

reliable, operating, and coordinated Work (system/equipment/facilities) that is in compliance 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 on 22-x-34-inch paper 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 Building or Facility.
    - (4) Name of Contractor or subcontractor.
    - (5) Drawing contents and locations.
    - (6) Specification Section and Subsection Numbers.
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 on either 8.5 x 11 inches or folded 11 x 17 inches size paper of 20 lb. (9.072 kg) weight. 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.

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 above.
4. Color, Texture, and Pattern Charts
  - a. The Contractor shall submit color, texture, or pattern charts of all required finishes.
  - b. A minimum of four charts of each item shall be submitted.
5. 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 Facility.
    - (4) Date Submitted.
  - b. Drawings—The Contractor shall mark submittal information on all Drawings in the left half of the 4-x-3-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. At least one original manufacturer product data sheet must be submitted; the balance can be copied. 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 is to be marked on the cover and title page.

6. 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. Operations and Maintenance Manuals shall conform to requirements defined in Sections 01830, Operations and Maintenance Manual and Training.

G. Required Submittals

1. Architectural and Structural Submittals

- a. This Section specifies general procedural requirements for contractual submittals for the following architectural and structural schedules, product data, samples, and manufacturer's certificates.
  - (1) Product Data—The Contractor shall provide product data for all architectural and 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) Power and Riser Diagrams—Single line riser, power diagrams, and all conduit runs shall be provided for all equipment and facilities.
  - (3) Wiring Diagrams—Elementary controls diagrams and separate wiring diagrams for mechanical and electrical unit/subsystem. Drawing for starting and shutdown of equipment including controls shall be provided, including a comprehensive description of operation.
  - (4) 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.
  - (5) 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.
  - (6) 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.
  - (7) 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.

(8) Site Test and Acceptance Report—Site test and acceptance reports shall be submitted to the Owner and Engineer.

(9) 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 instructions.

c. Compliance with this Section does not relieve the Contractor from compliance with the requirements of Section 01830, Operations and Maintenance Manuals and Training.

#### 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 and approve Submittals within 10 business days from Engineer's receipt of the completed submittal package.
3. 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 shall be equal to the Engineer's full cost.
4. No partial submittals will be reviewed. A submittal or re-submittal not complete will be returned to the Contractor for completing and re-submittal.

5. 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 be in compliance 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.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

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

1.08 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.

1.09 QUALIFICATIONS (NOT USED)

## 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 Engineer for review 60 days before Final Completion. The Contractor shall be provided with CADD files, AutoCAD Version 2012 or newer. Final Record Drawings shall be printed on 22-inch x 34-inch sheets and on CDs, AutoCAD Version 2012.

### 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 hay bales, 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. The Contractor shall prepare a sedimentation and erosion-control drawing meeting the requirements of the law and furnish two copies of the approved Drawing to the Engineer.



## 1.02 RELATED WORK

- A. Section 01100, Summary of Work.
- B. Section 02230, Site Preparation.
- C. Section 02370, Erosion and Sedimentation Control.

## 1.03 SUBMITTALS (NOT USED)

## 1.04 WORK SEQUENCE

- A. Before beginning the Work, the Contractor shall meet with the Engineer 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.

## 1.05 REFERENCE STANDARDS

- A. Reference standards and recommended practices referred to in this Specification 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.

## 1.06 QUALITY ASSURANCE (NOT USED)

## 1.07 WARRANTIES

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

## 1.08 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.

## 1.09 QUALIFICATIONS (NOT USED)

## 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 siltation basins, hay check dams, mulching, jute netting, and other equivalent techniques shall be used as appropriate. Surface water shall be prevented from flowing into excavated areas. Ditches shall be used around the construction area to carry away water resulting from dewatering excavated areas. At the completion of the Work, ditches shall be backfilled 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. The Contractor shall not discharge water from dewatering operations directly into any live or intermittent stream, channel, wetlands, surface water, or any storm sewer. Water from dewatering operations shall be treated by filtration, settling basins, or other approved method to reduce the amount of sediment contained in the water to allowable levels.
- C. 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 the Florida Department of Environmental Protection and the US EPA. The Contractor shall submit two copies of approved contingency plans to the Engineer.
- D. Water being flushed from structures or pipelines after disinfection with  $\text{Cl}_2$  shall be treated with a dechlorination solution approved by the Engineer before discharge.

### 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. Outside of areas requiring earthwork for the construction of the new facilities, 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. 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 Engineer 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 Engineer's approval.
- E. If the Contractor proposes to construct temporary roads or embankments and excavations for plant and/or work areas, the Contractor shall submit the following 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. Landscaping drawings showing the proposed restoration of the area. The proposed removal of any trees and shrubs outside the limits of the existing



clearing area must be indicated. Locations of guard posts or barriers required to control vehicular traffic and protect trees and shrubs to be maintained undamaged must also be indicated. The drawings shall provide for the obliteration of construction scars as such and shall provide for a natural appearing final condition of the area. Modification of the Contractor's approved drawings shall be made only with the written approval of the Engineer. No unauthorized road construction, excavation, or embankment construction including disposal areas will be permitted.

- 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. It is anticipated that excavation, filling, and plowing of roadways will 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 Engineer or 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, plant sites, 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 may be permitted with approval from the Engineer.
- 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.

END OF SECTION

SECTION 01450  
TESTING AND TESTING LABORATORY SERVICES

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Owner will pay for the costs of all passing Construction Quality Assurance (CQA) laboratory tests required for geosynthetics. Failed tests will be back-charged to the Contractor at the time of final payment.
  - 1. The Contractor shall cooperate with the laboratory to facilitate the execution of required services.
  - 2. The Owner 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.
- B. All required soil, concrete, and other testing will be the responsibility of the Contractor.
- C. Manufacturer's Quality Control (MQC) and Construction Quality Control (CQC) testing required by the geosynthetic specifications is the responsibility of the Contractor.

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: Certification of products.
- C. Each Section listed: Laboratory tests required and standards for testing.
- D. Testing Laboratory inspection, sampling, and testing are required for but are not limited to the following:
  - 1. Section 02230, Site Preparation.
  - 2. Section 02300, Earthwork.
  - 3. Section 03300, Cast-In-Place Concrete.
  - 4. Section 15055, Piping Systems—General.

### 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 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 WORK SEQUENCE (NOT USED)

### 1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification 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 E329—Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.

2. 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.

#### 1.06 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 representational samples of materials proposed to be used and which require testing.
  3. Providing to the laboratory the preliminary design mix proposed to be used for concrete and other materials mixes which 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 for the laboratory 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 directly to the testing firm and these will not be reimbursable to the equipment supplier or Contractor (as applicable).

#### 1.07 WARRANTIES

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

#### 1.08 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.

#### 1.09 QUALIFICATIONS

- A. Comply with requirements of ASTM E329 and ASTM D3740.
- B. Laboratory: Licensed to operate in Florida.
- C. Laboratory Staff: Maintain a full-time Professional Engineer registered in Florida on staff to review the services performed under this project.
- D. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either Nation Bureau of Standards (NBS) or accepted values of natural physical constants.
- E. Provide qualified personnel at the site. Cooperate with the Engineer and Contractor in performing services.

- F. Perform specified inspection, sampling, and testing of products in accordance with specified standards.
- G. Ascertain compliance of materials and mixes with requirements of Contract Documents.
- H. Promptly notify the Engineer and Contractor of observed irregularities or non-conformance of Work or Products.
- I. 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 SCOPE OF WORK (NOT USED)

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS (NOT USED)

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

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

1.08 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.

1.09 QUALIFICATIONS (NOT USED)

1.10 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.

1.11 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.

#### 1.12 COSTS

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

#### 1.13 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.

#### 1.14 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.

#### 1.15 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.

#### 1.16 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.

#### 1.17 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.

#### 1.18 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 not 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 which 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.

#### 1.19 NOISE CONTROL

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

#### 1.20 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.

#### 1.21 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. Prior approval shall be obtained from the proper authorities for the use of public or private lands or facilities for such disposal.

#### 1.22 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.

### 1.23 ADVERSE IMPACT

- A. The Contractor shall evaluate and assess the impact of any adverse effects on the natural environment which 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.

### 1.24 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 so as to avoid or otherwise prevent pollution of siltation of streams, lakes, and reservoirs and to avoid interference with the movements of migratory fish.

### 1.25 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.

### 1.26 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.

### 1.27 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 which 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 which will come in contact with water shall be stored off the ground to prevent contamination.

#### 1.28 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.

#### 1.29 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.

#### 1.30 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.

#### 1.31 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.

#### 1.32 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.

### 1.33 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.

### 1.34 SIGNAGE

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

### 1.35 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

1.01 SCOPE OF WORK

- A. Promptly after starting work, the Contractor shall provide a field office for his use and the use of the Engineer or Engineer's representative. The Contractor shall maintain the office until the completion of the Project to be done under this Contract.
- B. The Contractor shall furnish, install, and maintain storage and work sheds as needed or required for the construction. If the construction site changes, field offices, storage, and work sheds shall be moved to a convenient location at the new site.
- C. The Contractor shall be responsible for obtaining all permits required to install and maintain the field offices.

1.02 RELATED WORK (NOT USED)

1.03 SUBMITTALS (NOT USED)

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

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

1.08 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.

1.09 QUALIFICATIONS (NOT USED)

## 1.10 SPECIFIC REQUIREMENTS

- A. At a minimum, the Contractor shall provide the following in the construction field office for the Engineer's use:
1. Electric lights (50 foot-candles at desk top height) and power supply outlets (minimum of four).
  2. Two private telephone lines with a facsimile/answering machine. The basic monthly telephone charges and installation fee shall be the Contractor's expense. The Contractor shall submit monthly telephone toll charges to the Engineer for payment.
  3. Acceptable toilet facilities.
  4. Two fire extinguishers (Halon type, minimum 4-lb capacity).
  5. First-aid kit.
  6. Water cooler, bottled water, and paper cups for the duration of the Contract Period.
  7. Table for viewing Project Drawings.
  8. Suitable file cabinet(s) containing a copy of the complete Project records.
  9. Standard Office Supplies.
  10. Air Conditioning and Heating System.
  11. Min max thermometer.
  12. Rain gauge.
- B. The Contractor shall provide the Engineer's office and utilities. The office shall be no smaller than 7 feet 6 inches by 9 feet. The Engineer's office may be a separate room in conjunction with the Contractor's office. The Contractor shall provide one standard 2-foot-6-inch-by-5-foot desk with side drawers, one office chair, one cordless telephone for the Engineer's use, and one four-drawer locking metal file cabinet.

## PART 2 PRODUCTS (NOT USED)

## PART 3 EXECUTION

### 3.01 GENERAL

- A. The field office shall be installed on a clean, graded, well-drained area of suitable size. The installation of the field office shall meet all local building codes and ordinances. Where no such codes and ordinances apply, the Contractor shall, at a minimum, install the structure on a level foundation and secure it against 100-mph winds. The office shall be provided with structurally sound and safe steps and landings for each door. The office shall be designated a "No Smoking Area."

### 3.02 REMOVAL AT COMPLETION OF CONTRACT

- A. On the completion of the contract, the Contractor shall remove the office, storage sheds, and all such temporary facilities from the site. The Contractor shall also remove foundations and debris, grade the site to required elevations, grass disturbed areas, and clean and remove trash and debris.

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 or equipment are specifically shown or specified to be reused in the Work, special care shall be used in removing, handling, storing, and reinstalling to ensure their proper function in the completed Work.
- 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 RELATED WORK

- A. General Conditions.
- B. Supplementary Conditions.
- C. Section 01000, Project Requirements.
- D. Section 01740, Final Cleaning.
- E. Section 01780, Warranties and Bonds.
- F. Section 01830, Operations and Maintenance Manuals and Training.
- G. Section 15055, Piping Systems—General.

1.03 SUBMITTALS (NOT USED)

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

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

1.08 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.

1.09 QUALIFICATIONS (NOT USED)

1.10 ACCEPTANCE OF MATERIAL AND EQUIPMENT

- A. Only new materials and equipment shall be incorporated in the Work. 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 or Owner 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 and Owner.
- 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.
- G. The Contractor shall submit copies of welding procedures for all welding. Welders and welding operators shall be selected in accordance with the qualification requirements of the AWS Code. Welders and welding operators for stainless steel shall pass qualification tests using stainless steel filler metal and procedures developed for stainless steel. Procedures, welder, and operator qualifications shall be certified by an independent testing laboratory retained and paid by the Contractor.
- H. The Contractor shall not start fabrication of the Work until the Contractor receives written acceptance of the proof of welding procedures from the Engineer for each type of weld.

- I. The Contractor shall submit copies of mill certificate for each type of rolled steel and as required in the Specifications. The Contractor shall not start fabrication of the work until the Contractor receives written acceptance of all mill certificates from the Engineer.

#### 1.11 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.

#### 1.12 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 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.



- C. The Contractor shall furnish the service of competent manufacturers' representatives for Contractor- or Owner-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 and electric drives. 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, motors, and other items of equipment customarily grouted, the Contractor shall make an allowance of at least 1 inch (2.54 cm) 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 so as to be 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 chamber 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, given burlap-rubbed finish, and painted with at least two coats of an acceptable paint.

#### 1.13 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 Owner 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 which because of their limited use are not normally available, but which 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 Owner.

#### 1.14 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.

#### 1.15 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 Tests 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.

1.16 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 11350. 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 and the Owner.
- 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.

## 1.17 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 facilities performance tests which 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.

#### 1.18 GREASE, OIL, AND FUEL

- A. All grease, oil, and fuel required for start-up and testing of equipment shall be furnished with the respective equipment.
- B. The Contractor shall be responsible for changing the oil in all drives and intermediate drives of each mechanical equipment from after initial break-in of the equipment, which shall be no greater than 30 days.

#### 1.19 ELECTRICAL EQUIPMENT ENCLOSURES

- A. All items of electrical equipment that are furnished with process, heating, ventilating, or other equipment shall conform to the requirements specified under the appropriate electrical sections of the Specifications. Enclosures for electrical equipment, such as switches and starters, shall conform to the requirements specified under the appropriate electrical sections of the Specifications.

#### 1.20 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, which will permit easy removal for servicing the equipment.

#### 1.21 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjoining surfaces so as 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.

#### 1.22 CONCRETE INSERTS

- A. Concrete inserts for hangers shall be designed to support safely, in the concrete that is used, the maximum load that can be imposed by the hangers used in the inserts. Inserts for hangers shall be of a type which will permit adjustment of the

hangers both horizontally (in one plane) and vertically and locking of the hanger head or nut. All inserts shall be galvanized.

#### 1.23 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.
- B. Sleeves in exterior walls below ground or in walls to have liquids on one or both sides shall have a 2-inch annular fin of 1/4-inch plate welded with a continuous weld completely around the sleeve at about mid-length. Sleeves shall be galvanized after the fins are attached.
- C. All sleeves shall be set accurately before the concrete is placed or shall be built-in accurately as the masonry is being built.

#### 1.24 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.
- 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. Heating, Ventilating, and Air Conditioning Systems
  - 4. Flow Meters

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 RELATED WORK

- A. Section 02070, Geocomposite.
- B. Section 02071, Geomembrane (HDPE).
- C. Section 02072, Geosynthetic Clay Liner.
- D. Section 02074, Geotextile.

1.03 SUBMITTALS (NOT USED)

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

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

1.08 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 Engineer, 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 Engineer.
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 Engineer, 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 Engineer. 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.

#### 1.09 QUALIFICATIONS (NOT USED)

#### 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 RELATED WORK (NOT USED)

1.03 SUBMITTALS (NOT USED)

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

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

1.08 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.

1.09 QUALIFICATIONS (NOT USED)

1.10 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 01770  
PROJECT CLOSEOUT

PART 1 GENERAL

1.01 SCOPE OF WORK (NOT USED)

1.02 RELATED WORK

- A. General Conditions.
- B. Supplementary Conditions.
- C. Section 01000, Project Requirements.
- D. Section 01740, Final Cleaning.
- E. Section 01785, Record Documents.
- F. Section 01830, Operations and Maintenance Manuals and Training.

1.03 SUBMITTALS (NOT USED)

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES

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

1.08 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.

1.09 QUALIFICATIONS (NOT USED)

1.10 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 inspection 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.

#### 1.11 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 inspected 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, maintenance manuals, instruction manuals, test reports, samples, operational manuals, 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 inspection 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.

#### 1.12 REINSPECTION FEES

If the status of Completion of Work requires more than one re-inspection by the Engineer due to failure of the Work to comply with the Contractor's claims on initial inspection, the Owner will deduct from the final payment to the Contractor the amount of the Engineer's compensation for additional re-inspection services.

### 1.13 CLOSEOUT SUBMITTALS

- A. Evidence of Compliance with Requirements of Governing Authorities:
  - 1. Certificate of Occupancy.
  - 2. All required Certificates of Inspection.
- B. Operation and Maintenance Manuals: Under provisions of Section 01830.
- C. Record Documents: Under provisions of Section 01785.
- D. Evidence of Payment and Release of Liens: In accordance with Conditions of the Contract.
- E. Consent of Surety to Final Payment.
- F. Signed Warranties: Under provisions of Section 01780.

### 1.14 STATEMENT OF ADJUSTMENT OF ACCOUNTS

- A. Submit final statement reflecting adjustments to 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 re-inspection fees.
  - 9. Other adjustments to total Contract Price.
  - 10. Total Contract Price as adjusted.
  - 11. Previous payments.
  - 12. Sum remaining due.
- B. The Engineer will issue a final Change Order reflecting approved adjustments to the total Contract Price not previously made by change orders.

### 1.15 APPLICATION FOR FINAL PAYMENT

Submit application for final payment in accordance with provisions of 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 and bonds.
- B. Co-execute submittals when so specified.
- C. Review submittals to verify compliance with Contract Documents.
- D. Submit submittals to the Engineer for review.

1.02 RELATED WORK

- A. General Conditions.
- B. Supplementary Conditions.
- C. Section 01600, Materials and Equipment.

1.03 SUBMITTALS

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

- A. Assemble warranties, bonds, and service and maintenance contracts 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, fax and E-mail number, and name 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, faxes and E-mail numbers, and the name of responsible principal.
- D. Submittal of warranties, bonds, and service and maintenance contracts 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 1 year (or such longer period may otherwise be specified in the Contract Documents) beginning from the date Substantial Completion is achieved.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 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 which 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 which would cause the equipment to fail under normal design and/or specific operating conditions for 1 year or such longer period as may be shown and/or specified from and after the date of Substantial Completion.
- D. The Contractor shall replace and install each piece of equipment, device, or component which shall fail within the term specified above of the guarantee with reasonable promptness without increase in the Contract Price. The replaced

equipment, device, or component shall be guaranteed subject to Paragraph 1.07C for 1 year from the time of replacement and approval. 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.

#### 1.08 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.

#### 1.09 QUALIFICATIONS (NOT USED)

#### 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 RELATED WORK

- A. Section 01000, Project Requirements.

1.03 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.

#### 1.04 WORK SEQUENCE (NOT USED)

#### 1.05 REFERENCE STANDARDS (NOT USED)

#### 1.06 QUALITY ASSURANCE (NOT USED)

#### 1.07 WARRANTIES

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

#### 1.08 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.

#### 1.09 QUALIFICATIONS (NOT USED)

### 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. 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.
  - 3. 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.

4. 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.
  5. 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 Licensed Land Surveyor certify the Record Drawings as being correct and complete.

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.
- 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 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 01830  
OPERATIONS AND MAINTENANCE MANUALS AND TRAINING

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 Operations and Maintenance (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 Engineer 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 Facility.

1.02 RELATED WORK

- A. Section 01000, Project Requirements.
- B. Section 01300, Contract Administration.

1.03 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. Size: 8 1/2 x 11 inch (21.59 x 27.94 cm).
2. White paper: 20-lb (9.072 kg) minimum.
3. Text: Manufacturer's printed data or neatly word-processed.
4. Drawings:
  - a. Provide reinforced, punched binder tab, bind in with text.
  - b. Reduce larger drawings and fold to size of text pages but not larger than 11 x 17 inch (27.94 x 43.18 cm).
  - c. Place all drawings at the end of each Section and drawing shall be printed on one side only.
5. Provide a blank 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.

6. Cover: Identify each volume with typed or printed 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.

C. Media

1. Original word-processed CD shall be delivered to the Engineer.
2. All word processing must be done using the latest version of Microsoft Word or as directed by the Engineer.
3. All drawings except control system configuration drawings must be submitted on CD using AutoCAD.

D. Binders

1. Filled to not more than 75% capacity.
2. When multiple binders are used, arrange the data into related consistent groupings.

E. The Contractor shall submit the following:

1. Equipment Manuals—Five copies of the O&M Instruction Manual for each piece of equipment shall be submitted to the Engineer with delivery of the equipment. O&M manuals will not include the manufacturer's test results and Record specifications. Equipment manuals shall include the recommended calibration schedule and procedures for all equipment.
2. Systems O&M Manuals—Five copies of the systems O&M Manuals, bound and indexed and submitted to the Engineer no later than 60 days before the Facility's Phase I 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—Five copies of the Final Equipment and Systems O&M Manuals, bound and indexed and submitted to the Engineer before the Substantial Completion under this Contract.

4. The cost of these Manuals submitted shall be included in the total Contract Price. Copies supplied under Item 2 will not be included under Item 3.
- F. Any modifications required after final O&M submission shall be made to the manuals by issuance of addenda in the form of change pages to the manual. The addenda will identify where the new data are to be inserted, what data are to be removed, and new index sheets as necessary and list of shop drawings and submittals.

#### 1.04 WORK SEQUENCE (NOT USED)

#### 1.05 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 Specification section differs from these documents, the requirements of this section shall apply.

- A. Florida Administrative Code, 62-555.350, "Operation and Maintenance of Public Water Systems."

#### 1.06 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 draftsman competent to prepare required drawings.

#### 1.07 WARRANTIES

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



## 1.08 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.

## 1.09 QUALIFICATIONS (NOT USED)

## 1.10 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.

## 1.11 MANUAL FOR MATERIALS AND FINISHES

A. Content, for architectural products, applied materials, and finishes:

1. Manufacturer's data, giving full information on products.
  - a. Catalog number, size, composition.
  - b. Color and texture designations.
  - c. Information required for re-ordering special-manufactured products.

2. Instructions for care and maintenance.
  - a. Manufacturer's recommendation for types of cleaning agents and methods.
  - b. Cautions against cleaning agents and methods that are detrimental to product.
  - c. Recommended schedule for cleaning and maintenance.
- B. Content, for moisture-protected and weather-exposed products:
  1. Manufacturer's data, giving full information on products.
    - a. Applicable standards.
    - b. Chemical composition.
    - c. Details of installation.
  2. Instructions for inspection, maintenance, and repair.
- C. Additional requirements for maintenance data as required by other Sections of the Specifications.

#### 1.12 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 boards.
    - 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 printed 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 pertinent 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 Sections of Specifications.

## PART 2 PRODUCTS

### 2.01 O&M MANUALS

- A. Binders: The manuals shall be supplied in binders that are the same as those provided in Paragraph 1.03D above.
- B. Electronic Version: Word-processed portions of the manuals shall also be provided on CDs. The electronic version manuals must be capable of being read, edited, and printed with Microsoft Word or Owner-approved file format at the time of the transmittal of documents. The format will be provided to the Contractor upon request. All drawings shall be generated using personal computer and plotter with the software package program from AutoCAD.

## PART 3 EXECUTION

### 3.01 TRAINING

A. The Contractor shall do the following:

1. Instruct and train the Owner's personnel in the operation, maintenance and calibration of the equipment and systems supplied and/or installed under this Contract.
2. 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.
3. 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.
4. Prepare instructors and training materials required for complete factory, field, classroom, and hands-on training.
5. Furnish training videos and manuals during the training program.
6. Include in the total Contract Price the cost for training equipment; preparing training manuals; conducting classroom instructions; 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.

END OF SECTION

SECTION 01900  
PERMITS

PART 1 GENERAL

1.01 GENERAL

- A. The Contractor shall be responsible for obtaining and paying for 100 percent of all permits, fees, and licenses required for performing the work of the Contract.

The Contractor has been made aware herein that the location of the Work described in the Contract Documents is in Hendry County and the Work is being performed for Lee County. Pursuant to Section 218.80 Florida Statutes, Lee and Hendry County discloses to the Contractor that the following permits are applicable and are either issued, pending, or will be required for this Work. Any costs or fees, if required are payable by the Contractor. The following is list of permits and/or fees that may be required for the project.

1. FDEP Construction Permit (Available upon request)
  2. Environmental Resource Permit (Available upon request)
  3. Hendry County Contractor Registration
  4. South Florida Water Management District Dewatering Permit (Available upon request)
  5. Building Department Fees (If required)
  6. Land Alteration/Landscape Fee (If required)
- B. In addition to the items indicated in Paragraph A, there may be other licenses, permits, and fees payable by the Contractor to entities other than Lee or Hendry County, The Contractor shall remain responsible to obtain and pay for all such other licenses, permits, and fees as well. The Contractor is responsible for all building and site construction permits. No allowance will be made for these permits.
- C. The Contractor shall be registered in Hendry County, Florida to perform work as required.

PART 2 PRODUCTS (NOT USED)

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 primary and secondary geocomposite as part of both the leak-detection and leachate-collection layers for the Landfill.

1.02 RELATED WORK

- A. Section 02071, Geomembrane (HDPE).
- B. Section 02072, Geosynthetic Clay Liner.
- C. Section 02074, Geotextile.
- D. Section 02300, Earthwork.

1.03 SUBMITTALS

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

- 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.
- B. Pre-Construction Submittals: Submit the following within 10 days of the Notice to Proceed.
  - 1. Manufacturer's Information:
    - a. The Manufacturer's name, address, and primary contact.
    - b. The Manufacturing plant name and address where the geocomposite for this project will be produced.
    - c. The Manufacturer's qualifications including:
      - (1) Evidence of production of at least 10 million square feet of geocomposite that meets the specifications of Article 2.01.



- (2) Certification that the Manufacturer has sufficient capacity to provide required material in the given timeframe.
    - (3) 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.
  - d. Product name and the Manufacturer's description of the proposed geocomposite 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.
  - e. The Manufacturer's material properties sheet (cut sheet) of proposed geocomposite including transmissivity test results in accordance with ASTM D4716.
  - f. Available data documenting that the proposed geocomposite will meet specified interface shear strength requirements in accordance with ASTM D5321 and the requirements listed in Article 2.01 of this Section and in Specification Section 02071, Geomembrane, Article 2.02.
  - g. The Manufacturer's Quality Control (MQC) Plan, including examples of geocomposite certification documents, name and address of the quality control testing laboratory, quality control laboratory certification, examples of retesting notification, and documentation.
  - h. 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).
  - i. Sample product warranty.
  - j. Sample Manufacturer's certifications.
2. Installer's Information:
- 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 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.

c. Construction Quality Control (CQC) Plan including but not limited to the following:

- (1) Description of seaming equipment and techniques.
- (2) Description of methods for repairing geotextiles and geonet.
- (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 QC data, including but not limited to daily record documents.

d. Installer's written procedures manual.

e. Panel layout drawings identifying panels and seams.

C. Project-Specific Product Acceptance Tests: After the Engineer's review of the Manufacturer's information and the Manufacturer's material properties sheet, 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 CQA Laboratory for Project-Specific Product Acceptance Testing as listed in Article 2.01.

1. Acceptance by the Engineer 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 Engineer 21 days before shipping the geocomposite. The geocomposite shall not be shipped before review and acceptance of the Project-Specific Product Acceptance Test results.
2. Product samples shall be sent to the CQA Laboratory 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, machine direction, and MQC test data documented for the particular production run from which the sample was taken. Five copies of the cover letter shall be sent to the Engineer.

TRI/Environmental, Inc.  
9063 Bee Caves Road  
Austin, Texas 78733  
Attention: John Allen  
(800) 880-8378

3. The Contractor shall bear the cost of all project-specific Product Acceptance Testing, including shipping samples to CQA Laboratory.
4. Geocomposite Samples: Two 3-foot-long-by-the-width-of-roll samples for laboratory testing. Samplers will mark the Manufacturer's roll identification number as well as the machine direction on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. The Contractor may elect to have the CQA Laboratory collect the samples from the Manufacturer or direct the Manufacturer to ship the samples to the CQA Laboratory. The samples shall be packaged securely for shipping to prevent damage. Each sample shall be clearly marked with lot and roll number and date of sampling.
5. Interface Direct Shear Strength Testing: The CQA Laboratory shall perform three interface direct shear strength tests for three normal load conditions in accordance with ASTM D5321 on representative samples of geocomposite as discussed below. This requirement is in addition to the requirement for interface direct shear strength tests included in the Specification Section 02072, Geosynthetic Clay Liner, and Specification Section 02071, Geomembrane.
  - a. Test Configuration—Geocomposite versus Drainage Soil: Lower geotextile of geocomposite clamped to the bottom of the box and drainage soil 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 02300 from onsite stockpile.
    - (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: 240, 5,000, 10,000, and 12,000 pounds per square foot (psf).

- 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 location of the failure (i.e., slip plane).
6. Transmissivity Testing: The CQA Laboratory shall perform transmissivity testing and report results in accordance with ASTM D4716. Leachate will be provided to the Contractor upon request. Laboratory procedures shall use digital gradient level indicators. The geocomposite must be tested with geomembrane on one side and drainage soil (meeting the requirements of Section 02300) on the other. Test as follows:
- a. Normal Load of 1,000 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 15,000 psf, gradient of 0.02, and test duration of 100 hours. Report results at 15 minutes, 1 hour, and then every 24 hours.
7. If the results of any test do not conform to the requirements of this Specification, 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 Specification, 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.
8. Creep Reduction Factor Testing: A Creep Reduction Factor test shall be submitted for the composite geonet core in accordance with GRI-GC8. Test conditions shall be 10,000 hours at 15,000 psf and 40° C. The creep reduction factor should be less than 1.1.

D. Manufacturer's Quality Control (MQC):

1. 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.
2. The number and frequency of the tests shall be in accordance with Table 1 in Article 2.01.
3. If the results of any test do not conform to the requirements of this specification, 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 seven days. If the retest does not conform to the requirements of this specification, the product shall be rejected and removed from the site.
4. Contractor shall submit MQC testing reports and certifications meeting requirements of Article 2.01.

E. Construction Quality Control (CQC): During construction, the Contractor shall submit CQC documentation weekly:

1. Material delivery report.
2. Rejected material removal report.
3. Records of daily installation including roll numbers placed.
4. Records of daily personnel activity.
5. Meeting reports.
6. Updated Record Drawing.

F. Construction Quality Assurance (CQA): Submit five copies of the CQA sample package cover letter to the Engineer in accordance with Article 1.06F.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCES

Reference standards and recommended practices referred to in this Specification 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 D1557—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 D4354—Standard Practice for Sampling of Geosynthetics for Testing.
9. ASTM D4491—Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
10. ASTM D4533—Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
11. ASTM D4632—Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
12. 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.
13. ASTM D4751—Standard Test Method for Determining Apparent Opening Size of a Geotextile.
14. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
15. ASTM D5199—Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.
16. ASTM D5261—Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
17. ASTM D5321—Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
18. ASTM D6141—Standard Guide for Screening Clay Portion of Geosynthetic Clay Liner (GCL) for Chemical Compatibility to Liquids.
19. ASTM D6992—Standard Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method.
20. ASTM D7005—Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites.



B. Geosynthetics Research Institute (GRI)

1. GRI-GC8—Determination of the Allowable Flow Rate of a Drainage Geocomposite.

1.06 QUALITY ASSURANCE

- A. MQC and CQC are the responsibility of the Contractor to document that the material and installation are in accordance with this Specification.
- B. The Manufacturer and Installer shall coordinate activities with the Engineer.
- C. The Manufacturer and Contractor shall help the Owner with product sampling for Construction Quality Assurance (CQA) testing by providing samples, personnel, and equipment necessary.
  1. The Owner will engage and pay for the CQA testing of the GCL in accordance with the CQA Plan.
  2. CQA tests will be the basis of 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.

1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.
- B. The Geocomposite Manufacturer shall warrant, in writing, the geocomposite material for 5 years on a pro rata basis. 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.

1.08 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 do the following to ensure proper delivery, storage, and handling:
- a. Comply with the Manufacturer's instructions provided as part of the pre-construction submittals described in Paragraph 1.03A.1.g.
  - b. Deliver materials to the site only after the Owner or their designated representative accepts pre-construction submittals and project-specific product acceptance submittals.
  - c. Deliver Geocomposite covered with a waterproof, tightly fitting, plastic covering resistant to ultraviolet degradation.
  - d. Deliver Geocomposite on a rigid core sufficient to prevent collapse during shipping, shattering or breaking during deployment, and to facilitate handling.
  - e. Ship less than 1 month before scheduled installation.
  - f. Deliver each roll with the following information marked on each label:
    - (1) Manufacturer's name.
    - (2) Project name.
    - (3) Product identification.
    - (4) Lot and roll numbers.
    - (5) Roll dimensions and weight.
  - g. Each roll shall have a label clearly visible and attached to the outside of the roll and at the end of the roll.
  - h. Preserve integrity and readability of roll labels.
  - i. Store rolls in space allocated by the Owner. Space shall be at high-ground level or elevated above ground surface.
  - j. Stack no more than three rolls high.
  - k. Protect rolls from precipitation, mud, dirt, dust, puncture, cutting, standing water, or any other damaging or deleterious conditions.
  - l. Use appropriate handling equipment meeting the Manufacturer's recommendations to load, move, or deploy Geocomposite rolls.

- m. Handle rolls to prevent damage to the product or to its protective wrapping and labels. Follow handling procedures outlined in ASTM D5888.
- n. Immediately repair damage to protective covering due to mishandling or sampling. Repair to protect rolls from moisture or other deleterious conditions.
- o. The Installer is responsible for off-loading, storing, and transporting material from the storage area to the installation site, installing the Geocomposite, and performing or coordinating CQC activities.
- p. The Contractor shall reject any roll that does not have an identifying roll number and lot number.

#### 1.09 QUALIFICATIONS

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

#### 1.10 TESTING REQUIREMENTS (NOT USED)

#### 1.11 MAINTENANCE (NOT USED)

#### 1.12 RECORD DRAWINGS (NOT USED)

#### 1.13 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 Engineer 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. *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.
- F. *Installer*: The party responsible for field handling, transporting, storing, deploying, seaming, and temporarily restraining (against wind and thermal/solar expansion) the Geotextile.
- G. *Lot*: Group of consecutively numbered rolls from the same manufacturing line.
- H. *Geocomposite Manufacturer (Manufacturer)*: The party responsible for the production and quality of geocomposite.
- 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 is in compliance 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. *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 a non-collapsible waterway for unrestricted flow.
- D. Manufactured with core material made of polyethylene that maintains the required flow under specified loads.
- E. Manufactured to meet or exceed the following product requirements in Articles 2.02 and 2.03, based on minimum average roll values.
- F. Conforming to the following minimum property values shown in Table 1.

| Table 1 Geocomposite Manufacturing Quality Control Test Requirements |                       |                        |  |
|--|-----------------------|------------------------|--|
| Test   | ASTM Test Designation | Minimum Test Frequency | Required Test Values                   |
| Geocomposite   |                       |                        |  |
| Peel Strength (min. avg.)  | D7005                 | 1/50,000 sf            | > 0.75 lb/in                           |
| Geonet Component of Geocomposite                                     |                       |                        |  |
| Thickness  | D751 or D5199         | 1/100,000 sf           | >275 mil                               |
| Melt Flow Index  | D1238, E              | 1 per resin batch      | < 1.0 g/10 mins                        |
| Density  | D792 or D1505         | 1/100,000 sf           | 0.940 to 0.970 g/cc                    |
| Carbon Black Content (range)   | D1603                 | 1/100,000 sf           | 2-3%                                   |
| SIM Creep Reduction Factor   | D6992                 | Data available         | RF <sub>CR</sub> < 1.25 <sup>(1)</sup> |
| Geotextile Component of Geocomposite                                 |                       |                        |  |
| Mass/unit area   | D5261                 | 1/100,000 sf           | ≥ 7.0 ounce per square yard            |
| Apparent Opening Size  | D4751                 | 1/540,000 sf           | < 0.60 mm                              |
| Grab Tensile Strength  | D4632                 | 1/100,000 sf           | > 150 lbs.                             |
| Trapezoidal Tear   | D4533                 | 1/100,000 sf           | > 50 lbs                               |
| Puncture Strength  | D4833                 | 1/100,000 sf           | > 80 lbs.                              |
| Thickness  | D5199                 | 1/100,000 sf           | > 90 mils                              |
| Flow rate  | D4491                 | 1/540,000 sf           | > 50 gpm/ft <sup>2</sup>               |
| Permittivity   | D4491                 | 1/540,000 sf           | 1.0 s <sup>-1</sup>                    |

NOTE:

(1) – Creep-Reduction Factor determined using ASTM Method D6992 at 15,000 psf and 0° horizontal inclination at 40°C.

| Table 2 Project-Specific Product Acceptance Test Requirements          |                       |                        |   |                   |
|--|-----------------------|------------------------|---|-------------------|
| Test   | ASTM Test Designation | Minimum Test Frequency | Required Test Values                      |                   |
| Interface Shear Strength<br>(see Article 1.03 for test configurations) | D5321                 |                        | Minimum Peak Shear Strength (psf)         | Normal Load (psf) |
|  |                       | 1 per project          | 40-85(range)                              | 240               |
|  |                       |                        | 790 (min)                                 | 5,000             |
|  |                       |                        | 1,270 (min)                               | 8,000             |
|  |                       |                        | 1,900 (min)                               | 12,000            |
| Transmissivity (leachate) (100 hour Result)                            |                       |                        |   |                   |
| 1,000 psf; 0.02  | D4716                 | 1/project              | $> 6 \times 10^{-3} \text{ m}^2/\text{s}$ |                   |
| 10,000 psf; 0.02   | D4716                 | 1/project              | $> 4 \times 10^{-3} \text{ m}^2/\text{s}$ |                   |
| 15,000 psf; 0.02   | D4716                 | 1/project              | $> 2 \times 10^{-3} \text{ m}^2/\text{s}$ |                   |

## 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 a non-collapsible waterway for unrestricted flow.
- C. Manufactured with material made of polyethylene that maintains the required flow under specified loads.
- D. The geonet resin shall be virgin materials with no more than 10% reworked material from the same formulation as the parent material.
- E. Resistant to soil, chemicals, landfill gas, and leachate.
- 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 Engineer.
- 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 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 PREPARATION

- A. Before geocomposite installation the Contractor shall confirm:
  - 1. Lines and grades for the geocomposite liner subgrade (top of geomembrane) have been verified by the Contractor and approved by the Engineer.
  - 2. Surfaces do not contain objects that could damage the geocomposite.
  - 3. Geomembrane installation and documentation is complete.

#### 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 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. 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 Engineer.
- B. 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 Engineer.
- C. 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 Engineer.. The geonet should be joined with cable ties spaced every 12 inches along the roll width or as recommended by the Manufacturer and approved by the Engineer.
- D. The Contractor shall provide additional cable ties along points of high stress or as instructed by the Engineer.

- E. The top layers of geotextiles shall be sewn together. The Contractor, upon approval by the Engineer, 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 Engineer for approval a minimum of 14 days before installation.
- F. 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. Patching: 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. Complete replacement: 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 Engineer has completed Final Inspection and any noted defects have been repaired.

END OF SECTION

SECTION 02071  
GEOMEMBRANE (HDPE)

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Work includes manufacturing and installing a 60-mil, textured, high-density polyethylene (HDPE) geomembrane as a component of the geomembrane liner system as shown on the Drawings and specified in this Section.

1.02 RELATED WORK

- A. Section 01330, Submittals and Acceptance
- B. Section 02070, Geocomposite
- C. Section 02072, Geosynthetic Clay Liner
- D. Section 02074, Geotextile
- E. Section 02240, Dewatering
- F. Section 02300, Earthwork

1.03 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. The Manufacturer's name and address and primary contact.
    - b. The manufacturing plant name and address where the Geomembrane for this project will be produced.
    - c. The Manufacturer's qualifications including:
      - (1) Evidence of production of at least 10 million square feet of Geomembrane that meets the specifications of Article 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 Geomembrane has been supplied by the Manufacturer, three of which shall have been for projects of similar size.
- d. Product name and the Manufacturer's description of the proposed Geomembrane and five representative samples of the product proposed for use on this project.
- e. The Manufacturer's material properties sheets (cut sheets) of proposed Geomembrane product meeting the requirements listed in the Article 2.02.
- f. The Manufacturer's Quality Control (MQC) Plan, including examples of Geomembrane certification documents, name and address of the quality control testing laboratory, quality control laboratory certification, examples of retesting notification, and documentation.
- g. The Manufacturer's written instructions for storing, handling, installing, seaming, protecting from hydration, and repairing the proposed Geomembrane, including recommendations for handling equipment (model number and load capacity).
- h. Sample product warranty.

2. Installer's Information:

- a. Installer's name and address and primary contact.
- b. 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.
- c. The Construction Quality Control (CQC) Plan, including examples of subgrade certification documents, daily record documents, methods for repairing Geomembrane and Subbase and example documents to certify repairs, method for removing rejected materials, proposed staffing, and proposed equipment.
- d. Description of welding equipment, techniques, and material, including a list of proposed equipment.



- e. The panel layout plan, including at a minimum:
    - (1) Panel layout
    - (2) Panel identification numbers
    - (3) Field seams
    - (4) Installed square footage of the geomembrane
    - (5) Details that do not conform to the construction drawings
  - f. A complete set of forms to be used for record installation CQC data.
  - g. Résumés of key installation personnel. The Installation Supervisor, Master Seamers, and QC Representative must be clearly identified.
  - h. The Installer's qualifications.
  - i. Workmanship warranty.
- B. Project-Specific Product Acceptance Tests—After the Engineer's review of the Manufacturer's information and the Manufacturer's material properties sheet, 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.
- 1. 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.
  - 2. Product samples shall be sent to the CQA 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.

3. Samples shall be sent to the Product Acceptance Laboratory:

TRI/Environmental, Inc.  
9063 Bee Caves Road  
Austin, Texas 78733  
Attention: John Allen  
(800) 880-8378

4. The Contractor shall bear the cost of all Project-Specific Product Acceptance Testing, including shipping samples to Product Acceptance Laboratory.
5. Samples of geomembrane: The Manufacturer shall package securely and ship two 3-foot-long by the width-of-roll-wide samples to the CQA Laboratory. The Manufacturer shall package the samples securely for shipping to prevent damage.
6. The CQA Laboratory shall perform interface direct shear strength tests, one test configurations for four normal load conditions in accordance with ASTM D5321 on representative samples of geomembrane as discussed below. This requirement is in addition to the requirement for interface direct shear strength tests included in any other specifications provided for this project.
  - a. Test Configuration—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.
    - (2) Saturate for 1 hour under full load before shearing and shear under fully saturated (tap water) conditions.
  - b. Normal loads: See Paragraph 2.02A.
  - c. Shear rate: 0.04 inch/minute.
  - d. Provide complete shear versus displacement length to at least 3 inches of displacement.

- e. 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).
  - 7. If the results of any test do not conform to the requirements of this Specification, 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.
- C. The Manufacturer will submit the following 10 days before products are scheduled to be shipped for this project:
- 1. The Manufacturer's quality control certificates for raw resin material. Testing must be done in accordance with the Manufacturer's Quality Control (MQC) plan with a minimum of one test per lot and include tests listed in the table in Paragraph 2.01C.
  - 2. The Manufacturer's quality control certificates for finished geomembrane. Testing must be done in accordance with the Manufacturer's QA/QC plan on the actual material to be shipped and include tests and frequencies performed as listed in the table in Paragraph 2.02H.
- D. Manufacturer's Quality Control (MQC):
- 1. 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.
  - 2. The number and frequency of the tests shall be in accordance with Table 1 in Article 2.01.
  - 3. If the results of any test do not conform to the requirements of this specification, 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 seven days. If the retest does not conform to the requirements of this specification, the product shall be rejected and removed from the site.

4. Contractor shall submit MQC testing reports and certifications meeting requirements of Article 2.01.
- 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 subbase certification signed by the Contractor.
  4. Records of daily installation logs, including but not limited to:
    - a. Deployment, including roll numbers placed
    - b. Destructive sample testing
    - c. Seaming
    - d. Non-destructive tests
    - e. Trial welds
    - f. Repairs
  5. Records of daily personnel activity.
  6. Meeting reports.
  7. Updated record drawings.

#### 1.04 WORK SEQUENCE (NOT USED)

#### 1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification 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 D1603—Standard Test Method for Carbon Black Content in Olefin Plastics.



6. ASTM D3895—Standard Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry.
7. ASTM D4218—Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.
8. ASTM D4437—Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes.
9. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
10. ASTM D5199—Standard Test Method for Measuring Nominal Thickness of Geosynthetics.
11. ASTM D5321—Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by the Direct Shear Method.
12. ASTM D5397—Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.
13. ASTM D5596—Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.
14. ASTM D5641—Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber.
15. ASTM D5721—Standard Practice for Air-Oven Aging of Polyolefin Geomembranes.
16. ASTM D5820—Standard Practice for Pressurized Air Channel Evaluation at Dual-Seamed Geomembranes.
17. ASTM D5885—Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.
18. ASTM D5994—Test Method for Measuring the Core Thickness of Textured Geomembranes.
19. ASTM D6392—Standard Test Method for Determining the Integrity of Non-Reinforced Geomembrane Seams Produced using the Thermo-Fusion Methods.
20. ASTM D6497—Standard Guide for Mechanical Attachment of Geomembrane to Penetrations or Structures.
21. ASTM D6693—Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.
22. ASTM D7466—Test Method for Measuring the Asperity Height of Textured Geomembranes.
23. 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) Standards.
  - 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.

#### 1.06 QUALITY ASSURANCE

- A. Construction quality control is the responsibility of the Installer who must document that the installation proceeds in accordance with this Section.
- 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.
- C. The Installer's QC Representative will be responsible for construction quality control which is independent of CQA.
- D. The Installer must help the CQA Consultant with product sampling by providing personnel and equipment as necessary.
- E. The Manufacturer and the Installer shall coordinate activities with the CQA Consultant.
- F. The geomembrane Manufacturer must be a company engaged in the development and manufacture of geomembrane with a history of successful production of geomembrane for a minimum of 5 years. The Manufacturer shall submit written information verifying qualifications, including:
  - 1. The Manufacturer's Quality Control (MQC) manual.
  - 2. Plant size and capacity (square feet of geomembrane produced daily) and a statement that daily production quantity is sufficient to meet the requirements of this project.



3. A list of projects for which similar geomembrane has been produced that total a minimum of 10 million square feet.
- G. The Installer must submit the following written information verifying qualifications:
1. A CQC Manual (should procedures differ from those listed in the Specification, the most stringent requirement shall govern).
  2. 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.
  3. The résumé of a Field Installation Supervisor who has directly supervised over 1 million square feet of installation.
  4. The résumé of a Master Seamer who has seamed a minimum of 500,000 linear feet of seam.
  5. 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.
  6. 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.

#### 1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification 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. This warranty shall apply to normal use and service in a landfill bottom liner (primary and secondary containment) application under exposure to landfill leachate and landfill gas as well as other exposures that can be anticipated from the intended use.

## 1.08 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.
- C. The Contractor shall deliver materials to the site only after the CQA Consultant accepts required submittals.
- D. 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. 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. Store geomembrane rolls to protect them from puncture, dirt, grease, water, moisture, mud, mechanical abrasions, excessive heat, or other damage.
- G. Store geomembrane rolls on a prepared surface. Prevent water from accumulating beneath the rolls.
- H. Do 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. Stack geomembrane no more than three rolls high.
- J. 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. Do not drag panels on the ground.
- L. Do 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.

#### 1.09 QUALIFICATIONS (NOT USED)

#### 1.10 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.

#### 1.11 MAINTENANCE (NOT USED)

#### 1.12 RECORD DRAWINGS (NOT USED)

#### 1.13 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. *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 Engineer to determine compliance of the materials with the product and contract specifications.
- D. *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.

- E. *CQA Laboratory*: An independent laboratory contracted by the Owner to monitor the quality and installation of the product.
- F. *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.
- G. *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.
- H. *Geomembrane*: An essentially impermeable membrane used as a solid or liquid barrier. Synonymous term for flexible membrane liner (FML).
- I. *Geomembrane Manufacturer (Manufacturer)*: The party responsible for producing the geomembrane rolls from resin and for the quality of the resin.
- J. *Geomembrane Subbase*: The soil or geosynthetic surface on which the geomembrane lies.
- K. *Installer*: The party responsible for field handling, transporting, storing, deploying, seaming, temporarily restraining (against wind), and installing the geomembrane.
- L. *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.
- M. *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.
- N. *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.

- O. *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 (MANUFACTURER)

The Manufacturer shall supply the products listed below.

### 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:

| Test                | Test Designation               | Requirements            |
|---------------------|--------------------------------|-------------------------|
| 1. Melt Index       | ASTM D1238                     | Less than 1.0 g /10 min |
| 2. Specific Gravity | ASTM D1505 or D792<br>Method B | 0.940 g/cc minimum      |

### 2.02 PROPERTIES FOR TEXTURED HIGH-DENSITY POLYETHYLENE (HDPE) GEOMEMBRANE

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

- A. Project-Specific Product Acceptance Test Requirements included in the CQA Plan.

| Project-Specific Product Acceptance Test Requirements                       |                       |                        |                                    |                   |
|---|-----------------------|------------------------|------------------------------------|-------------------|
| Test  | ASTM Test Designation | Minimum Test Frequency | Required Test Values               |                   |
| Interface Shear Strength<br>(see Paragraph 1.03B.6 for test configurations) | D5321                 | 1 per project          | Required Peak Shear Strength (psf) | Normal Load (psf) |
|   |                       |                        | 40-85(range)                       | 240               |
|   |                       |                        | 790 (min)                          | 5,000             |
|   |                       |                        | 1,270(min)                         | 8,000             |
|   |                       |                        | 1,900 (min)                        | 12,000            |



- 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. Roll manufactured sheets for shipment.
- H. The geomembrane must conform to the following requirements in general accord with GRI GM-13 (some requirements are stricter than GM-13):

| 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), (2) | 10 mils and as needed to meet shear-strength requirements   |
| 3. Sheet density          | ASTM D 1505 (preferred) or D 792 Method B | 1/50,000 sf                | Minimum average 0.940 g/cc  |
| 4. Tensile Properties (3) |   |                            |   |
| a. Yield Strength         | ASTM D6693 Type IV                        | 1/50,000 sf                | Min 126 lb/in   |
| b. Break Strength         | ASTM D6693 Type IV                        | 1/50,000 sf                | Min 90 lb/in  |
| c. Yield Elongation       | ASTM D6693 Type IV                        | 1/50,000 sf                | Min 12% each sample   |

| Test   | Test Designation   | MQC Test Frequency  | Requirements                |
|--|--------------------|---------------------|-----------------------------|
| d. Break Elongation                                      | ASTM D6693 Type IV | 1/50,000 sf         | Minimum average 100%        |
| 5. Tear Resistance                                       | ASTM D1004, Die C  | 1/100,000 sf        | Minimum average 42 lb       |
| 6. Puncture Resistance                                   | ASTM D4833         | 1/100,000 sf        | Minimum average 90 lb       |
| 7. Stress Crack Resistance (4)                           | ASTM D 5397 (App.) | Per GRI GM10        | Min 300 hr                  |
| 8. Carbon Black Content                                  | ASTM D1603 (5)     | 1/50,000 sf         | 2.0 to 3.0%                 |
| 9. Carbon Black Dispersion                               | ASTM D5596         | 1/100,000 sf        | (6)                         |
| 10. Standard Oxidation Induction Time of Polyolefins (7) | ASTM D3895         | One per formulation | Minimum average 100 minutes |

- (1) Report all 10 readings and an average reading for each side.
- (2) Perform 10 readings on both sides of each roll if textured on both sides, one side if textured on one side.
- (3) Machine direction (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.
- (4) The SP-NCTL test is not appropriate for testing geomembranes with textured or irregular rough surfaces. Tests should be conducted on the smooth edges of textured rolls or on smooth sheets made from the same formulation as that being used for the textured sheet.
- (5) Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
- (6) Carbon black dispersion (only near spherical agglomerates) for 10 views: nine in Categories 1 and 2 and one in Category 3.
- (7) The Manufacturer has the option to select high-pressure OIT (ASTM 5885) per GRI GM-13 requirements. It is also recommended that samples be evaluated at 30 and 60 days to compare with the 90-day response.

## 2.03 MANUFACTURER SOURCE QUALITY CONTROL (MQC) TESTING

- A. The Manufacturer shall perform the Manufacturer's quality control 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 subbase should meet the requirements of Section 02300.
- 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. If there are wide changes in temperature ( $\pm 30^{\circ}\text{F}$ ), humidity, or wind speed.
  - 4. 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 (unless strength is achieved)
  - 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) should 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. Give careful consideration to 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 or in accordance with the Manufacturer's recommendations, whichever is more stringent
- E. Dual-hot-wedge welding is the preferred method of seaming. Extrusion welding should 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 4437).
- 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. Temperature 6 inches above the geomembrane surface being welded.
  - 2. Extrudate temperatures in barrel and at nozzle (extrusion welder).
  - 3. Operating temperature of hot wedge (hot-wedge welder) and any pressure adjustments made.
  - 4. Preheat temperature.
  - 5. 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 4437).
- 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 Specification.

### 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 Specification.

### 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 Specification.
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 500 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 (CQA) 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 if 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), large panel defects, undispersed raw materials, welds, 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: Used to replace areas with large defects where the preceding methods are not appropriate. Also used to remove excess material (wrinkles, fishmouths, intersections, etc.) from the installed geomembrane. Areas of removal shall be patched or capped.

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

1. Abrade geomembrane surfaces to be repaired (extrusion welds only) no more than 30 minutes 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 or final cover system.

1.02 RELATED WORK

- A. Section 02071, Geomembrane.
- B. Section 02300, Earthwork.

1.03 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. The Manufacturer's name and address and primary contact.
    - b. The manufacturing plant name and address where the GCL for this project will be produced.
    - c. The Manufacturer's qualifications including:
      - (1) Evidence of production of at least 10 million square feet of GCL that meets the specifications of Article 2.01.
      - (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 GCL has been supplied by the Manufacturer, three of which shall have been for projects of similar size.

- d. Product name and the Manufacturer's description of the proposed GCL and five representative samples of the product proposed for use on this project.
  - e. The Manufacturer's material properties sheets (cut sheets) of proposed GCL product meeting the requirements listed in the Article 2.01.
  - f. 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.
  - g. 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).
  - h. Sample product warranty.
2. Installer's Information:
- a. Installer's name and address and primary contact.
  - b. 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.
  - c. 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.
  - d. The Installer's written procedures manual.
  - e. Panel layout drawings identifying panels and overlaps.
- B. Project-Specific Product Acceptance Tests: After the CQA Consultant's review of the Manufacturer's information, 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 CQA Laboratory for Project-Specific Product Acceptance Testing as listed in the CQA Plan.

1. The Engineer'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 Engineer 21 days before shipping the GCL. The GCL shall not be shipped before review and acceptance of the Project-Specific Product Acceptance Test results.

2. Samples shall be sent to the CQA Laboratory:

TRI/Environmental, Inc.  
9063 Bee Caves Road  
Austin, Texas 78733  
Attention: John Allen  
800-880-8378

3. The sample package shall include a cover letter referencing the project name, project location, the Engineer's project number, the Manufacturer's name and address, product name, date of sampling, lot, roll number, and MQC test data documented for the particular production run from which the sample was taken. Five copies of the cover letter shall be sent to the Engineer.
4. The Contractor shall bear the cost of all Project-Specific Product Acceptance testing, including shipping samples to the CQA Laboratory.
5. The GCL samples shall include two 3-foot-long-by-the-width-of-roll samples for laboratory testing. Samplers will mark the Manufacturer's roll identification number as well as the machine direction on the sample. Samplers will assign a conformance test number to the sample and mark the sample with that number. The Contractor may elect to have the CQA Laboratory collect the samples from the Manufacturer or direct the Manufacturer to ship the samples to the CQA 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.
6. Interface Direct Shear Testing: The Product Acceptance Laboratory shall perform 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 Subgrade Soil GCL clamped to bottom of box and compacted subgrade soil on top. Subgrade soil shall be compacted within 2% of optimum moisture content to 90% of Modified Proctor in accordance with ASTM D1557. Report Modified Proctor Test.
  - b. Test Configuration 2—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, for geomembrane sampling and shipping requirements.
  - c. Normal loads shall be 250, 5,000, 10,000, and 12,000 pounds per square foot (psf).
  - 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 three 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. If the results of any test do not conform to the requirements of this Specification, 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 Specification, 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.

C. Manufacturer's Quality Control (MQC):

1. 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.
2. The number and frequency of the tests shall be in accordance with Table 1 in Article 2.01.
3. If the results of any test do not conform to the requirements of this specification, 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 seven days. If the retest does not conform to the requirements of this specification, the product shall be rejected and removed from the site.
4. Contractor shall submit MQC testing reports and certifications meeting requirements of Article 2.01. Before shipping the product, the certification that GCL is essentially free of broken needle fragments shall be submitted by the Manufacturer on the Manufacturer's letterhead and signed by an authorized representative of the Manufacturer.

D. Construction Quality Control (CQC): During construction, the Contractor shall submit CQC documentation weekly:

1. Material delivery report.
2. Rejected material removal report.
3. Soil subbase 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.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification 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/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
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 D5887—Standard Test Method for Measurement of Index Flux through Saturated Geosynthetic Clay Liner Specimens Using a Flexible Wall Permeameter.
9. ASTM D5888—Standard Guide for Storage and Handling of Geosynthetic Clay Liners
10. ASTM D5889—Standard Practice for Quality Control of Geosynthetic Clay Liners.
11. ASTM D5890—Standard Test Method for Swell Index of Clay Mineral Component of Geosynthetic Clay Liners.
12. ASTM D5891—Standard Test Method for Fluid Loss of Clay Component of Geosynthetic Clay Liners.
13. ASTM D5993—Standard Test Method for Measuring Mass Per Unit of Geosynthetic Clay Liners.
14. ASTM D6072—Standard Practice for Obtaining Samples of Geosynthetic Clay Liners.
15. ASTM D6141—Standard Guide for Screening Clay Portion of Geosynthetic Clay Liner (GCL) for Chemical Compatibility to Liquids.
16. ASTM D6243—Standard Test Method for Determining the Internal and Interface Shear Resistance of Geosynthetic Clay Liner by the Direct Shear Method.
17. ASTM D6496—Standard Test Method for Determining Average Bonding Peel Strength Between the Top and Bottom Layers of Needle-Punched Geosynthetic Clay Liners
18. ASTM D6766—Standard Test Method for Evaluation of Hydraulic Properties of Geosynthetic Clay Liners Permeated with Potentially Incompatible Liquids.
19. ASTM D6768—Standard Test Method for Tensile Strength of Geosynthetic Clay Liners

## 1.06 QUALITY ASSURANCE

- A. MQC and CQC are the responsibility of the Contractor to document that the material and installation are in accordance with this Specification.
- B. The Manufacturer and Installer shall coordinate activities with the Engineer.
- C. The Manufacturer and Contractor shall help the Owner with product sampling for Construction Quality Assurance (CQA) testing by providing samples, personnel, and equipment necessary.
  - 1. The Owner will engage and pay for the CQA testing of the GCL in accordance with the CQA Plan.
  - 2. CQA tests will be the basis of 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.

## 1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplementary Conditions, and Specification Section 01780, Warranties and Bonds.
- B. The GCL Manufacturer shall warrant in writing the GCL material for 5 years on a pro rata basis. 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.

## 1.08 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 Section 1.03 Manufacturer's Instructions and Installer's Procedures.
- C. The Contractor shall do the following to ensure proper delivery, storage, and handling:
  - a. Comply with the Manufacturer's instructions provided as part of the pre-construction submittals described in Paragraph 1.03A.1.g.



- b. Deliver materials to the site only after the Owner or their designated representative accepts pre-construction submittals and project-specific product acceptance submittals.
- c. Deliver GCL covered with a waterproof, tightly fitting, plastic covering resistant to ultraviolet degradation.
- d. Deliver GCL on a rigid core sufficient to prevent collapse during shipping, shattering or breaking during deployment, and to facilitate handling.
- e. Ship less than 1 month before scheduled installation.
- f. Deliver each roll with the following information marked on each label:
  - (1) Manufacturer's name.
  - (2) Project name.
  - (3) Product identification.
  - (4) Lot and roll numbers.
  - (5) Roll dimensions and weight.
- g. Each roll shall have a label clearly visible and attached to the outside of the roll and at the end of the roll.
- h. Preserve integrity and readability of roll labels.
- i. Store rolls in space allocated by the Owner. Space shall be at high-ground level or elevated above ground surface.
- j. Stack no more than three rolls high.
- k. Protect rolls from precipitation, mud, dirt, dust, puncture, cutting, standing water, or any other damaging or deleterious conditions.
- l. Use appropriate handling equipment meeting the Manufacturer's recommendations to load, move, or deploy GCL rolls.
- m. Handle rolls to prevent damage to the product or to its protective wrapping and labels. Follow handling procedures outlined in ASTM D5888.



- n. Immediately repair damage to protective covering due to mishandling or sampling. Repair to protect rolls from moisture or other deleterious conditions.
- o. 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.
- p. The Contractor shall reject any roll that does not have an identifying roll number and lot number.

#### 1.09 QUALIFICATIONS

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

#### 1.10 TESTING REQUIREMENTS (NOT USED)

#### 1.11 MAINTENANCE (NOT USED)

#### 1.12 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 Engineer any time upon request.

#### 1.13 DEFINITIONS

- A. *Bentonite*: Clay soil, comprised primarily of sodium montmorillonite, characterized by high-swelling potential and low hydraulic conductivity.
- B. *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 Engineer to determine compliance of the materials with the product and contract specifications.
- C. *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.

- D. *CQA Laboratory*: An independent laboratory contracted by the Owner to monitor the quality and installation of the product.
- E. *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.
- F. *Geosynthetic Clay Liner (GCL)*: Manufactured liner material consisting of a layer of granular bentonite encapsulated by geotextiles.
- G. *GCL Manufacturer (Manufacturer)*: The party responsible for the production and quality of GCL.
- H. *Geotextile*: Permeable geosynthetic comprised solely of textiles (ASTM D4439).
- I. *Installer*: The party responsible for field handling, transporting, storing, deploying, seaming, and protection against hydration of the GCL.
- J. *Lot*: A group of consecutively numbered rolls from the same manufacturing line.
- K. *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.
- L. *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.
- M. *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.

- N. *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. Manufactured to meet the requirements listed in Table 1 and the CQA Plan.

| 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          | $\geq 24$ mL/2g                              |
| Bentonite Fluid Loss (Tap water)                             | D5891                 | Every 50 tons          | <18 mL                                       |
| Non-Woven Geotextile Component of GCL                        |                       |                        |  |
| Mass per Unit Area (cover and base)                          | D5261                 | 1/200,000 sf           | 6 oz/sy                                      |
| Grab Tensile Strength  | D4632                 | 1/100,000 sf           | Cover >15 lb<br>Base > 145 lb                |
| GCL Requirements   |                       |                        |  |
| Bentonite Mass/Unit Area (minimum. average)                  | D5993                 | 1/50,000 sf            | > 0.75 lb/sf <sup>(1)</sup>                  |
| Index Flux and calculated hydraulic conductivity (Tap water) | D5887                 | 1/200,000 sf           | < $1.0 \times 10^{-7}$ cm/sec <sup>(2)</sup> |
| Peel Strength  | D6496                 | 1/50,000 sf            | > 3.5 lb/in                                  |
| Tensile Strength (MARV)                                      | D6768                 | 1/200,000 sf           | 45 lb/in                                     |

Notes:

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

(2) Hydraulic Conductivity 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               |                   |
| Shear Strength (min.)<br>(see Article 1.03C for test configurations) | D6243                 | 1 per project          | Required Peak Shear Strength (psf) | Normal Load (psf) |
|  |                       |                        | 40-85(range)                       | 240               |
|  |                       |                        | 790 (min)                          | 5,000             |
|  |                       |                        | 1,270(min)                         | 8,000             |
|  |                       |                        | 1,900 (min)                        | 12,000            |

## 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 of Article 2.01 and the CQA Plan.

## 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 SUBBASE

- A. The Contractor shall verify in writing to the Owner and Engineer with standard subbase acceptance forms (Article 1.03D3) that the surface on which the GCL will be installed is acceptable.
- B. Subbase acceptance forms shall also verify that the subbase meets the requirements of Section 02300, Earthwork.

### 3.02 DEPLOYMENT

- A. Installation shall not begin until submittals have been received and approved (see Article 1.03).
- B. Do not deploy GCL in the presence of excessive moisture, precipitation, ponded water, or high winds.
- C. Deploy only after submittal of subbase acceptance forms signed by the Installer, received and reviewed by the Owner and Engineer, and accepted by the Engineer.
- 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 Engineer.
- 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 1.07).
- L. Repair any damage to the subbase 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 1.03D).

- 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 1.03D) 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 Engineer 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.

### 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 Engineer 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 subbase 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 CONTRACTOR'S CERTIFICATE  
OF  
ACCEPTABLE INSTALLATION

The GCL Contractor \_\_\_\_\_ for the (Project)  
\_\_\_\_\_ hereby certifies that the installation of the  
subgrade for the liner system is in accordance with our recommendations, approved QA/QC  
Plan, and the quality of the work has been to our satisfaction.

Signed: \_\_\_\_\_  
(Representative of GCL Contractor)

\_\_\_\_\_  
(Position)

Date: \_\_\_\_\_

Witness: \_\_\_\_\_

END OF SECTION

SECTION 02074  
GEOTEXTILE

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. The Contractor shall furnish and install non-woven geotextile around the gravel in the Leachate Collection System.

1.02 RELATED WORK

- A. Section 02070, Geocomposite.
- B. Section 02071, Geomembrane (HDPE).
- C. Section 02300, Earthwork.

1.03 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. The Manufacturer's name, address, and primary contact.
    - b. The manufacturing plant name and the address where the geotextile for this project will be produced.
    - c. The Manufacturer's qualifications including:
      - (1) Evidence of production of at least 10 million square feet of geotextile that meets the specifications of Article 2.01.
      - (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.



- d. The Manufacturer's quality control (MQC) certificates. Testing must be done in accordance with the quality control plan and in accordance with Article 2.01.
  - e. The Manufacturer's material properties sheet (cut sheet) of proposed geotextile documenting it will meet or exceed the requirements specified in Article 2.01.
  - f. 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).
  - g. Sample product warranty.
2. Installer's Information:
- 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.

B. Manufacturer's Quality Control (MQC)

1. The Contractor shall provide the following information with the MQC test data: project name, project location, Manufacturer, product name, and lot and roll numbers.
2. Provide results of quality-control tests, including a description of test methods used and the number and frequency of the tests in accordance with Paragraph 2.01D.
3. 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 Engineer that a retest is planned. Retesting results shall be reported within 7 days.
  - a. 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.
  - b. 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.
  - c. If the retest does not conform to the requirements of this Specification, the material shall be rejected and removed from the site.

C. 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.

- D. The Contractor will bear the cost of all the Manufacturer's certification testing, including shipping samples to the CQA Laboratory.

#### 1.04 WORK SEQUENCE (NOT USED)

#### 1.05 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—Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
  - 3. ASTM D4533—Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
  - 4. ASTM D4632—Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
  - 5. ASTM D4751—Standard Test Method for Determining Apparent Opening Size of a Geotextile.
  - 6. ASTM D4833—Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.
  - 7. ASTM D5261—Standard Test Method for Measuring Mass per Unit Area of Geotextiles.

#### 1.06 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 Engineer with product sampling by providing personnel and equipment when necessary.

E. The Manufacturer and the Installer shall coordinate activities with the Engineer.

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 Article 2.01.
2. The Engineer 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 Engineer will observe and document the following:
  - a. Delivery and storing material.
  - b. Subsurface preparation.
  - c. Placement and seaming.
  - d. Repairs.
  - e. Quantities used.

#### 1.07 WARRANTIES

- A. Warranties shall be in accordance with General Conditions, Supplemental Conditions, and Specification 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.

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



- l. Use appropriate handling equipment meeting the Manufacturer's recommendations to load, move, or deploy geotextile rolls.
- m. Handle rolls to prevent damage to the product or to its protective wrapping and labels. Follow handling procedures outlined in ASTM D5888.
- n. Immediately repair damage to protective covering due to mishandling or sampling. Repair to protect rolls from moisture or other deleterious conditions.
- o. The Installer is responsible for off-loading, storing, and transporting material from the storage area to the installation site, installing the Geotextile, and performing or coordinating CQC activities.
- p. The Contractor shall reject any roll that does not have an identifying roll number and lot number.

#### 1.09 QUALIFICATIONS (NOT USED)

#### 1.10 PROJECT CONDITIONS (NOT USED)

#### 1.11 MAINTENANCE (NOT USED)

#### 1.12 RECORD DRAWINGS

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

#### 1.13 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 Engineer 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

- 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:

| Test                     | ASTM Test Designation | Minimum MQC Test Frequency | Required Test Values       |
|--------------------------|-----------------------|----------------------------|----------------------------|
| 1. Permittivity          | D4491                 | 1/540,000 sf               | 1.26 sec <sup>-1</sup>     |
| 2. Mullen Burst          | D3786                 | 1/540,000 sf               | 290 psf                    |
| 3. Mass Per Unit Area    | D5261                 | 1/100,000 sf               | >7.0 ounce per square yard |
| 4. Apparent Opening Size | D4751                 | 1/540,000 sf               | ≤ 0.60 mm                  |
| 5. Grab Tensile Strength | D4632                 | 1/100,000 sf               | > 180 lb                   |
| 6. Trapezoidal Tear      | D4533                 | 1/100,000 sf               | > 50 lb                    |
| 7. Puncture Strength     | D4833                 | 1/100,000 sf               | > 80 lb                    |
| 8. Flow rate             | D4491                 | 1/540,000 sf               | > 50 gpm/ft <sup>2</sup>   |

- 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 Engineer.
- 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 Engineer.
- 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. Complete replacement: The Contractor shall remove damaged material and replace it with new geotextile. The overlying geotextile will be sewn or heat-bonded to the in-place geotextile.
- C. 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 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, including clearing and tree removal.
- C. The areas to be cleared, grubbed, and stripped within public rights-of-way and utility easements shall be minimized to the extent possible for the scope of pipeline work and in consideration of the actual means and methods of construction used. No unnecessary site preparation shall be performed within these areas.

1.02 RELATED WORK

- A. Section 01350, Environmental Protection Procedures.
- B. Section 02300, Earthwork.
- C. Section 02920, Seeding and Sodding.

1.03 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.

1.04 WORK SEQUENCE (NOT USED)

1.05 REFERENCE STANDARDS (NOT USED)

1.06 QUALITY ASSURANCE (NOT USED)

1.07 WARRANTIES (NOT USED)

1.08 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.09 QUALIFICATIONS (NOT USED)

1.10 TESTING REQUIREMENTS (NOT USED)

1.11 MAINTENANCE (NOT USED)

1.12 RECORD DRAWINGS (NOT USED)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CLEARING

- A. The Contractor shall cut and remove all timber, trees, stumps, brush, shrubs, roots, grass, weeds, rubbish, and any other objectionable material resting on or protruding through the surface of the ground.
- B. The Contractor shall preserve and protect trees and other vegetation designated on the Drawings or directed by the Engineer to remain as specified below.

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, timber, logs, concrete rubble, and other debris encountered to a depth of 18 inches below original grade or 18 inches beneath the bottom of foundations, 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 02300.

3.03 STRIPPING

- A. The Contractor shall strip topsoil from all areas to be occupied by buildings, structures, and roadways and all areas to be excavated or filled.
- B. Topsoil shall be free from brush, trash, large stones, and other extraneous material. Avoid mixing topsoil with subsoil.
- C. The Contractor shall stockpile topsoil and unsuitable soil in a location onsite designated by Owner.

### 3.04 DISPOSAL

- A. Dispose of material and debris from site preparation operations by hauling such materials and debris to an approved onsite disposal area. No rubbish or debris of any kind shall be buried on the site.

### 3.05 PROTECTION

- A. Trees and other vegetation designated on the Drawings or directed by the Engineer to remain shall be protected from damage by all construction operations by erecting suitable barriers, guards and enclosures, or by other approved means. The Contractor shall conduct clearing operations in a manner to prevent falling trees from damaging trees and vegetation designated to remain and to the work being constructed. The Contractor shall provide for the safety of employees and others.
- B. The Contractor shall maintain protection until all work in the vicinity of the work being protected has been completed.
- C. The Contractor shall not operate heavy equipment or stockpile materials within the branch spread of existing trees.
- D. The Contractor shall immediately repair any damage to existing tree crowns, trunks, or root systems. Roots exposed and/or damaged during the work shall immediately be cut off cleanly inside the exposed or damaged area. Treat cut surfaces with an acceptable tree wound paint and topsoil spread over the exposed root area.
- E. When work is completed the Contractor shall remove all dead and downed trees. Live trees shall be trimmed of all dead and diseased limbs and branches. All cuts shall be cleanly made at their juncture with the trunk or preceding branch without injury to the trunk or remaining branches. Cuts over 1 inch in diameter shall be treated with an acceptable tree wound paint.
- F. The Contractor shall restrict construction activities to those areas within the limits of construction designated on the Drawings, within public rights-of-way, and within easements provided by the Owner. Adjacent properties and improvements on these properties, public or private, which become damaged by construction operations shall be promptly restored to their original condition to the full satisfaction of the property owner.

- G. The Contractor shall remove trees damaged beyond saving, through no fault of the Contractor, as directed by the Engineer. The cost to perform this work will be paid for under Miscellaneous Work and Cleanup.

END OF SECTION

SECTION 02240  
DEWATERING

PART 1 GENERAL

1.01 SCOPE OF WORK

- A. This Section covers the work necessary to complete the dewatering activities. All work in this Section shall be done in accordance with the requirements of the Environmental Resource Permit and Water Use Permit.
- B. In addition to the requirements listed in this Section, the Contractor shall obtain and comply with all requirements of the Generic Permit for the Discharge of Ground Water from Any Non-Contaminated Site Activity as described in 62-621.300, FAC.
- 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 subgrades.
  - 1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
  - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
  - 3. Remove dewatering system if no longer needed.
  - 4. The Contractor shall dewater Ash Monofill construction until Trench Gravel, Drainage Soil, and Protective Soil installation is complete.
- D. The Contractor shall dewater so as to prevent damage to existing work. The Contractor shall repair or replace damage resulting from the dewatering activities promptly, remedy environmental damage as approved by the Engineer, and pay any and all fines levied to Contractor at no additional cost or time to the Owner.
- E. The Contractor shall retain a professional engineer licensed in Florida who is experienced in dewatering to design the dewatering system. The Dewatering Plan shall be signed and sealed by the licensed professional engineer responsible for its preparation.



- F. The Contractor shall be responsible for obtaining whatever investigations are necessary, before bidding, to design the dewatering system.

## 1.02 RELATED WORK (NOT USED)

## 1.03 SUBMITTALS

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

- A. Before construction, the Contractor shall provide a detailed dewatering plan for review and approval by the Engineer before beginning dewatering. The Contractor shall then submit the approved dewatering plan the SFWMD. At a minimum, the dewatering plan shall include the following:

1. Duration of dewatering for each area.
2. Number and size of pumps.
3. Method of dewatering each area.
4. Methods for routing/containing the discharge.
5. Methods of isolating dewatering areas.
6. Time dewatering structure will be in place.
7. Proposed discharge points.

Five copies of the plan shall be submitted to the Engineer for record purposes only.

- B. The Contractor shall be responsible for determining if a Water Use Permit will be required. If a Water Use Permit is required. It is the Contractor's responsibility to obtain the required information from the Engineer and Owner to complete the Water Use Permit application to submit with the Dewatering Plan. If a Water Use Permit is required, the Contractor shall submit five copies of the application to the Owner/Engineer for submittal purposes only.
- C. The Contractor shall be responsible for obtaining a Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity as set forth in FDEP Rule 62-621.300(2), FAC. The Contractor shall obtain the required Permit Form 62-621.300(2) and the required information from the Engineer and Owner to complete the Generic Permit for the Discharge of Produced Ground Water from any Non-Contaminated Site Activity application to submit with the Dewatering Plan. The Contractor shall submit five copies of the application to the Owner/Engineer for submittal purposes only.

- D. 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.
- E. 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 (NOT USED)

#### 1.05 REFERENCE STANDARDS (NOT USED)

#### 1.06 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with water disposal requirements of authorities having jurisdiction.
- B. Pre-installation Conference: Conduct conference at the Project site to present and discuss dewatering means, methods, and monitoring program.
- C. Identify a person who shall be present 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.
- D. It shall be the responsibility of the Contractor to determine the water levels before and during the dewatering work.

#### 1.07 WARRANTIES

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

#### 1.08 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.

## 1.09 QUALIFICATIONS

- A. The Contractor shall provide at least one person who shall be present at all times during the execution of this portion of the Work and who shall be thoroughly familiar with the dewatering system being installed, the referenced standards, the requirements of this Work, and who shall direct all work performed under this Section.
- B. The Contractor shall be responsible for determining the water level before beginning excavation and construction.

## 1.10 TESTING REQUIREMENTS (NOT USED)

## 1.11 MAINTENANCE (NOT USED)

## 1.12 RECORD DRAWINGS (NOT USED)

## 1.13 PRE-BID INSPECTION AND TESTING

- A. The Contractor is advised that site soil borings may indicate groundwater levels below the levels which may occur in response to normal, seasonal, extreme, or prolonged rainfall. The 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 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 surface and subsurface dewatering as required to construct the Project in complete compliance with the Drawings and these Specifications.

## 1.14 PROJECT CONDITIONS

- A. The 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. A geotechnical report has been prepared for this Project and is available 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.

1. The following geotechnical reports are available upon request:
    - a. *Test Boring Field Reports*. January 28, 2013. Jones Edmunds & Associates, Inc. Gainesville, Florida. Prepared by Thomas R. Brown, PG.
    - b. *Report of Geotechnical Engineering Services Lee/Hendry Ash Monofill Expansion Hendry County, Florida*. March 21, 2013. Ardaman & Associates, Inc. Fort Myers, Florida. Signed and sealed by Gary A. Drew, PE.
    - c. *Report of Geotechnical Engineering Services Lee/Hendry Ash Monofill Expansion Hendry County, Florida*. April 15, 2013. Ardaman & Associates, Inc. Fort Myers, Florida. Signed and sealed by Gary A. Drew, PE.
  2. Make additional test borings and conduct other exploratory operations necessary for dewatering.
- 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 (NOT USED)

## PART 3 EXECUTION

### 3.01 DEWATERING SYSTEM

- 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 6 inches below the trench bottom.

- B. If layered soils are encountered, the hydrostatic head in the zone below the subgrade elevation shall be relieved to prevent uplift.
- 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, throughout construction to maintain and protect all work until the work has been completed to the satisfaction of the Engineer.
- D. Where used, well points shall be installed in an Engineer-approved manner and in sufficient numbers to provide the necessary removal of water as stated previously. Well points and header piping shall be installed so that traffic on public thoroughfares and site access roads will not be impeded.
- E. The Contractor shall be solely responsible for the arrangement, location, and depths of the dewatering system necessary to accomplish the specified work. The dewatering system shall stay in full operation until not less than 90% of the total building load is applied, as will be determined by the Engineer, or until excavations and trenches have been backfilled and compacted.
- F. To prevent excessive noise, exhaust from all pumps and engines shall be silenced and muffled.
- G. Wellpoint or surface water pump discharge shall be controlled to prevent erosion, undermining, and all other damage and be piped to approved locations.
- H. With the Engineer's assistance, the Contractor is responsible for determining what approvals and permits are required to comply with any and all applicable regulations and permitting requirements relating to dewatering activities. With the Engineer's assistance the Contractor shall obtain all necessary approvals and permits and comply with any and all applicable regulations and permitting requirements concerning all dewatering activities, including pumpage and discharge. The Contractor is solely responsible for all costs associated with the proper implementation of dewatering activities.
- I. The Contractor shall perform all dewatering work in strict compliance with Section 01350, Environmental Protection Procedures, and the Contract Drawings.
- J. Excavations shall be kept free from water during the placing of concrete and for 36 hours after or until concrete forms are removed.



- K. Protect structures, utilities, sidewalks, 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 subsurface or groundwater from entering excavations, ponding on prepared subgrades, or flooding the site and surrounding area.
  - 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- L. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- M. Install sufficient dewatering equipment to drain water-bearing strata above and below the bottom of foundations. If excavating through layered soils, relieve any potential groundwater hydrostatic head in the zones below to prevent uplift.
  - 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.

### 3.02 OBSERVATION WELLS

- A. The Contractor shall install observation wells as may be required to record accurate water levels.
- B. The 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.

### 3.03 CLEANUP

- A. Upon completing dewatering elsewhere on the Project, the Contractor shall remove all equipment and leave the project site in a neat, clean, and acceptable condition satisfactory to the Owner. Wellpoint holes and excavations shall be adequately backfilled and compacted to prevent settlement.

END OF SECTION

SECTION 02300  
EARTHWORK

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 Ash Monofill Expansion and Composting Facility Expansion including the following:
1. Clearing and Stripping
  2. Excavating
  3. Hauling
  4. Soil Stockpiling
  5. Soil Filling: Subgrade Fill, Structural Fill, and Embankment Fill
  6. Compacting
  7. Grading
  8. Preparing Subgrade
  9. Anchor Trench Backfilling
  10. Drainage Soil Filling
  11. Protective Soil Filling
  12. Trench Gravel Filling

1.02 RELATED WORK

- A. Section 01350, Environmental Protection Procedures.  
B. Section 02070, Geocomposite.  
C. Section 02071, Geomembrane (HDPE).  
D. Section 02072, Geosynthetic Clay Liner.  
E. Section 02074, Geotextile.  
F. Section 02230, Site Preparation.  
G. Section 02240, Dewatering.  
H. Section 02700, Paving.  
I. Section 03300, Cast-In-Place Concrete.

### 1.03 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. Soil Management Plan

- a. The Contractor shall provide a detailed Soil Management Plan signed by the Contractor. Information that may aid the Contractor in preparing the Soil Management Plan is included with supplemental information available to Bidders.
- b. The Owner's site soil investigation reports are available for reference but are not Contract Documents included in these Specification. The Contractor shall verify site subsurface conditions.
- c. The Soil Management Plan shall include the project title, Engineer'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.
- d. The Soil Management Plan shall include procedures for site clearing and proposed disposal methods of cleared materials.
- e. The Soil Management Plan shall include a breakdown of estimated volume for each of the soil types specified from each of the possible sources including Drainage Soil and Protective Soil. The Soil Management Plan should show that sufficient quantity is available from the borrow sources to complete the project.
- f. The Soil Management Plan shall include procedures and locations for excavation, segregating, stockpiling, loading, and removing the unsuitable soils from the Limits of Construction. The Plan shall anticipate that stripping 1 foot of unsuitable soil over the Ash Monofill Expansion Area is required and other unsuitable soil may be present. The Plan shall demonstrate how the Contractor will use excavated soil for earthfill while minimizing stockpiling and double handling.

- g. The Soil Management Plan shall identify stockpile and staging areas indicated in accordance with the Drawings and the Owner's requirements.
- h. The Soil Management 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.
- i. The Soil Management 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.
- j. The Soil Management Plan shall include controls for stormwater runoff and groundwater management in accordance with Specification Section 02240, Dewatering, and erosion control in accordance with Specification Section 01350, Environmental Protection Procedures. The Plan shall include procedures to prevent surface water and dewatering water from flowing into excavated areas.

## 2. Construction Quality Control Plan

- a. The Contractor shall provide a detailed Construction Quality Control (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.
- b. The CQC Plan shall include project title, Engineer's project number, project location, sample test identification numbering procedures, sample soil test and retest reports, and sample test location site plans.
- c. The Contractor shall retain an independent Geotechnical Testing Agency to perform CQC testing of the material sources and in-place materials testing including, density and moisture content (see Article 1.06).
- d. 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.



3. Drainage Soil and Protective Soil Installation Plan

- a. The Contractor shall provide a detailed Drainage Soil and Protective Soil Installation Plan signed by the Contractor addressing placement methods of the Drainage Soil, Protective 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.
- b. The Drainage Soil and Protective Soil Installation Plan shall include project title, Engineer'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. Refer to Article 3.11 for additional requirements.
- c. The Drainage Soil and Protective Soil Installation Plan shall include a sample of the proposed marker to be used for measuring Drainage Soil, Protective 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.
- d. The Drainage Soil and Protective Soil 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.
- e. The Drainage Soil and Protective Soil Installation Plan shall be coordinated with the Soils Management Plan, identify on-site sources for Drainage Soil and Protective Soil, and identify location for stockpiling imported gravel.

- B. **Project-Specific Material Source Certificates of Compliance:** The Contractor shall submit the following a minimum of 30 days before proposed placement of Soil Materials:
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. Sources included off-site gravel to be identified by the Contractor, onsite stockpiles, and Ash Monofill excavation.
  2. The Material Source Certificates of Compliance shall include project title, Engineer'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 Contractor shall confirm on-site stockpiles meet project requirements or notify the Owner immediately.

| Table 1 Material Source Certification                 |                                      |  |
|---|--------------------------------------|--|
| Property  | Test Designation                     | Frequency  |
| USCS Soil Classification                              | ASTM D2487<br>(excluding hydrometer) | 1 test per source.   |
| Compaction Characteristics                            | ASTM D1557                           | 1 test per source.   |
| Carbonate Content                                     | ASTM D4373                           | 1 test per source.   |
| Organic Content                                       | ASTM D2974<br>Method C or D          | 1 test per source.   |
| Permeability<br>(for Drainage Soil and Trench Gravel) | ASTM D2434                           | 1 per source - samples compacted to 90% Modified Proctor dry density for permeability. |

- 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, Engineer'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.  |
| Compaction Characteristics (for Subgrade and Embankment 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.  |
| Permeability (for Drainage Soil and Trench Gravel)            | 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 and Embankment Fill) | ASTM D1557                        | 1 per 10,000 CY before compaction.   |
| In-place density (for Subgrade and Soil Fill)                 | ASTM D2937, D1556, or D6938       | 2 per acre (for Subgrade)<br>1 per 10,000 sf per lift (for General and Structural Fill)<br>1 per 250 linear feet per lift (for Anchor Trench Fill) |

| Table 2 Construction Quality Control Testing                      |                            |   |
|---|----------------------------|---|
| Property  | Test Designation           | Frequency   |
| In-place moisture content (for Subgrade and Embankment Fill)      | ASTM D2216, D4643 or D6938 | 2 per acre (for Subgrade)<br>1 per 10,000 sf per lift (for General and Structural Fill)<br>1 per 250 linear feet per lift (for Anchor Trench Fill)            |
| Thickness (for Protective Soil, Drainage Soil, and Trench Gravel) |                            | 4 per acre before covering with next lift (for Protective Soil and Drainage Soil)<br>1 per 50 linear feet before covering with geotextile (for Trench Gravel) |

5. The test or sample location shall be identified by giving dimensions from known points of reference and shown on a site map.
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.

#### 1.04 WORK SEQUENCE

- A. The Contractor shall begin with dewatering and must allow time for dewatering in the schedule.
- B. The Curing area of the compost facility must be completed before other field work on the compost facility can begin.
- C. Sequencing shall maximize the use of excavated soil for soil fill without intermediate stockpiling.

#### 1.05 REFERENCE STANDARDS

Reference standards and recommended practices referred to in this Specification 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.