



**Gude Landfill Remediation Design  
Project Manual  
Montgomery County, Maryland  
60% Revised Submission**

*Prepared for*

Northeast Maryland Waste Disposal Authority and  
Montgomery County Department of Environmental Protection  
Recycling and Resource Management Division  
Montgomery County, Maryland

*Prepared by*

EA Engineering, Science, and Technology, Inc., PBC  
225 Schilling Circle, Suite 400  
Hunt Valley, Maryland 21031  
(410) 584-7000

January 2020  
EA Project No. 15646.01

*This page intentionally left blank*

**GUDE LANDFILL REMEDIATION  
CONSTRUCTION SPECIFICATIONS**

**Note: Sections that are struck through are anticipated for 90% Design submittal.**

**CONTENTS**

DIVISION 0 – PROCUREMENT

<del>IFB</del>	<del>INVITATION FOR BIDS</del>
<del>SECTION 00 31 19</del>	<del>EXISTING CONDITION INFORMATION</del>
<del>SECTION 00 52 13</del>	<del>SAMPLE CONTRACT</del>
<del>SECTION 00 71 00</del>	<del>CONTRACTING DEFINITIONS</del>
<del>SECTION 00 73 00</del>	<del>SUPPLEMENTARY CONDITIONS</del>

DIVISION 1 – GENERAL REQUIREMENTS

SECTION 01 11 00	SUMMARY OF WORK
<del>SECTION 01 20 00</del>	<del>MEASUREMENT AND PAYMENT</del>
SECTION 01 26 00	CONTRACT MODIFICATION PROCEDURES
SECTION 01 31 19.13	PRECONSTRUCTION MEETING
SECTION 01 31 19.23	PROGRESS MEETINGS
SECTION 01 32 33	PHOTOGRAPHIC DOCUMENTATION
<del>SECTION 01 33 00</del>	<del>SUBMITTALS</del>
SECTION 01 40 00	QUALITY CONTROL
SECTION 01 45 00	HEALTH AND SAFETY
SECTION 01 50 00	MOBILIZATION, DEMOBILIZATION, AND TRAFFIC CONTROL
<del>SECTION 01 57 19</del>	<del>TEMPORARY ENVIRONMENTAL CONTROLS</del>
<del>SECTION 01 58 13</del>	<del>PROJECT IDENTIFICATION AND SIGNS</del>
SECTION 01 59 00	TEMPORARY FACILITIES AND CONTROLS
SECTION 01 70 00	EXECUTION AND CLOSEOUT REQUIREMENTS

DIVISION 2 – EXISTING CONDITIONS

<del>SECTION 02 41 00</del>	<del>DEMOLITION</del>
SECTION 02 61 13.13	WASTE EXCAVATION AND MATERIAL HANDLING
<del>SECTION 28 13 00</del>	<del>ACCESS CONTROL</del>
<del>SECTION 28 23 00</del>	<del>VIDEO SURVEILLANCE</del>

DIVISION 3 – CONCRETE

<del>SECTION 03 30 53</del>	<del>MISCELLANEOUS CAST IN PLACE CONCRETE</del>
-----------------------------	---

DIVISION 31 – EARTHWORK

SECTION 31 05 15	EARTHWORK
<del>SECTION 31 05 16</del>	<del>AGGREGATES</del>
SECTION 31 05 19.13	GEOTEXTILES
SECTION 31 05 19.16	GEOMEMBRANE
SECTION 31 05 19.26	GEOCOMPOSITE
<del>SECTION 31 05 19.29</del>	<del>ALTERNATE CLOSURE CAP SECTION</del>
SECTION 31 09 13	SETTLEMENT PLATES
SECTION 31 11 00	CLEARING AND GRUBBING
<del>SECTION 31 25 00</del>	<del>EROSION AND SEDIMENT CONTROL</del>

DIVISION 32 – EXTERIOR IMPROVEMENTS

<del>SECTION 32 15 00</del>	<del>AGGREGATE SURFACING</del>
<del>SECTION 32 31 13</del>	<del>CHAIN LINK FENCES AND GATES</del>
<del>SECTION 32 92 00</del>	<del>TURF AND GRASSES</del>

DIVISION 33 – UTILITIES

<del>SECTION 33 31 00</del>	<del>PIPING AND APPURTENANCES</del>
<del>SECTION 33 40 00</del>	<del>STORM DRAINAGE UTILITIES</del>
SECTION 33 51 10	LANDFILL GAS MANAGEMENT SYSTEM PIPE, PIPE FITTINGS, AND VALVES
SECTION 33 51 11	LANDFILL GAS EXTRACTION WELL AND CONDENSATE DRAIN SYSTEM

ATTACHMENTS

**SECTION 01 11 00  
SUMMARY OF WORK**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. The Work to be performed under these Contract Documents consists of the construction of a closure cap for the Gude Landfill located in Montgomery County, Maryland. This Specification Section provides a general description of the scope of work. The CONTRACTOR shall refer to the appropriate detailed Specification Section for additional information. The work includes, but is not limited to, the following:

1. Gude Landfill Closure:

- a. Clearing, grubbing, and stripping all areas within the limit of work.
- b. Demolition of existing stormdrain structures, dewatering sumps, and foundations as noted in the Contract Drawings.
- c. Preparation of the landfill closure cap subgrade which consists of:
  - 1) Existing cover soil excavation and stockpiling.
  - 2) Grading and soil/waste relocation.
  - 3) Placement of minimum one (1) foot of final cover soil over relocated waste.
- d. Construction of surface drainage benches and gabion slope drain channels.
- e. Construction of landfill closure cap from bottom to top consists of:
  - 1) Hydraulic barrier layer consisting of forty (40)-mil linear low density polyethylene geomembrane, underlain by geotextile.
  - 2) Geosynthetic drainage layer consisting of double-sided geocomposite.
  - 3) Minimum one (1)-foot, eight (8)-inch-thick layer of Vegetative Support Soil and minimum four (4)-inch-thick layer of Topsoil.
  - 4) An alternate closure cap may be selected by the OWNER and would consist of a material that combines the geomembrane and geocomposite drainage layer into a single product.

- f. Construction of daylighted drainage systems.
  - g. Improvements to active landfill gas collection system including modifying existing extraction wells, new extraction wells, new below-grade lateral and header collection piping, and installing new condensate drains.
  - h. Construction of access roads.
  - i. Construction/implementation of stormwater management controls and improvements.
  - j. Placement and maintenance of erosion and sediment controls as depicted in the Contract Drawings and in accordance with applicable local and state regulations including silt fence, super silt fence, bench construction, swale construction, pumping and filtering practices, and temporary stabilization.
  - k. Permanent seeding, mulching, and fertilization.
  - l. Other project or Contract work as shown on the Contract Drawings and as specified herein.
- B. The project site is located in Montgomery County, Maryland, at 600 East Gude Drive, Rockville, Maryland 20850. The detailed scope of work is annotated in the following sections. The CONTRACTOR is to coordinate his work (materials handling and traffic) with the landfill operators and other site contractors. The CONTRACTOR is to be advised that Work operations will be adjacent to private homeowners; therefore, working hours as well as noise and dust control will be monitored and strictly enforced.
- C. Hours of Work are defined in the General Conditions.
- D. The summary of the Work described in the Division 01 Sections is an overall summary of the responsibilities of the CONTRACTOR and his relationship to the OWNER. It does not represent an all-encompassing listing of the project work nor does it supersede the specific requirements elsewhere in the Contract Documents.

**1.1.2 Related Work Specified Elsewhere**

- A. Not used.

**1.2 References**

- A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. Not used.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

**1.10 Contracts**

A. The Work shall be coordinated by the CONTRACTOR.

**1.11 Work By Others**

A. Work by OWNER:

1. The OWNER may let other contractors within the Gude Landfill site during the term of this Contract. The CONTRACTOR will cooperate with other contractors and activities associated with this Work.

**1.12 Sequence of Work**

A. CONTRACTOR is responsible for establishing a schedule, to be approved by the CONSTRUCTION MANAGEMENT ENGINEER, for the sequence and progress of the Work. CONTRACTOR shall be solely responsible for coordination of all the Work to ensure completion of the Work within the time limits specified in the Contract.

**1.13 Contractor's Use of Premises**

A. CONTRACTOR'S use of the premises shall be confined to the areas within the Limits of Disturbance or as approved by the OWNER.

B. CONTRACTOR shall:

1. Assume full responsibility for protection and safekeeping of products stored on or off premises.
2. Move/relocate stored products that interfere with the operations of OWNER.
3. Obtain and pay for all additional storage or work areas required for the construction operations.

C. Limits on CONTRACTOR'S use of site:

1. Shall be by agreement between the OWNER and the CONTRACTOR.
2. CONTRACTOR shall provide and maintain temporary facilities and access to these facilities for the duration of the Contract.

**2. MATERIALS**

A. Not used.

**3. EXECUTION**

A. Not used.

-- End of Section --



**SECTION 01 26 00**  
**CONTRACT MODIFICATION PROCEDURES**

**1. GENERAL**

**1.1 Description**

A. General

1. This Section expands upon provisions of the General Conditions and Supplementary Conditions, and includes:
  - a. Requests for interpretation.
  - b. Minor changes in the Work and Field Orders.
  - c. Work Change Directives.
  - d. Proposal requests.
  - e. Change Order proposals.
  - f. Change Orders.

B. Submit Contract modification documents to CONSTRUCTION MANAGEMENT ENGINEER at addresses in Section 01 33 00, Submittals.

C. Retain at CONTRACTOR'S office and at the Site complete copy of each Contract modification document and related documents, and OWNER'S and CONSTRUCTION MANAGEMENT ENGINEER'S responses.

**1.1.1 Requests For Interpretation**

A. General

1. Submit written requests for interpretation to CONSTRUCTION MANAGEMENT ENGINEER.
2. Submit request for interpretation to obtain clarification or interpretation of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents using requests for interpretation.
3. Do not submit request for interpretation when other form of communication is appropriate, such as submittals, requests for substitutions or "or equals," notices, ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action and noted as such.

## B. Procedure

1. Submit one (1) original and one (1) copy and an electronic PDF document of each request for interpretation to the CONSTRUCTION MANAGEMENT ENGINEER for distribution. CONSTRUCTION MANAGEMENT ENGINEER will forward the request for distribution to the following:
    - a. CONSTRUCTION MANAGEMENT ENGINEER (original).
    - b. OWNER (copy).
  2. CONSTRUCTION MANAGEMENT ENGINEER will provide review of requests for interpretation and will provide response within three (3) days. Allow sufficient time for review and response.
  3. CONSTRUCTION MANAGEMENT ENGINEER will maintain log of requests for interpretation. Copy of log will be provided upon request.
  4. CONSTRUCTION MANAGEMENT ENGINEER will provide written response to each request for interpretation. One (1) copy of CONSTRUCTION MANAGEMENT ENGINEER'S electronic response (via email) will be distributed to CONTRACTOR and OWNER.
  5. If CONSTRUCTION MANAGEMENT ENGINEER requests additional information to make an interpretation, provide information requested within five (5) days, unless CONSTRUCTION MANAGEMENT ENGINEER allows additional time, via correspondence referring to request for interpretation number.
  6. If CONTRACTOR believes that a change in Contract Price or Contract Times or other change to the Contract is required, notify CONSTRUCTION MANAGEMENT ENGINEER in writing before proceeding with Work associated with the request for interpretation.
- C. Each request for interpretation shall be submitted on the request for interpretation form included with this Section, or other form acceptable to CONSTRUCTION MANAGEMENT ENGINEER.
1. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three (3)-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract No. XXXX Gude Remediation" would be, "RFI No. X Contract XXXX-GC-001."
  2. In space provided on form, describe the interpretation requested. Provide additional sheets as required. Include text and sketches as required in sufficient detail for CONSTRUCTION MANAGEMENT ENGINEER's response.

3. When applicable, request for interpretation shall include CONTRACTOR'S recommended resolution.

### **1.1.2 Minor Changes in Work and Field Orders**

#### **A. General**

1. A Field Order, when required, will be initiated by CONSTRUCTION MANAGEMENT ENGINEER and issued by OWNER.
2. Field Orders authorize minor variations in the Work, but do not change the Contract Price or Contract Times.
3. Field Orders will be submitted on the field order form included with this Section.
4. CONSTRUCTION MANAGEMENT ENGINEER will maintain a log of Field Orders Issued.

#### **B. Procedure**

1. One (1) copy of each Field Order will be distributed to:
  - a. CONTRACTOR.
  - b. OWNER.
  - c. CONSTRUCTION MANAGEMENT ENGINEER.
2. If Field Order is unclear, submit request for interpretation.
3. If CONTRACTOR believes that a change in Contract Price or Contract Times or other change to the Contract is required, immediately notify OWNER and CONSTRUCTION MANAGEMENT ENGINEER in writing. Approval is required before proceeding with Work associated with the Field Order.

### **1.1.3 Work Change Directives**

#### **A. General**

1. Work Change Directives are for use in situations involving changes in the Work which, if not processed expeditiously, might delay the project. These changes are often initiated in the field and may affect the Contract Price or the Contract Times. They are not a Change Order, but only a directive to proceed with Work that may be included in a subsequent Change Order.
2. Work Change Directives, when required, order additions, deletions, or revisions to the Work.

3. Work Change Directives do not change the Contract Price or Contract Times, but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times. Work Change Directives require approval from the Northeast Maryland Waste Disposal Authority prior to implementation.
4. Work Change Directives will be submitted on the work change directive form included with this Section.

#### B. Procedure

1. Three (3) originals of Work Change Directive signed by OWNER and CONSTRUCTION MANAGEMENT ENGINEER will be furnished to CONTRACTOR, who shall promptly sign each original Work Change Directive and, within five (5) days of receipt, return all originals to CONSTRUCTION MANAGEMENT ENGINEER.
2. Original, signed Work Change Directives will be distributed as follows:
  - a. CONTRACTOR: One (1) original.
  - b. OWNER: One (1) original.
  - c. CONSTRUCTION MANAGEMENT ENGINEER: One (1) original.
3. When required by CONSTRUCTION MANAGEMENT ENGINEER, documentation for the Work performed under each separate Work Change Directive, for each day, the number and type of workers employed and hours worked; equipment used including manufacturer, model, and year of equipment, and number of hours; materials used, receipts for and descriptions of materials and equipment incorporated into the Work, invoices and labor and equipment breakdowns for Subcontractors and Suppliers, and other information required by OWNER or CONSTRUCTION MANAGEMENT ENGINEER, in a format acceptable to CONSTRUCTION MANAGEMENT ENGINEER. Submit this documentation to CONSTRUCTION MANAGEMENT ENGINEER as a Change Order proposal.
4. Once the Work covered by this directive is completed or final costs and times are determined, CONTRACTOR shall submit documentation for inclusion in a Change Order.

#### 1.1.4 Proposal Requests

##### A. General

1. Proposal requests are initiated by OWNER.

2. Proposal requests are for requesting the effect on Contract Price and Contract Times and other information relative to contemplated changes in the Work.
3. Proposal requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
4. Proposal requests will be furnished using the proposal request form included with this Section.

B. Procedure

1. One (1) copy of each signed proposal request will be furnished to CONTRACTOR with one (1) copy each to:
  - a. OWNER.
  - b. CONSTRUCTION MANAGEMENT ENGINEER.
2. Submit request for interpretation to clarify conflicts, errors, ambiguities, and discrepancies in proposal request.
3. Upon receipt of proposal request, CONTRACTOR shall prepare and submit a Change Order proposal, in accordance with this Section, for the proposed Work described in the proposal request.

**1.1.5 Change Order Proposals**

A. General

1. Submit written Change Order proposal to OWNER and CONSTRUCTION MANAGEMENT ENGINEER in response to each proposal request, and when CONTRACTOR believes a change in the Contract Price or Contract Times or other change to the terms of the Contract is required.

B. Procedure

1. Submit to CONSTRUCTION MANAGEMENT ENGINEER one (1) original and four (4) copies of each Change Order proposal with accompanying documentation. CONSTRUCTION MANAGEMENT ENGINEER will distribute for review.
2. CONSTRUCTION MANAGEMENT ENGINEER will review Change Order proposal and either request additional information from CONTRACTOR or provide to OWNER recommendation regarding approval of the Change Order proposal.
3. If CONSTRUCTION MANAGEMENT ENGINEER requests additional information to render a decision, submit required information within five (5) days of receipt of CONSTRUCTION MANAGEMENT ENGINEER's request, unless

CONSTRUCTION MANAGEMENT ENGINEER allows greater amount of time. Submit the required information via correspondence that refers to Change Order proposal number.

4. Upon completing review, one (1) copy of CONSTRUCTION MANAGEMENT ENGINEER's written response, if any, will be distributed to:
    - a. CONTRACTOR.
    - b. OWNER.
    - c. CONSTRUCTION MANAGEMENT ENGINEER.
  5. If Change Order proposal is recommended for approval by CONSTRUCTION MANAGEMENT ENGINEER and approved by OWNER, a Change Order will be issued.
  6. If parties do not agree on terms for the change, OWNER or CONTRACTOR may file a Claim against the other, in accordance with the General Conditions and the Supplementary Conditions.
- C. Each Change Order proposal shall be submitted on the Change Order proposal form included with this Section, or other form acceptable to OWNER.
1. Number each Change Order proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three (3)-digit sequential number. Example: First Change Order proposal for the general contract for project named "Contract 13-229" would be, "Change Order Proposal No. 13-229-001."
  2. In space provided on form:
    - a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for CONSTRUCTION MANAGEMENT ENGINEER'S review and response. If a change item is submitted in response to proposal request, write in as scope, "In accordance with Proposal Request No." followed by the proposal request number. Provide written clarifications, if any, to scope of change.
    - b. Provide justification for each proposed change. If change is in response to proposal request, write in as justification, "In accordance with Proposal Request No." followed by the proposal request number.
    - c. List the total change in Contract Price and Contract Times for each proposed change.
  3. Unless otherwise directed by CONSTRUCTION MANAGEMENT ENGINEER, attach to the Change Order proposal detailed breakdowns of pricing (Cost of the Work and CONTRACTOR'S fee) including:

- a. List of Work tasks to accomplish the change.
- b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification.
- c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each.
- d. Detailed breakdown of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier's written quotations.
- e. Breakdowns of the Cost of the Work and fee for Subcontractors, including labor, construction equipment and machinery, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees.
- f. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions.
- g. Other information required by CONSTRUCTION MANAGEMENT ENGINEER.
- h. CONTRACTOR'S fees applied to eligible CONTRACTOR costs and eligible Subcontractor costs.

### **1.1.6 Change Orders**

#### **A. General**

1. Change Orders will be recommended by CONSTRUCTION MANAGEMENT ENGINEER, signed by CONTRACTOR and approved by OWNER, to authorize additions, deletions, or revisions to the Work, or changes to the Contract Price or Contract Times.
2. Change Orders will be issued utilizing the form included.

#### **B. Procedure**

1. Three (3) originals of each Change Order will be furnished to CONTRACTOR, who shall promptly sign each original Change Order and return all originals to OWNER within five (5) days of receipt.
2. Each original Change Order will be signed by representatives of OWNER and forwarded to the Northeast Maryland Waste Disposal Authority for approval.

3. After approval by County, original Change Orders will be distributed to CONTRACTOR, OWNER, and CONSTRUCTION MANAGEMENT ENGINEER.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. Not used.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

**1.10 Contracts**

A. Not used.

**1.11 Work By Others**

B. Not used.

**1.12 Sequence of Work**

C. Not used.



**1.13 CONTRACTOR'S Use of Premises**

A. Not used.

**2. MATERIALS**

A. Not used.

**3. EXECUTION**

A. Not used.

-- End of Section --

**MONTGOMERY COUNTY, MARYLAND  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
RECYCLING AND RESOURCE MANAGEMENT DIVISION  
GUDE LANDFILL REMEDIATION PROJECT**

**REQUEST FOR INTERPRETATIONS**

CONTRACTOR: \_\_\_\_\_ RFI No. \_\_\_\_\_  
Date Transmitted: \_\_\_\_\_ Date Received: \_\_\_\_\_  
Date Response Requested: \_\_\_\_\_ Date Response Transmitted: \_\_\_\_\_

Subject: \_\_\_\_\_  
Specification Section and Paragraph: \_\_\_\_\_

Drawing References: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**INTERPRETATION REQUESTED:**

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

**CONSTRUCTION MANAGEMENT ENGINEER'S RESPONSE:**

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

**MONTGOMERY COUNTY, MARYLAND  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
RECYCLING AND RESOURCE MANAGEMENT DIVISION  
GUDE LANDFILL REMEDIATION PROJECT**

**WORK CHANGE DIRECTIVE NO. \_\_\_\_\_**

DATE OF ISSUANCE: \_\_\_\_\_ EFFECTIVE DATE: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

Contract: \_\_\_\_\_

You are directed to proceed promptly with the following change(s):  
Description:

Purpose of Work Change Directive:

Attachments: (List documents supporting change)

If OWNER or CONTRACTOR believe that the above change has affected Contract Price any Claim for a Change Order based thereon will involve one (1) or more of the following methods as defined in the Contract Documents.

Method of determining change in Contract Price:

- Unit Prices  
 Lump Sum  
 Cost of the Work \_\_\_\_\_

**Estimated change in Contract Price and Contract Times:**

Contract Price \$ \_\_\_\_\_ (increase/decrease) Contract Time \_\_\_\_\_ (increase/decrease)  
days

If the change involves an increase, the estimated amounts are not to be exceeded without further authorization.

Recommended for Approval by Construction Management Engineer:	Date
Authorized for Owner by:	Date
Accepted for Contractor by:	Date
Approved by Northeast Maryland Waste Disposal Authority:	Date:

**MONTGOMERY COUNTY, MARYLAND  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
RECYCLING AND RESOURCE MANAGEMENT DIVISION  
GUDE LANDFILL REMEDIATION PROJECT**

**PROPOSAL REQUEST**

Proposal Request No.: \_\_\_\_\_ Date: \_\_\_\_\_

Contract Name and No.: \_\_\_\_\_

Contractor: \_\_\_\_\_

Other Contracts Involved in Proposed Change: \_\_\_\_\_  
\_\_\_\_\_

TO CONTRACTOR: Please submit a complete Change Order proposal for the proposed modifications described below. If the associated Change Order proposal is approved, a Change Order will be issued to authorize adjustment so the scope of Work. This Proposal Request is not a Change Order or an authorization to proceed with the proposed Work described below.

**SCOPE OF PROPOSED WORK:**

1. *Item:*
2. *Item:*
3. *Item:*

Proposal Requested By: \_\_\_\_\_

Signature of Requestor: \_\_\_\_\_

**MONTGOMERY COUNTY, MARYLAND  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
RECYCLING AND RESOURCE MANAGEMENT DIVISION  
GUDE LANDFILL REMEDIATION PROJECT**

**CHANGE ORDER PROPOSAL**

Change Order Proposal No.: \_\_\_\_\_ Date: \_\_\_\_\_

Submitted in Response to Proposal Request No.: \_\_\_\_\_

Contract Name and No.: \_\_\_\_\_

Contractor: \_\_\_\_\_

Subject: \_\_\_\_\_

The following changes to the Contract are proposed:

**SCOPE OF WORK:** *(attach and list supporting information as required)*

1. *Item:*
2. *Item:*

**JUSTIFICATION:**

1. *Item:*
2. *Item:*

**CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:**

We propose that the Contract Price and Contract Times be changed as follows:

*For Contract Price, when requested by CONSTRUCTION MANAGEMENT ENGINEER, attach detailed cost breakdowns, Supplier quotations, and other information required.*

*For Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to Contract Times.*

Description	Amount	Contract Times (days)	
		Substantial	Final
1. Item	\$0.00	0	0
2. Item	\$0.00	0	0
<i>Total This Change Order Proposal</i>	<i>\$0.00</i>	<i>0</i>	<i>0</i>

Changes to Milestones, if any: \_\_\_\_\_

The adjustment proposed is the entire adjustment to the Contract to which the proposer believes it is entitled as a result of the proposed change.

Change Order Proposal By: \_\_\_\_\_

Signature of Proposer: \_\_\_\_\_

**MONTGOMERY COUNTY, MARYLAND  
DEPARTMENT OF ENVIRONMENTAL PROTECTION  
RECYCLING AND RESOURCE MANAGEMENT DIVISION**

**CHANGE ORDER NO. \_\_\_\_\_**

**PROPOSAL NO:** \_\_\_\_\_ **PROJECT:** Gude Landfill Remediation Project  
**DATE:** \_\_\_\_\_ **CONTRACTOR:** \_\_\_\_\_

You are directed to make the following changes in the Contract Documents:

Description:

- Item:

Reason for Change Order:

- Item:

Attachments: (List documents supporting change): 1. Item:

CHANGE IN CONTRACT PRICE:
Original Contract Price: \$ _____
Net increase (decrease) from previous Change Orders No. _____ to _____: \$ _____
Contract Price prior to this Change Order: \$ _____
Net increase (decrease) of this Change Order \$ _____
Contract Price with all approved Change Orders \$ _____

CHANGE IN CONTRACT TIMES:
Original Contract Times: Substantial Completion: _____ Ready for final payment: _____ (days or dates)
Net change from previous Change Orders No. ___ to ___: Substantial Completion: _____ Ready for final payment: _____ (days)
Contract Times prior to this Change Order Substantial Completion: _____ Ready for final payment: _____ (days or dates)
Net increase (decrease) of this Change Order Substantial Completion: _____ Ready for final payment: _____ (days)
Contract Times with all approved Change Orders Substantial Completion: _____ Ready for final payment: _____ (days or dates)

RECOMMENDED:

By: \_\_\_\_\_  
**XXX**  
(Construction Management Engineer)

RECOMMENDED:

By: \_\_\_\_\_  
Project Manager, Recycling and  
Resource Management Division

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

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

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

By: \_\_\_\_\_  
Chief Engineer, Recycling and  
Resource Management Division

By: \_\_\_\_\_  
Director of Procurement

By: \_\_\_\_\_  
(Contractor)

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

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

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

01 26 00-14

Recycled Paper

**SECTION 01 31 19.13  
PRECONSTRUCTION MEETING**

**1. GENERAL**

**1.1 Description**

- A. The Preconstruction Meeting will be held to establish a working understanding among the parties as to the Work and to discuss the Preliminary Schedules, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. CONTRACTOR shall attend the conference prepared to discuss all items on the agenda. The representatives present for each party shall be authorized to act on their behalf.
- C. Purpose of the conference is to designate responsible personnel, establish working relationships, and establish administrative provisions for the Project. Matters requiring coordination will be discussed and procedures for handling such matters will be established.
- D. Date, Time and Location: Conference will be held after execution of the Contract and before Work starts at the Site. CONSTRUCTION MANAGEMENT ENGINEER will determine the date, time, and location of the conference and advise the interested and involved parties.
- E. CONSTRUCTION MANAGEMENT ENGINEER will distribute an agenda and preside at the conference. CONSTRUCTION MANAGEMENT ENGINEER will prepare and distribute meeting minutes to all meeting participants and others as requested. CONTRACTOR will review the draft minutes and provide comment to all within four (4) days.
- F. CONTRACTOR shall provide data required and contribute appropriate items for discussion. Unless previously submitted to OWNER and CONSTRUCTION MANAGEMENT ENGINEER, CONTRACTOR shall bring to the conference a draft of each of the following or any other pertinent (relevant) information:
  - 1. Progress Schedule.
  - 2. List of required Shop Drawings and submittals.
  - 3. Schedule of Values.
  - 4. Contractor's Site-Specific Health and Safety Plan.
  - 5. List of emergency contact information.

### **1.1.1 Required Attendance**

- A. Conference shall be attended by CONTRACTOR'S project manager, Site superintendent, and major Subcontractors and major equipment Suppliers, as CONTRACTOR deems appropriate.
- B. Other attendees will be representatives of:
  - 1. Montgomery County Department of Environmental Protection (OWNER).
  - 2. CONSTRUCTION MANAGEMENT ENGINEER.
  - 3. Northeast Maryland Waste Disposal Authority representative.
  - 4. Governmental agencies having control or responsibility, if available.
  - 5. Others as requested by OWNER, CONTRACTOR, or CONSTRUCTION MANAGEMENT ENGINEER.

### **1.1.2 Agenda**

- A. Agenda: CONTRACTOR shall be prepared to discuss the following:
  - 1. Designation of responsible personnel.
  - 2. Communications and correspondence.
  - 3. Coordination with other contractors.
  - 4. Emergency contact information.
  - 5. Review of Scope of Work.
  - 6. Review of Contract Times, Milestones, and completion dates.
  - 7. Subcontractors.
  - 8. Progress Schedule.
  - 9. Schedule of Values.
  - 10. Project coordination and coordination with OWNER'S operations.
  - 11. Progress meetings.
  - 12. Submittals and Shop Drawings: processing and schedule of submittals.
  - 13. Substitutions.
  - 14. Owner's tax-exempt status.
  - 15. Payments, retainage, payrolls, and Substantial Completion.
  - 16. Processing of Field Orders and Change Orders.
  - 17. Use of premises, security, housekeeping, safety, CONTRACTOR'S responsibility for safety and first aid procedures, Site access.
  - 18. Field offices, trailers, temporary facilities.
  - 19. Storage of materials.
  - 20. Construction photographs.
  - 21. Record drawings.
  - 22. Clarifications.
  - 23. Requirements for copies of Contract Documents and availability.
  - 24. CONTRACTOR correction period.
  - 25. Layouts and surveys.
  - 26. Hours of Work and overtime.



27. Restoration.
28. Permits.
29. Insurance in force.
30. Financing.
31. Disposal of demolition materials.
32. Next meeting.
33. General discussion and questions.
34. Site visit if required.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. Not used.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

**1.10 Contracts**

A. Not used.

**1.11 Work By Others**

A. Not used.

**1.12 Sequence of Work**

A. Not used.

**1.13 Contractor's Use of Premises**

A. Not used.

**2. MATERIALS**

A. Not used.

**3. EXECUTION**

A. Not used.

-- End of Section --

**SECTION 01 31 19.23  
PROGRESS MEETINGS**

**1. GENERAL**

**1.1 Description**

- A. Progress meetings will be held throughout the Project. CONTRACTOR shall attend each meeting prepared to discuss all items on the agenda. The representatives present for each party shall be authorized to act on their behalf.
- B. Date and Time:
  - 1. Every month on a day and time agreeable to OWNER, CONSTRUCTION MANAGEMENT ENGINEER, and CONTRACTOR.
  - 2. Frequency may be adjusted as required by progress of Work.
- C. Place: CONTRACTOR'S or CONSTRUCTION MANAGEMENT ENGINEER'S trailer or other mutually agreed upon location.
- D. OWNER and CONSTRUCTION MANAGEMENT ENGINEER will preside at meetings. CONSTRUCTION MANAGEMENT ENGINEER will prepare and distribute meeting minutes to all meeting participants and others as requested.
- E. CONTRACTOR shall provide to the CONSTRUCTION MANAGEMENT ENGINEER the following data a minimum of two (2) days prior to the meeting:
  - 1. List of work accomplished since the previous progress meeting
  - 2. Schedule of Work with specific starting and ending dates for each task, planned until the next progress meeting
  - 3. "Look-ahead" Schedule of Work for major shutdowns, major equipment installations, and other important milestones
  - 4. List of upcoming planned time off, including dates, for personnel with significant roles on the project and designated contact person during their absence

**1.1.1 Minimum Attendance**

- A. CONTRACTOR:
  - 1. CONTRACTOR'S project manager.
  - 2. CONTRACTOR'S site superintendent.

3. When needed for the discussion of a particular agenda item, CONTRACTOR shall require representatives of Subcontractors or Suppliers to attend a meeting.
- B. OWNER'S Project Manager.
- C. CONSTRUCTION MANAGEMENT ENGINEER.
- D. Northeast Maryland Waste Disposal Authority.
- E. Others, as appropriate.

### **1.1.2 Agenda**

- A. Agenda will include, but will not necessarily be limited to, the following:
  1. Review and comment on minutes of previous meeting.
  2. Review of progress since the previous meeting.
  3. Planned progress for next period.
  4. Review of overall project schedule, including offsite fabrication and delivery schedules and corrective measures, if required.
  5. Review of status of critical submittals, including Shop Drawings and Applications for Payment.
  6. Review of change issues and change orders.
  7. Problems, conflicts and observations.
  8. Quality standards and control.
  9. Coordination between parties.
  10. Safety concerns.
  11. Permits.
  12. Construction photographs.
  13. Record drawings.
  14. Punch list status.
  15. Other business.

B. CONSTRUCTION MANAGEMENT ENGINEER will provide an adequate number of copies of the agenda for each attendee.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. Not used.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

**1.10 Contracts**

A. Not used.

**1.11 Work By Others**

A. Not used.

**1.12 Sequence of Work**

A. Not used.

**1.13 Contractor's Use of Premises**

A. Not used.

**2. MATERIALS**

A. Not used.

**3. EXECUTION**

A. Not used.

-- End of Section --

**SECTION 01 32 33**  
**PHOTOGRAPHIC DOCUMENTATION**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. CONTRACTOR shall designate onsite personnel to perform services specified, including:

1. Digital photography.

B. Provide photographic documentation for the following:

1. Preconstruction.
2. Construction progress.
3. Final.

C. Image Quality:

1. All photographic documentation shall be in color.
2. Photographic images shall be suitably staged and set up (“framed”), focused, and with adequate lighting.
3. For still photographs, use digital camera with minimum 10.1-megapixel resolution.

**1.1.2 Related Work Specified Elsewhere**

A. Not used.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

## 1.5 Submittals

### A. Frequency of Photographic Documentation Submittals:

1. Preconstruction—Submit preconstruction photographic documentation (prints and USB drives) prior to mobilizing to and disturbing the Site. Provide preconstruction photographic documentation no later than first Application for Payment, unless other schedule is accepted by CONSTRUCTION MANAGEMENT ENGINEER.
2. Progress—Provide construction progress photographic documentation (prints and USB drives) monthly. Submit with each Application for Payment, unless otherwise agreed to by CONSTRUCTION MANAGEMENT ENGINEER.
3. Final—Submit acceptable final photographic documentation (prints and USB drives) prior to submitting final Application for Payment.

### B. Photographic Prints:

1. Quantity:
  - a. For each photograph taken, provide to OWNER one (1) print.
  - b. Furnish additional photographs or prints requested by OWNER at cost.
2. Print Size and Finish:
  - a. Photographs—Provide four (4)-inch by six (6)-inch standard weight prints with a satin finish, unless specified otherwise.
  - b. Provide a date stamp on the front of each picture.
  - c. Provide the following information on back of each print and front of each USB drive containing photographic documentation:
    - 1) Date photograph was taken.
    - 2) Project name.
    - 3) Description of view shown in photograph.
    - 4) Digital File name.

### C. Digital Files of Photographs:

1. For each photograph taken, provide high-quality digital image on a USB drive in uncompressed “\*.JPG” or “TIF” file format. USB drive shall be compatible with Microsoft Windows XP, Microsoft Windows 7, Microsoft Windows 8, and Microsoft Windows 10.



2. Image resolution shall be sufficient for clear, high-resolution prints. Resolution shall be the maximum provided by the camera.
3. Provide two (2) copies of each USB drive with photographic images.
4. Provide, with each USB drive, a proof sheet(s) containing all digital image files. Images shall be presented large enough in size to be recognizable (at minimum the size of an original thirty-five [35]-millimeter negative), and the individual file name shall appear adjacent to each respective image.
5. Label each USB drive with Project Name, date range of photos, and a brief description.

**1.6 Safety**

- A. Not used.

**1.7 Quality Assurance**

- A. OWNER will approve the views to be taken and select time at which images will be taken. Photographic subjects, views, and angles will vary with progress of the Work.

**1.8 Product Delivery, Handling, and Storage**

- A. Not used.

**1.9 Schedule**

- A. Not used.

**2. MATERIALS**

- A. Not used.

**3. EXECUTION**

**3.1 Preconstruction Photographic Documentation**

- A. Preconstruction Photographic Documentation:
  1. Obtain and submit sufficient preconstruction photographic documentation to record Site conditions prior to construction. Photographs shall document all work areas.

2. Furnish to CONSTRUCTION MANAGEMENT ENGINEER specified number of photographs. Preconstruction photographs are not part of required number of construction progress photographs specified in Paragraph 1.5 of this Section.
- B. If dispute arises and preconstruction photographic documentation was not submitted prior to the dispute, restore disputed area to extent directed by CONSTRUCTION MANAGEMENT ENGINEER and to complete satisfaction of OWNER.

### **3.2 Construction Progress Photographic Documentation**

A. Progress Photographs:

1. Take photographs on a regular basis to document progress of the Work. At minimum, photographs shall be taken once per week.
2. The minimum of weekly progress photographs taken shall be twenty-five (25). Submit additional monthly photographs as necessary to adequately document all aspects of the progress of Work.
3. Provide interior and exterior photographic documentation of each structure as directed by CONSTRUCTION MANAGEMENT ENGINEER.

### **3.3 Final Photographic Documentation**

A. Final Photographs:

1. Take photographs at time and day acceptable to CONSTRUCTION MANAGEMENT ENGINEER. Do not take final photographs prior to Substantial Completion. Work documented in final photographs shall be generally complete, including painting, furnishings, landscaping, and other visible Work.
2. Take a minimum four hundred fifty (450) final photographs, based on scope of Work at the time Contract Times commence running. Proportionately modify the number of final photographs if scope of Project is modified. Final photographs are not part of construction progress photographs required under Paragraph 3.2.A of this Section.

-- End of Section --

**SECTION 01 40 00  
QUALITY CONTROL**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. This Section includes requirements of a general nature related to the CONTRACTOR'S responsibility for quality control involving inspections, tests, certificates, and reports. Requirements for general quality control applicable to geosynthetics are included herein, and additional quality control for specific products are included in individual Specification Sections.

**1.1.2 Related Work Specified Elsewhere**

A. Not used.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Geotechnical Testing Laboratory—the CONTRACTOR'S independent soils testing laboratory, approved by the CONSTRUCTION MANAGEMENT ENGINEER, that shall perform the required preconstruction and frequency testing and quality control (QC) testing on samples supplied by and at the expense of the CONTRACTOR.

B. Geosynthetics Testing Laboratory—the CONTRACTOR'S independent geosynthetics testing laboratory, approved by the CONSTRUCTION MANAGEMENT ENGINEER, that shall perform the required preconstruction and frequency testing and QC testing on samples supplied by and at the expense of the CONTRACTOR.

C. Geosynthetics Installer shall be responsible for the installation of geomembrane, geocomposite, and geotextiles in accordance with the Contract Documents. The Geosynthetics Installer shall provide sufficient evidence of installation experience and competence with geosynthetics, and shall demonstrate an acceptable level of training and supervision will be utilized in order to ensure the quality of the installation. The CONTRACTOR shall be responsible for the performance of the Geosynthetics Installer.

## 1.4 Qualifications

- A. Geotechnical Testing Laboratory must meet “Recommended Requirements for Independent Laboratory Qualification,” latest edition, published by American Council of Independent Laboratories and shall be authorized to operate in the State of Maryland.
- B. Geosynthetics Testing Laboratory shall be accredited via the Geosynthetic Accreditation Institute's Laboratory Accreditation Program for the tests the QC Laboratory will be required to perform. The Geosynthetics Testing Laboratory shall have provided QC testing of the proposed geosynthetics and geosynthetic seams for at least five (5) completed projects having a total minimum area of ten (10) million square feet.
- C. Geosynthetics Installer must be qualified to install geomembrane, geocomposite, and geotextiles in accordance with the following:
  - 1. The Geosynthetics Installer shall be a specialist in the installation of geomembrane (linear low-density polyethylene [LLDPE]). The Geosynthetics Installer shall demonstrate a minimum of twenty-five (25) million square feet of geomembrane (LLDPE) during the last five (5) years, as applicable, and shall have at least five (5) continuous years of experience in the installation of geomembrane (LLDPE). In addition, the Geosynthetics Installer shall be an “Approved Installer” of the geomembrane manufacturer (LLDPE).
  - 2. The Geosynthetics Installer shall be a specialist in the installation of geocomposite. The Geosynthetics Installer shall provide a field superintendent with demonstrated experience in field seaming, field testing, and other pertinent aspects of geocomposite installation, as applicable.
  - 3. The Geosynthetics Installer shall be a specialist in the installation of polyester and/or polypropylene geotextile, and have a minimum of three (3) years’ experience of geotextile installation and have installed a minimum of five (5) million square feet of said geotextile fabric that was used in successful installations.
  - 4. The Geosynthetics Installer shall have a field superintendent with demonstrated experience in field seaming, field testing, and other pertinent aspects of the installation of geomembrane (LLDPE). The field superintendent shall be qualified to inspect the prepared Closure Cap Subgrade and supervise any corrective work required; supervise the unloading, handling, storage, unrolling, and placement of all geomembrane liner sheets; perform all field seaming operations and testing of geomembrane liner; perform all repairs to damaged geomembrane materials; and supervise the placement of the overlying Vegetative Support Soil.
  - 5. The Geosynthetics Installer shall have a field crew foreman with successful installation experience for fifty (50) acres geomembrane (LLDPE) on a minimum of five (5) different projects. The foreman shall also have a minimum of three (3) continuous years of experience welding geomembrane (LLDPE).

6. The Geosynthetics Installer shall meet the requirement for each welding technician to have a minimum of one (1) year of continuous experience welding or ten thousand (10,000) feet of seaming experience for geomembrane (LLDPE).

## 1.5 **Submittals**

- A. Geotechnical Testing Laboratory qualifications.
- B. Geosynthetics Testing Laboratory qualifications.
- C. Geosynthetics Installer:
  1. Documentation to verify the installer's experience in geosynthetics, including approval and certification of the geosynthetics manufacturer.
  2. Qualifications and references for the field superintendent, field crew foremen, and welding technicians shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval approximately one (1) month prior to the commencement of geosynthetic installation activities. The CONSTRUCTION MANAGEMENT ENGINEER reserves the right to reject any field superintendent based on the information submitted. Any rejected field superintendent shall be replaced with no delay in the Contract Schedule and at no additional cost to the OWNER.
- D. Geosynthetics Installer's Installation Plan shall be submitted for approval at least thirty (30) days prior to delivery of the geosynthetic materials to the site. The CONSTRUCTION MANAGEMENT ENGINEER reserves the right to require changes to the Installation Plan.
  1. Geosynthetic Installer's proposed construction repair procedures.
  2. Geosynthetic Installer's proposed field seaming procedures and techniques, including methods, overlap, personnel identification, quality assurance/quality control of seaming operations, operating temperatures, and preparation of materials.
  3. Geosynthetic Installer's nondestructive and destructive seam testing procedures, including type(s) of tests, a list of equipment required, frequency of tests with locations, methods, qualifications of personnel that perform the tests, and acceptance/rejection criteria for tested seams, as well as recommended repair procedures to remediate those welded seams which fail the required test procedures.
  4. Geosynthetic Installer's proposed installation panel layout drawings for the geomembranes to be installed (LLDPE). These proposed layout drawings shall identify the proposed installed configuration of the noted geosynthetic panels and identify each sheet. The layout drawings shall also include anchor trench and pipe penetration details. To accommodate in-field conditions, these proposed layouts may

be modified during installation with the approval of the CONSTRUCTION MANAGEMENT ENGINEER. The geomembrane panels shall be placed in the Work area to permit termination in the perimeter anchor trench or as required by the governing Contract Drawings. The layout of geosynthetics panels/sheets shall minimize the length of field seaming required and locate seams where applied stresses will be minimal. Panel/sheet layout shall take into consideration any expansion and contraction anticipated due to ambient temperature variations. The upgradient panels of the geosynthetic shall overlap the downgradient panels.

5. Geosynthetic Installer's daily QC log format to be used during geomembrane liner installation.
6. Work plan for geosynthetics installation including manpower and equipment requirements.

#### **1.6 Safety**

- A. Not used.

#### **1.7 Quality Assurance**

- A. Maryland Department of the Environment (MDE) will perform quality assurance inspections and reviews of the closure cap system. MDE approval is required at certain stages of each system installation, as indicated in the Sequence of Construction. The CONSTRUCTION MANAGEMENT ENGINEER will coordinate with MDE to schedule site visits and will submit necessary surveys and test results to MDE for review in advance of the scheduled site visit. The CONTRACTOR is responsible for providing necessary surveys and test results to the CONSTRUCTION MANAGEMENT ENGINEER in a timely manner to minimize potential delays. CONTRACTOR should expect that MDE approval will take five (5) days for each stage of approval.

#### **1.8 Product Delivery, Handling, and Storage**

- A. Not used.

#### **1.9 Schedule**

- A. Not used.

#### **1.10 Inspection**

- A. The CONSTRUCTION MANAGEMENT ENGINEER has the right to inspect all materials and equipment at all stages of development or fabrication, and shall be allowed access to the site and to the CONTRACTOR'S and supplier's shops to conduct such inspections. Onsite work will be subjected to continuous inspection. Inspection by the CONSTRUCTION MANAGEMENT ENGINEER will not release the CONTRACTOR

from responsibility or liability with respect to material or equipment. The CONSTRUCTION MANAGEMENT ENGINEER will provide the CONTRACTOR a minimum of twenty-four (24) hours' notice prior to offsite inspections.

- B. When a shop test of mechanical equipment is required by the manufacturer before shipment to the Contract Site, the CONTRACTOR shall give the CONSTRUCTION MANAGEMENT ENGINEER a minimum of ten (10) working days written notice of the time of the required test. The CONTRACTOR shall ensure that the test site is safe, accessible, dry, ventilated, and well lit. Work involved with the installation of such equipment shall not proceed until the test results are approved by the CONSTRUCTION MANAGEMENT ENGINEER.
- C. When local codes or laws require approval or inspection of the work by other agencies or organizations before installation or operation, the CONTRACTOR shall obtain such approval and submit one (1) signed original and three (3) copies of the approval to the CONTRACTOR.

## **1.11 Testing**

- A. All QC Laboratory testing (not including manufacturers' internal quality assurance) shall be performed by an independent testing laboratory, as approved by the CONSTRUCTION MANAGEMENT ENGINEER, with materials to be tested furnished by the CONTRACTOR and at the expense of the CONTRACTOR.

### **1.11.1 Field and Laboratory**

- A. The CONTRACTOR shall contract with an independent QC Laboratory to perform laboratory testing as required by these Specifications, including the following periodic inspections, engineering, and associated services:
  - 1. Soils—Inspect and test the placement and compaction of fills. Perform field density testing using a Troxler 3401 series nuclear moisture-density gauge (or approved equal) to assess the adequacy of compaction. Inspect subgrades and foundations.
  - 2. Concrete—Inspect forms, reinforcement, and placement; witness CONTRACTOR'S slump and air entrainment tests; make cylinder samples and store them onsite; perform seven (7)- and twenty-eight (28)-day unconfined compression tests on the cylinders.
- B. The CONTRACTOR shall include the cost of QC Laboratory services in their proposal.
- C. The CONTRACTOR shall cooperate with the CONSTRUCTION MANAGEMENT ENGINEER and the QC Laboratory and provide at least twenty-four (24) hours' notice prior to specified testing. The CONTRACTOR shall provide labor, materials, and testing facilities at the site as required by the Specifications and the approved subcontractor.

- D. The CONTRACTOR shall be solely responsible for the adequate stability of cut soil slopes at the site and for providing a safe working condition within the excavated areas.

### **1.11.2 Other Testing**

- A. Test procedures and requirements are specified in the appropriate Specification Section.

## **1.12 Reports**

### **1.12.1 Certified Test Reports**

- A. Where transcripts or certified test reports are required by the Contract Documents, the CONTRACTOR shall submit them for approval by the CONSTRUCTION MANAGEMENT ENGINEER. Approval shall be obtained before delivery of any material to the site. Transcripts of test reports shall be accompanied by a notarized certificate in the form of a letter from the manufacturer or supplier certifying that the tested material meets the specified requirements and is of the same type, quality, manufacturer, and make as that specified. The certificate shall be signed by an officer of the manufacturer or supplier.

### **1.12.2 Certificate of Compliance**

- A. At the option of the CONSTRUCTION MANAGEMENT ENGINEER, or where specified, the CONTRACTOR may, in lieu of the required tests, submit for approval a notarized Certificate of Compliance in the form of a letter from the manufacturer. The Certificate shall include identification of the materials manufactured and shall state the following:
  - 1. Manufacturer has performed all required tests.
  - 2. Materials supplied meet all test requirements.
  - 3. Tests were performed within six (6) months of submittal of the Certificate.
  - 4. Materials that were tested are of the same type, quality, manufacture, and make as those specified.
- B. A Certification of Compliance may be provided for the geomembrane, landfill gas pipes, landfill gas pipe fittings, and landfill gas valves.
- C. The Certificate shall be signed by an officer of the manufacturer. Materials shall not be delivered until the CONSTRUCTION MANAGEMENT ENGINEER approves the Certificate.



### **1.12.3 Manufacturer's Certificates**

- A. The CONTRACTOR shall submit Manufacturer's Certificates for the installation of those items listed in the Specifications.
- B. Manufacturer's Certificates shall state that the equipment has been installed under the supervision of the manufacturer's authorized representative, that it has been adjusted and initially operated in the presence of the manufacturer's authorized representative, and that it is operating in accordance with the specified requirements to the manufacturer's satisfaction.

### **1.13 Manufacturer Services**

- A. When required, manufacturer services are specified in appropriate Specification Sections.

### **1.14 Equipment Calibration**

- A. All field test equipment will be kept under control of the CONTRACTOR. The CONTRACTOR will be fully trained in the use of equipment, test procedures, and interpretation of results for each piece of test equipment. A copy of the Calibration Certificate will be kept by the CONTRACTOR and supplied to the CONSTRUCTION MANAGEMENT ENGINEER.
- B. Calibration of nuclear-density gauges shall conform to the frequencies and methods outlined in ASTM D2922-78 and D3017. Unstable or erratic gauges shall not be used in density testing and shall be immediately removed from the site.

## **2. MATERIALS**

- A. Not used.

## **3. EXECUTION**

- A. Not used.

-- End of Section --

*This page intentionally left blank*

**SECTION 01 45 00  
HEALTH AND SAFETY**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

- A. Site-specific safety and health procedures are required due to the hazardous conditions potentially present on site during landfill closure activities. These procedures must be written by the CONTRACTOR'S certified industrial hygienist and submitted to the CONSTRUCTION MANAGEMENT ENGINEER prior to the initiation of the landfill closure activities. The CONTRACTOR shall implement, maintain, and enforce these procedures at the appropriate time prior to and during all phases of the project.
1. Provisions of this Section provide additional guidance to activities in which the CONTRACTOR will or may come into contact with solid waste materials, liquids, or gas due to intrusive activities into the waste fill area. This includes, at a minimum, waste excavation, leachate outbreaks, installation of the gabion drainage structures, landfill gas well and pipeline installation, subgrade preparation, and closure cap construction.
  2. The CONTRACTOR shall employ such procedures and provide protection equipment as necessary to protect workers and other persons in conformance with Health and Safety Regulations for Hazardous Operations, 29 Code of Federal Regulations (CFR) 1926.120.
- B. The Site Safety and Health Plan shall be consistent with the requirements and guidance provided in the following regulations:
1. Occupational Safety and Health Administration (OSHA) Standards and Regulations contained in 29 CFR 1926.
  2. Maryland Occupational Safety and Health (MOSH) Standards and Regulations applicable regulations.
- C. The Site Safety and Health Plan will include at a minimum the following components:
1. Site overview, including identification of potential intrusive activities and type of waste or hazards, such as leachate discharge, landfill gases, anticipated to be encountered.
  2. Names of key personnel and alternates responsible for site safety and health.

3. Accident Prevention Plan that addresses the safety hazards expected, personnel responsibilities, task-specific safety procedures, subcontractor supervision, safety meetings, fire prevention and protection, site housekeeping, mechanical equipment inspection, first aid and medical concerns, sanitation, accident reporting, and daily safety inspections conducted by CONTRACTOR personnel.
4. Employee training requirements.
5. Personal protective equipment (PPE) requirements for each intrusive work operation, including types/materials, respiratory protection, and site-specific action levels dictating decisions to upgrade or downgrade and description of decontamination procedures and policies.
6. Location, frequency, and type of air monitoring to be conducted, including instrumentation, methods of maintenance, and calibration of monitoring and sampling equipment to be used. At minimum, the CONTRACTOR shall continuously monitor air quality in the vicinity of all open excavations and boreholes.
7. Site control measures, including communications, security, and site access.
8. Heat and cold stress monitoring.
9. Confined Space Entry
10. Personnel and equipment decontamination procedures.
11. Emergency Response Plan and contingency procedures, including:
  - a. Emergency vehicular access.
  - b. Evacuation procedures of personnel from the work area.
  - c. Methods of preventing and containing fire and explosion.
  - d. On site first aid, automatic external defibrillator (AED), eye wash, fire suppression, protective gear, and other emergency equipment to be maintained by the CONTRACTOR on site.
  - e. Listing of emergency contact personnel with phone numbers, to include the CONTRACTOR, OWNER, CONSTRUCTION MANAGEMENT ENGINEER, Maryland Department of the Environment, fire officials, ambulance service, state and local law enforcement, and local hospitals (with routes to hospitals).
12. Logs, reports, and recordkeeping.

- D. The Site Safety and Health Plan shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER at minimum fourteen (14) days prior to the Notice to Proceed. Submittal of this plan is for information only. The CONTRACTOR is liable for the health and safety of all its employees and agents and shall indemnify the OWNER, the Northeast Maryland Waste Disposal Authority, and CONSTRUCTION MANAGEMENT ENGINEER from any defense costs and damages attributable to any claim of any of its employees, independent contractors or agents for injuries at the site.
- E. Specifications delineated in this Section are in addition to or an amplification of procedures and requirements of the above-referenced regulations and documents.
- F. Should any unforeseen or site-specific safety factors, health hazard, or conditions become evident during the performance of work at this site, the CONTRACTOR shall notify the CONSTRUCTION MANAGEMENT ENGINEER verbally and in writing as soon as possible for resolution. The CONTRACTOR shall take prudent action to establish and maintain safe working conditions and to safeguard employees, the surrounding community, and the environment.
- G. Any changes, updates, revisions, etc. to the Site Safety and Health Plan shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER in writing.
- H. Any disregard for the provision of these Specifications shall be deemed just and sufficient cause for termination of Contract or any Subcontract without compromise or prejudice to the rights of the CONSTRUCTION MANAGEMENT ENGINEER.
- I. The Site Safety and Health Plan developed by the CONTRACTOR shall include provisions for work related to initial site preparation prior to implementation of the intrusive activities such as, but not limited to, waste excavation and handling and other activities described in the Contract. It shall be the responsibility of the CONTRACTOR to conduct whatever testing and monitoring is necessary to ensure a safe operation.
- J. The following landfill and landfill gas related information is included to assist the CONTRACTOR in developing a Site Safety and Health Plan and is not intended to encompass all steps that may be necessary to protect the workers or to comply with applicable regulations. Landfills have the potential to create hazardous conditions if working conditions are not controlled or recognized. Some potential hazards may include:
  - 1. Spontaneous fire from exposed and/or decomposing refuse.
  - 2. Fires and explosions from the presence of methane gas.
  - 3. Oxygen deficiency from landfill gases in underground trenches, vaults, conduits and structures.

4. Presence of hydrogen sulfide, or other highly toxic and flammable gases.
  5. Caving of trenches and excavations when working over or in refuse fills
- K. The CONTRACTOR shall be solely responsible for initiating, maintaining, and supervising all the health and safety precautions and programs for personnel and site property during all phases of the project, including during activities that utilize intrusive activities that may lead to encountering solid waste, leachate or landfill gas. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in performance of their work, nor for the compliance with applicable health and safety laws and regulations.

### **1.1.2 Related Work Specified Elsewhere**

- A. Not used.

### **1.2 References**

- A. Not used.

### **1.3 Definitions**

- A. Not used.

### **1.4 Qualifications**

- A. Not used.

### **1.5 Submittals**

- A. Health and safety personnel qualifications and certifications.
- B. Site Safety and Health Plan.
- C. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site.

### **1.6 Safety**

- A. CONTRACTOR shall comply with all applicable laws and regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. CONTRACTOR shall notify owners of adjacent property and of underground facilities and other utility owners when prosecution of the Work may affect them, and

shall cooperate with them in the protection, removal, relocation, and replacement of their property.

- B. CONTRACTOR shall comply with the applicable requirements of OWNER'S safety programs, if any. The Supplementary Conditions identify any OWNER'S safety programs that are applicable to the Work.
- C. CONTRACTOR shall inform OWNER and CONSTRUCTION MANAGEMENT ENGINEER of the specific requirements of CONTRACTOR'S safety program with which OWNER'S and CONSTRUCTION MANAGEMENT ENGINEER'S employees and representatives must comply while at the Site. While at the Site, OWNER'S and CONSTRUCTION MANAGEMENT ENGINEER'S employees and representatives shall comply with the specific applicable requirements of CONTRACTOR'S safety programs of which OWNER and CONSTRUCTION MANAGEMENT ENGINEER have been informed.
- D. All damage, injury, or loss to any property caused, directly or indirectly, in whole or in part, by CONTRACTOR, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by CONTRACTOR (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of OWNER or CONSTRUCTION MANAGEMENT ENGINEER or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of CONTRACTOR or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- E. CONTRACTOR'S duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed until Final Acceptance.
- F. All persons entering and working in confined spaces are required to follow the requirements of 29 CFR 1910.146 and 29 CFR 1926.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

### **1.10 Safety Representative**

- A. CONTRACTOR shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs. The safety representative may not be the same person as the superintendent.

### **1.11 Hazard Communication Programs**

- A. CONTRACTOR shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with laws or regulations.
- B. CONTRACTOR shall provide a centralized location for the maintenance of the material safety data sheets or other hazard communication information required to be made available by any employer on the Site. Location of the material safety data sheets or other hazard communication information shall be readily accessible to the employees of any employer on the Site.

### **1.12 Site Control**

- A. The CONTRACTOR shall restrict personnel access to site areas where intrusive activities are occurring.
- B. In order to restrict unauthorized access to the site during periods of intrusive activities into the waste fill area, sufficient barricades/fencing shall be provided and maintained if work operations make it necessary to leave open holes or pits overnight. Vehicular access to areas of the site where intrusive activities are conducted shall be restricted to authorized vehicles only.

### **1.13 Training Requirements**

- A. Qualified personnel shall certify that all CONTRACTOR and Subcontractor personnel performing intrusive work into the waste fill areas shall have received appropriate health and safety training in accordance with OSHA and MOSH for the planned work activities. Documentation of all such training shall be submitted to the OWNER before any employees will be allowed to perform intrusive work activities, and no unsatisfactorily trained personnel will be allowed to perform intrusive work activities.
- B. In addition to the above training, prior to conducting intrusive work activities, all personnel directly involved with the Work (including visitors), shall read and sign the Site Safety and Health Plan and be familiar with the use of safety, respiratory, and protective equipment, and with the health, safety, and security procedures.



#### **1.14 First Aid Requirements**

- A. The CONTRACTOR shall have at least one (1) certified First Aid Technician on the site at all active times during the execution of intrusive work activities; this First Aid Technician must be certified by the American Red Cross or other approved agency in first aid and cardiopulmonary resuscitation (CPR) (including use of an AED).

#### **1.15 Emergency Response and Contingency Procedures**

- A. As part of the Site Safety and Health Plan, the CONTRACTOR shall develop site-specific emergency response and contingency plans for exposure to leachate, personal injury, potential or actual fire or explosion, and environmental accident. These plans shall include evacuation procedures and routes to places of refuge or safe distances from the danger area.
- B. In case of emergency, the CONTRACTOR shall take diligent action to remove or reduce the cause of the emergency, to alert the OWNER and the CONSTRUCTION MANAGEMENT ENGINEER, and institute measures necessary to prevent any repetition of the conditions or actions leading to, or resulting in, the emergency. Written notification of emergencies must be provided to the CONSTRUCTION MANAGEMENT ENGINEER within twenty-four (24) hours.
- C. The CONTRACTOR shall pre-arrange for emergency medical care services at a primary and alternate medical facility located near the site and shall establish emergency routes. Arrangements for notifying medical staff of the need to contact contaminated skin and/or clothing must be made.
- D. A list of emergency contacts and phone numbers shall be included in the plan and also posted onsite.

#### **1.16 Personnel Protective Equipment Requirements**

- A. The CONTRACTOR shall provide all onsite personnel with appropriate PPE, and shall ensure that all safety equipment and protective clothing is kept clean and well maintained.

#### **1.17 Personal Hygiene and Contamination**

- A. The CONTRACTOR shall specify personal hygiene concerns and requirements for this site in the Site Safety and Health Plan. The CONTRACTOR shall be required to provide and require that personnel use appropriate storage and disposal for used disposable clothing, and to provide a break area.
- B. The CONTRACTOR shall specify required decontamination procedures for both personnel and equipment in the Site Safety and Health Plan, including procedures for

removing contaminated clothing, cleaning personnel and equipment, disposing of disposable clothing, and laundering of reusable clothing.

**1.18 Air Monitoring**

- A. The CONTRACTOR shall develop and implement an air monitoring program conforming with federal, state, and local regulations to detect and quantify methane, volatile organic compounds, carbon dioxide, hydrogen sulfide, and general airborne dust monitoring associated with the intrusive work activities into the waste fill areas. In addition, the CONTRACTOR shall determine appropriate safety and personnel protective measures to be implemented during work operations, to document employee exposures, and to assess offsite migration of contaminants potentially released during intrusive work activities so that appropriate control measures and/or contingency plans can be implemented.
- B. The CONTRACTOR shall be responsible for establishing and documenting baseline (background) air quality conditions using direct-reading instruments prior to commencement of, during, and after completion of work operations.
- C. The CONTRACTOR shall establish action levels for oxygen, methane, volatile organics, and dust in order to direct determination of upgrading and PPE adequacy and to determine appropriate implementation of offsite response procedures for contingency planning. These action levels shall be based upon OSHA permissible exposure limits.

**1.19 Logs, Reports, and Recordkeeping**

- A. The CONTRACTOR shall maintain logs and reports covering the implementation of the Site Safety and Health Plan according to these Specifications and including daily training logs, employee/visitor logs, security logs, air monitoring logs, daily safety logs, and medical certification records.

**1.20 Onsite Medical Monitoring**

- A. The Site Safety and Health Plan must include procedures for monitoring personnel for heat and cold stress. Monitoring shall be performed by a person with a current first aid/CPR certification or who has been trained to recognize the symptoms of heat or cold stress and will comply with the applicable requirements of OSHA and MOSH.

**2. MATERIALS**

- A. Not used.

3. **EXECUTION**

A. Not used.

-- End of Section --

*This page intentionally left blank*

**SECTION 01 50 00**  
**MOBILIZATION, DEMOBILIZATION, AND TRAFFIC CONTROL**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. Perform construction preparatory operations, including the movement of personnel and equipment to the project site and for the establishment of CONTRACTOR'S trailer, CONSTRUCTION MANAGEMENT ENGINEER'S trailer, buildings, and other facilities necessary to begin work. Provide construction closeout operations, including removal of equipment and personnel from the project site, removal of CONTRACTOR'S trailer, CONSTRUCTION MANAGEMENT ENGINEER'S trailer, buildings and other facilities, cleanup and site restoration. The CONTRACTOR is responsible for maintenance of traffic control for the movement of personnel, equipment, and materials to and from the project site.

**1.1.2 Related Work Specified Elsewhere**

A. Not used.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. Not used.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

**1.10 Traffic Control**

A. Maintain traffic control, both vehicular and pedestrian, on any facility affected by the Work. Provide regular maintenance, sweeping, and dust control on access roadways as required by the CONSTRUCTION MANAGEMENT ENGINEER.

**2. MATERIALS**

A. All materials used for traffic maintenance, whether temporary or permanent, shall be approved in writing by the CONSTRUCTION MANAGEMENT ENGINEER.

**3. EXECUTION**

A. All work performed in providing facilities and services shall be done in a safe and workmanlike manner.

B. CONTRACTOR shall provide all labor, materials, and equipment necessary to maintain vehicular and pedestrian traffic throughout the project duration. CONTRACTOR shall be responsible for obtaining all permits, approvals, and pay any fees necessary from local, OWNER, and state regulatory agencies required to access public roads with earth moving equipment. Signs, light, barricades, flaggers and other manpower shall be provided wherever necessary to protect the traveling public and landfill customers and operators from hazardous conditions in accordance with local, OWNER, and state transportation and Occupational Safety and Health Administration requirements. Traffic Control Plan shall be developed by CONTRACTOR and submitted to CONSTRUCTION MANAGEMENT ENGINEER in accordance with MSHA 104.01.

C. The CONTRACTOR shall contact Utility Locating Company three (3) days prior to starting any work shown on these plans to confirm and identify the location of all utilities and protection requirements of the respective service lines within the limits of work.

D. Prior to initiating construction, the CONTRACTOR shall inspect the site and identify monitoring wells and existing surface conditions.

- E. The CONTRACTOR shall provide for the protection and preservation of the existing monitoring wells located within the project area. Any damage to these items caused by the CONTRACTOR'S activities shall be repaired by the CONTRACTOR at no additional expense to the OWNER.
- F. Due to the sensitive nature of the site, the CONTRACTOR shall not engage in work outside the limits of disturbance without the express written direction of the CONSTRUCTION MANAGEMENT ENGINEER.
- G. The CONTRACTOR shall restore all roads, paved surface and access roads damaged during the construction of the landfill closure cap to their original condition.
- H. CONTRACTOR shall keep the premises free from accumulations of waste materials, rubbish and other debris resulting from the Work, on a daily basis. Failure to comply herewith constitutes grounds for the CONSTRUCTION MANAGEMENT ENGINEER to recommend not to approve payment.
- I. At the completion of the work, CONTRACTOR shall remove all waste materials, rubbish and debris from and about the premises as well as all tools, construction equipment and machinery, surplus materials, and shall leave the site clean and ready for occupancy by OWNER. CONTRACTOR shall restore to their original condition those portions of the site not designated for alteration by the Contract Documents.

-- End of Section --

*This page intentionally left blank*



**SECTION 01 59 00**  
**TEMPORARY FACILITIES AND CONTROLS**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. This Section includes the requirements for field office construction, maintenance, and removal. The CONTRACTOR shall provide field offices as specified herein at his own expense.

**1.1.2 Related Work Specified Elsewhere**

A. Not used.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. Not used.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

## **1.9 Schedule**

- A. Field offices shall be ready for occupancy fifteen (15) days prior to groundbreaking on site.
- B. Maintain storage areas and sheds until readiness for final payment, unless otherwise approved by OWNER.

## **2. MATERIALS**

- A. Materials, equipment, and furnishings shall be new or used, and adequate for the required purpose. The CONTRACTOR shall furnish and install all needed aggregate and piping for drainage, and maintain ingress and egress roadways for the designated field staging areas.

## **3. EXECUTION**

### **3.1 Preparation**

- A. Fill grade sites for temporary structures to provide drainage away from buildings, and install office spaces ready for occupancy.

### **3.2 Construction**

- A. Construction specifications include the following:
  - 1. Portable or mobile buildings, or buildings constructed with floors raised aboveground, securely fixed to foundations, with steps and landings at entrance doors.
  - 2. Structurally sound foundation and superstructure.
  - 3. Completely weathertight and insulated floors, walls, and ceilings.
  - 4. Exterior finish acceptable to OWNER.
  - 5. Interior materials in offices shall be sheet-type for walls and ceilings, finished or painted; resilient floors and bases in like new condition.
  - 6. Size: minimum one hundred fifty (150) square feet floor area.
  - 7. Windows: ten (10) percent of floor area with operable sash and screens. Windows shall be furnished with locks and exterior security bars approved by the OWNER.
  - 8. Two (2) means of ingress and egress, each with landing, stairs, and handrails conforming to local building codes.

9. Interior materials in storage sheds will be as required to provide specified conditions for the storage of products.

### **3.3 Minimum Services**

#### **A. Provide the following for each office:**

##### **1. Electrical System:**

- a. CONTRACTOR shall make all provisions for obtaining temporary electrical services for the office space. Cost of installation, maintenance, monthly charges, and removal shall be the responsibility of CONTRACTOR.
- b. Interior lighting of fifty (50) foot-candles at desktop height.
- c. Exterior light at entrance.
- d. Minimum four (4) one hundred twenty (120)-volt, wall-mounted, convenience electrical receptacles.

##### **2. Heating, Ventilating, and Air Conditioning System:**

- a. Automatic heating to maintain minimum sixty-five (65) degrees Fahrenheit in the cold weather. Furnish and pay for all fuel and utility costs.
- b. Automatic cooling to maintain maximum seventy-five (75) degrees Fahrenheit in warm weather.

##### **3. Telephone Service:**

- a. Dedicated telephone service for each office, including payment of installation charges.
- b. Pay local and long distance charges for the duration of the Project.

##### **4. Internet Service:**

- a. Provide all equipment necessary for high speed internet service by 4G LTE wireless broadband with forty (40) gigabytes per month of data at a minimum.
- b. Pay all charges for internet service for the duration of the Project.

5. Water and Sewerage:

- a. Provide a suitably enclosed chemical or self-contained toilet located near field offices. Toilets shall be serviced, at minimum weekly, kept clean and supplied throughout course of work.
  - b. Provide drinking water and dispenser. Dispenser shall have hot and cold taps and a cup dispenser. Supply refill water containers as necessary.
  - c. Provide waterless hand sanitizer and paper towels. Keep adequate supplies throughout the course of work.
- B. CONTRACTOR shall make all provisions for obtaining temporary electrical services for the office space. Cost of installation, maintenance, monthly charges, and removal shall be the responsibility of CONTRACTOR.
- C. Should actions of utility companies delay the complete set up of the field office, CONTRACTOR shall provide temporary electricity, heat, water supply, and sanitary facilities as required at no additional cost to the OWNER.
- D. No separate payment shall be made for the Inspector's office, facilities, and temporary power. All costs associated with providing and maintaining said facilities, including electric, shall be included in the price of mobilization.

**3.4 CONTRACTOR'S Office and Facilities**

- A. CONTRACTOR shall provide a field office for use by CONTRACTOR with the minimum facilities specified. Provide required storage and work sheds.
- B. Field Office and Furnishings:
1. Telephone, fax, and high speed internet service.
  2. Six (6) safety vests and protective helmets for visitors' use.
  3. Identifying exterior sign acceptable to the OWNER, at least twenty-four (24) inches by thirty-six (36) inches in size. Text shall be four (4) inches high, Arial font, unless otherwise approved by the OWNER. At minimum, the sign shall read "CONTRACTOR'S OFFICE."
  4. Other furnishings at CONTRACTOR'S option.
- C. Provide one (1) set of Contract Documents in the field office for ready reference by interested parties.

### **3.5 OWNER and CONSTRUCTION MANAGEMENT ENGINEER'S Office**

- A. CONTRACTOR shall provide and maintain a separate trailer or structure for the sole use as a field office for the OWNER, and CONSTRUCTION MANAGEMENT ENGINEER. Provide the office at a location approved by the OWNER.
- B. Allocate five (5) reserved parking spaces for use by the OWNER in close proximity to the inspector's field office. Parking area shall be paved with asphalt concrete or crushed stone, and shall include a walkway of asphalt, concrete, crushed stone, or material acceptable to the OWNER, between the parking area and the field office.
- C. The CONSTRUCTION MANAGEMENT ENGINEER will provide the following furnishings and equipment for the duration of the Work:
  - 1. Desks: Two (2) five (5)-drawer desks, each sixty (60) inches by thirty (30) inches with at least one (1) eight and a half (8.5)-inch by eleven (11)-inch file drawer each.
  - 2. Desk Chairs: Three (3) new or used (in good condition) five (5)-point, high backed, swivel chairs
  - 3. One (1) four (4)-drawer file cabinets.
  - 4. One (1) two (2)-door storage cabinet or locking closet.
  - 5. Shelving or bookcase with a total of six (6) feet of shelf length at least twelve (12) inches deep.
  - 6. Outdoor thermometer mounted in the shade and located for convenient reading from inside the field office.
  - 7. One (1) multifunction (fax, copy, print, scan) laser printer and all cords necessary for fax and computer use. Multifunction laser printer shall have built in 10/100 Ethernet, wireless 802.11b/g, and USB 2.0 interfaces. Printer shall be capable of automatic duplexing and print speeds of at least twenty (20) pages per minute, Brother model MFC-9970CDW or equal.
- D. CONTRACTOR shall provide the following furnishings and equipment for the duration of the Work:
  - 1. One (1) thirty-five (35) gallon waste basket for mixed containers.
  - 2. One (1) sixty-five (65) gallon waste basket for recyclable fiber.
  - 3. Suitable mat or carpet at each doorway.

4. One (1) tack board thirty (30) inches by thirty-six (36) inches, with thumbtacks.
5. One (1) white board for use with dry markers, approximately four (4.0) feet by four (4.0) feet, with marker holding tray, installed by CONTRACTOR at a location directed by CONSTRUCTION MANAGEMENT ENGINEER in the field. Provide a supply of colored markers and eraser for the white board.
6. Fire extinguishers and associated signage, and smoke detector, per local codes. At minimum provide two (2) wall-mounted fire extinguishers and one (1) battery operated ceiling-mounted smoke detector.
7. Identifying exterior sign acceptable to the OWNER, at least twenty-four (24) inches by thirty-six (36) inches in size. Text shall be four (4) inches high, Arial font, unless otherwise approved by the OWNER. At minimum, the sign shall read “CONSTRUCTION MANAGEMENT ENGINEER’S OFFICE.”
8. First aid kit, by Zee Medical Service Co., Item 0125, “Kit, Utility, Metal, Full (ANSI)”, (800) 225-5933), [www.zeemedical.com](http://www.zeemedical.com), or equal.
9. Six (6) ANSI approved protective helmets for use by visitors—white with ratchet suspension.
10. One (1) battery powered, wall mount clock.
11. Six (6) safety vests—fluorescent lime with orange and silver stripes.
12. Six (6) safety glasses—clear poly carbonate lenses, ANSI Z87.1 compliant.

### **3.6 Storage Areas and Sheds**

- A. Size to storage requirements for products of individual sections. Allow for access, orderly provision for maintenance, and for inspection of products.

### **3.7 Maintenance and Cleaning**

- A. CONTRACTOR shall be responsible for janitorial, cleaning and maintenance services for both offices and the storage areas.
  1. Provide toner or ink cartridges for printer, copier, and fax machine, as required.
  2. Provide colored dry markers.
  3. Provide bottled water and disposable cups.
  4. Replenish contents of the first-aid kit as required.

5. Immediately repair malfunctioning, damaged, leaking, or defective field office systems and equipment.
6. Provide all supplies, including toner and paper, and pay for maintenance on the multifunction laser printer.
7. Promptly provide snow removal for the field office, including parking area, walkways, and stairs/landings.
8. Provide continuous maintenance and janitorial service of the field office and sanitary facilities. Clean the field offices at least once per week and properly dispose of trash.
9. Provide waterless soap, paper towels, cleansers, sanitary supplies, and janitorial implements in the OWNER and CONSTRUCTION MANAGEMENT ENGINEER's office.

### **3.8 Removal**

- A. Remove the field offices and furnishings when directed by the OWNER. Restore site to preconstruction conditions.

-- End of Section --

*This page intentionally left blank*



**SECTION 01 70 00**  
**EXECUTION AND CLOSEOUT REQUIREMENTS**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. This Specification includes the execution and closeout procedures, including surveys, field engineering, and contract closeout.

**1.1.2 Related Work Specified Elsewhere**

A. Not used.

**1.2 References**

A. Not used.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. Submit the following:

1. Submit resume of CONTRACTOR'S field engineer to CONSTRUCTION MANAGEMENT ENGINEER prior to the Preconstruction Meeting for approval.
2. Submit name and address of CONTRACTOR'S surveyor to CONSTRUCTION MANAGEMENT ENGINEER.
3. On request of CONSTRUCTION MANAGEMENT ENGINEER, submit documentation to verify accuracy of field engineering work.
4. Submit certificate signed by registered engineer or surveyor certifying that elevations (lines and grades) and locations of Work are in conformance with Contract Documents. Explain all deviations.

- B. Submit copies of field notes to CONSTRUCTION MANAGEMENT ENGINEER.
- C. Four (4) copies of each survey listed in Table 01 70 00 shall be submitted by the CONTRACTOR in reproducible drawings and one (1) portable document format (PDF) electronic version and one (1) AutoCAD electronic version in 2013 or newer format.
- D. At the completion of the Contract, or at the CONSTRUCTION MANAGEMENT ENGINEER'S request and before final payment is made, the CONTRACTOR shall furnish the CONSTRUCTION MANAGEMENT ENGINEER four (4) sets of reproducible drawings and one (1) PDF electronic version and one (1) AutoCAD electronic version of the final record drawings (as-builts) reflecting all revisions herein described.

**1.6 Safety**

- A. Not used.

**1.7 Quality Assurance**

- A. Not used.

**1.8 Product Delivery, Handling, and Storage**

- A. Not used.

**1.9 Schedule**

- A. Not used.

**1.10 Surveying**

- A. Surveys shall be field run by an independent surveyor licensed in the State of Maryland.
- B. The OWNER has established benchmarks with horizontal and vertical control as shown on the plans for use by the CONTRACTOR. Control datum for survey is indicated on the Drawings.
- C. CONTRACTOR shall establish, maintain and protect new control points as shown on the Contract Drawings. New control points shall be surveyed to at least second order accuracy (e.g. 1:10000) and tied into the existing network.
- D. CONTRACTOR shall locate and protect survey control and reference points. Promptly notify CONSTRUCTION MANAGEMENT ENGINEER of discrepancies discovered. CONTRACTOR shall safeguard all survey points and benchmarks.

Should any of these points be destroyed, the replacement cost shall be borne by the CONTRACTOR. The CONTRACTOR shall assume the entire expense of rectifying work improperly constructed due to failure to maintain and protect established survey points and benchmarks. The CONTRACTOR shall be responsible for verification of the information provided by OWNER. The Contract Drawings provided to the CONTRACTOR consist of elevations and contours based on aerial topography combined with some areas of field run topography. Additionally the Site is prone to settlement as a landfill, and as a result, all indicated elevations and contours are approximate. Accordingly, elevations shown on these plans are to be adjusted to reflect field conditions, relative dimensioning, and minimum or maximum grades where necessary and approved by the CONSTRUCTION MANAGEMENT ENGINEER.

- E. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- F. Provide all surveying equipment required including transit, level, stakes, and required surveying accessories.
- G. Provide field engineering services. Establish elevations, lines, and levels using recognized engineering survey practices.
- H. Furnish all required lines and grades for construction of operations. Check all piping, other materials, and equipment.
- I. Survey, locate, and record and redline Drawings to accurately represent all utilities and buried structures prior to backfilling.
- J. CONTRACTOR shall develop and make all detail surveys and measurements needed for construction including slope stakes, batter boards, piping layouts, and all other working lines, elevations, and cut sheets.
- K. As a minimum survey control requirement, maintain a transit and leveling instrument onsite at all times and a skilled instrument person employed or obtained whenever necessary for layout work.
- L. CONTRACTOR shall keep neat, legible field notes of all measurements and calculations made by the CONTRACTOR while surveying and laying out the Work proposed in this Contract.
- M. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- N. Surveys shall be performed at the milestones indicated in the following Table 01 70 00-1 and as further detailed in this specification.

**TABLE 01 70 00-1  
Required Surveys**

<b>Milestone</b>	<b>Required Survey</b>
<b>Prior to Construction</b>	
Preconstruction	Survey entire site prior to any construction, including the existing ground elevation at landfill gas extraction wells.
Existing Conditions after Clearing and Grubbing	Survey within limit of disturbance immediately after clearing and grubbing.
<b>During Construction</b>	
Closure Cap Subgrade	Survey after soil and waste excavation and relocation and subgrade construction.
Geosynthetics	Survey after placement of membrane and limits of geosynthetics.
Landfill Gas System	Survey belowgrade pipes, valves, and condensate drains before completion of Vegetative Support Soil placement. Survey final ground and top of extraction wells (well heads).
Cover Soil	Survey after placement of Vegetative Support Soil, including buried piping and location of landfill gas extraction wells. Survey after placement of Topsoil.
<b>Post-Construction</b>	
	Survey final site after improvements to Pond No. 3, including stormdrain horizontal and vertical locations (invert elevations), access road locations, landfill gas extraction wells, groundwater monitoring wells, landfill gas monitoring probes, condensate sumps, fencing, line-of-sight markers, and property corner monuments.

O. Surveys at a minimum shall include the following where applicable:

1. Horizontal and vertical location of any installed buried piping or utilities including but not limited to landfill gas, stormwater culverts, and electrical service.
2. Limits of geosynthetics associated with closure cap.
3. Survey points shall include all slope features and grade breaks. A minimum twenty-five (25)-foot by twenty-five (25)-foot grid shall be used and the survey tolerance shall be one-tenth (0.1) foot.
4. Membrane survey shall designate locations of all field welded seams, repair patches, extrusion fillet beads, and geomembrane liner panel numbers with associated roll numbers, location of each random weld destructive sample, and those samples obtained for plant physical property testing as required in these Specifications.
5. Coordinate position and total depth of all new landfill gas extraction wells and modified existing landfill gas extraction wells.

6. Compact verification locations will be shown as a separate layer in the file.

### **1.11 CONTRACTOR'S Field Engineer**

- A. CONTRACTOR shall employ and retain at the work site a full time field engineer capable of performing all engineering tasks required of the CONTRACTOR. Tasks include, but are not limited to:
  1. Daily reports of Project activity to be submitted to the CONSTRUCTION MANAGEMENT ENGINEER with all pertinent information pertaining to the Project as follows:
    - a. Numbers of employees onsite.
    - b. Subcontractor's employees onsite.
    - c. Breakdown of employees by trade.
    - d. Major equipment and materials installed.
    - e. Major construction equipment utilized.
    - f. Location of all areas in which construction was done.
    - g. Materials and equipment received.
    - h. Quantity of the items completed or in progress with daily as well as cumulative quantity of work done for each item.
    - i. Adherence to the construction schedule and construction sequencing.
    - j. Weather conditions.
    - k. Health and Safety.
  2. Submit two (2) copies of CONTRACTOR'S daily report to the CONSTRUCTION MANAGEMENT ENGINEER'S field office by 9:00 a.m. the next working day after the Work was performed. Daily reports shall be signed by a responsible member of CONTRACTOR'S staff.
  3. Maintain field office files and drawings, record drawings, and coordinate engineering services with subcontractors. Prepare layout and coordination drawings for construction operations.

4. Check and coordinate Work for conflicts and interferences, and immediately advise CONSTRUCTION MANAGEMENT ENGINEER of all discrepancies noted.
5. Cooperate with CONSTRUCTION MANAGEMENT ENGINEER in field inspections as required.
6. Review and coordinate Shop Drawing and other submittals.
7. Attend all progress meetings.

**1.12 Qualifications of Field Engineer**

- A. Qualified individual (engineer, experienced personnel, or Maryland registered land surveyor), having completed comparable projects to this Work and having a minimum of five (5) years' experience conducting similar functions and acceptable to CONSTRUCTION MANAGEMENT ENGINEER. Submit for OWNER'S approval.

**1.13 Project Record As-Built Documents**

- A. Maintain onsite one (1) set of the following record documents; record actual revisions to the Work. Record documents include:
  1. Drawings.
  2. Specifications.
  3. Addenda.
  4. Change Orders Change Orders, Work Change Directives, Field Orders and other modifications to the Contract.
  5. Written interpretations and clarifications.
  6. Approved Shop Drawings, product data, and Samples.
  7. Inspection reports.
  8. Laboratory test records.
  9. Field test reports and records Factory test reports and records.
  10. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by OWNER.

- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications—Legibly mark and record, at each product section, description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates used.
  - 3. Changes made by Addenda and modifications.
- F. Record Drawings—Legibly mark each item to record actual construction as follows:
  - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
  - 2. Include locations of concealed elements of the Work, such as anchor trench locations, limits of geosynthetic closure cap, weld locations, seam locations, belowgrade piping, and locations of samples taken of geosynthetic components for destructive and nondestructive testing.
  - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
  - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
  - 5. Identify and locate existing buried or concealed items encountered during Project.
  - 6. Measured depths of foundations in relation to ground elevation.
  - 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 9. Field changes of dimension and detail.
- G. Where the Contract Drawings are not of sufficient size, scale, or detail, the CONTRACTOR shall furnish its own drawings for incorporation of details and dimensions using AutoCAD or Microstation.

H. The final submittal of record ("as-built") drawings shall be stamped "Project Record," signed and dated in blue ink by the CONTRACTOR, and shall be delivered to the CONSTRUCTION MANAGEMENT ENGINEER.

#### **1.14 Cleanup**

- A. Construction cleanup shall proceed as construction progresses and shall consist of the removal of all mud, dirt, trash, debris, and surplus excavated material. All cleaning materials and equipment used shall be selected and employed with care to avoid scratching, marring, defacing, staining, or discoloring the surfaces cleaned.
- B. Immediately prior to the CONTRACTOR'S written request for a final inspection of the Contract Work, or any portion thereof, perform final cleanup.
- C. In addition to the normal "broom clean" requirements, the exposed surfaces of the following materials shall be cleaned as listed herein:
  - 1. Gravel roads—Remove mud, dirt, and redress.
  - 2. Other surfaces—Remove all blemishes. Leave clean, uniform, and dust free.
  - 3. Premises and site—Remove all trash, debris, and surplus excavated material.
- D. No items shall remain on or be discarded on this site, or any other OWNER'S site. Items and excess materials that are to be discarded shall be removed to the active landfill. Leave premises orderly and "broom clean."

#### **1.15 Restoration and Restabilization**

- A. All areas disturbed by the CONTRACTOR'S operation shall be restored and restabilized as specified herein. This shall include, but not be limited to, staging and stockpiling areas, offsite borrow areas, construction strips, access to roads, and all areas within the Limit of Work.
- B. Final restoration and restabilization shall proceed in accordance with the Construction Schedule. This shall include seeding and/or sodding of disturbed areas and outside slopes of landfill cells. Disassemble and removal all temporary construction facilities constructed by the CONTRACTOR and leave the Site in an orderly and restored condition as required by the Contract Documents.
- C. Preserve signs, guard rails, property corner monuments, line-of-sight markers, groundwater monitoring wells, landfill gas monitoring probes, and fences, and maintain in their existing locations and condition unless written permission is obtained from the CONSTRUCTION MANAGEMENT ENGINEER for their removal and restoration or replacement. Remove such conflicting facilities when grading operations begin and store in a manner to keep them clean and in their existing condition. Restore to their locations before removal or such new locations as directed. Repair or replace damaged items when directed, at no cost to the OWNER.



- D. Restabilization of turf areas shall be performed in accordance with Section 32 92 00, Turf and Grasses.
- E. Gravel surfaces and access roads shall be repaired and restored as near as practicable to “like new” condition.

**1.16 Disposal of Waste and Excess Materials**

- A. Construction waste and excess construction materials shall be disposed by the CONTRACTOR at offsite locations in accordance with applicable local, state, and federal regulations.
- B. Waste and excess material disposed of in an unauthorized area shall be removed by the CONTRACTOR and the area shall be restored as near as practicable to its condition before disturbance, at no cost to the OWNER.

**1.17 Removal of Rejected Material**

- A. Material delivered to the Contract site by the CONTRACTOR, which has been determined by the CONSTRUCTION MANAGEMENT ENGINEER to be unsuitable or not in accordance with the Contract Documents, shall be removed from the Work site and disposed of in an approved area at no cost to the OWNER.

**2. MATERIALS**

- A. Not used.

**3. EXECUTION**

- A. Upon receiving the CONTRACTOR’S written request for substantial completion inspection, the CONSTRUCTION MANAGEMENT ENGINEER will perform a walk-through of the Site area with the CONTRACTOR’S and the OWNER’s representative(s). The CONSTRUCTION MANAGEMENT ENGINEER shall identify and document, via a punch list, the additional construction items required to declare “substantial completion” of the Contract. If, in the opinion of the CONSTRUCTION MANAGEMENT ENGINEER, the Site area can be fully utilized for purposes for which it was intended, a “Certificate of Substantial Completion” shall be issued. If, in the opinion of the CONSTRUCTION MANAGEMENT ENGINEER, the Site area cannot be fully utilized for purposes for which it was intended, no “Certificate of Substantial Completion” will be issued and another walk-through will be scheduled. All punch list items identified during the walk-throughs shall be addressed to the satisfaction of the CONSTRUCTION MANAGEMENT ENGINEER. Final payment will not be made until all of the punch list items are resolved to the satisfaction of the CONSTRUCTION MANAGEMENT ENGINEER.

- B. Unless otherwise specified in the Contract Documents, the CONTRACTOR guarantees and warrants all materials, supplies, and equipment furnished and all work performed under the Contract for a period of twelve (12) months after the date of Substantial Completion as determined by the CONSTRUCTION MANAGEMENT ENGINEER.

-- End of Section --

**SECTION 02 61 13.13**  
**WASTE EXCAVATION AND MATERIAL HANDLING**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

- A. The work shall consist of excavation, transportation, and placement of municipal solid waste for waste relocation activities and the associated dewatering necessary to facilitate construction.

**1.1.2 Related Work Specified Elsewhere**

- A. Section 01 45 00, Health and Safety.
- B. Section 31 05 15, Earthwork.
- C. Section 31 05 16, Aggregates.
- D. Section 31 09 13, Settlement Plates.
- E. Section 31 25 00, Erosion and Sediment Control.

**1.2 References**

- A. Not used.

**1.3 Definitions**

- A. Cover Soil—Existing soil that is to be removed prior to waste excavation and stockpiled for future use as subgrade material. Refer to Section 31 05 15, Earthwork.
- B. Waste—Municipal solid waste and residual cover soil that remains after cover soil removal requiring excavation and relocation under this contract.
- C. Unusual Waste—Solid waste that may not be considered municipal, including: waste with oil like sheen and/or odor; drums or tanks containing waste or liquid (unless empty and flattened); tires; and any waste suspect of being hazardous in nature.

**1.4 Qualifications**

- A. Not used.

**1.5 Submittals**

A. Not used.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

**2. MATERIALS**

A. Not used.

**3. EXECUTION**

**3.1 Existing Structures and Utilities**

A. Refer to Section 31 05 15, Earthwork, for excavation near existing groundwater and landfill gas monitoring wells.

**3.2 Waste Relocation**

**3.2.1 Excavation**

A. Refer to Section 31 05 15, Earthwork, for requirements that relate to the removal of existing cover soil and construction of the Closure Cap Subgrade.

B. Waste excavation and relocation is required to meet subgrade, as shown on the Contract Drawings.

C. The CONTRACTOR is responsible for transporting, placing, and compacting excavated waste as required to achieve the design grades and address leachate seeps encountered during construction.

- D. While working in waste, equipment operators may be exposed to landfill gas or leachate. The CONTRACTOR is responsible for providing safe working conditions and proper equipment to handle the potential environment in accordance with Specification Section 01 45 00, Health and Safety.
- E. Areas of excavation shall be excavated to the depth and extent shown on the Contract Drawings. Excavation shall be performed in a manner that will limit spills and the potential for waste to be mixed with uncontaminated material. An excavation log shall be maintained for each area of excavation and shall include the following: existing surface materials, types of underlying soil/waste encountered, utilities encountered, visible signs of contamination encountered, and any other notable features.
- F. When waste is exposed at the subgrade elevation, CONTRACTOR shall over-excavate the waste one (1) foot and backfill with Closure Cap Subgrade material to ensure one (1)-foot minimum Closure Cap Subgrade soil is in place prior to placement of cap geosynthetics. Closure cap subgrade soil shall be placed in maximum twelve (12)-inch lifts. Exposed waste shall be covered at the end of each day as required in this specification.
- G. CONTRACTOR will encounter waste during the drilling of the proposed landfill gas wells. Waste shall be placed below the subgrade and managed as described in this specification.
- H. The CONTRACTOR shall be prepared for encountering hazardous or unusual waste. The CONSTRUCTION MANAGEMENT ENGINEER shall be notified immediately if hazardous or unusual waste is encountered or if other discrepancies between information provided and actual field conditions are discovered.

### **3.2.2 Waste Handling**

- A. Material shall be transported in water-tight trucks or containers from location of excavation to location of placement. No waste may be placed or transported over finished subgrade.
- B. Waste must remain on the property during all construction activities.
- C. The CONTRACTOR shall clean up litter and debris that results from handling waste.
- D. Tires encountered during waste excavation are to be disposed of by the CONTRACTOR at a facility permitted by the State of Maryland.

### **3.2.3 Waste Placement**

- A. Install settlement plates in accordance with Section 31 09 13, Settlement Plates.

- B. Waste is to be placed in maximum two (2)-foot lifts and compacted by three (3) passes of a D6 bulldozer or equivalent.
- C. Waste must be covered at the end of each working day. Methods of covering include placing six (6) inches of cover soil or placing a plastic cover over the waste.
  - 1. The plastic cover must be free of holes or other damage to prevent precipitation from entering the waste. Plastic covers shall have a minimum thickness of ten (10) mils. The cover shall be water resistant, seamed, and shed rainwater off the area preventing precipitation from infiltrating into the soils. The cover material shall be extended over the exposed waste and anchored at the perimeter and ballasted to prevent it from being removed or damaged by wind. The cover interior shall be properly anchored using ultraviolet (UV)-resistant sandbags as needed. Each sandbag shall be filled with sand or other ballast and secured with UV-resistant nylon rope. Sandbags and rope shall be UV-resistant for two (2) years of exposure.
  - 2. Cover soil shall be uniformly placed and compacted and meet the specification for Closure Cap Subgrade in Section 31 05 15, Earthwork, if placed within one (1) foot of the Closure Cap Subgrade elevation.
  - 3. Erosion and sediment controls shall be in accordance with Section 31 25 00, Erosion and Sediment Control.

#### **3.2.4 Work Area Dewatering**

- A. The CONTRACTOR is responsible for the management of any leachate encountered and shall notify the CONSTRUCTION MANAGEMENT ENGINEER immediately upon encountering leachate. In case of encountering leachate, the CONTRACTOR shall excavate into waste until the leachate is redirected into the underlying waste mass, backfill with No. 2 stone as specified in Specification Section 31 05 16, Aggregates, and cover with eighteen (18) inches of general fill.
- B. In the instance where leachate cannot be redirected into the underlying waste, the CONTRACTOR is to notify the CONSTRUCTION MANAGEMENT ENGINEER. The CONTRACTOR must pump the leachate from the excavation area and dispose of the leachate offsite. Up to six thousand (6,000) gallons per day of leachate may be hauled to Oaks Landfill with prior approval from the OWNER. The CONTRACTOR shall notify the OWNER a minimum of twenty-four (24) hours prior to anticipated disposal. If not approved, the CONTRACTOR must dispose of leachate offsite in accordance with regulatory requirements. Tickets for disposal of the leachate shall be provided to the CONSTRUCTION MANAGEMENT ENGINEER within twenty-four (24) hours of the disposal for records purposes.

### **3.3 Sampling and Analysis**

- A. No sampling or analysis of excavated material is required for the work. Hazardous or unusual waste analysis is not anticipated, but if encountered may require sampling or analysis based on direction from the CONSTRUCTION MANAGEMENT ENGINEER and/or to meet disposal requirements.

-- End of Section --

*This page intentionally left blank*



**SECTION 31 05 15  
EARTHWORK**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. This Section includes requirements for identifying acceptable onsite and/or offsite borrow material and for the installation of these materials. This includes preparation, transportation, placement, compaction, backfilling, testing, grading, waste excavation, and related items as indicated in the Contract Documents. Materials specified in this Specification Section shall be installed as shown on the Contract Drawings and as noted in Table 31 05 15-1 below.

**TABLE 31 05 15-1  
Location of Specified Materials**

<b>Specified Material</b>	<b>Location</b>
Closure Cap Subgrade	Soil layer below geomembrane
Vegetative Support Soil	Soil layer over geomembrane
Low Permeability Soil	Stormwater Management Pond, Sediment Basins
Pond Embankment Soil	Sediment Basin and Stormwater Management Pond Embankments
Clay Core Trench	Sediment Basin and Stormwater Management Pond Core Trenches

**1.1.2 Related Work Specified Elsewhere**

- A. Section 01 40 00, Quality Control.
- B. Section 01 45 00, Health and Safety.
- C. Section 02 61 13.13, Waste Excavation and Material Handling
- D. Section 01 57 20, Environmental Protection.
- E. Section 31 05 16, Aggregates.
- F. Section 31 05 19.13, Geotextiles.
- G. Section 31 05 19.16, Geomembrane.
- H. Section 31 25 00, Erosion and Sediment Control.

## **1.2 References**

A. Not used.

## **1.3 Definitions**

A. Borrow material is defined as soil material transferred from one (1) location to another and shall be inclusive of onsite or offsite sources unless explicitly identified herein.

## **1.4 Qualifications**

A. The Geotechnical Testing Laboratory shall meet the qualifications in Specification Section 01 40 00, Quality Control.

## **1.5 Submittals**

### **1.5.1 Delivery Tickets**

A. The CONTRACTOR shall submit delivery tickets for offsite materials and a load count for onsite materials. The delivery ticket for offsite material shall include:

1. Name and location of supplier.
2. Type and amount (weight) of material delivered.

B. The load count for onsite material shall include:

1. Number of loads of onsite material.
2. Estimated volume (cubic yards) of each load.

### **1.5.2 Certified Test Reports**

A. The CONTRACTOR shall submit to the CONSTRUCTION MANAGEMENT ENGINEER certified test reports, prepared by the Geotechnical Testing Laboratory, which present the results of preconstruction testing for each proposed offsite borrow material. If the test results show that the required properties, as outlined in this Specification Section, are not met, the CONSTRUCTION MANAGEMENT ENGINEER will require the CONTRACTOR to retest the material or to identify another offsite borrow material. Submit the reports before delivery of any materials to the site.

B. The CONTRACTOR shall also submit to the CONSTRUCTION MANAGEMENT ENGINEER four (4) copies of certified reports, prepared by the Geotechnical Testing Laboratory, which present the results of construction frequency and field permeability tests. These reports shall also be submitted within fourteen (14) days of the date that the respective samples were collected in the field.

## **1.6 Safety**

A. Not used.

## **1.7 Quality Assurance**

### **1.7.1 General**

- A. The CONTRACTOR shall test materials to determine acceptability. Unless otherwise indicated, all testing shall be performed by the Geotechnical Testing Laboratory, approved by the CONSTRUCTION MANAGEMENT ENGINEER, with samples furnished by and at the expense of the CONTRACTOR.
- B. Placement and compaction of the borrow materials and performance of associated earthwork shall be subject to continuous inspection by the CONSTRUCTION MANAGEMENT ENGINEER. As the various earthwork is conducted, the CONSTRUCTION MANAGEMENT ENGINEER may continuously monitor the lift thickness and compacted conditions of soil materials to verify compliance with the requirements specified herein. The CONSTRUCTION MANAGEMENT ENGINEER may periodically perform in-place field density tests of each compacted lift in accordance with the approved methods stated herein.

### **1.7.2 Preconstruction Testing**

- A. The CONTRACTOR shall request of the CONSTRUCTION MANAGEMENT ENGINEER and arrange for a site inspection for each proposed soil borrow source prior to the commencement of material placement. For each borrow source inspection, the CONTRACTOR shall provide any equipment necessary to excavate test pits throughout the limits of the proposed source to provide the CONSTRUCTION MANAGEMENT ENGINEER with a thorough inspection of the type(s) and uniformity of materials encountered throughout the proposed source. Upon the CONSTRUCTION MANAGEMENT ENGINEER'S visual inspection of a proposed borrow source material(s), but prior to acceptance and delivery of said materials, preconstruction geotechnical testing of the materials from each proposed borrow source shall be performed by the CONTRACTOR to verify that the properties of the proposed borrow material(s) are in conformance with this Specification. The testing shall be performed on samples collected by the CONTRACTOR at locations determined by the CONSTRUCTION MANAGEMENT ENGINEER during the site inspection. The number of preconstruction tests to be performed by the Geotechnical Testing Laboratory at the expense of the CONTRACTOR is listed in Table 31 05 15-2.

**TABLE 31 05 15-2  
Testing for Borrow Materials**

<b>Applicability</b>	<b>Laboratory Tests</b>	<b>ASTM Test Method</b>	<b>No. of Acceptance Tests per Proposed Borrow Material</b>	<b>Frequency of One (1) Test Per Volume (cubic yard) for Each Approved Borrow Material</b>
Closure Cap Subgrade, Vegetative Support Soil, Low Permeability Soil	Natural Moisture Content	ASTM D2216	3	5,000
Closure Cap Subgrade, Vegetative Support Soil, Low Permeability Soil	Particle Size Analysis (sieve)	ASTM D421	3	5,000
Closure Cap Subgrade, Vegetative Support Soil, Low Permeability Soil	Atterberg Limits	ASTM D4318	3	5,000
Closure Cap Subgrade, Vegetative Support Soil, Low Permeability Soil	Modified Proctor Compaction	ASTM D1557	2	5,000
Vegetative Support Soil, Low Permeability Soil, Clay Core Trench	Flexible-Wall Permeameter	ASTM D5084	3	3,000 (initial) 10,000 (maximum)
Pond Embankment Soil	Standard Proctor Compaction	ASTM D698	2	N/A
Vegetative Support Soil	Direct Shear	ASTM D5321	3	5,000

- B. If CONTRACTOR uses onsite material, preconstruction testing is also required.
- C. Based upon the results of each required Modified Proctor compaction test (ASTM D1557), a remolded sample shall be prepared for permeability testing at a moisture content greater than +two (2.0) percent of the optimum moisture content and at a dry density value equal to ninety (90) percent of the soil's maximum dry density for each borrow source, and at a dry density value equal to ninety-five (95) percent of the soil's maximum dry density for the Low Permeability Soil Layer. Each of the remolded samples shall then be subjected to flexible-wall permeability testing in accordance with EPA SW-846 Method 9100. Distilled water may be used as the permeant.
- D. If preconstruction test results indicate that permeability of each borrow material may not consistently satisfy the Specifications, the CONSTRUCTION MANAGEMENT ENGINEER will decide whether to require the CONTRACTOR to retest the material at a greater degree of compaction, to obtain additional samples from the proposed material source, or to reject the borrow source. Should a greater degree of compaction be required by the CONSTRUCTION MANAGEMENT ENGINEER, the field density shall increase to match the densities used in the preconstruction tests at no cost to the OWNER. The CONSTRUCTION MANAGEMENT ENGINEER has the authority to reject any proposed borrow material that he believes is not suitable for

construction based upon the results of the site inspection and/or preconstruction testing.

- E. Interface Friction Angle Testing—Prior to the placement of overlying materials, the CONTRACTOR shall provide Geotechnical Testing Laboratory test results verifying the shear strength of all material interfaces. Geotechnical Testing Laboratory tests shall be based on actual materials, including actual geosynthetics and soils. Construction materials shall meet the minimum interface friction angles specified in Specification Section 31 05 19.16, Geomembrane. Test results indicating differing friction angles and/or cohesion values for materials meeting the required shear strength may be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval. Borrow materials with unacceptable results shall be retested at no additional cost to the OWNER.

### **1.7.3 Construction Testing Frequency**

- A. The CONTRACTOR shall test representative samples from each approved borrow source at the frequency specified in Table 31 05 15-2 as the approved materials are delivered to the site. The samples shall be submitted to the Geotechnical Testing Laboratory by and at the expense of the CONTRACTOR for the required geotechnical testing to ensure that the physical and engineering properties of the materials remain consistent for the duration of the construction.
- B. Flexible-wall permeameter tests shall be performed on samples remolded in the Geotechnical Testing Laboratory from approved borrow material delivered to the site at an initial frequency of one (1) test per three thousand (3,000) cubic yards delivered. The frequency of permeability tests will decrease to one (1) test per ten thousand (10,000) cubic yards if three (3) consecutive tests meet the permeability requirement for a borrow material. The frequency of testing will return to one (1) test per three thousand (3,000) cubic yards if a different borrow source is used, if the grain-size distribution falls outside the range of previously approved samples as determined by the CONSTRUCTION MANAGEMENT ENGINEER, or at the CONSTRUCTION MANAGEMENT ENGINEER'S direction.

### **1.7.4 Field Density Testing**

- A. As borrow materials are placed and compacted, material shall be tested by the Geotechnical Testing Laboratory to ensure that at least ninety (90) percent of the material's maximum dry density for each borrow source, as determined by the Modified Proctor compaction test (ASTM D1557), has been achieved. Compaction for the materials associated with Sediment Basin embankment and clay core trench shall be determined by the Standard Proctor compaction test and be ninety-five (95) percent of the material's maximum dry density (AASHTO Method T-99).
- B. Lift thickness and the initial (before compaction) moisture content of the delivered material shall be continuously monitored by the Geotechnical Testing

Laboratory to ensure conformance with the requirements specified herein. One (1) field moisture/density test shall be performed for each lift placed, for every 10,000 square feet of borrow material placed and for every fifty (50) linear feet of trench backfilled. Testing shall occur more frequently if so directed by the CONSTRUCTION MANAGEMENT ENGINEER. A Troxler 3401 series nuclear moisture-density gauge (or approved equal) shall be used in conjunction with ASTM D6938.

### **1.7.5 Quality Control Laboratory**

- A. The Geotechnical Testing Laboratory shall serve as the Quality Control Laboratory, and shall meet the qualifications in Specification Section 01 40 00, Quality Control.

### **1.7.6 Dust Control**

- A. CONTRACTOR shall be responsible for all aspects of dust control.

### **1.8 Product Delivery, Handling, and Storage**

- A. CONTRACTOR shall maintain proper access and appropriate drainage and erosion and sediment controls for all material stored, whether generated onsite or furnished from an offsite source.

### **1.9 Schedule**

- A. Not used.

## **2. MATERIALS**

### **2.1 Clay Core Trench**

- A. This material shall be used as the Clay Core Trench for the sediment basin and stormwater management pond where shown on the Contract Drawings.

- B. [To be developed in future design phases]

### **2.1 Closure Cap Subgrade**

- A. The CONTRACTOR shall obtain borrow materials from onsite sources first and shall use these borrow materials for onsite applications until exhausted or deemed unacceptable based on testing. Onsite materials shall only be used if these materials comply with the Contract Specifications or if they can be screened to meet the Contract Specifications. It is the responsibility of the CONTRACTOR to confirm if onsite materials meet the Specifications. Verification must be submitted to the CONSTRUCTION MANAGEMENT ENGINEER as required per the Specifications for both onsite and offsite borrow sources.

- B. This material shall be used as the final cover layer to achieve subgrade contours as shown on the Contract Drawings. If the onsite borrow materials have been exhausted, the CONTRACTOR shall obtain offsite borrow material from approved offsite sources for Closure Cap Subgrade. Borrow used for soil backfill, embankments, and other structures shall be as shown on the Contract Drawings.
- C. Material shall have a maximum dry density of at least one hundred (100) pounds per cubic foot as determined by AASHTO Designation T-180, Method D Procedures, and shall be free of excess organic material, boulders, sharp stones, and stones larger than two (2) inches in their longest dimension.
- D. Material shall meet ASTM D2487, classification GM, SW, SP, or SM.

## **2.2 Vegetative Support Soil**

- A. Material shall meet ASTM D2487, classification GM, SW, SP, or SM.
- B. Vegetative Support Soil shall have a maximum permeability of  $1 \times 10^{-4}$  centimeters per second (cm/sec) when compacted to ninety (90) percent of the maximum dry density.
- C.  $D_{85}$  of the material shall be greater than 0.089 millimeter.
- D. Material shall have a minimum internal friction angle of thirty (30) degrees.

## **2.3 Low Permeability Soil**

- A. Low Permeability Soil Layer soils shall be from the approved offsite borrow source(s) or cut to fill and shall be naturally occurring, environmentally clean, inert, free of organics, waste, excess moisture, and miscellaneous or deleterious material, and shall not contain particles larger than one-half (0.5)-inch diameter. The maximum allowable clod size of the material is two (2) inches. Low Permeability Soil Layer material shall classify as CL or CH according to the Unified Soil Classification System, unless otherwise approved by the CONSTRUCTION MANAGEMENT ENGINEER.
- B. Material shall meet the gradations below, and shall have a plasticity index between ten (10) and thirty (30), a liquid limit greater than thirty (30), plot above the A-line on Casagrandes' plasticity chart, clod size less than six (6) inches, and permeability, when compacted to ninety (90) percent of modified Proctor, of  $1 \times 10^{-5}$  cm/sec or less.

Sieve Size	Percent Passing by Weight
1 inch	100
No. 200	80
Clay Size Fines	0-25

**2.4 Sediment Basin Embankment Soil**

- A. Material shall consist of soils classified as CL, GC, SC or CH according to the Unified Soil Classification System and must have at least thirty (30) percent passing the #200 sieve.
- B. The material shall be free of roots, stumps, wood, rubbish, stones greater than six (6) inches, frozen, or other objectionable materials.

**3. EXECUTION**

**3.1 General**

- A. Do not place, spread, or compact acceptable fill material while it is frozen or thawing, or place upon muddy, frozen or thawing ground, while the soil underneath is frozen or thawing, or during unfavorable weather conditions. When the Work is interrupted by rain, Work shall not be resumed until field tests indicate that the moisture content and density of the placement material are within the limits specified. A compacted layer that has been frozen shall be reworked, recompacted, and approved in accordance with the requirements specified herein, after thawing before the next lift is placed thereon.
- B. Thoroughly mix each lift before compaction to ensure uniform distribution of water content. Distribute rocks of permissible sizes throughout the fill material.
- C. Backfill around a structure or pipe shall be brought up evenly on all sides so that no unbalanced pressure will be imposed on the structure or pipe.
- D. Where unsuitable material is encountered, undercut of the unsuitable material and backfill with appropriate material may be directed by the CONSTRUCTION MANAGEMENT ENGINEER. Unsuitable material may be placed in the onsite stockpile area as long as it is not comingled with suitable material. If a stabilization geotextile is necessary, as directed by the CONSTRUCTION MANAGEMENT ENGINEER, refer to Specification Section 31 05 19.13, Geotextiles.
- E. Perform grading operations as shown on the Contract Drawings so that the ground surface will be well-drained at all times. Maintain benching and drainage ditches and keep them open and free from soil, debris, and leaves until final acceptance of the Work. Finish all grading on neat, regular lines conforming to the sections, lines, grades, and contours shown on the Contract Drawings, or if not shown, in accordance



with the criteria set forth herein. Perform the grading work in proper sequence with all other associated operations.

### **3.2 Closure Cap Subgrade**

#### **3.2.1 Subgrade Preparation**

- A. Prior to excavation or soil placement activities, the items identified on the Contract Drawings shall be removed or abandoned.
- B. Remove twelve (12) to eighteen (18) inches of existing cover soil and stockpile for future use as subgrade material. Existing cover soil thickness is generally two (2) feet. Test pit information is included in Appendix A. No waste or woody vegetation may be present in stockpiled material. If no waste is encountered at a depth of eighteen (18) inches, the CONTRACTOR may dig deeper until waste is observed. Visual inspection will be required to determine the presence of waste.
- C. Subgrade shall be placed to the lines and grades shown on the Contract Drawings, to provide a stable base for the cap. In no location shall a grade steeper than three (3) horizontal to one (1) vertical be permitted.
- D. The surface shall provide a smooth, firm, unyielding foundation for the geosynthetics, with no sudden, sharp, or abrupt changes or breaks in grade. No standing water or excessive moisture shall be allowed. The CONSTRUCTION MANAGEMENT ENGINEER shall have reviewed and accepted the subgrade immediately prior to covering.
- E. No protruding stones or other debris shall be on the subgrade surface, The CONTRACTOR shall employ inspection staff to ensure the subgrade is free of objects that may damage the membrane.

#### **3.2.2 Excavation of Existing Waste**

- A. Refer to Specification Section 02 61 13.13, Waste Excavation and Material Handling.

#### **3.2.3 Placement of Vegetative Support Soil and Topsoil**

- A. Vegetative Support Soil shall be placed on top of the cap geosynthetics after their installation is approved by the CONSTRUCTION MANAGEMENT ENGINEER.
- B. All material shall be back-dumped and spread over the cap geosynthetics. No construction equipment will be allowed to travel directly on the geosynthetics.
- C. Only the equipment used to spread the Vegetative Support Soil shall be allowed on the Vegetative Support Soil until the material is compacted to the design depth in accordance with these Specifications. A minimum twenty (20)-inch soil layer shall be

maintained for protection of the cap geosynthetics while placing Vegetative Support Soil.

- D. The CONTRACTOR shall place the Vegetative Support Soil over the cap geosynthetics to the lines and grades as shown on the Contract Drawings. Full thickness of the material shall be placed in one (1) lift, then graded to the thickness shown on the Contract Drawings.
- E. The Vegetative Support Soil must be placed with low ground pressure track equipment as approved by the CONSTRUCTION MANAGEMENT ENGINEER, with a maximum ground pressure of five (5) pounds per square inch. The soil material must be pushed into place and tracked-in a minimum of four (4) passes without rutting, settlement, or damage to the cap geosynthetics. Soil shall not be dropped on slopes. On slopes, Vegetative Support Soil shall be placed starting at the toe and proceeding up the slope. CONSTRUCTION MANAGEMENT ENGINEER shall verify that the Vegetative Support Soil has been tracked sufficiently. No compaction tests are required for the Vegetative Support Soil.
- F. Cover shall be placed such that no stretching, folding, or bridging of the cap geosynthetics occurs.
- G. Grading operations around landfill gas wells and piping shall be done with great care. Damage to any wells, piping, or other structures during grading shall be repaired by the CONTRACTOR at no additional cost to the OWNER. Compaction within three (3) feet of all such structures shall be done with small equipment (such as jumping jack, plate compactor, or walk-behind compactor) under close supervision by the CONSTRUCTION MANAGEMENT ENGINEER.
- H. The CONTRACTOR shall protect the Vegetative Support Soil until Topsoil placement.
- I. Material placed beyond the limits of the lines and grades shown on the Contract Drawings will not be accepted and shall be removed at the CONTRACTOR'S expense.
- J. The CONTRACTOR shall place a maximum of five (5) acres of Vegetative Support Soil prior to topsoil placement. Seed and mulch immediately after topsoil placement and before moving to the next section of vegetative soil placement.
- K. After precipitation events, the CONTRACTOR shall repair washouts, repair erosion damage, and place displaced soil back on the landfill cap in accordance with the Contract Drawings, at no cost to the OWNER.
- L. The grading tolerance for the Vegetative Support Soil over the cap geosynthetics shall be -zero (0.0) foot, +two-tenths (0.2) foot, from required grade.

### **3.3 Low Permeability Soil Placement**

- A. The CONTRACTOR shall not place, spread, or compact the Low Permeability Soil Layer material while it is frozen or thawing, while the soil underneath it is frozen or thawing, or during unfavorable weather conditions. When the work is interrupted by rain or excessively cold weather, Low Permeability Soil Layer placement operations shall not be resumed until field tests indicate that the moisture content and dry density of the in-place Low Permeability Soil Layer material are within the limits specified. A compacted layer that has been frozen shall be reworked and recompacted after thawing before the next layer is placed on it.
- B. The Low Permeability Soil Layer shall be two (2) feet in compacted thickness. The finished surface of the Low Permeability Soil Layer shall conform to the lines and grades shown on the Contract Drawings. The Low Permeability Soil Layer shall be constructed in six (6)-inch lifts (maximum loose thickness) and compacted to a minimum of ninety-five (95) percent of its maximum dry density as determined by the Modified Proctor test (ASTM D1557) or to the degree of compaction required to achieve an in-place permeability of no greater than  $1.0 \times 10^{-5}$  cm/sec, whichever is greater. During compaction, the moisture content of the Low Permeability Soil Layer shall be between +zero (0.0) and +five (5.0) percent of optimum moisture content as determined by the Modified Proctor test (ASTM D1557).
- C. The CONTRACTOR shall thoroughly mix each loose lift before compaction to ensure uniform distribution of moisture and coarse fragments of permissible sizes throughout the fill material.
- D. The finished surface of the Low Permeability Soil Layer shall be smooth, uniform, free of any objects larger than one-half (0.5) inch in diameter, and free of desiccation cracking. A smooth-drum roller (minimum ten [10]-ton static load) shall be used to roll the Low Permeability Soil Layer surface prior to field survey for acceptance by the CONSTRUCTION MANAGEMENT ENGINEER. The final grades shall deviate no more than -zero (0.0) foot, +one-tenth (0.1) foot from the Contract Drawings. All minimum slopes shall be achieved, unless prior approval is provided by the CONSTRUCTION MANAGEMENT ENGINEER. Final acceptance of the Low Permeability Soil Layer will be provided by the CONSTRUCTION MANAGEMENT ENGINEER only after all required geotechnical testing results and "As-Built" Surveys have been reviewed and approved by the CONSTRUCTION MANAGEMENT ENGINEER.

### **3.4 Anchor Trench Backfill**

- A. Soils backfilled in and around the anchor trench shall be placed in eight (8)-inch lifts (maximum loose thickness) and compacted utilizing hand-held mechanical equipment to achieve the degree-of-compaction required. The soil in and around the anchor trench shall be compacted to a minimum of eighty-five (85) percent of maximum dry density as determined by the Modified Proctor compaction test (ASTM D1557).

- B. The in-place dry density and moisture content of the anchor trench backfill shall be determined at one hundred (100)-foot intervals within the anchor trench for each lift. The CONTRACTOR shall ensure the anchor trench is drained of water at all times. The CONTRACTOR shall submit his proposed anchor trench dewatering methods to the CONSTRUCTION MANAGEMENT ENGINEER prior to constructing the anchor trench.
- C. Any anchor trench material which becomes saturated, frozen, or is otherwise unacceptable as determined by the CONSTRUCTION MANAGEMENT ENGINEER shall be excavated, dried, and reworked accordingly, by and at the expense of the CONTRACTOR.

### **3.5 Excavation Near Existing Monitoring Wells**

- A. The CONTRACTOR may not use machinery to excavate within two (2) feet of existing groundwater monitoring wells or landfill gas monitoring wells.

### **3.6 Sediment Basins**

- A. The embankment for Sediment Basin shall be modified as shown on the Contract Drawings. Clear the surface of the existing embankment and strip any topsoil, vegetation, or other organic matter. Scarify the embankment in preparation for placement of new material.
- B. Fill materials shall be placed in maximum eight (8)-inch lifts (before compaction) which are continuous over the entire length of fill.
- C. The in-place dry density shall not be less than ninety-five (95) percent of the maximum dry density with moisture content within  $\pm$ two (2) percent of optimum. All compaction is to be determined by AASHTO Method T 99 (Standard Proctor).

### **3.7 Material Storage**

- A. All stockpiled soils shall be stored in a manner that will not erode and cause sedimentation. Establish adequate erosion and sediment controls according to Specification Section 31 25 00, Erosion and Sediment Control.

### **3.8 Dewatering and Drainage**

- A. The CONTRACTOR is responsible for managing groundwater, perched water, leachate, and runoff during excavation and subsequent fill placement activities. The presence or absence of water or leachate shall not entitle the CONTRACTOR to additional compensation. Excavation is not expected below the groundwater table.

- B. Any liquids encountered during waste excavation shall be considered leachate. Stormwater runoff that has been in contact with waste shall be considered leachate. Leachate shall be managed as required in Specification Section 02 61 13.13, Waste Excavation and Material Handling.

### **3.9 Maintenance**

- A. Protect newly graded areas from traffic and erosion. Keep free of trash and debris. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density and moisture range prior to further construction.
- C. Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work and eliminate evidence of restoration to greatest extent possible.

### **3.10 Finishing Work**

- A. After earthwork is completed, the disturbed areas shall be finish graded. Any roots, sharp, angular stones larger than two (2) inches or rounded stones in excess of two (2) inches in their longest dimension, or other undesirable material shall be removed from the surface immediately and the surface shall be prepared for vegetative stabilization.
- B. Unless otherwise specified by the CONSTRUCTION MANAGEMENT ENGINEER, the elevation of all drainage features and structures shall be within  $\pm$ one-tenth (0.1) foot of those shown on the Contract Drawings.
- C. After the Closure Cap has been installed, the CONTRACTOR shall maintain the surface free of ruts, depressions, and damage resulting from the hauling and handling of any material, equipment, tools, etc. Damage shall be repaired by the CONTRACTOR as indicated on the Contract Drawings and/or specified in the Specifications.

### **3.11 As-Built Survey**

- A. Survey shall be in accordance with Specification Section 01 70 00, Execution and Closeout Requirements.

-- End of Section --

*This page intentionally left blank*

**SECTION 31 05 19.13  
GEOTEXTILES**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

- A. The Work includes the supply, delivery, and installation of geotextile fabrics. Materials specified in this Specification Section shall be installed as shown on the Contract Drawings and as noted in Table 31 05 19.13-1 below.

**TABLE 31 05 19.13-1  
Location of Specified Materials**

<b>Specified Material</b>	<b>Location</b>
Separation Geotextile (8 oz.)	Closure Cap
Stabilization Geotextile	As Needed for Subgrade Stabilization
Erosion and Sediment Control Geotextiles	As Needed for Erosion and Sediment Control as shown on Contract Drawings

**1.1.2 Related Work Specified Elsewhere**

- A. Section 01 40 00, Quality Control.  
B. Section 31 05 15, Earthwork.

**1.2 References**

- A. Not used.

**1.3 Definitions**

- A. Not used.

**1.4 Qualifications**

- A. The geotextile manufacturer(s) shall be a specialist(s) in the manufacture of polyester and/or polypropylene geotextile, and have produced and manufactured a minimum of five (5) million square feet of said geotextile fabric that was used in successful installations.
- B. The geotextile shall be installed by a Geosynthetics Installer meeting the qualifications in Specification Section 01 40 00, Quality Control.

## **1.5 Submittals**

- A. A Statement of Qualifications for the Geosynthetics Installer meeting the requirements of Geosynthetic Installer qualifications noted in Specification Section 01 40 00, Quality Control, shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval four (4) weeks prior to installation. No geotextile installation shall begin until the CONSTRUCTION MANAGEMENT ENGINEER has received and approved the items as identified.
- B. A Statement of Qualifications for the geotextile Manufacturer shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval. The following information regarding the manufacturer's geomembrane (high-density polyethylene and linear low-density polyethylene) shall be submitted by the CONTRACTOR to the CONSTRUCTION MANAGEMENT ENGINEER for approval four (4) weeks prior to installation. No geotextile installation shall begin until the CONSTRUCTION MANAGEMENT ENGINEER has received and approved the items as identified in this submittal.

### **1.5.1 Certified Test Reports**

- A. The CONTRACTOR shall submit in writing to the CONSTRUCTION MANAGEMENT ENGINEER for approval the manufacturers' names and the materials intended for use for each geotextile. Certified test reports for the material that is to be delivered to the site conforming to the requirements of standards and testing methods specified herein shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval prior to delivery of geotextile. The material manufacturer and the CONTRACTOR must satisfy the CONSTRUCTION MANAGEMENT ENGINEER that the material will meet the requirements listed in Tables 31 05 19.13-2 and 31 05 19.13-3. The CONTRACTOR shall transmit to the CONSTRUCTION MANAGEMENT ENGINEER all information provided by the manufacturers or suppliers, prior to approval for furnishing and installing any such materials.

### **1.5.2 Installation and Repair Procedures**

- A. The CONTRACTOR shall submit to the CONSTRUCTION MANAGEMENT ENGINEER for approval four (4) weeks prior to installation, the geotextile manufacturer's recommended installation procedures, including placement and joining, and the manufacturers recommended procedures for repairing or replacing damaged or defective geotextile material.
- B. The CONTRACTOR shall also submit Geosynthetic Installer's Installation Plan for geotextile in accordance with Specification Section 01 40 00, Quality Control.



## **1.6 Safety**

A. Not used.

## **1.7 Quality Assurance**

### **1.7.1 Material Testing**

#### **1.7.1.1 Material Testing by Manufacturer**

- A. Geotextiles shall be tested by the respective manufacturer(s) prior to shipment to ensure that the physical and mechanical properties of the finished products are in accordance with this Specification. The required material properties, test methods, values, and units are presented in Table 31 05 19.13-2 and Table 31 05 19.13-3. Test frequencies shall be in accordance with Manufacturer's Quality Control frequencies from ASTM D4354.
- B. Compatibility testing shall be performed to verify the chemical and physical resistance of the nonwoven, needle-punched geotextile. Manufacturer(s) shall submit test data based on EPA's Method 9090, Compatibility Test for Wastes and Membrane Liners, using the geotextile material to be furnished and typical solid municipal waste sanitary landfill leachate.

#### **1.7.1.2 Material Testing by Contractor**

- A. Samples of the Separation Geotextile and Stabilization Geotextile (if required) shall be obtained by the CONTRACTOR (for testing at a Geosynthetics Testing Laboratory) at a frequency of one (1) sample (at least four [4] feet by four [4] feet) for every two (2) acres of material installed. The geotextiles shall be tested for the properties listed in Tables 31 05 19.13-2 and 31 05 19.13-3. Each sample collected shall have the roll, lot, and manufacturer clearly marked on or attached to the sample. Sample shipping and testing shall be the responsibility of the CONTRACTOR. All samples not submitted for testing shall be properly stored onsite during construction and submitted to the CONSTRUCTION MANAGEMENT ENGINEER at the completion of the project.

**TABLE 31 05 19.13-2**  
**Physical Properties of Nonwoven Needle-Punched Separation Geotextile**

<b>Property</b>	<b>Test Method</b>	<b>Minimum Average Roll Values (MARV)</b>	<b>Unit</b>
Unit Weight	ASTM D5261	8	oz/yd <sup>2</sup>
Grab Tensile Strength	ASTM D4632	205	lb
Grab Elongation	ASTM D4632	50	%
Puncture Strength	ASTM D4833	500	lb
Permittivity	ASTM D4491	1.1	sec <sup>-1</sup>
AOS	ASTM D4751	80	Sieve no.
UV Resistance	ASTM D4355	70	% retained at 500 hours

**TABLE 31 05 19.13-3**  
**Physical Properties of Woven Stabilization Geotextile**

<b>Property</b>	<b>Test Method</b>	<b>Minimum Average Roll Values (MARV)</b>	<b>Unit</b>
Grab Tensile Strength	ASTM D4632	315	lb
Grab Elongation	ASTM D4632	15	%
Mullen Burst	ASTM D3786	675	psi
Puncture Strength	ASTM D4833	150	lb
Trapezoid Tear Strength	ASTM D4533	120	lb
AOS	ASTM D4751	40	Sieve no.

Notes: % = Percent.	oz/yd <sup>2</sup> = Ounce(s) per square yard.
AOS = Angle of Strength.	psi = Pound(s) per square inch.
lb = Pound(s)	sec = Second.
gpm/sf = Gallon(s) per minute per square foot.	

### **1.7.2 Daily Quality Control (QC) Log**

- A. The Geosynthetic Installer's field superintendent shall maintain a daily QC log during all phases of geotextile installation. This log shall document the daily progression of the geotextile installation from delivery of the material to final acceptance. The daily log shall designate those construction activities that influence the integrity of the geotextile material during installation. The log, at a minimum, shall include entries and detailed documentation of the following:
1. Weather, i.e., temperature, winds, precipitation.
  2. Site preparation activities, including removal of water, sediment, and any cleaning, smoothing and/or repair to materials underlying the geotextile.
  3. Roll and panel number of each sheet that is deployed on a daily basis.
  4. Repairs and replacements.
  5. Seaming activities, including name of welder or seamer, as applicable.
  6. Inspection of geotextile material delivered to the site.
  7. Calibration dates of each piece of seaming equipment and seam test equipment.
- B. The Geosynthetic Installer's field superintendent shall submit the required daily QC logs to the CONSTRUCTION MANAGEMENT ENGINEER for review within two (2) calendar days of the activities documented. At any point during the Work, if the daily QC log has not been submitted, the CONSTRUCTION MANAGEMENT ENGINEER has the right to stop the geotextile installation activities at no cost to the OWNER. Upon receiving the required daily QC logs, Work may resume.

### **1.7.3 Visual Inspection**

- A. During deployment of the various geotextiles, the Geosynthetic Installer and CONSTRUCTION MANAGEMENT ENGINEER shall carry out visual inspections of the material surfaces. Any faulty areas relating to fabric integrity, uniformity, rips or tears, sewing completeness, or seam overlap shall be repaired by the Geosynthetic Installer using techniques pre-approved by the CONSTRUCTION MANAGEMENT ENGINEER. Such repairs shall be reported to the CONSTRUCTION MANAGEMENT ENGINEER by means of the daily QC log.

### **1.7.4 QC Laboratory**

- A. The Geosynthetics Testing Laboratory shall serve as the QC Laboratory for geotextile testing, and shall meet the qualifications in Specification Section 01 40 00, Quality Control.

## **1.8 Delivery, Storage, and Handling**

A. Materials shall be delivered to the site only after the required submittals have been approved by the CONSTRUCTION MANAGEMENT ENGINEER. Storage and handling of the materials shall conform to the manufacturer's recommendations and shall be done in such a manner as to prevent damage to any part of the work. The CONTRACTOR shall provide sufficient labor and equipment to properly unload material upon delivery to the site. The material shall be stored in a reasonably smooth, well-drained, level area, away from sharp objects or rocks that may puncture the fabric; away from brush, poison oak or ivy; oil, grease, or fuels; and in an area accessible for inspection. Individual pieces or bundles shall be stored with safe walking space and clearance between them to allow full view for inspection purposes. To prevent ultraviolet degradation of the materials, the protective wrapper on each geotextile roll shall not be removed until the material is ready for deployment. Identification tags attached to the rolls of geotextiles delivered to the site shall not be removed until the material is installed. Any roll not properly identified prior to deployment activities may be deemed unacceptable for use by the CONSTRUCTION MANAGEMENT ENGINEER and replaced at the expense of the CONTRACTOR.

## **1.9 Schedule**

A. Not used.

## **2. MATERIALS**

### **2.1 General**

A. Nonwoven and woven geotextile fabrics shall be manufactured from polypropylene resin and polymeric yarn or fiber, respectively, and provide the minimum physical properties outlined in Tables 31 05 19.13-2 and 31 05 19.13-3. The properties shown represent the minimum-acceptable minimum average roll values (MARV) for the installed materials.

B. End uses for the Separation Geotextile and Stabilization Geotextile fabrics to be installed for the project are shown on the Contract Drawings.

C. Specifications for Erosion and Sediment Control geotextiles shall be in accordance with Contract Drawings.

## **3. EXECUTION**

### **3.1 Geotextile Placement**

A. Nonwoven, needle-punched Separation Geotextile shall be placed by the Geosynthetic Installer at the locations shown on the Contract Drawings. All geotextile

panels shall have their seams overlapped a minimum of four (4) inches and securely fastened according to seaming procedures as approved by the CONSTRUCTION MANAGEMENT ENGINEER. On the slopes, seams shall be sewn securely using polymeric thread with a “prayer” stitch and shall be oriented up and down the slope. In wet weather geotextile must be sewn.

- B. Geotextile that has soil or stone placed upon it shall have eighteen (18) inches (minimum) of the material placed onto the fabric in advance of either tracked or rubber-tired construction equipment. The material shall be placed in the same direction as the fabric seam. Extreme care is required by the CONTRACTOR so that the equipment operator does not cause damage to the geotextiles. At no time will construction equipment be permitted to track directly on fabric. Any damage to the geotextile fabrics or underlying materials shall be repaired by the Geosynthetic Installer (using approved methods) at no additional expense to the OWNER.
- C. Erosion and Sediment Control Geotextile shall be placed in accordance with Contract Drawings.

### **3.2 Subgrade Stabilization**

- A. Where determined by the CONSTRUCTION MANAGEMENT ENGINEER as noted in Specification Section 31 05 15, Earthwork, reinforcement shall be performed by deploying the woven, slit-film Stabilization Geotextile to at least ten (10) feet beyond the CONSTRUCTION MANAGEMENT ENGINEER-delineated limits of the unstable area in all directions. Panel overlaps shall be a minimum of six (6) feet for both panel edges and end-of-roll edges where required. The CONTRACTOR shall provide any and all measures necessary to anchor the geotextile against wind uplift or drag until Vegetative Support Soil is placed atop the geotextile, in accordance with Specification Section 31 05 15, Earthwork. Under no circumstances shall construction equipment traverse directly on the geotextile.

### **3.3 Geosynthetic Deployment**

- A. All-terrain vehicles (ATVs) may be used in the deployment of geosynthetic materials provided the following conditions are adhered to:
  - 1. ATVs shall not be permitted to operate directly on the geomembrane material unless written approval is given by the CONSTRUCTION MANAGEMENT ENGINEER.
  - 2. The use of ATVs is considered to be at the CONTRACTOR’s risk.
  - 3. Any damage resulting from the use of ATVs, as determined by the CONSTRUCTION MANAGEMENT ENGINEER, will be repaired to the satisfaction of the CONSTRUCTION MANAGEMENT ENGINEER at no

additional cost to the OWNER. If three (3) repairs are required as a result of using ATVs, further use of ATVs on the project will be prohibited.

4. ATVs shall be inspected by the CONSTRUCTION MANAGEMENT ENGINEER prior to use.
5. ATVs that leak fuel and/or oil shall not be permitted to operate over the geosynthetics.
6. Any fuel which leaks onto the geosynthetic shall be thoroughly removed (cleaned) by the CONTRACTOR or have the geosynthetic material replaced at the discretion of the CONSTRUCTION MANAGEMENT ENGINEER at no additional cost to the OWNER.
7. ATVs shall not be refueled on the geosynthetic.
8. ATVs shall have tires with low ground pressure, less than five (5) pounds per square inch, and shall have shallow treads.
9. ATVs shall be operated by a single operator at speeds less than five (5) miles per hour.
10. Quick starts, stops, and sharp turns shall not be permitted.
11. Pulling material up slopes greater than five (5) percent shall not be permitted.

### **3.4 Temporary Securement of Geotextiles**

- A. CONTRACTOR shall secure any exposed geotextiles in place from wind uplift or drag. The amount of sandbags or extent of other methods approved by the manufacturer needed to secure geotextiles shall be determined by and at the expense of the CONTRACTOR.

### **3.5 Placement of Cover Materials**

- A. All geotextile fabrics shall be covered with overlying materials as specified in the Contract Documents, within fourteen (14) calendar days following removal of their protective wrapping and their placement in the field, in order to protect them from ultraviolet light degradation. The CONTRACTOR shall stage his activities to accomplish this requirement and maintain the construction schedule. Any geotextiles left exposed longer than the fourteen (14) calendar days shall, at the CONSTRUCTION MANAGEMENT ENGINEER'S direction, be removed for suitable disposal and replaced with new material by the Geosynthetic Installer at no cost to the OWNER.

B. CONTRACTOR shall place all cover materials in such a manner to ensure geotextiles are not damaged, slippage of underlying materials is minimized, and no excessive wrinkling or tensile stresses in the geotextiles develop.

**3.6 As-Built Survey**

A. Not used.

-- End of Section --

*This page intentionally left blank*



**SECTION 31 05 19.16  
GEOMEMBRANE**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

- A. The Work includes the manufacture, supply, delivery, installation, and testing of linear-low-density polyethylene (LLDPE) geomembrane materials. Materials specified in this Specification Section shall be installed as shown on the Contract Drawings.
- B. The CONTRACTOR shall furnish all labor, materials, supplies, supervision, equipment, construction machinery, and incidentals that may be necessary to construct the project as described in these Specifications and as shown on the Contract Drawings.
- C. The CONTRACTOR is responsible for inspecting the site conditions and existing tie-in requirements prior to bidding.

**1.1.2 Related Work Specified Elsewhere**

- A. Section 01 40 00, Quality Control.
- B. Section 01 70 00, Execution and Closeout Requirements.
- C. Section 31 05 19.13, Geotextiles.

**1.2 References**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to within the text by the basic designation only.

**1.2.1 Geosynthetic Research Institute (GRI)**

- A. (2012) Test Methods, Test Properties and Testing Frequency for LLDPE Smooth and Textured Geomembranes. GRI GM17.
- B. (2011) Seam Strength and Related Properties of Thermally Bonded Polyolefin Geomembrane. GRI GM19.

## **1.2.2 U.S. Environmental Protection Agency (USEPA)**

- A. (1991) Inspection Techniques for the Fabrication of Geomembrane Field Seams. EPA-530-SW-91-051.

## **1.3 Definitions**

- A. Not used.

## **1.4 Qualifications**

- A. Each Geomembrane manufacturer shall be a specialist in the manufacture of the same type of geomembrane to be installed and have at least five (5) years' experience in the manufacture of and have manufactured at least an annual production of thirty (30) million square feet during the last five (5) years that were used in successful similar installations.
- B. Geomembrane shall be installed by a Geosynthetics Installer meeting the qualifications included in Paragraph 1.4.1.

### **1.4.1 Geosynthetics Installer's Qualifications and Experience**

- A. The CONTRACTOR shall retain the services of a Geosynthetics Installer. The CONTRACTOR shall be responsible for the performance of the Geosynthetics Installer. The Geosynthetics Installer shall:
  - 1. Be a specialist in the installation of the same type of geomembrane being installed (LLDPE).
  - 2. Have at least five (5) continuous years of experience in the installation of the same type of geomembrane being installed.
  - 3. Have installed at least twenty-five (25) million square feet of the same type of geomembrane being installed during the last five (5) years, as applicable.
  - 4. Be documented by the manufacturer as an "Approved Installer" of the geomembrane manufacturer for the same type of geomembrane being installed.

## **1.5 Submittals**

- A. A Statement of Qualifications for the Geosynthetics Installer meeting the requirements of Geosynthetic Installer qualifications and submittal requirements noted in Specification Section 01 40 00, Quality Control, shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval. No geomembrane installation shall begin until the CONSTRUCTION MANAGEMENT ENGINEER has received and approved the items as identified.

- B. Geosynthetics Installer's Installation Plan in accordance with Specification Section 01 40 00, Quality Control, Paragraph 1.5.D.
- C. A Statement of Qualifications for the Geomembrane Manufacturer shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval. The following information regarding the manufacturer's geomembrane shall be submitted by the CONTRACTOR to the CONSTRUCTION MANAGEMENT ENGINEER for approval four (4) weeks prior to installation. No geomembrane installation shall begin until the CONSTRUCTION MANAGEMENT ENGINEER has received and approved the items as identified in this submittal.
  - 1. Manufacturer's quality control program and/or manual that outlines the factory and field quality control procedures to be utilized for both the manufacturing process and installation of the geomembrane system. This shall address, at a minimum, delivery and use of raw materials, geomembrane roll production, installation (including cold weather installation), and quality assurance (QA)/quality control (QC) of these activities.
  - 2. Manufacturer's certificate of compliance to this Specification. Certificate of compliance shall be notarized certifying that each type of geomembrane material furnished for this project (reference project title and number) complies with all requirements specified in the Contract Documents prior to delivery of geomembrane materials. No geomembrane shall be shipped until the manufacturer's certificate of compliance has been received by the CONTRACTOR and approved by the CONSTRUCTION MANAGEMENT ENGINEER.
  - 3. Manufacturer's warranty for the geomembrane to be installed, including pipe penetration seals and field seams as applicable, prior to delivery of material.
  - 4. Name and location of manufacturer's QA/QC facility where laboratory testing will be conducted for the CONTRACTOR.
  - 5. Manufacturer's proposed product defect repair procedures.

### **1.5.1 Installation**

- A. Geosynthetic Installer's daily QC log, in accordance with Paragraph 1.7.2 of this Section.

### **1.5.2 Post-Installation**

- A. At the completion of the geomembrane installation activities, the Geosynthetic Installer shall submit to the CONSTRUCTION MANAGEMENT ENGINEER:

1. Post-construction As-Built Drawing of the geomembrane showing all numbered geomembrane panels with their associated roll numbers, location and types of all welded seams, destructive coupon test locations, location and reason for construction repairs and patches, repaired factory defects, surveyed location of anchor trench, and pipe penetrations, surveyed location of landfill gas well penetrations, and limit of closure cap liner. The As-Built Drawings shall identify the panel and roll numbers from which the archive coupons were taken for future physical and chemical characteristics testing, if required.
2. Reports with field quality test reports, daily acceptance certificates, daily seaming reports, daily QC logs, Geosynthetic Installer's completion report, and written certification from the Geosynthetic Installer that the geomembrane has been installed in accordance with the installation and testing requirements established by both the manufacturer and the Geosynthetic Installer, and these Specifications.
3. Geosynthetic Installer's warranty within ten (10) days of final completion.

## **1.6 Safety**

- A. Not used.

## **1.7 Quality Assurance**

### **1.7.1 Single Source**

- A. All material must be obtained from a single material supplier and shall be manufactured by a single manufacturer. If a second supplier for the geomembrane is proposed, separate Pre-Installation submittals shall be submitted to CONSTRUCTION MANAGEMENT ENGINEER for approval. Additionally, it must be certified that the new material is compatible and will effectively interface with existing material and meet all pertinent Contract Specifications. The CONTRACTOR shall be solely responsible for additional testing costs associated with the acceptance of the new supplier or manufacturer.

### **1.7.2 Daily QC Log**

- A. The Geosynthetic Installer's field superintendent shall maintain a daily QC log during all phases of the complete geomembrane installation. This log shall document the daily progression of the geomembrane installation from delivery of the geomembrane to final acceptance. The daily log shall designate those construction activities that influence the integrity of the geomembrane during installation. The log, at a minimum, shall include entries and detailed documentation of the following:
  1. Weather, i.e., temperature, winds, precipitation.
  2. Required calculations of geomembrane expansion/contraction.

3. Acceptance of the prepared subgrade surface by the CONSTRUCTION MANAGEMENT ENGINEER and Geosynthetic Installer.
  4. Record the roll and panel number of each sheet that is deployed on a daily basis.
  5. Repairs and replacements.
  6. Document seaming activities, including name of welder(s) for each seam and any failures resulting from testing of the seams.
  7. Results and locations of destructive and nondestructive testing performed as part of geomembrane installation, including corrective action taken.
  8. Inspection of geosynthetic material delivered to the site.
  9. Calibration dates of each piece of seaming equipment and seam test equipment.
- B. The Geosynthetic Installer's field superintendent shall submit the required daily QC logs to the CONSTRUCTION MANAGEMENT ENGINEER for review within two (2) calendar days of the activities documented. At any point during the Work, if the daily QC log has not been submitted, the CONSTRUCTION MANAGEMENT ENGINEER has the right to stop the geomembrane system installation activities at no cost to the OWNER. Upon receiving the required daily QC logs, Work will resume.

### **1.7.3 Material Testing by Manufacturer**

- A. The Manufacturer shall test materials as set forth in the applicable referenced Specifications and as required herein. Requirements for inspection and testing for each type of the geomembrane to be installed are:
1. Plant Testing of Raw Materials—Compounded resin to be used for production shall be tested by the geomembrane manufacturer. At a minimum, one (1) sample shall be obtained from each shipping container (typically a railcar) compartment. Two (2) tests for each of the listed properties in Table 31 05 19.16-1 shall be performed on each LLDPE compartment sample. The material will be accepted for production use if all test results conform to the material requirements and results between the various shipment compartments are comparable. Variations are indicative of poor quality and/or inconsistent materials and may be cause for rejection by the CONSTRUCTION MANAGEMENT ENGINEER. ASTM standard test numbers and the range of acceptable results are shown in Tables 31 05 19.16-2 and 31 05 19.16-3 are from Geosynthetic Research Institutes Test Methods GRI-GM17 for LLDPE. In the event of a conflict, the latest edition of GRI-GM17 for LLDPE shall govern.

**TABLE 31 05 19.16-1**

**Physical Properties of Compounded Resin for LLDPE Geomembrane Liner and Extrudate Welding Rod**

<b>Property</b>	<b>Test Method</b>	<b>Required Value</b>	<b>Unit</b>	<b>Sample Frequency*</b>
Specific Gravity	ASTM D792 or ASTM D1505	≤0.939 max. avg.	g/mL	1/200,000 pounds
Melt Index	ASTM D1238 (190°/2.16 kg)	<1.0	g/10 min	One (1) per shipping container

\* In addition, the CONSTRUCTION MANAGEMENT ENGINEER at his discretion may select up to ten (10) samples of extrudate welding rod delivered to the site to be tested for these properties.

2. Plant Testing of Geomembrane—The LLDPE geomembranes shall be tested by the manufacturer(s) prior to shipment to ensure that the physical and chemical properties of the finished product(s) are in conformance with the Specifications. The required conformance and testing frequencies of geomembranes as well as required values are presented in Table 31 05 19.16-2. Required values listed are minimum average roll values unless otherwise stated. The manufacturer shall provide individual roll test results to prove statistically that the geomembrane maximum meets the minimum average roll values required in Table 31 05 19.16-2 and the Test Methods GRI-GM 17 for LLDPE. In the event of conflict, the Test Methods in GRI-GM 17 shall be the ruling documents.

**1.7.4 Material Testing by CONTRACTOR**

A. The CONTRACTOR shall test materials as set forth in the applicable referenced Specifications and as required herein. Requirements for inspection and testing of the LLDPE geomembrane are:

1. Archive Field Samples—Five (5) samples of each type of geomembrane installed one (1)-square-foot (minimum) coupon produced and installed shall be retained intact by the field crew foreman as an archive sample. These coupons shall be labeled by the field crew foreman with the appropriate roll numbers and panel numbers of the geomembrane material from which they are obtained and shall be properly stored onsite for the duration of construction and delivered to CONSTRUCTION MANAGEMENT ENGINEER at the end of construction.
2. Destructive and Nondestructive Weld Testing—Geomembrane seam welding and random destructive and nondestructive testing shall be in accordance with procedures outlined in Paragraphs 3.6 and 3.7 of this Section. The CONTRACTOR shall provide test results to prove that the field seam tests meets the minimum average roll values required in Table 31 05 19.16-2 or GRI Test Method-GM 19. In the event of conflict between the tables and the GRI Test Method, GRI-GM 19 shall be the ruling document.
3. Conformance Testing of Geomembrane—Upon delivery of the material to the project site, samples of the geomembrane to be installed shall be collected by the CONTRACTOR at locations selected by the CONSTRUCTION

MANAGEMENT ENGINEER and submitted to the Geosynthetics Testing Laboratory to ensure that the physical and chemical properties of the product are in conformance with the Specifications. Conformance Testing shall be conducted prior to the installation of the geomembrane. The required Conformance Testing and required values are presented in Table 31 05 19.16-2. Test frequencies shall be eight (8) samples minimum. Additional samples may be required, as directed by the CONSTRUCTION MANAGEMENT ENGINEER, if failing results are reported. Conformance testing shall be coordinated by and conducted at the expense of the CONTRACTOR. Results of the conformance testing shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval prior to material installation

4. Interface Friction Angle Testing—A minimum of thirty (30) days prior to the placement of the cap geosynthetics, the CONTRACTOR shall provide lab test results verifying the shear strength of the interfaces with testing conducted according to direct shear methods as specified by ASTM D5321. Lab tests shall be performed with actual geosynthetics and soils to be used in the project. Materials shall meet the minimum interface friction angles specified in Table 31 05 19.16-3. Test results demonstrating adherence to minimum shear strength with differing friction angles and/or cohesion values may be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval. Materials with unacceptable results shall be retested at no additional cost to the OWNER. Tests shall be performed with the following parameters:
  - a. Shear rate: one (1) millimeter per minute.
  - b. Seating time: twenty-four (24) hours in fully hydrated condition.
  - c. Normal stress: one hundred (100)/two hundred (200)/four hundred (400) pounds per square foot.

### **1.7.5 QC Laboratory**

- A. The Geosynthetics Testing Laboratory shall serve as the QC Laboratory for geomembrane testing, and shall meet the qualifications in Specification Section 01 40 00, Quality Control.

**TABLE 31 05 19.16-2**  
**Physical Properties of Geomembrane Liner – Textured 40 Mil LLDPE**  
**(Minimum Average Roll Values)**

Property	Test Method	Required Value	Unit	Sample Frequency
Thickness mils (min. avg.) • Lowest 8 of 10 (and per GRI-17)	ASTM D5994	-10%	%	Per roll
Asperity Height mils (min. avg.) <sup>(1)</sup>	ASTM D7466	16	mil	Every 2 <sup>nd</sup> roll <sup>(2)</sup>
Density (min. avg.)	ASTM D1505 ASTM D792	0.940	g/cc	200,000 lb
Tensile Properties (min. avg.) <sup>(3)</sup> • Tensile Strength to Yield • Tensile Strength to Break • Elongation at Yield • Elongation at Break	ASTM D6693 Type IV	126 90 12 100	lb/inch width lb/inch width % %	20,000 lb
2% Modulus (max)	ASTM D5323	2400	lb/in.	Per Formulation
Tear Resistance (min. avg.)	ASTM D1004	42	lb	45,000 lb
Puncture Resistance	ASTM D4833	90	lb	45,000 lb
Axi-Symmetric Break Resistance Strain	ASTM D5617	30	min	Per Formulation
Carbon Black Content (range)	ASTM D4218 <sup>(4)</sup>	2-3	%	45,000 lb
Carbon Black Dispersion	ASTM D5596	Note (5)	----	45,000 lb
Oxidative Induction Time (OIT) (a) Standard OIT -- or -- (b) High Pressure OIT	ASTM D 3895  ASTM D 5885	100  400	min  min	200,000 lb
Oven Aging at 85°C <sup>(6)(7)</sup> (a) Standard OIT (min. avg.) -- % retained after 90 days -- or -- (b) High Pressure OIT (min. avg.) -- % retained after 90 days	ASTM D 5721  ASTM D 3895  ASTM D 5885	  55  80	  %  %	Per Formulation
UV Resistance <sup>(8)</sup> High Pressure OIT (min. avg.) -- % retained after 1600 hrs <sup>(9)</sup>	ASTM D7238 ASTM D 5885	50	%	Per Formulation
Hot Wedge Seams <sup>(10)</sup> • Sheer Strength <sup>(11)</sup> • Peel Strength <sup>(11)</sup> • Peel Separation	GRI GM19	60 50 25	lb/in. lb/in. lb/in.	-
Extrusion Fillet Seams • Sheer Strength <sup>(11)</sup> • Peel Strength <sup>(11)</sup> • Peel Separation	GRI GM19	60 44 25	lb/in. lb/in. lb/in.	-

- (1) Of 10 readings; 8 out of 10 must be  $\geq 7$  mils, and lowest individual reading must be  $\geq 5$  mils.  
(2) Alternate the measurement side for double sided textured sheet.  
(3) Machine direction (MD) and cross machine direction (XMD) average values should be on the basis of 5 test specimens each direction. Yield elongation is calculated using a gage length of 1.3 inches. Break elongation is calculated using a gage length of 2.0 inches.  
(4) Other methods such as D1603 (tube furnace) or D6370 (TGA) are acceptable if an appropriate correlation to D4218 (muffle furnace) can be established.  
(5) Carbon black dispersion (only near spherical agglomerates) for 10 different views: 9 in Categories 1 or 2 and 1 in Category 3  
(6) The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.  
(7) It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.  
(8) The condition of the test should be 20 hr. UV cycle at 75°C followed by 4 hr. condensation at 60°C.  
(9) UV resistance is based on percent retained value regardless of the original HP-OIT value.  
(10) Value listed for shear and peel strengths are for 4 out of 5 test specimens; the 5<sup>th</sup> specimen can be as low as 80% of the listed values.  
(11) Also for hot air and ultrasonic seaming methods.



**TABLE 31 05 19.16-3  
Interface Friction Angles  
(Minimum Acceptable Values)**

Interface 1	Interface 2	Minimum Interface Friction Angle (degrees)	Adhesion (lb/ft <sup>3</sup> )
Vegetative Support Soil	Geocomposite	27	0
Geocomposite	LLDPE	27	0
LLDPE	Geotextile	27	0
Geotextile	Closure Cap Subgrade	27	0

**1.8 Delivery, Storage, and Handling**

- A. Materials shall be delivered to the site only after the required submittals have been furnished by the CONTRACTOR and approved by the CONSTRUCTION MANAGEMENT ENGINEER. Storage and handling of the materials shall conform to the manufacturer’s recommendations and shall be done in such a manner as to prevent damage to any part of the Work. Materials shall be labeled for easy identification and comparison to bills of lading and QC test results.
  
- B. The CONTRACTOR shall provide labor and equipment to properly unload material upon arrival at the site. Any damage (i.e., tears, creases, or punctures) to the geomembrane material caused by transportation, unloading, storage, or placement of the material shall be repaired according to the manufacturer’s recommendations, as approved by the CONSTRUCTION MANAGEMENT ENGINEER, at no additional cost to the OWNER. CONTRACTOR shall be responsible for replacing all unacceptable or damaged material at no additional cost to the OWNER.
  
- C. The geomembrane shall be stored under the responsibility of the CONTRACTOR. The material shall be stored in a reasonably level area, well-drained, away from oils/fuels, brush, poison oak or ivy, in an accessible area for inspection, and on a smooth surface so that the material is well supported and not resting on sharp objects that could damage it. Individual rolls shall be stored with safe walking space and clearance between them to allow full view for inspection purposes. If the geomembrane material is delivered with protective roll covers, these covers shall not be removed until immediately before the material is to be installed. Rolls of geomembrane shall not be stacked more than two (2) rolls high. In addition, the CONTRACTOR shall cover the stored geomembrane materials onsite with plastic so as to protect the geomembrane from the elements for the entire time the geomembrane is stored onsite.

**1.9 Schedule**

- A. Not used.

## **2. MATERIALS**

### **2.1 Compounded Resin**

A. The geomembrane shall be manufactured of new, first-quality low-density polyethylene (compounded) resin conforming to the material properties listed in Table 31 05 19.16-2 for LLDPE. No post-consumer resin of any type shall be added to the formulation.

### **2.2 Geomembrane**

A. The minimum acceptable physical, mechanical, and hydraulic properties are outlined in Table 31 05 19.16-2.

B. All geomembrane material used for construction shall be textured material. Textured geomembrane shall generally have uniform texturing appearance. It shall be free from such defects that would affect the specified properties and hydraulic integrity of the geomembrane.

### **2.3 Extrudate Welding Rod**

A. Resin used for extrudate welding rod shall have the same material properties as those in the compounded resin used in the manufacture of the geomembrane. These properties are outlined in Table 31 05 19.16-2.

## **3. EXECUTION**

### **3.1 Inspection of Sheet Liner at Job Site**

A. The Geosynthetic Installer and CONSTRUCTION MANAGEMENT ENGINEER shall be responsible for the inspection of the rolls of geomembrane material upon delivery to the job site. CONTRACTOR shall provide all labor and equipment required to assist CONSTRUCTION MANAGEMENT ENGINEER and Geosynthetic Installer in inspection of geomembrane materials upon delivery to the site. Should rolls show damage from transit, they will be so identified and set aside for return to manufacturer at no additional cost to the OWNER.

B. During deployment of the geomembrane material, the Geosynthetic Installer and the CONSTRUCTION MANAGEMENT ENGINEER will carry out a visual inspection of the geomembrane sheet surface. Any detected flaws or damage shall be repaired by the Geosynthetic Installer using the pre-approved techniques. Such repairs shall be recorded on the As-Built Drawings and documented on the field superintendent's daily QC log.

## **3.2 Geomembrane Liner Termination**

### **A. Cell Cap**

1. The LLDPE Geomembrane shall extend to the limit of liner as shown on the Contract Drawings.

## **3.3 Installation**

### **3.3.1 General**

- A. The geomembrane shall be laid out and installed by trained technicians in accordance with the applicable CONSTRUCTION MANAGEMENT ENGINEER-approved proposed panel layout drawing. The geomembrane shall be installed by the Geosynthetic Installer. The CONSTRUCTION MANAGEMENT ENGINEER'S approval of a proposed panel layout drawing does not relieve the manufacturer or approved Geosynthetic Installer of the responsibility to properly deploy and weld the geomembrane material to best accommodate prepared site conditions.
- B. After the panels of geomembrane are deployed and properly positioned, the pre-approved welding technicians shall then weld the geomembrane using the approved welding methods. No geomembrane installation activity shall begin until the CONSTRUCTION MANAGEMENT ENGINEER has received, reviewed, and approved the required qualifications for the manufacturer's or Geosynthetic Installer's field superintendent, field crew foreman, and welding technicians.
- C. Power supply equipment required for seaming of the geomembrane panels shall be in good working order and be able to continuously supply power. Each generator shall be placed on a scrub sheet consisting of two (2) layers of geomembrane material if located within the limits of the Work previously covered with geomembrane. Oil and gas to power the generators shall not be stored within the active limits of Work. The CONTRACTOR shall mobilize and position power supply equipment in a manner that prevents damage to installed geomembrane material. Any geomembrane material repairs required due to damage by the CONTRACTOR shall be performed by the CONTRACTOR at no cost to the OWNER. Such action will not be grounds for a contract extension.
- D. The CONTRACTOR shall maintain temporary anchorage of the geomembrane panels against wind uplift damage throughout the entire geomembrane installation process. Geomembrane materials damaged by wind uplift shall be repaired according to the manufacturer's recommended repair procedures by the manufacturer or Geosynthetic Installer at no additional cost to the OWNER. If damage incurred to any geomembrane material is deemed irreparable by the CONSTRUCTION MANAGEMENT ENGINEER, the geomembrane materials shall be removed and properly disposed of by the CONTRACTOR at no additional cost to the OWNER.

- E. All personnel working directly on the geomembrane material shall wear rubber-soled shoes so as not to damage the material. Any damage incurred to the geomembrane material resulting from adverse activities of the manufacturer's or Geosynthetic Installer's personnel shall be repaired according to the recommended repair procedures by the CONTRACTOR at the expense of the CONTRACTOR.
- F. Hand-held or hand-operated equipment (e.g., shovels) used to remove sediment, debris, etc. from the geomembrane shall be plastic or be manufactured from a material which will not cause damage to the geomembrane surface. Damage incurred to the geomembrane material caused by equipment not approved for its intended use as specified herein as witnessed by the CONSTRUCTION MANAGEMENT ENGINEER will be repaired by the CONTRACTOR at the expense of the CONTRACTOR.
- G. The manufacturer's or Geosynthetic Installer's field superintendent shall be present during all activities related to the installation, welding, and repair of the geomembrane material.

### **3.3.2 Field Panel Placement**

- A. As specified in Paragraph 1.5, prior to commencement of geomembrane installation activities, the CONTRACTOR shall provide the CONSTRUCTION MANAGEMENT ENGINEER with a proposed panel layout drawing, which details the placement of geomembrane panels throughout the entire limits of the Work area. The proposed panel layout drawings are tentative and may be modified with the CONSTRUCTION MANAGEMENT ENGINEER'S approval to accommodate site conditions. Any approved variation shall be noted on the As-Built Drawings.
- B. The field panel layout shall minimize the length of field seaming required to locate seams where applied stresses will be minimal. Sheet panel layout shall take into consideration any expansion and contraction anticipated due to ambient temperature variations.
- C. The geomembrane panels shall be oriented parallel to the line of maximum slope, i.e., up and down, not across, the slope. Panels shall be shingled to promote positive drainage. In corners and odd-shaped locations, the number of extrusion welded seams shall be minimized. Extrusion welded seams shall not be permitted within five (5) feet of the toe of the slope, the top of the berm, or areas of stress concentration (e.g., cell corners) within the entire limits of the Work area.
- D. The CONTRACTOR shall avoid the use of horizontal seams. In the event that horizontal seams are necessary and approved by the CONSTRUCTION MANAGEMENT ENGINEER, no two (2) adjacent panels/sheets shall be placed such that their horizontal seams are continuous. All panel/sheets that require horizontal seams must be staggered a minimum distance of fifteen (15) feet above or below the location of the horizontal seam of the adjacent panel/sheet.

- E. Placement of panels/sheets shall result in a good fit in all corners and grade changes. No bridging of the geomembrane at any change in grade or at penetrations will be accepted. Excessive slack shall be avoided to minimize rippling of the geomembrane during placement geocomposite and vegetative support soil.
- F. Placement of geomembrane shall not proceed under interfering conditions including, but not limited to, wind in excess of twenty (20) miles per hour, precipitation, ambient temperatures below forty (40) degrees Fahrenheit or above one hundred four (104) degrees Fahrenheit, high humidity, fog, dew, ponded water, and blowing dust or snow. CONTRACTOR shall be responsible for monitoring working conditions and suspend geomembrane installation as conditions warrant.
- G. The amount of material unrolled and placed daily, shall be limited to the amount of material that can be properly seamed during a one (1)-day operation. Tack or spot welding does not constitute a completed seam.
- H. Damage to the approved subgrade surface during geomembrane placement shall be repaired to its approved condition by the CONTRACTOR at the expense of the CONTRACTOR. Furthermore, any damage incurred to the geomembrane panels during deployment activities (e.g., creases, crimping, scratches, etc.) shall be repaired by the Geosynthetic Installer according to the approved repair procedures at the expense of the CONTRACTOR.
- I. Adjacent geomembrane panels shall be properly positioned in order to provide a sufficient overlap, as indicated in the approved manufacturer's or Geosynthetic Installer's installation plan, of the panels to facilitate welding of the seams. The Geosynthetic Installer shall label each panel of geomembrane immediately upon its deployment with a panel number and corresponding roll number. All panel numbers and corresponding roll numbers of the installed geomembrane material shall be labeled and accurately represented on the As-Built Drawings upon completion of all geomembrane installation activities.
- J. All-terrain vehicles may be used in the deployment of geosynthetic materials provided conditions listed in Specification Section 31 05 19.13, Geotextiles, are adhered to.
- K. Slip sheet shall be used in the deployment of textured geomembrane. CONTRACTOR may submit to the CONSTRUCTION MANAGEMENT ENGINEER for approval in the Pre-Installation submittal, or a proposed alternative method for textured geomembrane deployment.

### **3.3.3 Seam Preparation**

- A. Prior to seaming operations, the seam area shall be kept thoroughly dry and clean. All seam interfaces shall be visually examined by the Geosynthetic Installer for scratches,

blemishes, flaws, and texture. All geomembrane panel/sheet surfaces to be seamed shall be free of dust, dirt, and moisture. Water shall be prevented from ponding on the liner material. Any detected damage to the area prepared for seaming operations shall be repaired at no additional cost to the OWNER, including any repairs necessary to the existing geomembrane.

- B. Seams shall be aligned to create the fewest possible number of wrinkles and fishmouths. If panel overlap exceeds what is noted in the installation plan, it shall be removed by trimming the lower sheet. Trimming of excessive panel overlap shall be accomplished using a shielded blade or hook knife. Whenever possible, the cutting of the geomembrane should be from the underside of the geomembrane in an upward motion. All trimming of excessive panel overlap should be completed at least fifty (50) feet ahead of seaming operations. Any damage caused to the geomembrane during this trimming operation shall be repaired at no additional cost to the OWNER.
- C. For extrusion-welded seams, a small hand-held electric rotary grinder with circular disc grit grinding paper shall be used to remove oxidation from the surface of the geomembrane material for the entire length of the prepared seam. The grinding plate shall be approximately four (4) inches in diameter and No. 80 or 100 grit paper shall be used. The depth of the grinding shall be less than ten (10) percent of the sheet thickness, but generally be only five (5) percent of the sheet thickness. Prior to tacking the overlapped geomembrane panels together, the leading edge of the upper panel shall be ground to a forty-five (45)-degree bevel with the electric rotary grinder while this panel is lifted up off of the lower panel. Grinding should proceed welding by approximately five (5) minutes and the grinding operation shall be oriented perpendicular to the seam direction, and extend approximately one-quarter (0.25) inch beyond the limit of extrudate after it is placed.

### **3.3.4 Seaming**

- A. The approved seaming techniques for this project are the dual-tract hot-wedge and extrusion fillet welding. The hot-wedge technique should be used for panel seams in open areas that can effectively accommodate the seaming equipment. The use of extrusion welding techniques shall only be used on panel seams in limited work space areas, for welding of geomembrane materials to geomembrane appurtenances, for the patching of liner coupons removed for destructive testing purposes, and minor repair procedures (e.g., patching small holes, tears, etc.).
- B. Field seaming operations are prohibited when the ambient air temperature approximately two (2) feet above the geomembrane surface is below forty (40) degrees Fahrenheit or above one hundred four (104) degrees Fahrenheit, during precipitation, or when winds are in excess of twenty (20) miles per hour.
- C. Dual-Tract Hot-Wedge Welding

1. Techniques for dual-tract hot-wedge seaming differ. Prior to initial production welding, the temperature of the wedge and speed of the nip rollers required for adequate seaming shall be determined from trial seam test strips performed throughout the daily welding operations.
2. A slight amount of “squeeze-out” or “flashing” is a good indicator that proper welds are achieved. Also, the depth of the nip rollers marks should be just barely evident to the touch.
3. The operator shall keep constant visual contact with the seam, occasionally adjusting the temperature or speed as necessary to maintain a consistent weld.
4. Damage caused to the geomembrane during the welding operations as detected by the Geosynthetic Installer’s field superintendent or the CONSTRUCTION MANAGEMENT ENGINEER shall be patched according to the Specifications herein at no additional cost to the OWNER. Such action will not be grounds for a contract time extension.
5. Adjustment of the hot-wedge device shall be made regularly as needed, and the device shall be cleaned at least daily.

#### D. Extrusion Welding

1. For the preparation of extrusion fillet seams, a hot-air gun shall be used to leister-weld the overlapped geomembrane panels together to hold them in proper position for extrusion welding once the leading edge of the upper panel is properly beveled.
2. The extrusion welder is to be purged of all heat-degraded extrudate in its barrel prior to welding operations. This must be done every time the extrusion welder is restarted after a one (1)-minute or longer downtime. The purged extrudate shall not be discharged onto the surface of the low permeability soil where it would eventually form a hard object under the geomembrane.
3. Extrudate in the form of a molten, viscous bead shall be deposited over the overlapped seam upon the conclusion of the grinding operation. The center of the extrudate shall be directly over the leading edge of the upper geomembrane. The extrudate should cover the grind marks on each side of the upper geomembrane to within one-quarter (0.25)-inch of the perimeter of these marks.
4. Liner sheet edges to be seamed shall lay flat against each other during seaming until the seam has reached specified strength.
5. The thickness of the applied extrudate should be approximately two (2) times the specified sheet thickness as measured from the top of the bottom sheet to the top or crown of the applied extrudate bead.

6. Following completion of the seaming operations, visual inspection of the applied extrudate bead shall be made by the field superintendent and CONSTRUCTION MANAGEMENT ENGINEER, particularly for straight line alignment, height, and uniformity of surface texture. There should be no bubbles or pock marks in the extrudate weld.
  7. Seam welding operations shall gradually terminate at the end of a panel, rather than abruptly terminate with a large mass of solidified extrudate. Where extrusion fillet welds are temporarily terminated during a seaming operation and the seams have had sufficient time to cool, the applied extrudate shall be ground prior to applying new extrudate over the existing seam.
- E. All “T” or “Y” seams created during the installation of the geomembrane (i.e., where more than two [2] panels form a seam) shall be capped with an extrusion welded patch according to these Specifications.

### **3.4 Production Trial Seams**

- A. Trial seams shall be made on surplus pieces of geomembrane material to verify that seam welding conditions and equipment operation are adequate. These seams shall be completed for both extrusion fillet and dual-tract hot-wedge seam welding operations for LLDPE. Trial seams shall be made under the same conditions as the actual production seam welding conditions.
- B. Trial field testing results as detailed in these Specifications shall be accurately documented by the Geosynthetic Installer’s field superintendent on the required daily QC logs (Paragraph 3.6). The date and time along with the ambient temperature, welding apparatus identification number, and name of welding technician shall be documented on said logs for each constructed trial field seam. Peel and shear test results of each trial field seam, along with subsequent coupon specimen testing required for failing post-weld trial seams, shall be recorded on the daily QC logs.

#### **3.4.1 Pre-Weld Trial Seams**

- A. Pre-weld trial seams shall be made for each welding apparatus (operated by an approved welding technician) at the beginning of each production seam welding period (i.e., at the start of the day and the start of the afternoon seam welding session) and at any time that a machine is turned off for more than five (5) minutes or following repair of a broken machine. The pre-weld trial seam sample shall be at least three (3) feet long by two (2) feet wide with the seam centered lengthwise. Four (4) adjoining coupon specimens, each one (1) inch wide, shall be cut from the pre-weld trial seam sample and tested in peel (two [2]) and shear (two [2]) using a Columbine International, Ltd. portable electronic tensile tester (tensiometer), or an approved equivalent set to a strain rate of two (2) inches per minute. The coupon specimen shall sustain sufficient tensile loading before subsequently failing outside of the seam area



(i.e., Film Tear Bond [FTB] failure required at a minimum tensile loading as specified for peel and shear in Table 31 05 19.16-2 for LLDPE. The coupon specimen shall not fail in the welded seam. If FTB occurs when a coupon specimen is tested in shear or peel at a tensile loading less than that specified, the pre-weld trial seam is considered a failure. If one (1) coupon specimen fails, the entire pre-weld trial seam operation shall be repeated. If any additional coupon specimen fails from the second pre-weld trial seam, the welding apparatus and welding technician shall not be used for seam welding operations until the deficiencies of the welding apparatus are corrected by the field superintendent and two (2) consecutive successful pre-weld trial seams are achieved.

### **3.4.2 Post-Weld Trial Seams**

- A. Post-weld trial seams shall be made for each welding apparatus at the conclusion of each production seam welding period (i.e., at the conclusion of the morning seam welding and at the end of the day). The post-weld trial seam shall be constructed and tested in the same manner as specified for the pre-weld trial seam in Paragraph 3.4.1. Should FTB occur when a coupon specimen is tested in shear or peel at a tensile loading less than that specified, the remaining portion of the failing post-weld trial seam material shall be properly labeled by the Geosynthetic Installer's field superintendent with the date, time of post-weld trial seaming operation, ambient temperature, welding apparatus identification number, and name of the welding technician. This specimen shall subsequently be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for immediate storage in an attempt to lower the temperature of this material as compared with the current ambient temperature. Upon sufficient cooling of this material (e.g., typically one [1] hour), the CONSTRUCTION MANAGEMENT ENGINEER will submit the remaining portion of the failing post-weld trial seam to the Geosynthetic Installer's field superintendent for the required test procedure. FTB occurs when a coupon specimen is tested in shear or peel at a tensile loading less than that specified, the post-weld trial seam is, again, considered a failure. All previous production seams welded by the welding apparatus/welding technician responsible for the failing post-weld trial seam shall be evaluated by the Geosynthetic Installer's superintendent. The evaluation shall consist of the Geosynthetic Installer cutting one (1)-inch-wide and twelve (12)-inch-long samples perpendicular to the suspect deficient welded seams. These samples shall be taken at locations directed by the CONSTRUCTION MANAGEMENT ENGINEER, and shall adequately represent the extent of welded seams constructed by the welding apparatus/welding technician responsible for the failed post-weld trial seam. Each of the samples obtained shall be tested. If any of the one (1)-inch-wide coupons tested from the samples obtained fail the specified criteria, the seam length of deficient welding as determined by the CONSTRUCTION MANAGEMENT ENGINEER shall be repaired at no additional cost to the OWNER. Required repair shall consist of placing an extrusion-welded cap strip over the deficient welded seam(s). The cap strip repair installation shall be in accordance with this Specification and shall extend a minimum of six (6) inches from the centerline of the deficient welded seams in all directions. If, however, each of the samples obtained passes the required testing, only

the locations of the samples obtained shall be patched in accordance with these Specifications at no additional cost to the OWNER.

- B. Subsequent production seam welding performed by the welding apparatus/welding technician responsible for the post-weld trial seam failure prior to the retesting of the failed post-weld trial seam shall be at the complete risk of the Geosynthetic Installer. Should the failed post-weld trial seam be deemed unacceptable based on the intermittent cooling and retesting procedures specified herein, all production seam welding performed at risk will be deemed unacceptable and repaired by the Geosynthetic Installer according to the repair procedures required in this Specification at no additional cost to the OWNER.

### **3.5 Nondestructive Seam Continuity Testing**

- A. The Geosynthetic Installer shall nondestructively test all welded seams over their full length using a vacuum test unit, air pressure testing, or other method approved by the CONSTRUCTION MANAGEMENT ENGINEER. The purpose of the nondestructive test is to check the continuity of the welded seams. Nondestructive tests shall be performed by experienced personnel thoroughly familiar with the specified test methods and equipment to be used. Nondestructive testing procedures cannot be correlated to the shear and peel strength of the welded seam. Nondestructive seam continuity testing shall be carried out as the seam welding operations progress, not at the completion of all field seam welding operations.

#### **3.5.1 Vacuum Box Testing**

- A. Extrusion fillet-welded seams shall be nondestructively tested with a pressurized vacuum box. For vacuum testing, the equipment shall be comprised of the following:
  - 1. A vacuum box assembly consisting of a rigid housing, a clean transparent viewing window, a soft leak-proof neoprene gasket, which is not cracked or otherwise deteriorated in any way, attached to the bottom, port hole of valve assembly, and a gauge to indicate chamber vacuum. Vacuum box assemblies shall be adequately sized to properly test welded seams surrounding and adjoining designed appurtenances.
  - 2. A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections.
  - 3. A rubber pressure/vacuum hose with fittings and connections.
  - 4. A bucket and wide brush or spray assembly.
  - 5. A soapy water solution.

6. Testing equipment which is not properly maintained will be rejected at the discretion of the CONSTRUCTION MANAGEMENT ENGINEER. Unusable equipment shall be promptly repaired or replaced at no expense to the OWNER with no delay to the Contract Schedule.

### **3.5.2 Testing fillet welded seams**

A. The following procedures shall be followed when nondestructively testing extrusion fillet welded seams:

1. Energize the vacuum pump and reduce the tank pressure to a minimum five (5) pounds per square inch (ten [10] inches of mercury) gauge.
2. Adequately wet a section of welded seam with the soapy water solution.
3. Place the vacuum box over the wetted area.
4. Close the bleed valve and open the vacuum valve.
5. Ensure that a leak tight seal is created.
6. For a period of approximately ten (10) seconds, examine the extrusion fillet-welded seam through the viewing window for the presence of soap bubbles along the edges of the welded seam or within the extrusion fillet bead.
7. If no bubble appears after ten (10) seconds, close the vacuum valve and open the bleed valve, move the vacuum box over the next adjoining welded seam area with a minimum three (3)-inch (seventy-five [75]-millimeter) overlap from the previously tested area, and repeat the process.
8. All areas where soap bubbles appear shall be adequately marked and repaired according to the recommended repair procedures.
9. Vacuum-tested, extrusion fillet-welded seam results shall be recorded on the Geosynthetic Installer's daily QC log.

### **3.5.3 Air-Pressure Testing Welded Seams**

A. Dual-tract hot-wedge welded seams shall be nondestructively tested with an approved air-pressure device. Equipment for air-pressure testing welded seams shall be comprised of the following:

1. An air pump (manual or motor driven) equipped with pressure gauge capable of generating and sustaining a pressure of between twenty-five (25) and thirty-five (35) pounds per square inch (one hundred sixty [160] and two hundred [200] kilo-

Pascals). The Geosynthetic Installer shall not use freon gas to pressurize the welded seam.

2. A rubber hose with appropriate fittings and connections.
  3. A sharp, hollow needle, or other approved pressure feed device.
- B. The following procedures shall be followed when nondestructively testing dual-tract, hot-wedge welded seams:
1. Adequately seal both ends of the welded seam to be tested with vice grip clamps or by heating and melting the air channel shut so as to prevent air from leaking from either end of the welded seam.
  2. Insert needle or other approved pressure feed device into the air channel created by the dual-tract, hot-wedge at one (1) end of the welded seam.
  3. Energize the air pump to a minimum pressure of thirty (30) pounds per square inch (two hundred [200] kilo-Pascals), close valve, and sustain pressure for a minimum of five (5) minutes.
  4. Once the air pressure is maintained for the five (5)-minute test period, the Geosynthetic Installer shall then cut the air channel at the opposite end of the tested span from where the pressure feed device is inserted. The entire seam length shall be accepted upon the CONSTRUCTION MANAGEMENT ENGINEER'S visual and audible observation of air pressure being released from this cut. The cut in the air channel shall subsequently be repaired with an extrusion bead and nondestructively tested by the Geosynthetic Installer.
  5. If loss of pressure exceeds three (3) pounds per square inch or pressure does not stabilize, or failure of alternate seam test approved in the installation plan, the dual-tract weld shall be considered failed, and the faulty area of the welded seam shall be located as follows:
    - a. The entire welded seam length shall be divided in half and both halves shall be retested (i.e., the air channel shall be sealed, by appropriate means, at the location of half its original length, and both halves shall be tested as separate seams). The air channel of the welded seam shall be repeatedly divided in this manner until the faulty portion of the welded seam is isolated for repair according to the above Specifications or until the CONSTRUCTION MANAGEMENT ENGINEER directs the Geosynthetic Installer to cap strip the entire faulty length of welded seam with an extrusion-welded patch at no additional cost to the OWNER. All punctures within the air channel made by either the pressure feed device, air-pressure release cut, or melting of the air channel itself shall be properly repaired by an extrudate bead and

nondestructively tested at the expense of the CONTRACTOR. Such corrective action will not constitute grounds for a Contract time extension.

### **3.6 Random Weld Destructive Samples**

- A. In the event of a conflict, GRI-GM19 shall govern testing parameters. Random weld destructive samples shall be cut by the Geosynthetic Installer from the installed welded geomembrane at a minimum frequency of one (1) sample for every five hundred (500) feet of welded seam. Additional locations shall be determined during the seam welding operations at the CONSTRUCTION MANAGEMENT ENGINEER'S discretion. In order to obtain destructive sample test results prior to completion of geomembrane installation activities, destructive samples shall be cut by the Geosynthetic Installer's field superintendent as the seam welding operations progress. Sampling locations shall be determined by the CONSTRUCTION MANAGEMENT ENGINEER based upon visual observation and experience. The CONSTRUCTION MANAGEMENT ENGINEER must witness the cutting of all destructive samples and the Geosynthetic Installer shall promptly mark all samples obtained with their welded seam number and welding technician. The field superintendent shall also record on the daily QC logs the date and time the welding operation occurred, ambient temperature, and field test results for both peel and shear. All holes in the geomembrane resulting from obtaining the seam samples shall be immediately repaired.

#### **3.6.1 Field Testing of Random Weld Destructive Samples**

- A. The Geosynthetic Installer shall cut a twelve (12)-inch-wide by forty (40)-inch-long destructive sample, or as required by Geosynthetics Testing Laboratory, with the welded seam centered lengthwise for each destructive sample. Two (2) one (1)-inch-wide specimens shall be cut from each end of the destructive sample. With the field tensiometer, the Geosynthetic Installer shall test the two (2) specimens from each end (total of four [4]) for shear strength and for peel adhesion using a two (2)-inch strain rate. For the destructive sample to be acceptable, all four (4) test specimens must fail in FTB at a minimum tensile value for peel and shear as specified in Table 31 05 19.16-2. Any specimen that fails either through the weld, or in FTB at a tensile value less than the minimum specified values, is considered a failure.
- B. Should the destructive sample fail the field testing requirements, the Geosynthetic Installer shall remediate the deficient welded seam(s) from which the destructive sample was obtained as detailed in the subsequent Paragraph 3.6.2. Should the destructive sample pass the field testing requirements and be deemed acceptable to the CONSTRUCTION MANAGEMENT ENGINEER, the Geosynthetic Installer shall prepare and submit the remaining portion of the destructive sample for laboratory testing as discussed below.

### 3.6.2 Laboratory Testing of Random Weld Destructive Samples

- A. The remaining portion of the destructive sample shall be cut into three (3) parts, each a twelve (12)-inch by twelve (12)-inch “coupon,” and distributed by the Geosynthetic Installer and at the expense of the CONTRACTOR as follows:
1. One (1) coupon to an approved independent Geosynthetics Testing Laboratory.
  2. One (1) coupon to the CONSTRUCTION MANAGEMENT ENGINEER for archive storage.
- B. The CONTRACTOR, or the Geosynthetic Installer, shall package and ship the destructive samples to the approved Geosynthetics Testing Laboratory for determination of both shear and peel strengths. The test method and procedures to be used by the Geosynthetics Testing Laboratory shall be the same as used in field testing, where welded seam specimens are one (1) inch wide, and the strain rate is two (2) inches per minute. Four (4) of the five (5) specimens per twelve (12)-inch by twelve (12)-inch coupon shall pass both shear strength and peel adhesion tests by exhibiting FTB failure at or above the specified minimum tensile values. Lab results shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER as soon as they become available for evaluation and possible remedial actions. Electronic lab testing results will be accepted by the CONSTRUCTION MANAGEMENT ENGINEER so as not to impede subsequent construction activities. Hard copy lab testing results shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER within twelve (12) calendar days of the sampling date.
- C. The following investigation and repair procedure will apply whenever a destructive sample fails the field or laboratory testing requirements:
1. The Geosynthetic Installer shall retrace the seam welding path in both directions from the failed destructive sample test location (ten [10]-foot distance minimum) and take two (2) twelve (12)-inch by twelve (12)-inch coupons for additional shear strength and peel strength field testing according to the procedure specified in Paragraph 3.6. If both coupons are acceptable according to the previously discussed testing requirements, then the faulty welded seam shall be cap-stripped according to the Specifications herein between the locations of the two (2) acceptable twelve (12)-inch by twelve (12)-inch coupons so as to cover the failed destructive sample test location. If either or both of the coupons are considered unacceptable, then the investigation process is repeated until the failed coupons are bounded by two (2) passing coupon test locations. The extrusion-welded cap strip shall extend to at least six (6) inches beyond the entire length of faulty welded seam on all sides and be nondestructively tested according to the procedures specified herein at no additional cost to the OWNER.

### **3.6.3 Laboratory Procedures for Testing Welded Seams**

- A. Laboratory testing of requirements for field-welded seam coupon specimens are listed below:
  - 1. Thickness (ASTM D5594).
  - 2. Field Seam Peel Strength (hot wedge and extrusion fillet) (ASTM D6392).
  - 3. Field Seam Shear Strength (ASTM D6392).
- B. Acceptable values for the thickness test are one hundred (100) percent or more of the values for the parent material. Acceptable peel and shear test results will be FTB at a minimum tensile value as specified in Table 31 05 19.16-2. Any specimens which fail in the weld during either peel or shear tests or result in FTB but at tensile values lower than the specified minimum values will be considered failures. At least four (4) of five (5) specimens tested in shear and peel shall exhibit an FTB value not in the seam area.

### **3.7 Liner Penetration**

- A. CONTRACTOR may elect to use manufactured or field fabricated liner boots. CONTRACTOR shall submit construction and installation procedure for field fabricated liner penetration boots to the CONSTRUCTION MANAGEMENT ENGINEER for approval. Boots attached to landfill gas extraction wells and leachate cleanouts penetrating the cap shall be attached per geomembrane manufacturer's specifications. Shop fabricated liner penetration boots shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval.
- B. Provide booted geomembrane penetration as shown on the Contract Drawings, manufacturer's specifications and specified herein. Include item penetrating cap, neoprene sponge, steel band clamp, and other miscellaneous items as required.
- C. Liner penetration shall be constructed with liner material of the same type and thickness as the Closure cap (forty [40]-mil textured LLDPE).
- D. Seal booted penetration of LLDPE using an extrusion welder. Clamp liner boot to well casing using neoprene sponge and stainless-steel band clamps, as shown on the Contract Drawings.
- E. Upon installation of booted liner penetration, CONTRACTOR shall Vacuum Box test extrusion fillet-welded seams as outlined in Paragraphs 3.5.1 and 3.5.2.
- F. CONTRACTOR shall not weld LLDPE liner directly to pipe penetrations.

## **3.8 Defects and Repairs**

### **3.8.1 Identification**

- A. All welded seams and non-seam areas of the geomembrane shall be evaluated by the Geosynthetic Installer's field superintendent and the CONSTRUCTION MANAGEMENT ENGINEER for identification of defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. Because light reflected by the geomembrane aids in the detection of defects, the surface of the geomembrane shall be kept clean at the time of inspection. The geomembrane surface shall be broomed or washed as necessary by the Geosynthetic Installer if the amount of dust or mud inhibits inspection.

### **3.8.2 Evaluation**

- A. Each suspect location as noted by either the Geosynthetic Installer's field superintendent or CONSTRUCTION MANAGEMENT ENGINEER, both in seam and non-seam areas, shall be nondestructively tested using the methods described in these Specifications. Each location that fails the nondestructive testing will be marked by the CONSTRUCTION MANAGEMENT ENGINEER and repaired by the Geosynthetic Installer.
- B. Upon inspecting the wrinkles within the geomembrane material during the installation of overlying materials, the CONSTRUCTION MANAGEMENT ENGINEER will decide which wrinkles shall be repaired by the Geosynthetic Installer at the expense of the CONTRACTOR. Any wrinkle which could potentially disrupt the flow of leachate or water along the floor of the containment cell or closure cap will be evaluated by the CONSTRUCTION MANAGEMENT ENGINEER for potential repair.

### **3.8.3 Repair Procedures**

- A. Repair procedures shall be agreed upon between the CONSTRUCTION MANAGEMENT ENGINEER and Geosynthetic Installer prior to geomembrane installation. Unless otherwise agreed upon the required repair procedures shall be as follows:
  - 1. Faulty Extrusion Fillet-Welded Seams—Minor defects detected during the nondestructive vacuum box testing procedures shall be adequately covered with an extrusion fillet bead which shall cover the entire length of faulty weld. If, based on the CONSTRUCTION MANAGEMENT ENGINEER'S evaluation, the number of welded seam defects or an individual defect is extensive, the entire length of welded seam shall be cap stripped with a patch extrusion-welded completely around its perimeter at no additional cost to the OWNER. The patch shall extend a minimum of six (6) inches beyond the centerline of the faulty weld



in all directions for its entire length and be nondestructively tested according to the procedures specified herein.

2. Faulty Dual-Tract, Hot-Wedge Welded Seams—Defects detected on the outer tract (i.e., that tract weld which is visible) during the air pressure testing procedures shall be adequately covered with an extrusion fillet bead for the entire length of faulty weld. If the leak cannot be detected along the outer tract, therefore concluding that the failed weld exists along the inner tract (i.e., that tract weld which is not visible from the upper surface of the welded geomembrane), the Geosynthetic Installer shall cover the entire width of the failed dual-tract weld along its entire length with an extrusion-welded cap strip. The extrusion cap strip shall be placed to at least six (6) inches beyond the edges of the dual-tract weld and nondestructively tested at no additional cost to the OWNER.
3. Wrinkles and Fishmouths—Wrinkles or fishmouths created within the LLDPE geomembrane shall be repaired by cutting their entire length along their maximum height. A “stress-relief” circle (approximately six (6) inches in diameter) shall be cut at the end of a fish mouth or at both ends of a wrinkle. The resulting excess geomembrane shall then be overlapped in the downgradient direction and extrusion fillet welded for its entire length. An extrusion welded patch shall then be placed over each “stress-relief” circle and the entire welded repair shall be nondestructively testing by the Geosynthetic Installer.
4. Geomembrane Defects—Pinholes detected within the geomembrane material shall be covered with an extrusion fillet bead. Blisters, larger holes, undispersed raw materials, tears, and contamination by foreign matter shall be capped with an extrusion welded patch. Each welded patch shall have its corners rounded and shall extend a minimum of six (6) inches beyond the extent of the underlying defect in all directions. All welded repairs shall be nondestructively tested by the Geosynthetic Installer.
5. Wind Damage—LLDPE geomembrane panels that suffer wind-blown or wind uplift damage (e.g., severe creases, crimping, tears) either during deployment activities or while temporarily anchored shall be replaced and properly disposed of by the Geosynthetic Installer at the expense of the CONTRACTOR. If damage incurred to the geomembrane is deemed repairable by the CONSTRUCTION MANAGEMENT ENGINEER, the entire limits of damaged material shall be cap stripped with an extrusion welded patch and nondestructively tested accordingly at the expense of the CONTRACTOR.
6. The time incurred repairing defects which occur as a result of faulty material, repair equipment, or workmanship will not be considered for a contract time extension.

### **3.8.4 Verification of Repairs**

- A. Each repair will be nondestructively tested using the methods described in this Section, as appropriate. Repairs which pass the nondestructive test will be considered an adequate repair. Repairs which fail will be repeated and retested by the Geosynthetic Installer at the expense of the CONTRACTOR until a passing test results. The CONSTRUCTION MANAGEMENT ENGINEER will observe all nondestructive testing of repairs.
- B. The location and associated repair work of each patch installed on the geomembrane must be documented in the Geosynthetic Installer's daily QC log.

### **3.9 As-Built Survey**

- A. As-Built Survey shall be completed after geomembrane installation shall designate locations of all field welded seams, repair patches, extrusion fillet beads, and geomembrane panel numbers with associated roll numbers, location of each random weld destructive sample, and those samples obtained for plant physical property testing as required in these Specifications. Survey shall be in accordance with Specification Section 01 70 00, Execution and Closeout Requirements.

### **3.10 Warranty**

- A. The CONTRACTOR shall warranty the geomembrane material free from defects for ten (10) years from the date of final acceptance and provide a one (1)-year warranty on workmanship.

-- End of Section --

**SECTION 31 05 19.26**  
**GEOCOMPOSITE**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. The Work covers the supply, delivery, and installation of the geocomposite drainage net. Materials specified in this Specification Section shall be installed as shown on the Contract Drawings.

**1.1.2 Related Work Specified Elsewhere**

A. Section 01 40 00, Quality Control.

B. Section 31 05 19.16, Geomembrane.

**1.2 References**

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

**1.2.1 ASTM International (ASTM)**

A. ASTM D1505 (2010) Density of Plastics by the Density-Gradient technique.

B. ASTM D1603 (2011) Carbon Black Content in Olefin Plastics.

C. ASTM D4218 (1996; R 2008) Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

D. ASTM D4355 (2007) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus.

E. ASTM D4491 (1999a; R 2009) Water Permeability of Geotextiles by Permittivity.

F. ASTM D4533 (2011) Trapezoid Tearing Strength of Geotextiles.

G. ASTM D4632 (2008) Grab Breaking Load and Elongation of Geotextiles.

H. ASTM D4716 (2008) Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using Constant Head.

- I. ASTM D4751 (2004) Determining Apparent Opening Size of a Geotextile.
- J. ASTM D4833 (2007) Index Puncture Resistance of Geotextiles, Geomembrane, and Related Products.
- K. ASTM D5035 (2011) Breaking Force and Elongation of Textile Fabrics (Strip Method).
- L. ASTM D5199 (2012) Measuring Nominal Thickness of Geosynthetics.
- M. ASTM D5261 (2010) Measuring Mass Per Unit Area of Geotextiles.
- N. ASTM D5321 (2012) Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear.
- O. ASTM D7005 (2003; R 2008) Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites.

### **1.3 Definitions**

- A. Not used.

### **1.4 Qualifications**

- A. The Geocomposite Manufacturer shall be a specialist in the manufacture of geocomposite and shall have produced and manufactured a minimum of five (5) million square feet (ft<sup>2</sup>) of geocomposite that has been used in successful installations.
- B. The geocomposite shall be installed by a Geosynthetics Installer meeting the qualifications in Specification Section 01 40 00, Quality Control.

### **1.5 Submittals**

- A. A Statement of Qualifications for the Geosynthetics Installer meeting the requirements of Geosynthetic Installer qualifications noted in Specification Section 01 40 00, Quality Control, shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval. No geocomposite installation shall begin until the CONSTRUCTION MANAGEMENT ENGINEER has received and approved the items as identified.
- B. A Statement of Qualifications for the geocomposite Manufacturer shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval. The following information regarding the geocomposite shall be submitted by the CONTRACTOR to the CONSTRUCTION MANAGEMENT ENGINEER for approval four (4) weeks

prior to installation. No geocomposite installation shall begin until the CONSTRUCTION MANAGEMENT ENGINEER has received and approved the items as identified in this submittal.

### **1.5.1 Certified Test Reports**

- A. The Geosynthetics Installer shall submit in writing to the CONSTRUCTION MANAGEMENT ENGINEER for approval within two (2) weeks after award of Contract the manufacturer's name along with the product name and certification of the material intended for use as geocomposite for the closure cap. Certified test reports conforming to the requirements of standards and testing methods specified herein shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER for approval prior to delivery of geocomposite. The material manufacturer and CONTRACTOR must satisfy the CONSTRUCTION MANAGEMENT ENGINEER that the material to be furnished and installed will meet in every aspect the requirements set forth in this Specification. The CONTRACTOR shall transmit to the CONSTRUCTION MANAGEMENT ENGINEER all information provided by the manufacturer or supplier prior to obtaining approval for furnishing and installing any such material.
- B. The CONTRACTOR shall obtain samples of the geocomposite material from the geocomposite manufacturer and submit these samples to the CONSTRUCTION MANAGEMENT ENGINEER for approval prior to geocomposite manufacturer's delivery.

### **1.5.2 Installation and Repair Procedures**

- A. The CONTRACTOR shall submit to the CONSTRUCTION MANAGEMENT ENGINEER for approval four (4) weeks prior to installation, the geocomposite manufacturer's recommended installation procedures, including placement and joining, and the manufacturers recommended procedures for repairing or replacing damaged or defective geocomposite material.
- B. The CONTRACTOR shall also submit Geosynthetic Installer's Installation Plan for geocomposite in accordance with Specification Section 01 40 00, Quality Control.

### **1.6 Safety**

- A. Not used.

## **1.7 Quality Assurance**

### **1.7.1 Single Source**

- A. All geocomposite must be obtained from a single material supplier and all geocomposite rolls used in construction shall be manufactured by a single manufacturer.

### **1.7.2 Material Testing**

#### **1.7.2.1 Material Testing by Manufacturer**

- A. Geocomposite shall be tested by the manufacturer(s) prior to delivery to the project site to ensure that the physical and hydraulic properties of the finished products are in accordance with this Specification. Required physical properties, test methods, and values are presented in Table 31 05 19.26-1. With exception of transmissivity, test frequency shall be one (1) of each test in Table 31 05 19.26-1 for every fifty thousand (50,000) ft<sup>2</sup> of net produced. In addition, one (1) three (3)-foot (ft) × roll width coupon of net produced for this installation shall be retained by the manufacturer until construction of the cells closure cap has been completed. Regarding planar transmissivity, a test shall be conducted on a sample of the following geosynthetic system for every two hundred thousand (200,000) ft<sup>2</sup> of net produced:
1. Steel plate (top).
  2. Proposed Vegetative Support Soil (three [3]-inch minimum thickness).
  3. Proposed eight (8)-ounce (oz), three hundred (300) mil double-sided Geocomposite.
  4. Proposed forty (40)-mil textured linear low-density polyethylene geomembrane.
  5. Proposed eight (8)-oz non-woven needle-punched geotextile.
  6. Steel plate (bottom).
- B. In addition to the results of testing required in Table 31 05 19.26-1, the manufacturer of the geocomposite shall submit a written certification stating that all geocomposite produced for the project meets or exceeds the minimum values of the respective physical properties and transmissivity listed in Table 31 05 19.26-1.
- C. The CONTRACTOR shall be solely responsible for the quality of the material provided. Should any of the tests performed on the material yield unsatisfactory results, the CONTRACTOR will be responsible for replacing the material with satisfactory material without delaying the total project time and without any additional cost to the OWNER.

**TABLE 31 05 19.26-1  
Physical Properties of Geocomposite**

Tested Property	Test Method	Frequency	Minimum Average Roll Value <sup>(c)</sup>
<b>Geocomposite</b>			
Transmissivity <sup>(a)</sup> , gal/min/ft (m <sup>2</sup> /sec)	ASTM D4716	1/200,000 ft <sup>2</sup>	3.5 (7.5×10 <sup>-4</sup> )
Ply Adhesion, lb/in	ASTM D7005	1/50,000 ft <sup>2</sup>	1.0
<b>Drainage net<sup>(b)</sup></b>			
Transmissivity <sup>(a)</sup> , gal/min/ft (m <sup>2</sup> /sec)	ASTM D4716		38.6 (8×10 <sup>-3</sup> )
Thickness, mil	ASTM D5199	1/50,000 ft <sup>2</sup>	300
Density, g/cm <sup>3</sup>	ASTM D1505	1/50,000 ft <sup>2</sup>	0.94
Tensile Strength (MD), lb/in	ASTM D5035	1/50,000 ft <sup>2</sup>	75
Carbon Black Content, %	Modified ASTM D1603 ASTM D4218	1/50,000 ft <sup>2</sup>	2.0
<b>Geotextile<sup>(b)</sup></b>			
Mass per Unit Area, oz/yd <sup>2</sup>	ASTM D5261	1/90,000 ft <sup>2</sup>	8
Grab Tensile, lb	ASTM D4632	1/90,000 ft <sup>2</sup>	220
Puncture Strength, lb	ASTM D4833	1/90,000 ft <sup>2</sup>	120
AOS, US Sieve (mm)	ASTM D4751	1/540,000 ft <sup>2</sup>	80 (0.180)
Permittivity, sec <sup>-1</sup>	ASTM D4491	1/540,000 ft <sup>2</sup>	1.3
Flow Rate, gpm/ft <sup>2</sup>	ASTM D4491	1/540,000 ft <sup>2</sup>	95
UV Resistance, % Retained	ASTM D4355 (after 500 hours)	Once per formulation	70
<p>(a) Gradient of 0.1, normal load of 10,000 pounds per square foot, water at 70 degrees Fahrenheit between stainless steel plates for 15 minutes.</p> <p>(b) Component properties prior to lamination.</p> <p>(c) These are minimum average roll values (MARV) and are based on the cumulative results of specimens tested.</p> <p>(d) The diameter of the presser foot shall be 2.22 inches and the pressure shall be 2.9 pounds per square inch. For other thickness options, see manufacturer's literature.</p> <p>(e) This is the average peak value for five (5) equally spaced machine direction tests across the roll width.</p> <p>(f) Average of five (5) tests across the roll width. Discounting the outer 305 millimeters of each side of the roll, collect samples at the 10, 30, 50, 70, and 90 percent positions across the roll width. Test both sides for double sided geocomposites.</p> <p>(g) At a minimum, one (1) sample shall be taken every production run or at the frequency specified.</p> <p>Note: No foaming agents shall be used in the manufacturing process of the geocomposite.</p>			

### 1.7.2.2 Material Testing by Contractor

A. The CONTRACTOR shall test geocomposite for physical and hydraulic properties as set forth herein:

1. Interface Friction Angle Testing—The CONTRACTOR shall test geocomposite for adherence to minimum acceptable interface friction angles as listed in Specification Section 31 05 19.16, Geomembrane, in accordance with direct shear testing as specified in ASTM D5321.

2. Field Sampling—Four (4) samples of geocomposite shall be obtained by the CONTRACTOR for possible testing (at least four [4] ft by four [4] ft).

Each sample shall be tagged with the numbers of the panel and roll from which it was collected. All collected samples shall be stored onsite at a location approved by the CONSTRUCTION MANAGEMENT ENGINEER. If testing is deemed necessary by the CONSTRUCTION MANAGEMENT ENGINEER, the collected geocomposite samples shall be tested by the Geosynthetics Testing Laboratory to determine density, carbon content, thickness, and/or transmissivity according to the methods listed in Table 31 05 19.26-1. Sample shipping and testing shall be the responsibility of the CONTRACTOR and at the expense of the CONTRACTOR. All samples not submitted for testing shall be properly stored onsite during construction and submitted to the CONSTRUCTION MANAGEMENT ENGINEER upon conclusion of the project.

### **1.7.3 Daily Quality Control (QC) Log**

- A. The Geosynthetics Installer's field superintendent shall maintain a daily QC log during all phases of the geocomposite installation. This log shall document the daily progression of the geocomposite installation from delivery of material to final acceptance of the complete cap system. The daily log shall designate those construction activities that influence the integrity of the geocomposite during installation. The log, at a minimum, shall include entries and detailed documentation of the following:
1. Weather, i.e., temperature, winds, precipitation.
  2. Site preparation activities, including removal of water, sediment, or geomembrane liner cleaning.
  3. Roll and panel number of each sheet that is deployed on a daily basis.
  4. Repairs and replacements.
  5. Seaming activities.
  6. Inspection of geocomposite material delivered to the site.
  7. Calibration dates of each piece of seaming equipment and seam test equipment.
- B. The Geosynthetics Installer's field superintendent shall submit the required daily QC logs to the CONSTRUCTION MANAGEMENT ENGINEER for review within two (2) calendar days of the activities documented. At any point during the Work, if the daily QC log has not been submitted, the CONSTRUCTION MANAGEMENT ENGINEER has the right to stop the geocomposite installation activities at no cost to the OWNER. Upon receiving the required daily QC logs, Work may resume.



#### **1.7.4 Visual Inspection**

- A. During deployment of the geocomposite, the Geosynthetics Installer and the CONSTRUCTION MANAGEMENT ENGINEER shall carry out daily visual inspections of the material surface. Any faulty areas identified relating to drainage net integrity (e.g., flattening of geocomposite ribs) shall be repaired by the Geosynthetics Installer using approved repair procedures and shall be reported in the daily QC log.

#### **1.7.5 QC Laboratory**

- A. The Geosynthetics Testing Laboratory shall serve as the QC Laboratory for geocomposite testing, and shall meet the qualifications in Specification Section 01 40 00, Quality Control.

#### **1.8 Product Delivery, Storage, and Handling**

- A. Materials shall be delivered to the site only after the required submittals have been approved by the CONSTRUCTION MANAGEMENT ENGINEER. Storage and handling of the materials shall conform to the manufacturer's recommendations and shall be done in such a manner as to prevent damage to any part of the work or the material itself.
- B. The CONTRACTOR shall provide necessary labor and equipment to properly unload material upon arrival at site. The Geosynthetics Installer's field superintendent shall be present during the delivery and unloading of the geocomposite and shall ensure the geocomposite material has not been damaged during shipping, storage, or handling. The material shall be stored in a reasonably level and smooth area that is well drained, away from brush, poison oak or ivy; away from oil, grease, or fuels; and in an accessible area for inspection. Individual pieces or bundles shall be stored with safe walking space and clearance between them to allow full view for inspection purposes. To prevent ultraviolet degradation, the protective wrapper on each geocomposite roll shall not be removed until the material is ready for use. Additionally, tarping may also be used to protect geocomposite during storage. Identification tags attached to the rolls of geocomposite delivered to the site shall not be removed until the material is installed.
- C. Each roll shall be labeled with the manufacturer's name, product identification, lot number, roll number, and roll dimensions. Any roll not properly identified immediately prior to deployment activities may be deemed unacceptable for use by the CONSTRUCTION MANAGEMENT ENGINEER at the expense of the CONTRACTOR.

#### **1.9 Schedule**

- A. Not used.

## **2. MATERIALS**

### **2.1 Geocomposite**

A. The geocomposite drainage net shall be high density polyethylene. The geocomposite shall be manufactured from three (3) sets of parallel, extruded polymer strands. Strands of one (1) set shall lie on top of strands of the other set, and the two (2) sets shall be bonded at the intersection. Strands shall be heat bonded on both sides to eight (8) oz per square yard nonwoven needle-punched geotextile. The material shall have the minimum physical properties specified in Table 31 05 19.26-1.

### **2.2 Geocomposite Ties**

A. The geocomposite ties shall be heavy-duty, high-strength polymer braid ties. Ties shall be brightly-colored for easy inspection.

## **3. EXECUTION**

### **3.1 Installation**

A. The geocomposite shall be laid out and installed by the Geosynthetics Installer in accordance with the applicable CONSTRUCTION MANAGEMENT ENGINEER-approved installation procedures. The CONSTRUCTION MANAGEMENT ENGINEER'S approval of the installation procedures does not relieve the CONTRACTOR of his responsibility to properly install the geocomposite. The geocomposite shall be installed only after the underlying linear low-density polyethylene geomembrane liner has been tested and accepted by the CONSTRUCTION MANAGEMENT ENGINEER. The geocomposite shall be rolled down (machine direction parallel to slope) the side slope, keeping the geocomposite flat against the liner to minimize wrinkles and folds. Rolling and joining of geocomposite across slopes is not permitted. Place adequate ballast (e.g., sandbags) to prevent uplift by wind prior to covering.

B. Care shall be taken not to entrap small stones when unrolling a geocomposite from the top of a geomembrane lined slope.

### **3.2 Seams and Overlaps**

A. Geocomposite side seams shall be overlapped a minimum of six (6) inches. Plastic fastener spacing along side seams shall be a maximum of five (5) ft.

B. Overlap geocomposite end seams a minimum of one (1) ft and offset geocomposite end seams a minimum of five (5) ft between adjacent roll ends. End seam plastic fastener spacing shall be a maximum of one (1) ft. The overlaps shall be in the direction of flow.

- C. Tie geocomposite rolls together with plastic fasteners. The fasteners shall be a contrasting color from the geonet and attached geotextiles. Metallic fasteners will not be allowed. The geotextile component of the geocomposite shall be eight (8)-oz nonwoven needle-punched geotextile and shall be overlapped in the direction of flow and shall have seams sewn using approved methods.
- D. Place geotextile cap strips over any exposed edges of geocomposite. Cap strips shall be a minimum of two (2) ft in width and shall be thermally bonded to the geotextile component of the geocomposite.

### **3.3 Penetrations**

- A. Submit penetration details. Mechanically attach a geotextile apron to the pipes and other appurtenances penetrating through the closure cap so that soil is prevented from getting into the geocomposite. The apron of the attached geotextile shall extend out from the pipe or appurtenance a minimum of two (2) ft. The apron geotextile shall be thermally bonded to the geotextile component of the geocomposite.

### **3.4 Repairs**

#### **3.4.1 Drainage Net Damage**

- A. Make repairs by placing a patch of the geocomposite over the damaged area. Extend the patch a minimum of two (2) ft beyond the edge of the damage. Use approved fasteners, spaced every six (6) inches around the patch, to hold the patch in place. If more than twenty-five (25) percent of the roll width is damaged, approval must be obtained from the CONSTRUCTION MANAGEMENT ENGINEER to repair or replace the damaged roll.

#### **3.4.2 Geotextile Damage**

- A. Repair damaged geotextile by placing a patch of eight (8)-oz geotextile over the damaged area with a minimum of twelve (12) inches of overlap in all directions. The geotextile patch shall be thermally bonded in place.

#### **3.4.3 Protection and Backfilling**

- A. Cover the geocomposite with the specified materials within fourteen (14) days of acceptance. Vegetative Support Soil shall be placed from the bottom of the slope upward and shall not be dropped directly onto the geocomposite from a height greater than three (3) ft. The Vegetative Support Soil shall be pushed out over the geocomposite in an upward tumbling motion so that the wrinkles in the geocomposite do not fold over. No equipment shall be operated on the top surface of the geocomposite without permission from the CONSTRUCTION MANAGEMENT ENGINEER. The initial loose soil lift thickness shall be twelve (12) inches. Use

equipment with ground pressures no greater than five (5) pounds per square inch to place the first lift of soil.

### **3.5 As-Built Surveys**

A. Not used.

-- End of Section --

**SECTION 31 09 13  
SETTLEMENT PLATES**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

- A. The Work covered by this Section consists of the fabrication, furnishing, installation, protection, maintenance, and surveying of settlement plates and includes the furnishing of all labor, materials and equipment required.
- B. The CONTRACTOR shall monitor the settlement plates and provide the data to the CONSTRUCTION MANAGEMENT ENGINEER.

**1.1.2 Related Work Specified Elsewhere**

- A. Not used.

**1.2 References**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- B. Unless otherwise indicated the most recent edition of the publication, including any revisions, shall be used.

**1.2.1 ASTM International (ASTM)**

- A. ASTM C778: Standard Specification for Standard Sand.
- B. ASTM D422: Particle-Size Analysis of Soils.
- C. ASTM D1586: Penetration Test and Split Barrel Sampling of Soils.
- D. ASTM D2216: Laboratory Determination of Water Content of Soil and Rock.
- E. ASTM D2487: Classification of Soils for Engineering Properties.
- F. ASTM D2488: Description and Identification of Soils Classification.
- G. ASTM D4318: Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- H. ASTM D5434: Field Logging of Subsurface Explorations of Soil and Rock.

I. ASTM D1785: Poly Vinyl Chloride (PVC) Plastic Pipe, Sch 40, 80, and 120.

**1.3 Definitions**

A. Not used.

**1.4 Qualifications**

A. Not used.

**1.5 Submittals**

A. The CONTRACTOR shall prepare submittals for review and approval by the CONSTRUCTION MANAGEMENT ENGINEER.

**1.5.1 Submittals for Information**

A. Within five (5) working days of receipt of each instrument shipment to the site, submit to the CONSTRUCTION MANAGEMENT ENGINEER a copy of the factory calibration, manufacturer's test equipment certification, and completed copy of the quality assurance checklists.

B. Within five (5) working days of installing each instrument, submit the following to the CONSTRUCTION MANAGEMENT ENGINEER:

1. As-built location plan of the surveyed instrument locations.

**1.6 Safety**

A. Not used.

**1.7 Quality Assurance**

A. Not used.

**1.8 Product Delivery, Handling, and Storage**

A. Not used.

**1.9 Schedule**

A. Not used.

## **1.10 Instrument Protection, Maintenance and Replacement**

- A. The CONTRACTOR shall protect all instruments from damage due to construction operations, weather, traffic, and vandalism.
- B. If an instrument is damaged or becomes inoperative due to inadequate protection by the CONTRACTOR, or due to CONTRACTOR's operations, the CONTRACTOR shall replace the damaged instrument within seventy-two (72) hours at no additional cost to the OWNER.
- C. Extreme care shall be exercised by the CONTRACTOR when filling near and around the settlement plates and risers.

## **2. MATERIALS**

### **2.1 General**

- A. All settlement plates materials shall be new.

### **2.2 Monitoring Instruments**

#### **2.2.1 Instruments**

- A. The following shall be provided:
  - 1. Settlement Plates:
    - a. Provide settlement plate and complete assembly in accordance with the standard details shown on the Contract Drawings.
    - b. All iron pipe and fittings shall be fabricated from standard weight stock.
    - c. All PVC pipe and fittings shall be Schedule 40.

## **3. EXECUTION**

### **3.1 Pre-Installation Activities**

- A. When settlement plates are received at the site, the CONTRACTOR shall perform the following tests:
  - 1. Check, by comparing with procurement document that dimensions and materials are correct.
  - 2. Verify that all components fit together in the correct configuration.

3. Check all components for signs of damage in transit.
4. Check that quantities received correspond to quantities ordered.

### **3.2 General**

- A. The CONTRACTOR shall install instruments that remain fully functional for a minimum of ten (10) years.
- B. The CONTRACTOR shall notify the CONSTRUCTION MANAGEMENT ENGINEER at least twenty-four (24) hours prior to installing each settlement plate.
- C. As each settlement plate is installed, an installation record sheet shall be prepared, including appropriate items from the following list:
  1. Project name.
  2. Planned location in horizontal position and elevation.
  3. Personnel responsible for installation.
  4. Date and time of start and completion.
  5. Type of backfill used.
  6. As-built location in horizontal position and elevation.
  7. Weather conditions at the time of installation.
  8. A space on record sheet for notes, including problems encountered, delays, unusual features of the installation, and details of any events that may have a bearing on instrument behavior.

### **3.3 Installation of Settlement Plates**

- A. The settlement plates shall be installed in pits, about one (1) ft deep into the existing cover soil at the locations shown on Contract Drawings C-135 to C-144. The bottom of plate shall be level and the plate shall be installed with a section of marker pipe plumb before proceeding with stem assembly.
- B. The elevation of the top of the plate shall be determined. With plate and marker pipe and casing centered with respect to each other and maintained in a vertical position, the pit shall be backfilled in layers by hand and thoroughly compacted by hand. A maximum of three (3) ft of soil cover can be placed to stabilize the settlement plates.



- C. When the installation of the settlement plates is complete, the CONTRACTOR shall notify the CONSTRUCTION MANAGEMENT ENGINEER so that the elevation of the top of the marker pipe at that time can be determined; and no fill shall be placed until this elevation has been determined.
- D. The settlement plate stem shall be flagged and protected from construction equipment and vehicles. If the settlement plate assembly is disturbed such that is more than ten (10) degrees from vertical, it shall be replaced in kind within twenty-four (24) hours, unless otherwise directed by the CONSTRUCTION MANAGEMENT ENGINEER. The settlement plate will be replaced completely, including reconstruction of the settlement plate, base, and risers at the adjacent grade of fill when disturbance or damage occurs. The CONTRACTOR shall resurvey the new settlement plate immediately upon completing the installation. All settlement plate replacement activity will be performed by the CONTRACTOR at no additional cost to the OWNER.
- E. During filling activities, the fill placed within five (5) ft of the settlement plates shall be placed extremely carefully to avoid moving or damaging the plates and pipes. Fill placement could be performed with small equipment or by hand.
- F. When the fill reaches a level approximately two (2) ft below the top of the stem section in place, the CONSTRUCTION MANAGEMENT ENGINEER shall be notified so that the elevation of the top of the existing marker pipe can be established. After the next section of the of marker pipe and casing is installed, the CONTRACTOR shall establish the elevation of the added marker pipe. The casing shall be capped and the stem flagged for protection. Added sections shall be five (5) ft or as directed by the CONSTRUCTION MANAGEMENT ENGINEER.
- G. As the height of the fill increases, this procedure shall be repeated until the fill is completed.
- H. Settlement plate assemblies shall remain in place and become the property of the OWNER.
- I. The CONTRACTOR shall obtain and record all measurements and elevations necessary for accurate determination of settlement data during construction.

### **3.4 Data Monitoring, Recording, and Submission**

- A. The CONTRACTOR shall monitor the settlement plates for the duration of the project.
- B. Establish the elevation of the top of the marker pipes every three (3) days when fill is actively being placed within twenty (20) ft of the settlement plate. Record the amount of fill with each reading.

- C. After fill placement has been completed within twenty (20) ft of the settlement plate, establish the elevation of the top of the marker pipes weekly.
- D. The elevations must be established based on a fixed datum or benchmark located outside the limit of work.
- E. Extreme events such as rainstorms, flooding, or seismic activity shall be recorded. Any damage, repair, or relocation of the settlement plates shall be recorded.
- F. Monitoring data from settlement plates shall be recorded on the CONTRACTOR'S daily reports and tabulated in a tracking spreadsheet that shall be maintained over the entire project. At a minimum, data shall include the date and time of each elevation measurement, weather conditions, the elevation, physical condition of the settlement plate, and any issues encountered. The tracking spreadsheet shall be organized by settlement plate and dates/times. The tracking spreadsheet shall be submitted to the CONSTRUCTION MANAGEMENT ENGINEER every two (2) weeks or when requested.
- G. At a minimum, monitoring shall include the data listed in Table 31 09 13-1 at the frequencies specified.

**TABLE 31 09 13-1  
Geotechnical Monitoring Requirements**

<b>Data to be Monitored</b>	<b>Monitoring Timing/Frequency</b>
Settlement plate elevation	<ul style="list-style-type: none"> <li>• At time of initial installation</li> </ul>
Settlement plate top of rod elevation and elevation of ground surface adjacent to settlement plate	<ul style="list-style-type: none"> <li>• At time of initial installation</li> <li>• Immediately before and after adding another length of rod</li> <li>• Weekly for the first two months</li> <li>• Every 2 weeks for the remainder of the project until the surcharge is removed</li> </ul>

-- End of Section --

**SECTION 31 11 00  
CLEARING AND GRUBBING**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

- A. This Section includes requirements for the clearing and grubbing of all areas of Work for the construction of the closure cap, and other areas indicated, including work designated in permits and other agreements, in accordance with the Contract Documents.
- B. Clearing and grubbing shall be limited to only those areas required to perform the work associated with this project. Limits of actual clearing and grubbing shall be coordinated with the CONSTRUCTION MANAGEMENT ENGINEER. CONTRACTOR shall not clear and grub beyond perimeter erosion and sediment control devices.

**1.1.2 Related Work Specified Elsewhere**

- A. Section 01 70 00, Execution and Closeout Requirements.
- B. Section 31 25 00, Erosion and Sediment Control.

**1.2 References**

- A. Not used.

**1.3 Definitions**

- A. Clearing is the removal from the ground surface and disposal of trees, brush, shrubs, down timber, decayed wood, other vegetation, concrete, rubbish, and debris, as well as the removal of fences, stockpiled materials, and incidental structures.
- B. Grubbing is the removal and disposal of all stumps, buried logs, roots, matted roots, and organic materials.

**1.4 Qualifications**

- A. Not used.

## **1.5 Submittals**

- A. Prior to initiating clearing and grubbing activities, CONTRACTOR shall submit a site plan with the specific areas within the Limit of Disturbance that will require Clearing and Grubbing to execute the work for review and approval by the CONSTRUCTION MANAGEMENT ENGINEER.

## **1.6 Safety**

- A. Not used.

## **1.7 Quality Assurance**

- A. Not used.

## **1.8 Product Delivery, Handling, and Storage**

- A. Not used.

## **1.9 Schedule**

- A. Not used.

## **2. MATERIALS**

### **2.1 General**

- A. Trees, brush, shrubs, down timber, decayed wood, other vegetation, concrete, rubbish, debris, fences, stockpiled material, and incidental structures existing in the limits of Work require removal. All roots and organic matter are to be removed and disposed of offsite.

## **3. EXECUTION**

### **3.1 Disposition of Trees**

- A. Trees and shrubs within the limits of Work shall be removed unless otherwise indicated in the Contract Documents. Do not cut or damage trees outside the limits of Work unless so indicated or unless written permission has been obtained from the OWNER. Written permission shall be furnished to the CONSTRUCTION MANAGEMENT ENGINEER before removal operations commence.
- B. CONTRACTOR shall remove from the site and satisfactorily dispose of all trees, shrubs, stumps, roots, brush, masonry, rubbish, scrap, debris, pavement, curbs, fences and miscellaneous other structures not covered under other sections as shown, specified, or otherwise required to permit construction of the Work.

- C. Unless otherwise directed by OWNER, trees, stumps and other cleared and grubbed material shall be transported offsite by the CONTRACTOR. No cleared or grubbed material may be used in backfills or structural embankments.
- D. Cleared and grubbed material may be ground or chipped onsite to ease in transportation to offsite locations.
- E. Burning onsite is prohibited.
- F. Trees and shrubs intended to remain, that are damaged beyond repair, or removed shall be replaced by CONTRACTOR at no additional cost to the OWNER.

### **3.2 Clearing and Grubbing**

- A. CONTRACTOR shall clear and grub items indicated on the Contract Drawings and remove cleared and grubbed material from the site. Earthwork operations shall not be started in areas where clearing and grubbing is not complete, with the exception that stumps and large roots may be removed concurrent with excavation and grading. Comply with erosion and sediment control and stormwater management measures in accordance with Specification Section 31 25 00, Erosion and Sediment Control.
- B. Clear and grub areas to be excavated, areas to receive fill, and areas upon which structures are to be constructed. Depressions made by the removal of stumps or roots shall be filled with suitable fill, as determined by the CONSTRUCTION MANAGEMENT ENGINEER. Care is to be taken while grubbing over areas of known waste, not to spread waste beyond the existing limit of waste.
- C. The CONTRACTOR shall clear, grub, and strip the site area as shown on the Contract Drawings. Clearing and grubbing shall be performed in accordance with the sequence of construction as defined on the Contract Drawings.
- D. Contractor shall take care to protect existing landfill gas extraction wells, utilities, and other items marked to remain.

### **3.3 Preconstruction Survey**

- A. Survey shall be in accordance with Specification Section 01 70 00, Execution and Closeout Requirements.

### **3.4 As-Built Survey**

- A. Not used.

-- End of Section --

*This page intentionally left blank*

**SECTION 33 51 10**  
**LANDFILL GAS MANAGEMENT SYSTEM PIPE, PIPE FITTINGS, AND VALVES**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

A. The CONTRACTOR shall supply all materials, equipment, and labor needed to install, complete and make ready for use all pipe, pipe fittings, and valves for landfill gas conveyance as specified herein and as indicated on the Contract Drawings.

**1.1.2 Related Work Specified Elsewhere**

A. Section 01 33 00, Submittals.

B. Section 01 45 00, Health and Safety.

C. Section 01 70 00, Execution and Closeout Requirements.

D. Section 33 51 11, Landfill Gas Extraction Well and Condensate Drain System.

**1.2 References**

A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only. Use of the most recent version is required.

**1.2.1 ASTM International (ASTM)**

A. ASTM D 1248, Specification for Polyethylene Plastics Molding and Extrusion Materials.

B. ASTM D 1598, Test for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.

C. ASTM D 1599, Test for Short-Time Rupture Strength of Plastic Pipe, Tubing and Fittings.

D. ASTM D 2122, Determining Dimensions of Thermoplastic Pipe and Fittings.

E. ASTM D 2513, Specification for Thermoplastic Gas Pressure Pipe Tubing and Fittings.

- F. ASTM D 2774, Practice for Underground Installation of Thermoplastic Pressure Piping.
- G. ASTM D 2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
- H. ASTM D 3035, Polyethylene Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
- I. ASTM D 3350, Specification for Polyethylene Plastics Pipe and Fittings Materials.
- J. ASTM F-714, Standard Specifications for 3-Inch to 36-Inch Polyethylene Pipe.
- K. ASTM F 1417, Test Method for Installation Acceptance of Plastic Gravity Sewer Lines using Low-Pressure Air.
- L. ASTM D638-03, Standard Test Method for Tensile Properties of Plastics.
- M. ASTM D790-07, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- N. ASTM D1505-03, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
- O. ASTM D1693-07a, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

### **1.2.2 American National Standard Institute (ANSI)**

- A. ANSI B 31.8, Code for Pressure Piping, Appendix N.

### **1.2.3 Plastics Piping Institute (PPI)**

- A. PPI TR-3 1/9-79, Technical Report.

## **1.3 Definitions**

- A. Not used.

## **1.4 Qualifications**

- A. Not used.



## 1.5 Submittals

- A. The CONTRACTOR shall prepare and submit to the CONSTRUCTION MANAGEMENT ENGINEER for review and approval in accordance with Specification Section 01 33 00, Submittals, certificates of compliance on materials furnished and manufacturer's brochures containing complete information and instructions pertaining to the storage, handling, installation, inspection, maintenance, and repair of each type of pipe, pipe fitting, and valve furnished.
- B. The CONTRACTOR shall prepare and submit a gas collection system work plan to the CONSTRUCTION MANAGEMENT ENGINEER and OWNER for review and approval for all phases of the project as defined on G-002 of the Contract Drawings.
- C. The CONTRACTOR shall prepare and submit Shop Drawings to the CONSTRUCTION MANAGEMENT ENGINEER for review and approval. The Shop Drawings shall show the following:
  - 1. Dimensions, slopes, and invert elevations at connections.
  - 2. Tie-ins to the existing system.
  - 3. Detailed procedures to be used in joining and installing piping system, including manufacturer's recommendations.
  - 4. Interfacing of piping system to equipment and appurtenances.
  - 5. Detailed requirements for burial, supports, anchors, guides, expansion joints, and accessories required for a satisfactory piping system.
  - 6. Bill of materials, indicating material composition of pipe, pressure rating, nominal size with wall dimensions, and its installation drawing.
  - 7. Valve Operation and Maintenance Data: Submit detailed operation and maintenance data for valves and appurtenances provided under this Section. As a minimum, include the following:
    - a. Technical information required to replace any piece of equipment
    - b. A list of manufacturers and suppliers, including addresses and phone numbers
    - c. Manufacturer's design and sizing criteria and calculations
    - d. A list of recommended spare parts.
  - 8. Tests: Submit description of proposed testing methods, procedures, and apparatus. Prepare and submit report for each test.

## 1.6 **Safety**

A. Safety shall be in accordance with Specification Section 01 45 00, Health and Safety.

## 1.7 **Quality Assurance**

A. Piping manufacturer shall maintain a continuous quality control program. Plastic molding materials used to manufacture pipe and fittings under this Section shall be tested for conformance to ASTM D 3035, ASTM D 3350, or ASTM D 1248.

B. Valves and appurtenances provided under this Section shall be the standard product in regular production by manufacturers whose products have proven reliable in similar service for at least two (2) years.

C. Insofar as possible, valves shall be the product of one (1) manufacturer.

## 1.8 **Delivery, Storage, and Handling**

A. Pipe shall be stored or stacked to prevent damage by marring, crushing, or piercing. Maximum stacking height shall be limited to six (6) feet. Pipe shall be stored in accordance with the manufacturer's recommendations.

B. Pipe and pipe fittings shall be handled carefully in loading and unloading. They shall be lifted by hoists and lowered on skidways in such a manner as to avoid shock. Derricks, ropes, or other suitable equipment shall be used for lowering the pipe into the extraction well borings. Pipe and pipe fittings shall not be dropped or dumped.

C. Unload pipe, fittings, and appurtenances opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign material.

D. Handle valves and appurtenances very carefully. Valves that are cracked, dented, or otherwise damaged or dropped will not be acceptable.

E. Store valves and appurtenances in approved enclosed shelter and off the ground, unless otherwise acceptable to CONSTRUCTION MANAGEMENT ENGINEER.

## 1.9 **Schedule**

A. Not used.

## 2. MATERIALS

### 2.1 High Density Polyethylene (HDPE) Pipe

#### A. General

1. HDPE pipe and fittings greater than three (3)-inch-diameter as indicated on the Contract Drawings shall be Standard Dimension Rating (SDR) 17 HDPE pipe using a 3408 type resin or approved equal. HDPE pipe and fittings that are three (3)-inch-diameter and less shall be SDR 11.
2. Pipe shall be extruded from a Type III, Class C, Category 5, Grade P34 compound as described in ASTM D 1248. It shall be classified as cell 345434C according to ASTM D 3350 and have the material designation of PE 3408. The pipe shall be manufactured to meet the requirements of ASTM D 2513. Manufacturer's literature shall be adhered to when "manufacturer's recommendations" are specified. Pipe and fittings shall be provided by one (1) manufacturer. Acceptable manufacturers include Plexco, Driscopipe, or approved equal.
3. The HDPE pipe shall have the typical physical properties as determined by the appropriate test method, as listed in Table 33 51 10-1.

**TABLE 33 51 10**  
**Material Physical Properties**

Physical Property	Test Method	Nominal Value
Density	ASTM D-1505	0.955 gram per cubic centimeter
Tensile Yield Strength	ASTM D-638	3,200 pounds per square inch
Tensile Modulus of Elast.	ASTM D-638	130,000 pounds per square inch
Flexural Modulus	ASTM D-790	135,000 pounds per square inch
Environmental Stress Condition A, B, C	ASTM D-1693	>5,000 hours
Compression	ASTM D-1248	>3,500 hours
Melt Index	ASTM D-1238	<0.15

- a. HDPE Fittings—Fittings shall be ASTM D-2513-latest edition, butt fusion molded. Fittings shall be pressure rated to match the system piping to which they are fused. Fittings shall conform to all applicable reference standards listed herein.
- b. Flexible Mechanical Couplings—Flexible mechanical couplings for buried and exposed service pipe connections shall be the stainless-steel type suitable for use with polyethylene pipe.
- c. HDPE Pipe shall be joined by heat fusion to provide a homogeneous, sealed and leak proof joint. Pipe shall be joined following manufacturer's recommendation. Polyethylene pipe shall not be solvent submitted.

## **2.2 Flanges for HDPE Pipe**

- A. Flanges for HDPE pipe shall be convoluted ductile iron back-up rings with a minimum thickness of one (1) inch, as manufactured by Improved Piping Products (925-254-0962), Inc., of Orinda, California or approved equal. Backup rings shall be finished with red oxide primer.
- B. Studs and bolts, nuts, and washers for flanges shall be 316 stainless steel.

## **2.3 Well Heads**

- A. Refer to Specification Section 33 51 11, Landfill Gas Extraction Well and Condensate Drain System.

## **2.4 Valves**

### **A. General**

1. Valves shall be complete with necessary operators, actuators, handwheels, chain wheels, extension stems, floor stands, worm and gear operators, operating nuts, chains, wrenches, and other accessories or appurtenances which are required for the proper completion of the work. Operators, actuators, and other accessories shall be sized and furnished by the valve supplier and factory mounted.
2. Manual valve operators shall turn right to close unless otherwise specified. Valves shall indicate the direction of operation.
3. Valves and operators shall be suitable for the exposure they are to be subjected to, e.g., buried and landfill gas. Valves shall have safety features required by the Occupational Safety and Health Administration.
4. Unless otherwise shown, valves shall be the same size as the adjoining pipe.
5. Valves shall have manufacturer's name and working pressure cast in raised letters on valve body. Valves shall be Type 57 provided by Asahi/America, Inc. of Malden, Massachusetts, or approved equal. Landfill gas Type 57 collection system valves should be polyvinyl chloride (PVC) body with polypropylene discs, and nitrile or ethylene-propylene-diene-monomer (EPDM) seat and seals. Manufacturer must be ISO-9001 certified.
6. All valves shall have a permanent (not painted on) open/close position indicator.

## B. Butterfly Valves

1. The header isolation valves shall be corrosion-resistant Type 1, Grade 1, butterfly bubble tight, wafer design, with a PVC body, nitrile seat, and compatible with a flat face flange, as manufactured by Asahi/America or equal. Butterfly valves shall be resistant to landfill and methane gas. The valves shall be rated for one hundred (100) pounds per square inch at thirty (30) to one hundred twenty (120) degrees Fahrenheit. If called for, the valve shall be supplied from the manufacturer with a two (2)-piece stem and housing for buried applications. The housing shall be carbon steel with a baked powder epoxy coat. The valve and where called for, the valve stem, shall be Type 57 for landfill gas collection system valves. If required, stem extensions shall be stainless steel in an epoxy coated steel outer housing with a gear box assembly mounted on top and equipped with a removable manual operating wheel. Monitoring ports at the butterfly valves shall be quick connects. If required, quick connects shall be attached to the pipeline via flexible metal hose connector, Swagelok Part No. SS-4HO-6-L4, or equal.

## C. Labcock Valves

1. Quick connects used for monitoring ports may be replaced by labcock valves at all monitoring ports in the system, subject to approval by the CONSTRUCTION MANAGEMENT ENGINEER. Labcock valves shall be one-quarter (1/4)-inch PVC with EPDM seats and seals. Valves shall have one-quarter (1/4)-inch male pipe thread on one (1) end and hose connection on the other end.

## 2.5 **Pipeline Locator/Warning Tape**

- A. Tape shall be a metallic locator/warning tape imprinted with the words “Caution Gas Line Buried Below,” as supplied by Terra Tape (800-231-2417) or equal.

## 2.6 **Detailed Requirements**

- A. Workmanship—The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, or other defects. The pipe shall be uniform in color, opacity, density, and other physical properties.
- B. Dimensions and Tolerances—Dimensions and tolerances shall be measured in accordance with ASTM D 3035 (HDPE). The eccentricity of the inside and outside circumferences of the pipe walls shall not exceed twelve (12) percent.
- C. Sustained Pressure—The pipe shall not fail, balloon, burst, or weep as defined in ASTM D 1598.
- D. Burst Pressure—The minimum burst pressure shall be as given, when determined in accordance with ASTM D 1599.

## 2.7 **Identification**

- A. Marking on the pipe shall include the following, spaced at intervals of not more than five (5) feet.
1. Pipe nominal size.
  2. Pipe schedule.
  3. Specification of plastic material.
  4. Type and grade of plastic.
  5. Provide butt welded joints, except joints at equipment and valves shall be flanged and gasketed.

## 3. **EXECUTION**

### 3.1 **HDPE Pipe Handling**

- A. HDPE pipe shall not be bent more than the minimum radius recommended by the manufacturer for type, grade, and SDR. Care shall be taken to avoid imposing strains that will overstress or buckle the HDPE piping or impose excessive stress on the joints.

#### B. Joining HDPE Pipe

1. Only two (2) methods shall be utilized for joining HDPE pipe: heat fusion and mechanical joining.
  - a. Mechanical Joining shall be accomplished with HDPE flange adapters, neoprene gaskets, and ductile iron back-up flanges, and shall be used only where shown on the Contract Drawings. Refer also to Paragraph 3.2 of this Section.
  - b. Heat Fusion joints shall be made in accordance with manufacturer's step by step procedures and recommendations. Fusion equipment and a trained operator shall be provided by the CONTRACTOR. Pipe fusion equipment shall be of the size and nature to adequately weld all pipe sizes and fittings necessary to complete the project. Branch saddle fusions shall be made in accordance with manufacturer's recommendations and step-by-step procedures. Branch saddle fusion equipment will be of the size to facilitate saddle fusion within the pipe trench. Heat fusion shall be performed outside of the trench whenever practical. Before heat fusing pipe, each length shall be inspected for the presence of dirt, sand, mud, shavings, and other debris. Any

foreign material shall be completely removed. At the end of each day, all open ends of fused pipe shall be capped or otherwise covered to prevent entry by animals or debris.

- c. As per the manufacturer's instructions, no fusion shall be performed in precipitation unless a shelter is provided.

### **3.2 HDPE Pipe Installation**

- A. Pipe installation shall comply with the requirements of ASTM D 2321, PPI TR-31/9-79, and the manufacturer's recommendations.
- B. Lengths of fused pipe to be handled as one (1) segment shall not exceed four hundred (400) feet.
- C. The CONSTRUCTION MANAGEMENT ENGINEER shall be notified prior to any pipe being installed in the trench in order for the inspector to have an opportunity to inspect the following items:
  - 1. Butt and saddle fusions.
  - 2. Pipe integrity.
  - 3. Trench excavation for rocks and foreign material.
  - 4. Proper trench slope.
  - 5. Trench contour to ensure the pipe will have uniform and continuous support.
- D. Any irregularities found by the CONSTRUCTION MANAGEMENT ENGINEER during this inspection must be corrected before lowering the pipe into the trench. Pipe shall be allowed sufficient time to adjust to trench temperature prior to any testing, segment tie-ins, and/or backfilling.
- E. Tie-ins shall be made outside of the trench whenever possible. When tie-ins are to be made only in the trench, a bell hole shall be excavated large enough to ensure an adequate and safe work area.
- F. Below grade piping shall be marked with metallic locator/warning tape to be buried in the trench above the pipe as indicated on the Contract Drawings.
- G. Plugs:
  - 1. Temporarily plug installed pipe at the end of each day's work or other interruption to the installation of any pipeline. Plugging shall be adequate to prevent the entry of animals or liquids into the pipe or the entrance, or insertion of deleterious materials.
  - 2. Where plugging is required for phasing of the Work for later connection, install watertight, permanent-type plugs.

### **3.3 Flanged Connections**

- A. Flanged connections for polyethylene (PE) pipe shall be installed per manufacturer's recommendations.
- B. The CONTRACTOR shall use an anti-seize compound on all stainless steel nuts and bolts.
- C. The CONTRACTOR shall wrap and tape the flanges and bolts in five (5)-mil polyethylene sheeting prior to backfilling to help protect the assembly from corrosion.

### **3.4 Segment Testing**

- A. The HDPE pipeline shall be subjected to an air test per ASTM F-1417 and as described herein to detect any leaks in the piping. Testing shall be performed below grade (inside the trench). The CONTRACTOR shall accept the responsibility for locating, uncovering (if previously backfilled), and repairing any leaks detected during testing.
- B. Like sizes of HDPE piping shall be butt welded together into testing segment not to exceed one thousand (1,000) feet. Segments shall be connected to a testing apparatus on one (1) end and fitted with fusion-welded caps on all openings.
- C. The segment to be tested should be allowed time to reach constant and/or ambient temperature before initiating the test.
- D. The test should be performed during a period when the pipe segment will be out of direct sunlight when possible; i.e., early morning, late evening, or cloudy days.
- E. This will minimize the pressure changes which will occur during temperature fluctuations.
- F. The test pressure shall be four (4) pounds per square inch gauge.
- G. Pressure drop during the test shall not exceed one (1) percent of the testing gauge pressure over a period of one (1) hour. This pressure drop shall be corrected for temperature changes before determining pass or failure. (See Paragraph 3.5 in this Section for test failures.) The CONSTRUCTION MANAGEMENT ENGINEER shall sign off on a test form to indicate test compliance.
- H. The CONSTRUCTION MANAGEMENT ENGINEER shall be notified prior to commencement of the testing procedure and shall be present during the test.
- I. Equipment for this testing procedure will be furnished by the CONTRACTOR. This shall consist of a polyethylene flange adaptor with a PVC blind flange. Polyethylene



reducers shall be utilized to adapt test flange to size of pipe being tested. Tapped and threaded into the blind flange shall be a temperature gauge zero (0) to one hundred (100) degrees Celsius, a “Schraeder tire valve” to accommodate an air compressor hose, a ball valve to release pipe pressure at completion of test, and a pressure measuring device. The pressure measuring device shall be:

1. Digital manometer. A digital manometer capable of measuring positive pressures of air and other non-corrosive gases over a range of zero (0) to one hundred ninety-nine and nine-tenths (199.9) inches water column, Model No. 475-3 as manufactured by Dwyer Instruments, Inc., or approved equal.

### **3.5 Test Failure**

- A. The following steps shall be performed when a pipe segment fails the one (1) percent-one (1) hour test described in this Section.
  1. The pipe and all fusions shall be inspected for cracks, pinholes, or perforations.
  2. Blocked risers and capped ends shall be inspected for leaks.
  3. Leaks shall be located and/or verified by applying a soapy water solution and observing soap bubble formation.
- B. Pipe and fused joint leaks shall be repaired by cutting out the leaking area and refusing the pipe.
- C. After all leaks are repaired, a retest shall be performed in accordance with this Section.

### **3.6 Valve Installation**

- A. Install valves and appurtenances in accordance with manufacturer’s recommendations.
- B. Butterfly valves shall be installed between two (2) flanged connections with stainless-steel nuts and bolts coated with anti-seize compound prior to assembly. Stud lengths shall accommodate the required distance between flanges and spacers.
- C. Spacers may be required for full operation of flanged butterfly valves. Install spacers with approval of CONSTRUCTION MANAGEMENT ENGINEER.
- D. Valve flanges, bolts and nuts shall be wrapped and taped in five (5)-mil polyethylene sheeting prior to backfilling.

- E. Unless otherwise approved, install valves plumb and level. Valves shall be installed free from distortion and strain caused by misaligned piping, equipment, or other causes.
- F. Install valves in horizontal pipes with shafts vertical unless otherwise indicated.

### **3.7 Valve Field Tests and Adjustments**

- A. Adjust parts and components as required to provide correct operation.
- B. Conduct functional field test of each valve in presence of CONSTRUCTION MANAGEMENT ENGINEER to demonstrate that each part and components together function correctly. Testing equipment required shall be provided.
- C. CONTRACTOR shall provide manufacturer's recommended maximum torque data for bolted connections and furnish his intended installation method to ensure that bolts are not over-torqued. Hand wrenching of plastic pipe connections without torque monitoring shall not be permitted. Cracking of pipe/appurtenances shall be repaired by CONTRACTOR at no additional cost to the OWNER.

### **3.8 As-Built Surveys**

- A. The CONTRACTOR shall survey the landfill gas pipe as it is placed to confirm alignment and that minimum slope is achieved. The CONTRACTOR shall survey the top of all landfill gas valves, condensate drains, extraction wells (ground and top of wellhead), and appurtenances associated with the landfill gas system. Survey shall be in accordance with Specification Section 01 70 00, Execution and Closeout Requirements.

-- End of Section --

**SECTION 33 51 11**  
**LANDFILL GAS EXTRACTION WELL AND CONDENSATE DRAIN SYSTEM**

**1. GENERAL**

**1.1 Description**

**1.1.1 Scope of Work**

- A. The work covered under this Section includes the furnishing of all labor, equipment, and materials, and performing all operations in connection with the installation and testing of the vertical landfill gas (LFG) extraction wells and condensate systems.

**1.1.2 Related Work Specified Elsewhere**

- A. Section 01 45 00, Health and Safety.
- B. Section 01 70 00, Execution and Closeout Requirements.
- C. Section 31 05 16, Aggregates.

**1.2 References**

**1.2.1 ASTM International**

- A. ASTM D-2513, Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings.
- B. ASTM D-3350, Specification for Polyethylene Plastic Pipe and Fittings Materials.
- C. ASTM D-1784, Rigid Poly (Vinyl Chloride) PVC Compounds and Chlorinated Poly (Vinyl Chloride) CPVC Compounds.
- D. ASTM D-2467, Socket-Type Poly (Vinyl Chloride) PVC Plastic Pipe Fittings, Schedule 80.

**1.3 Definitions**

- A. Not used.

**1.4 Qualifications**

- A. The CONTRACTOR responsible for constructing the gas wells shall be licensed as a driller employing only competent workers for the execution of this Work. All such Work shall be performed under the direct supervision of an experienced driller

satisfactory to the CONSTRUCTION MANAGEMENT ENGINEER. The driller shall have a minimum of three (3) years of demonstrated experience installing LFG collection wells in municipal landfill refuse.

- B. The CONTRACTOR will provide a list of all personnel who will be involved in the project and their corresponding qualifications and experience.
- C. The CONTRACTOR shall employ a qualified technician with a minimum of five (5) years of experience in LFG flow rate control and LFG blower and flare system operations who shall perform the initial balancing of the well field.

## **1.5 Submittals**

- A. CONTRACTOR qualifications.
- B. The CONTRACTOR shall supply to the CONSTRUCTION MANAGEMENT ENGINEER, in writing within ten (10) days after the Notice to Proceed, the proposed work schedule including the following:
  - 1. The starting date of construction.
  - 2. The dates and order of gas extraction well and condensate drain drilling.
  - 3. The completion date of gas extraction well and condensate drain drilling.
  - 4. Any anticipated work stoppage of duration greater than twenty-four (24) hours with exception of weekends and holidays.
- C. The CONTRACTOR shall submit shop drawings and/or product data for approval to the CONSTRUCTION MANAGEMENT ENGINEER for the following items:
  - 1. Piping and fittings, for high-density polyethylene (HDPE) hoses, gauges, and test parts.
  - 2. All dimensions and components of the well head and adapters shall be drawn to scale. A complete shop drawing showing all components shall be provided as a single submittal.
  - 3. Ductile iron flange adaptors.
  - 4. Construction diagrams for each well.
  - 5. Manufacturer's installation instructions.
  - 6. Shop drawings showing the dimensions and all components of the well fittings and adapters.

7. Manufacturer's Operation and Maintenance Manual.
  8. Manufacturer's warranty information.
  9. Prior to construction, the CONTRACTOR shall provide the CONSTRUCTION MANAGEMENT ENGINEER coordinates and surface elevation of proposed well locations. Notify CONSTRUCTION MANAGEMENT ENGINEER if surface elevation at drilling location differs more than one (1) foot from plan elevation.
- D. During all gas well and condensate drain drilling, a detailed driller's report shall be maintained and submitted in duplicate to the CONSTRUCTION MANAGEMENT ENGINEER. The report shall give a complete description of all subsurface material encountered, number of feet drilled, number of hours on the job, shutdown due to breakdown, and other pertinent data requested by the CONSTRUCTION MANAGEMENT ENGINEER.
- E. During drilling of each borehole within the refuse disposal area, the CONTRACTOR shall maintain a log of the reference points of depth measurements and the depth of each borehole.
- F. Upon completion of each gas well and condensate drain, the CONTRACTOR shall also submit to the CONSTRUCTION MANAGEMENT ENGINEER a report to include the following:
1. The name and location of the job.
  2. The date and time of the borehole drilling (start and finish), with borehole identification labeling.
  3. Gas well and condensate drain number and coordinates.
  4. Surface elevation.
  5. Depth to water.
  6. The depth or location of any lost drilling materials or tools.
  7. Names of drilling/installation crew staff, firm, and supervisor.
  8. Size and materials of pipe used in wells and drains.
  9. Type of drilling rig used for boreholes.

10. Depth of completed gas well and condensate drain, including depths to beginning and end of perforated sections, to the bottom of the well cap and height above ground of well head.
11. The nominal hole diameter of the borehole.
12. Description of extraordinary events encountered, including weather description.
13. Photoionization detector and combustible gas indicator lower explosive limit readings.
14. Amount, size, and description of crushed stone used and vertical limits.
15. Amount, description, quantity, and vertical limits of bentonite plugs installed.
16. Amount, description, and vertical limits of sand backfill installed.
17. Problems encountered in advancing the boreholes including locations of refusal and depth advanced.
18. Other pertinent data requested by the CONSTRUCTION MANAGEMENT ENGINEER.

#### **1.6 Safety**

- A. Safety shall be in accordance with Specification Section 01 45 00, Health and Safety.

#### **1.7 Quality Assurance**

- A. The CONTRACTOR shall be capable of identifying subsurface conditions and maintaining complete and current logs and daily notes for the gas well completion reports.
- B. The AUTHORITY/OWNER or CONSTRUCTION MANAGEMENT ENGINEER may make any other investigations regarding qualifications as deemed necessary to determine the ability of the CONTRACTOR to perform the Work, and the CONTRACTOR shall furnish to the AUTHORITY/OWNER or CONSTRUCTION MANAGEMENT ENGINEER all such information and data for this purpose as the AUTHORITY/OWNER or CONSTRUCTION MANAGEMENT ENGINEER may request.

#### **1.8 Delivery, Storage, and Handling**

- A. Parts and materials shall be properly protected so that no damage, deterioration, or contamination will occur from time of shipment until installation is completed.

- B. If, in the opinion of the CONSTRUCTION MANAGEMENT ENGINEER, parts and materials are damaged, deteriorated, or contaminated before acceptance of the well, the material and/or the gas well will be rejected. The CONTRACTOR shall replace the labor, parts, and materials at no additional cost to the AUTHORITY/OWNER.
- C. Materials shall be stored to ensure preservation of their quality and fitness for work. When deemed necessary, they shall be placed on wooden platforms or other hard, clean surfaces and not on the ground. Stored materials shall be located so as to facilitate prompt inspection.

## **1.9 Schedule**

- A. Not used.

## **1.10 Subsurface Conditions**

- A. Subsurface investigations have not been made within the landfill area to the depth of the proposed LFG wells. Methane gas extraction wells shall penetrate through municipal landfill refuse until reaching the depths shown on the Contract Drawings.
- B. The CONTRACTOR shall be aware that unfavorable subsurface conditions may exist at the sites selected for the gas extraction wells and condensate drains. Subsurface conditions at the landfill may include soils of any description, density, or consistency; municipal refuse, boulders, concrete rubble, perched water, or other large objects.
- C. The information concerning the subsurface conditions and problems of which the CONTRACTOR is advised is for the sole purpose of assisting the CONTRACTOR in the bid preparation. The OWNER, CONSTRUCTION MANAGEMENT ENGINEER, and their consultants do not guarantee the accuracy and the conditions and concerns stated above. These conditions and concerns may not be indicative of the conditions at the site.
- D. In the event subsurface conditions, in the opinion of the CONTRACTOR, may be unfavorable for gas extraction well installation, the CONTRACTOR shall promptly notify the CONSTRUCTION MANAGEMENT ENGINEER verbally, and in writing, of such conditions and present an alternative location for approval.
- E. Obstructions may be encountered when drilling in a landfill, many of which can be drilled through. The CONTRACTOR is expected to make reasonable effort to drill through such obstructions.
- F. During construction, it is expected that minor relocations of well installation will be necessary. Such relocations shall be made only by direction of the CONSTRUCTION MANAGEMENT ENGINEER. If obstructions are encountered during drilling requiring well or drain relocation, the CONTRACTOR shall notify the CONSTRUCTION MANAGEMENT ENGINEER verbally and in writing before

continuing with the construction in order that the CONSTRUCTION MANAGEMENT ENGINEER may make such field revisions as are necessary. If the CONTRACTOR fails to notify the CONSTRUCTION MANAGEMENT ENGINEER when an obstruction is encountered, and proceeds with the construction despite this interference, the CONTRACTOR shall do so at his own risk. Holes that are abandoned will be filled with sand to the original grade level. The CONTRACTOR shall receive no payment for any footage drilled for an abandoned borehole. Drilling occurring at a borehole which has been directed for abandonment and/or relocation by the CONSTRUCTION MANAGEMENT ENGINEER will be at the CONTRACTOR'S expense.

#### **1.11 Well Field Balancing**

- A. Prior to tuning the well field, the CONTRACTOR shall submit for approval his schedule and general procedure for balancing the well field, including instrumentation. Note that initially, daily measurements will allow timely corrections for wells and may ultimately reduce the overall adjustment period.
- B. The CONTRACTOR shall submit a statement indicating the test methods proposed to be used to evaluate each parameter.
- C. The CONTRACTOR shall provide copies of all field logs and test results to the OWNER and CONSTRUCTION MANAGEMENT ENGINEER with twenty-four (24) hours of sampling, including any well field adjustments.

#### **1.12 Notification**

- A. The CONTRACTOR shall notify the CONSTRUCTION MANAGEMENT ENGINEER, in writing, of the number of drilling rigs and personnel to be used on the project. Any change in the number of rigs and personnel shall require written notification to the CONSTRUCTION MANAGEMENT ENGINEER, forty-eight (48) hours prior to the change.
- B. The CONTRACTOR shall notify the CONSTRUCTION MANAGEMENT ENGINEER, in writing, ten (10) days prior to the commencement of drilling activities.
- C. The CONTRACTOR shall notify the CONSTRUCTION MANAGEMENT ENGINEER twenty-four (24) hours prior to start of any gas extraction well or condensate drain drilling activities.

#### **1.13 Gas Extraction Well and Condensate Drain Acceptance Criteria**

- A. Each gas extraction well and drain shall be approved based on the following criteria in the opinion of the CONSTRUCTION MANAGEMENT ENGINEER:



1. The well/drain is structurally sound and in conformance with designated standards.
  2. The borehole is drilled plumb and true to line.
  3. Provisions are made to keep well and drain piping centered in the borehole.
- B. All piping, crushed stone, bentonite seals, etc. shall be installed as directed by the Contract Drawings.
- C. No payment for the wells or drains shall be due to the CONTRACTOR if all of the above requirements are not met.

#### **1.14 Disposal of Drill Cuttings**

- A. Waste and waste soil excavated during construction of gas extraction wells and condensate drains shall be placed by the CONTRACTOR below the cap subgrade elevations if construction sequence allows for direct placement or at an approved location.

### **2. MATERIALS**

#### **2.1 Landfill Gas Extraction Wells and Condensate Drains**

##### **2.1.1 Pipe**

- A. HDPE, ASTM D2513/D3350 (Cell classification PE355434C), SDR-17, Material PE 3408, DriscoPlex 4100 or approved equal.
- B. All HDPE piping shall be butt-fused in strict compliance with the manufacturer's recommendations.

##### **2.1.2 Fittings and Flanges**

- A. HDPE, ASTM D2513/D3350, SDR-17.

##### **2.1.3 Bolts, Washers, and Nuts**

- A. Stainless Steel, Type 304.

#### **2.2 Landfill Gas Well Heads**

- A. The LFG collection system wellheads shall be a Quick-Change Orifice Plate design, Model ORP215 as manufactured by QED Environmental Systems, Inc. or equal as approved by the CONSTRUCTION MANAGEMENT ENGINEER and shall consist of well head piping and fittings, flow control valve, gas temperature gauge port, quick

connect gas sampling, static and differential pressure ports, reinforced flexible hose connector, dust cap. All well head piping and fittings shall be Schedule 80 polyvinyl chloride (PVC). Adapters shall be Elastomeric PVC.

- B. The wellhead shall incorporate an orifice plate system such that the plates can be quickly exchanged without shutting off the control valve.
- C. The wellhead shall incorporate a fine tune control valve.
- D. Each well head shall include a minimum of four (4) sample ports.
- E. The equipment shall be capable of withstanding the rigors of LFG recovery application, including internal high vacuum, weathering, gas constituent, and ultraviolet light exposure.
- F. The well heads shall be tight and leak-free and shall be height adjustable in the field.
- G. The well head assemblies shall be capable of being used with a CES Landtec GEM-2000 or 5000 Gas Analyzer incorporating all monitoring functions.
- H. The wellhead assemblies shall have a nominal size of two (2) inches and a nominal flow capacity range of zero (0) to one hundred twenty-five (125) cubic feet per minute (cfm).
- I. The wellhead shall be designed to withstand a vacuum of one hundred (100) inches of water.

### **2.2.1 Measurement Tube**

- A. The measurement tube shall be of sufficient length to allow gas to achieve a uniform velocity profile before being measured.
- B. The measurement tube assembly shall be pre-assembled and leak tested. The manufacturer shall conduct one hundred (100) percent testing for functionality. All units shall leak not more than ten (10) cubic centimeters per minute at a pressure of ten (10) pounds per square inch.

### **2.2.2 Orifice Plate**

- A. The orifice plates shall be constructed of one-sixteenth (1/16)-inch laser cut stainless steel.
- B. Each plate shall have an easy to read tab with the plate size. The plate size can be read without removing the plate from the housing.

- C. Each wellhead will be provided with a set of six (6) orifice plates, ranging in size from four-tenths (0.4) to one and four-tenths (1.4) inches.

### **2.2.3 Temperature Gauges**

- A. The temperature gauges shall have a stainless steel probe and all stainless steel fittings, hermetically sealed water-tight dial cover, UV resistant components, heavy-duty shatter-resistant glass dial, and calibration nut. They shall be connected to the well heads with quick-connect fittings or approved equal and operate from zero (0) to two hundred fifty (250) degrees Fahrenheit. Dial shall be Ashcroft two (2)-inch series EI Grade A or equal.

### **2.2.4 Quick-Connect Test Ports**

- A. Test ports shall be positive sealing and shall be constructed of chrome-plated brass compatible for use with the GEM-2000 or 5000 Gas Analyzer. Test Ports shall be Colder Products Company; Plugs#PMC 30; Test Port #MCD10-04 with shutoff. Or approved equal.

### **2.2.5 Valves**

- A. Wellhead Control Valve shall be constructed of Schedule 80 PVC and stainless steel.
- B. The Valve housing shall include an indexed scale for indexing valve settings for easy adjustment and reset.
- C. The Valve shall have a rising stem for easy identification of valve position.
- D. The Valve Stem shall have a three-quarter (3/4)-inch stainless steel shaft with coarse threads for long term durability and linear flow adjustment.
- E. The Valve Handle shall be made of stainless steel for long term durability. No plastic handles are allowed.
- F. All valves shall carry a permanent decal securely fastened to the body which includes the manufacturer and serial number.
- G. The Valve Handle shall include a numeric scale for easy setting adjustment and reset.
- H. Valve be capable of flows up to one hundred twenty-five (125) standard cfm and up to one hundred twenty (120) degrees Fahrenheit temperature.

### **2.2.6 Molded Well Cap**

- A. Each wellhead system shall include a high visibility molded well cap, which secures the gas wellhead and provides ports for a downhole dewatering pump and liquid level

access. Liquid level access will be completed without needing to close control valve, or remove the LFG wellhead.

- B. Well caps shall be manufactured to assure proper fit on standard well casings. Cap sizes shall be available for six (6)-inch standard casing.
- C. Well caps shall include flexible seals for the well casing and for the gas wellhead pipe.
- D. Well caps will have a minimum of five (5) threaded ports for installing pass through style compression fittings. Three (3) fittings can be used with nylon pump tubing, the other two (2) ports can be used for liquid sensing.
- E. Caps will include an integral gas pipe support ring at the cap base. The support ring and flexible coupling will provide two (2) points of stabilization for the gas pipe minimizing stress on the flexible gas hose.

### **2.2.7 Flex Connectors**

- A. Flex connectors shall be used to accommodate landfill settlement.
- B. The flex connectors shall be two (2)-inch-diameter hose and provided by the wellhead manufacturer for this connection. Flexible hose to pipe connections shall be made using stainless steel hose clamps to secure the flexible hose.
- C. Diameter of flexible connector shall be mated with wellhead discharge to ensure airtight connection.
- D. Two (2) extra flex connectors with clamps shall be provided for each well head.

### **2.2.8 Nuts, Bolts, Washers, and Gaskets**

- A. Nuts, bolts, and washers shall be Type 304 stainless steel.
- B. Gaskets for flange installation shall be neoprene.

### **2.2.9 Well Identification**

- A. Four (4)-inch by six (6)-inch aluminum well identification tags shall be permanently attached to each well head with stainless steel clamps. The well identification tags shall indicate the well identification number.
- B. Yellow fiberglass flexible marker, six (6) ft long, with well identification number in black three (3)-inch letters, Model PM-301 manufactured by Pro-Mark Utility Supply, Inc., or approved equal.

### **2.3 Granular Fill**

- A. Granular Fill, in accordance with Specification Section 31 05 16, Aggregates, shall be placed around the LFG extraction wells and condensate drains as indicated on the Contract Drawings.

## **3. EXECUTION**

### **3.1 Preparation**

- A. The CONTRACTOR shall be responsible for the layout and staking of all wells and condensate drains. The location (coordinates and surface elevations) of each well and condensate drain shall be documented.

### **3.2 LFG Extraction Well and Condensate Drain Installation**

- A. Drill hole to diameter and depth as indicated. Wells are not to be vented to the atmosphere without permission from the CONSTRUCTION MANAGEMENT ENGINEER. Blind flanges shall be installed on wells after installation to prevent discharge prior to well head installation.
- B. Well installation shall be accomplished with a thirty-six (36)-inch bucket auger rig. After the auger has reached its lowest elevation, all loose earth and debris shall be removed.
- C. The HDPE extraction well pipe and condensate drain pipe shall be inserted, taking care that it is centered in the hole. The annular space between the casing and the outer wall of the hole shall then be filled with crushed stone, sand, and bentonite as indicated on the Contract Drawings.
- D. Every effort shall be made on the part of the CONTRACTOR to ensure pipe plumbness and centralization. The CONTRACTOR shall use spacers at the perforated section of the well to assure the pipe is maintained within the center of the borehole. The CONSTRUCTION MANAGEMENT ENGINEER shall approve the spacer design method prior to its use.

### **3.3 Well Head Installation**

- A. The well heads shall be lifted and handled according to written procedures supplied by the manufacturer.
- B. The well heads shall be installed within two (2) percent of vertical (plumb).
- C. Where the well heads connect directly to the collection header, a reducer shall be welded to the lateral for flex hose connection in accordance with accepted methods and standards appropriate for the header material.

- D. The well heads shall be installed on the well casing in accordance with the manufacturer's written instructions.

### **3.4 Well Head Testing**

- A. After installing the well head, the following minimum test operations shall be performed:
  - 1. Leak test all components and connections of the wellhead to the landfill gas piping system. Apply soapy water to all fittings for visual observation for leaks.
  - 2. Test temperature gauge.
  - 3. Test pressure ports across orifice plate. Provide flow vs. pressure curve for zero (0) to forty (40) cfm range. Test shall be made on actual device installed. All well heads shall be identical.
  - 4. Test valve for proper closure and seat.
- B. Prior to acceptance, the following verifications shall be made:
  - 1. Verify that the well head is installed per the manufacturer's written instructions and these Specifications.
  - 2. Verify that the well head has passed the tests as specified.
  - 3. Verify that all submittal requirements have been met.

### **3.5 Well Field Balancing**

- A. The CONTRACTOR is responsible for balancing the well field to demonstrate its stability to the satisfaction of the CONSTRUCTION MANAGEMENT ENGINEER. Stability will be demonstrated by minimizing oxygen below one (1.0) percent by volume, and maximizing methane recovered for the long term. A vacuum must be observed at each well head. CONTRACTOR shall provide personnel for a minimum of two (2) months to balance the wellfield. No adjustments to fee will be made relative to the duration of the well balancing period.
- B. Balancing of the well field shall be performed by measurement of flow rate and composition. The following measurement parameters shall be recorded for each well every time it is monitored during the balancing process:
  - 1. Methane.
  - 2. Oxygen.
  - 3. Carbon dioxide.

4. Balance gas (primarily nitrogen).
  5. Well head gas temperature (flowing).
  6. Ambient temperature.
  7. Barometric Pressure.
  8. Static pressure.
  9. Velocity head.
  10. Well head gas flow.
  11. Well head adjusted valve position (initial and adjusted).
  12. New well head vacuum and flow information after adjustments.
  13. Water level.
  14. Additional observations or comments.
- C. At a minimum, each well must be tested once per week, with the above information recorded. Results are to be submitted to the CONSTRUCTION MANAGEMENT ENGINEER and the OWNER.
- D. As part of the well adjustment process, the CONTRACTOR shall compare previous readings on wells, and be aware of the effects the adjustments may have on the nearby wells.
- E. CONTRACTOR shall coordinate the transition of the operation and well field balancing with the AUTHORITY/OWNER following substantial completion of the project. A planning meeting shall be scheduled with the AUTHORITY/OWNER and CONSTRUCTION MANAGEMENT ENGINEER two (2) weeks prior to the transition.

### **3.6 Gas Well Abandonment**

- A. If the CONTRACTOR fails to meet the gas extraction well and condensate drain acceptance criteria as stated in this Section, or should the gas extraction well condensate drain be rendered inoperable due to loss of tools, collapse, or other causes related to gas extraction well or drain construction operations, the CONTRACTOR shall abandon the gas well(s) or drain. The abandonment shall entail backfilling the borehole with sand. Under these conditions, the CONTRACTOR shall receive no payment for time, materials, or work for abandonment and shall receive no compensation for the abandoned gas well or drain.
- B. The CONTRACTOR will notify the CONSTRUCTION MANAGEMENT ENGINEER immediately if any obstruction is encountered during drilling. If the CONTRACTOR is directed by the CONSTRUCTION MANAGEMENT ENGINEER to abandon a borehole, the CONTRACTOR will fill the borehole with sand.
- C. If borehole abandonment is directed by the CONSTRUCTION MANAGEMENT ENGINEER for reasons other than encountering an obstruction, the CONTRACTOR shall be compensated for footage drilled and abandonment.

### **3.7 Protection and Site Cleanup**

- A. At all times during the progress of the site work, the CONTRACTOR shall use all reasonable precautions to prevent either tampering with the gas extraction wells and condensate drains or the entrance of foreign material.
- B. All gas extraction wells and condensate drains shall be protected as indicated during construction by the use of hay bales or other approved means. The CONTRACTOR shall replace any gas extraction well or condensate drain which is damaged by construction operations at the CONTRACTOR'S expense.
- C. Immediately upon completion of site work, the CONTRACTOR shall remove all of his or her equipment, materials, and supplies from the site of the work, remove all surplus materials and debris, fill in all holes or excavations, and restore any disturbed areas to their original condition.
- D. Excavated material will be removed from the site at the end of each work day. The CONTRACTOR shall be responsible for all loading and transportation costs of the refuse. Refuse shall be handled and controlled such that it does not drift off as litter due to wind, water, or animals.

### **3.8 As-Built Surveys**

- A. Survey shall be in accordance with Specification Section 01 70 00, Execution and Closeout Requirements.

-- End of Section --