked By:	TSI	
Date:	12/07/23	

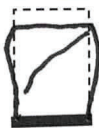


Ardaman & Associates, Inc.
Geotechnical, Environmental and
Materials Consultants

Unconsolidated Undrained Triaxial Compression Test

Test Method:	ASTM Standard D2850	
Project Name:	LEE-HENDRY COUNTY LF	
Project Number:	23-23-5241	
Sample Name:	TH-23-14	
Depth (feet):	19.0 - 22.0	
Confining Stress:	1.025	kg/cm ²
Strain Rate:	1.00	%/minute



Description: Light brown sandy clay		 Failure Sketch Diagonal ☐ Bulging ☐ Combination ☒ Other ☐	
Fines Content, -200 (%):	57.5		
Specific Gravity, G _s :	2.73		
Total Unit Weight (pcf):	123.3		
Dry Density (pcf):	99.9		
Water Content (%):	23.5		
Saturation (%):	91		
($\sigma_1 - \sigma_3$) _{max} (kg/cm ²):	0.669		
Undrained Shear Strength (kg/cm ²):	0.335		
Strain at Failure (%):	6.3		
Checked By:	TSI		
Date:	12/07/23		