

GENERAL CLOSURE PERMIT

**AUTHORIZATION TO CONDUCT CLOSURE AND POST-CLOSURE ACTIVITIES
AT MUNICIPAL SOLID WASTE LANDFILL FACILITIES IN ACCORDANCE WITH
CHAPTER 2, WYOMING SOLID WASTE RULES AND REGULATIONS**

In compliance with the provision of the W.S. 35-11-502, W.S. 35-11-531, and Chapter 1, Section 2(k) of the Wyoming Solid Waste Rules and Regulations, the operator of a municipal solid waste landfill may close a municipal solid waste landfill with less than thirty (30) acres of municipal solid waste disposal area with the provisions of this general closure permit. The operator of said facility shall submit the information required in Part IV of this permit in order to provide notice of intent to be covered under this permit. Operators are covered by this general permit when the Department issues a written Authorization of Coverage to the operator. Upon receipt of the Authorization of Coverage, the operator is authorized to conduct closure and post-closure activities in accordance with this permit. No closure or post-closure activities shall commence until a written Authorization of Coverage under the general closure permit has been received from the Department. This general permit consists of this page, the Table of Contents, Parts I-VI, and Appendices B-D.

This general permit becomes effective on the date of issuance and may be reviewed and amended or modified in accordance with the provisions of W.S. 35-11-502 and Chapter 1, Sections 3 and 4 of the Wyoming Solid Waste Rules and Regulations.

Authorizations of Coverage for municipal solid waste landfills shall be issued through the end of the post-closure period specified in Chapter 2, Section 7(q) of the Solid Waste Rules and Regulations and shall be extended until such time when the Administrator determines, upon petition by the operator accompanied by submission of relevant information, that the facility has been adequately stabilized in a manner protective of human health and the environment. Petitions to terminate the post-closure period shall include certification from a Wyoming licensed professional engineer that post-closure care has been completed in compliance with the approved post-closure plan and in a manner protective of human health and the environment. No renewals of Authorizations of Coverage shall be required.



Luke Esch, Administrator – Solid and Hazardous Waste Division



Todd Parfitt, Director – Department of Environmental Quality

8-25-14

Date of Issuance

Table of Contents

PART I.	DEFINITIONS.....	1
PART II.	COVERAGE.....	1
PART III.	PERMITTING PROCEDURES.....	3
PART IV.	MINIMUM APPLICATION PACKAGE CONTENT	3
PART V.	STANDARD PERMIT CONDITIONS.....	3
PART VI.	CLOSURE/POST-CLOSURE CONDITIONS	6

Attachments

ATTACHMENT A	MAP WITH SOLID WASTE PERMITTING DISTRICT OFFICE INFORMATION	A-1
ATTACHMENT B	SOLID WASTE FACILITY PERMIT APPLICATION FORM..	B-1
ATTACHMENT C	NOTICE OF INTENT FOR COVERAGE UNDER THE GENERAL CLOSURE PERMIT	C-1
ATTACHMENT D	CONSTRUCTION QUALITY ASSURANCE PLAN	D-1
ATTACHMENT E	CLOSURE CERTIFICATION FORM.....	E-1
ATTACHMENT F	POST-CLOSURE INSPECTION CHECKLIST.....	F-1

PART I DEFINITIONS

- A. “Administrator” means the administrator of the Solid and Hazardous Waste Division, Wyoming Department of Environmental Quality or the administrator’s authorized designee.
- B. “DEQ” means Department of Environmental Quality.
- C. “Director” means Director of DEQ.
- D. “Form” means Solid Waste Facility Permit Application Form.
- E. “General permit” means a permit issued by the director to conduct closure and post-closure activities at municipal solid waste landfill facilities within the State of Wyoming where coverage for each facility of that type can be permitted thereunder. The administrator or the administrator’s designee has the authority to issue acceptance of coverage under the permit.
- F. “Individual permit” means a permit issued in accordance with W.S. §35-11-502, by the Administrator to conduct closure and post-closure care activities at municipal solid waste landfill facilities.

Please refer to Chapter 1 of the Wyoming Solid Waste Rules and Regulations (SWRR) for additional definitions of terms used throughout this document.

PART II. COVERAGE

A. Facilities Covered Under This Permit

Municipal solid waste landfills with a total surface area of less than thirty (30) acres of municipal solid waste disposal area, which are in the process of ceasing receipt of municipal solid waste and closing.

B. Denial, Revocation, or Modification of Coverage Under a General Permit

- 1. Coverage under this general permit may be denied for any of the reasons listed in SWRR, Chapter 1, Section 4(a). These reasons include, but are not limited to:
 - a. The applicant fails to submit the required information.
 - b. Permit issuance would conflict with the policy and purpose of the Environmental Quality Act (Act).
 - c. The facility history indicates continual noncompliance with the SWRR or this general permit.

- d. The application indicates that the facility would not comply with the location, design and construction, monitoring, closure or post-closure standards as specified in the applicable sections of the SWRR or this general permit.
 - e. The application misrepresents actual site conditions.
 - f. The applicant fails to employ a solid waste manager who meets the qualifications of SWRR, Chapter 2.
 - g. The applicant, or any partners, has been found civilly or criminally liable for violations of environmental quality or criminal racketeering laws or regulations which, in the judgment of the director constitutes evidence that the applicant cannot be relied upon to conduct the closure and post-closure described in the application in compliance with the act and the SWRR.
2. Coverage under this general permit may be modified by the director or his authorized designee by notifying the facility operator in writing. The written notification shall contain the basis for modifying the permit.

C. Facilities That May Require an Individual Closure and Post-Closure Permit For A Municipal Solid Waste Landfill

1. The Administrator or his designee may require an operator authorized by a general permit or seeking coverage to apply for and obtain an individual closure and post-closure care permit for a municipal solid waste landfill under SWRR, Chapter 2. Cases where an individual closure and post-closure care permit for a municipal solid waste landfill may be required include, but are not limited to, the following:
- a. The permittee is not in compliance with the conditions of the general permit for closure and post-closure care activities at a municipal solid waste landfill facility.
 - b. The information submitted in accordance with Part IV indicates that a general permit would not be protective of human health and the environment.
 - c. Non-compliance with the provisions of the SWRR or this general permit.
 - d. Final cover system designs that deviate from the specified design outlined in Attachment C “Notice of Intent for Coverage Under the General Closure Permit”, Section F.1.
2. If, after evaluation of the general permit application and any additional information requested for the evaluation, it is found that this general permit is not applicable to the closure and post-closure care activities, the application will be processed as an application for an individual closure and post-closure care permit for a municipal solid waste landfill. The applicant will be notified of the administrator’s decision to deny authorization under the general permit and require coverage under an individual closure and post-closure care permit for a municipal solid waste landfill. Additional

information may be required and the individual closure and post-closure permit application will be processed in accordance with W.S. § 35-11-502 and the SWRR.

D. Closure and Post-Closure Care Activities In Compliance With Permit

The permittee shall conduct the closure and post-closure care activities of any facility permitted under this general permit according to statements, representations, and procedures presented in the application and the terms and conditions of the general permit and SWRR.

PART III PERMITTING PROCEDURES

A. Application Process

1. Any applicant who desires to be covered (permitted) under the conditions of this general permit shall submit two copies of the Notice and Intent described in Part IV. The application package shall be submitted to the appropriate district office (see Attachment A).
2. The Notice of Intent will be processed in accordance with the procedures outlined in SWRR, Chapter 1, Section 2(k).

B. Change of Ownership

When the ownership of a facility is to change, the new operator shall submit the information required by SWRR, Chapter 1, Section 3(c). The original operator shall retain responsibility for the facility according to the terms of the original permit until the application for permit transfer has been approved by the director. The new operator may not operate the facility until the permit transfer has been approved.

PART IV. MINIMUM APPLICATION PACKAGE CONTENT

The operator shall complete and submit the Notice of Intent for Coverage Under the General Closure Permit (Attachment C).

PART V STANDARD PERMIT CONDITIONS

A. Property Rights

The issuance of this general permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to either private property or any invasion of personal rights, nor any infringement of federal, state, or local laws or regulations.

B. Right to Access

The operator shall allow the administrator, or an authorized representative of the state, upon the presentation of credentials, during normal working hours, to enter the premises where a regulated site is located, or where records are kept under the conditions of this general permit, and inspect the condition of the facility, collect fluid samples for analysis, measure and record water levels, and perform any other function authorized by law or regulation.

C. Signatory Requirements

The Form shall be signed by the operator, the landowner, and any real property lien holder of public record. All Forms shall be signed by the operator under oath subject to penalty of perjury. All persons signing the Form shall be a duly authorized agent. For a municipality or other public agency, the head of the agency or ranking elected official is considered a duly authorized agent.

D. Duty to Comply

The operator must comply with all conditions of this general permit and is responsible for ensuring any subcontractors, employees or other persons associated with the construction, installation, monitoring, closure, or post-closure activity of the facility comply with all conditions of this general permit. Any general permit noncompliance constitutes a violation of SWRR, Chapter 2 and the Act and may be grounds for enforcement action, permit termination, revocation, or modification, or for denial of a permit application. The permittee shall give the administrator advance notice of any changes at the permitted facility prior to implementation.

E. Penalties for Falsification of Reports and Monitoring Systems

Article 9 of the Act provides that any persons who knowingly makes any false statement, representation or certification in any application, report, plan or other document filed or required to be maintained under the Act or who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method shall, upon conviction, be fined not more than \$10,000 per day for each violation or imprisoned for not more than one year or both.

F. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for an operator in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this general permit.

G. Duty to Provide Information

The operator shall furnish to the administrator, within a reasonable time, any information that the administrator may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this general permit or to determine compliance with this permit. The permittee shall also furnish to the administrator, upon request, copies of records required to be kept by this general permit.

H. Other Information

When the operator becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in any report to the administrator, he or she shall promptly submit such facts or information.

I. Transfers

This general permit is not transferable to any person except after notice to the administrator in accordance with SWRR, Chapter 1, Section 3(c).

J. State Laws

Nothing in this general permit shall be construed to preclude the institution of any legal action or relieve the operator from any responsibilities, liabilities, or penalties established pursuant to any applicable state law.

K. Permit Actions

This general permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the operator for a general permit amendment, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

L. Severability

The provisions of this general permit are severable, and if any provisions of this general permit, or the application of any provision of this general permit to any circumstance, are held invalid, the application of such provision to other circumstances, and the remainder of this general permit shall not be affected thereby.

M. Requirements of Other Agencies

Compliance with the conditions of this general permit does not relieve the operator of the necessity to comply with pollution control or other requirements of other state, local, or federal agencies.

N. Limit of Involvement

Nothing in this general permit constitutes an endorsement by the DEQ of the design or construction of the facility. This general permit verifies only that the submitted

application meets the design and construction standards imposed by SWRR, Chapter 2 for closure and post-closure care activities. The DEQ assumes no liability for, and does not in any way guarantee or warrant the performance of the permitted facility. The operator is solely responsible for any liability arising from the construction of the permitted facility. By issuing this general permit, the state does not waive its sovereign immunity.

O. Facilities Maintenance

The permittee shall at all times properly maintain all facilities and monitoring systems (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this general permit. Proper maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee when necessary to achieve compliance with the conditions of this general permit.

PART VI CLOSURE/POST-CLOSURE CONDITIONS

A. Deed Notice

At closure, an instrument which clearly gives notice of the restrictions that apply to future activities on the disposal facility property shall be filed for recording by the registrar of deeds (county clerk) in the county where the facility is located. Wording of such an instrument shall indicate that the property has been used as a solid waste disposal facility. This shall be recorded prior to any property transaction resulting in another use for the property. The owner/operator, or its successors, shall assure that post-closure use of the property will be restricted to prevent any disturbance to the facility's containment system including caps and liners, or the functioning of the facility's monitoring system. The operator shall submit to the Department a copy of the recorded instrument that was filed with the registrar of deeds (county clerk) within 60 days of completion of construction of the authorized facility.

B. Notification of Closure

Prior to the commencement of closure activities, a notice of closure shall be published in an area newspaper and posted at all facility access points. The operator shall submit to the Department a newspaper affidavit which verifies publication of the public notice of closure within 60 days of completion of construction of the authorized facility.

C. Inspection and Maintenance

1. The facility shall have an inspection and maintenance checklist for inspecting and maintaining the site during the post-closure period. The minimum inspection frequency for each item on the checklist shall be annual. At a minimum, the following items shall be included in the checklist:

- Final cover integrity - Repairs and revegetation will occur for any damage due to erosion, settlement, burrowing animal holes, slope failures, leachate outbreaks, and subsidence. If damage to the geomembrane is determined to have occurred, the geomembrane shall be carefully exposed and repaired with an additional piece of geomembrane overlapping the damage by at least six inches in all directions and welded to the underlying geomembrane (using hot air or solvent bonding methods, as appropriate). The final components shall then be replaced to original specifications CQA Plan (Attachment D), with repairs made during the summer months and the top layer reseeded in the fall, per the CQA Plan;
- Vegetation – Inspect. Areas with poor growth performance will be reseeded;
- Mowing – Only if necessary to control invasive weed species, and if so, shall be done prior to weeds “going to seed” for the season;
- Woody growths – Inspect. Remove as necessary;
- Groundwater monitoring wells – Inspect. Conduct repairs as required;
- Gas vents and probes – Inspect. Conduct repairs as required;
- Leachate collection system (if applicable) – Indicate frequency of monitoring and maintenance activities relating to the leachate collection system. Indicate the disposition of collected leachate, frequency of discharge or disposal, and the facility’s response to leachate seeps;
- Surface water channels and basin(s) – Inspect. Repair, if necessary, and remove accumulated sediment and debris so that flow is not impeded;
- Perimeter and final cover maintenance access road – Inspect. Grade and repair to allow access for maintenance and monitoring;
- Perimeter fencing and gates – Inspect. Repair, as required, to prevent unauthorized access to the facility; and
- Corrective action systems (if applicable) – Inspect. Conduct repairs as required

A sample Post-Closure Inspection Checklist is provided in Attachment F;

2. All repairs shall be made in accordance with the approved Closure and Post-Closure Plan and CQA Plan (Attachment D) requirements;
3. Inspections and repairs shall be documented on the Post-Closure Inspection Checklist (Attachment F);
4. Facility fences, gates and other access controls, waste containment systems, surface water diversion systems, environmental monitoring systems, corrective action systems shall be maintained and operated throughout the closure and post-closure periods;
5. The operator shall respond to any pollution problem reasonably related to the facility’s activities as required by applicable rules and regulations; and
6. The operator shall maintain all inspection results in the facility operating record for the duration of the post-closure period and submit the results with the annual reports.

D. Recordkeeping

1. The following records shall be maintained at the facility or an approved alternative location and available for inspection and copying by the department during reasonable business hours. Copies of these records shall be submitted to the administrator when requested:
 - a. Log of litter collection activities specifying the dates and areas of litter collection;
 - b. Log of refuse compaction and covering procedures specifying the dates on which compaction and covering operations were conducted, areas compacted and covered;
 - c. Types and disposition of special wastes, specifying the volume, date of disposition, and source of waste;
 - d. Records of waste sold or otherwise salvaged;
 - e. Record of any problems causing operations to cease, including but not limited to fire or equipment failure; and
 - f. Copy of the department permit letter.

3. The owner or operator shall maintain through the end of the post-closure period, in addition to the records required in paragraph above, an operating record which shall contain the following information:
 - a. Any permit application prepared under SWRR, Chapter 2 and/or SWRR Chapter 1 Section 2(k);
 - b. If not contained in the permit application, any location restriction demonstration which is required under SWRR, Chapter 2, Section 3(b);
 - c. Log of random inspections or other screening activities for regulated hazardous wastes and PCB wastes specifying the date, time, and name(s) of the inspection personnel, as required under SWRR, Chapter 2, Section 5(f)(ii), and any notifications to the administrator under SWRR, Chapter 2, Section 5(f)(iii);
 - d. Records of training of landfill operators to detect hazardous wastes and PCB wastes required under SWRR, Chapter 2, Section 5(a)(ii);
 - e. Methane monitoring results prepared under SWRR, Chapter 2, Section 6, and any methane notification or remediation plan prepared under SWRR, Chapter 2, Section 5(t);

- f. Groundwater monitoring results, and any other groundwater demonstration, certification, or finding, which is required under SWRR, Chapter 2;
- g. As-built specifications for length, width and depth of trenches, and location;
- h. Dates when trenches were completed, and contents of each trench;
- i. Closure and post-closure plans and any monitoring, testing, or analytical data required in the plans;
- j. Any cost estimates and financial assurance documentation required under SWRR, Chapter 7;
- k. Any information demonstrating the classification of the landfill as a Type I or Type II landfill as defined in SWRR, Chapter 1, Section 1(e);
- l. Any engineered containment demonstration which is required under SWRR, Chapter 2, Section 4(j), and
- m. Dates when reclamation activities take place.

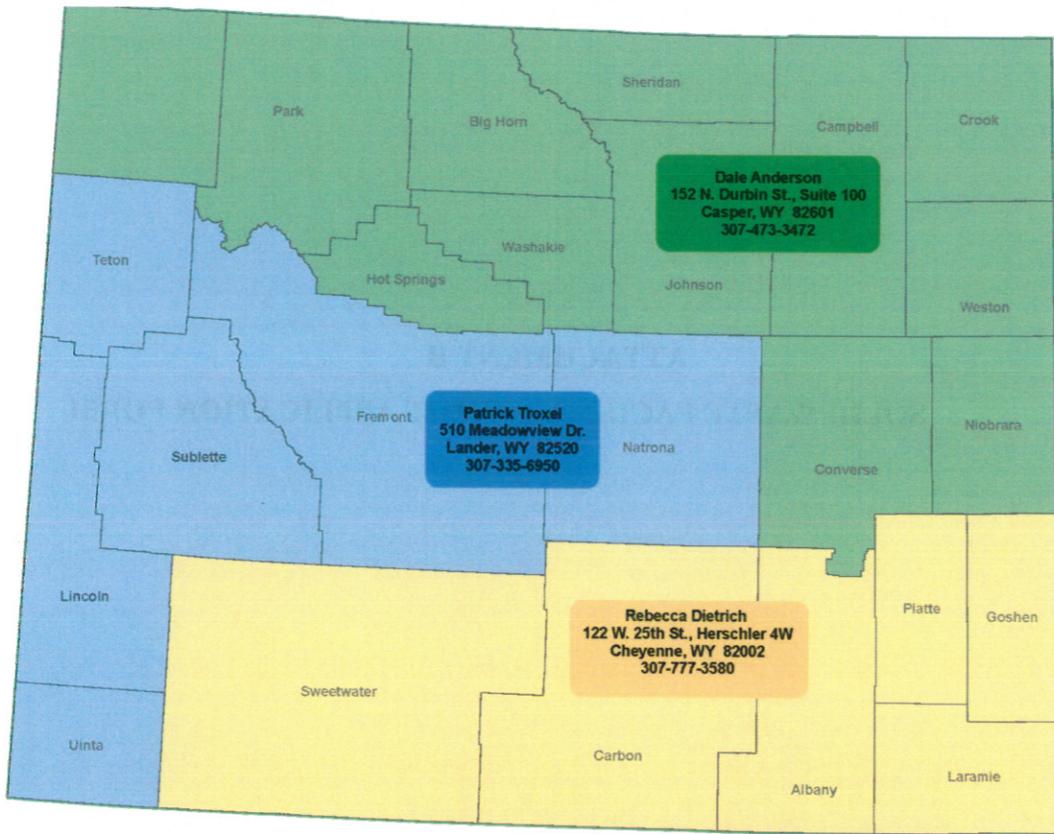
E. Other Closure and Post-Closure Information

- 1. Special waste management units shall be closed in compliance with the applicable closure standards in SWRR, Chapter 8;
- 2. Any facility used for the transfer, treatment, or storage of solid wastes shall comply with the applicable closure standards established under Chapter 6;
- 3. Unless a delay is approved by the administrator, closure activities shall commence no later than thirty (30) days following the time the facility ceases to receive solid wastes;
- 4. Unless a delay is approved by the administrator, closure activities shall be completed within one hundred eighty (180) days following commencement of closure;
- 5. The administrator may approve a delayed closure in order for the facility to reach final closure grade if the owner or operator demonstrates to the satisfaction of the administrator, that the delayed closure will be protective of human health and the environment; and
- 6. Petitions to terminate the post-closure period shall include certification from a Wyoming registered professional engineer that post-closure care has been completed in compliance with the post-closure plan and in a manner protective of human health and the environment.

F. Reporting

1. Annual reports shall be submitted to the Department including at least the following information:
 - a. Facility inspection reports, including the dates and times of inspections and a detailed description of any actions taken to correct problems encountered.
 - b. Copies of all environmental monitoring data including, but not limited to, any required statistical evaluations, electronic copies of groundwater and methane monitoring data in a format specified by the administrator, and potentiometric surface maps for each groundwater monitoring event which have not been previously submitted.
2. The operator will notify the Department of the following:
 - a. Two weeks prior to commencement of construction and the estimated completion date.
 - b. Any changes or modifications in accordance with SWRR, Chapter 1, Section 3.
3. The Closure Certification Form (see Attachment E) shall be submitted within 60 days of completion of construction of the authorized facility. The Closure Certification Form shall include the following information:
 - a. Date of completion of closure activities at the municipal solid waste landfill facility; and
 - 1) Certification from a professional engineer registered in the State of Wyoming confirming that the provisions of the closure plan have been carried out and that the facility has been closed in compliance with the closure standards specified in SWRR, Chapter 2; or
 - 2) Certification that the facility was completed with changes or modifications. Submittal of as-constructed plans and specifications for the system as it was constructed. All modifications or deviations from the authorized plans must be highlighted.
 - b. Submittal of the Construction Quality Assurance Report (see Attachment D)

ATTACHMENT A
MAP WITH SOLID WASTE PERMITTING DISTRICT OFFICE
INFORMATION



Wyoming Solid Waste Permitting & Corrective Action Program Districts

Districts	Color	Responsible Person	Contact Information
Green	Green	Dale Anderson	152 N. Durbin St., Suite 100 Casper, WY 82601 307-473-3472
Blue	Blue	Patrick Troxel	510 Meadowview Dr. Lander, WY 82520 307-335-6950
Yellow	Yellow	Rebecca Dietrich	122 W. 25th St., Herschler 4W Cheyenne, WY 82002 307-777-3580

ATTACHMENT B
SOLID WASTE FACILITY PERMIT APPLICATION FORM

Solid Waste Facility Permit Application Form

For SHWD Use Only

Facility Name:	SHWD File No.:
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Applicant Information

Name:	Phone:
Address:	
City, State, Zip:	

Landowner Information

Name:	Phone:
Address:	
City, State, Zip:	

Lienholder Information

Name:	Phone:
Address:	
City, State, Zip:	

Facility Information

Application Type:	Range:	Facility Type:	Section:
Township:	County:	Total Acreage:	
Service Area:			
Total Disposal Capacity:			
Total Transfer/Treatment/Storage Capacity:			
Waste Type(s):			

Landowner Approval

I have read this application and consent to the operations which are described herein. I understand the land use restrictions and any deed notice which are part of this application.

Signature Date

Lienholder Approval

I have read this application and consent to the operations which are described herein. I understand the land use restrictions and deed notice which are part of this application.

Signature Date

Professional Engineer Certification

I am a registered professional engineer in the State of Wyoming and am qualified to design solid waste management facilities. I certify that this application was prepared by me or under my direct supervision (Stamp, sign and date)

Signature Date

Professional Geologist Certification

I am a registered professional geologist in the State of Wyoming. I certify that the geologic services and work contained in this application were prepared by me or under my direct supervision. (Stamp, sign and date)

Signature Date

Applicant Oath

I (we) have prepared or reviewed this application and swear that the information contained in it is accurate and represents actual site conditions. I (we) understand that submission of false information subjects me (us) to a penalty for perjury in accord with W.S. 35-11-506. I (we) shall allow the administrator or an authorized representative, upon the presentation of credentials and other documents as may be required by law to enter upon the premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit; have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit; inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the appropriate rules and regulations of the department, any substances or parameters at any location.

Applicant signature title date

Applicant signature title date

The forgoing permit application form was acknowledged before me by _____
Applicant(s)

in _____ County, State of _____, this _____ day of _____, _____

Witness my hand and official seal.

Notary Public signature

My commission expires: _____

TABLE OF CONTENTS

A	PERMIT APPLICATION FORM	C-1
B	INTRODUCTION	C-2
C	LEGAL DESCRIPTION	C-3
D	SITE SPECIFIC DATA DESCRIBING UNDERLYING SOILS GEOLOGY AND HYDROGEOLOGY	C-4
E	FINAL COVER SYSTEM	C-5
F	STRUCTURES PROVIDED TO PREVENT THE CONTAMINATION OF AQUIFERS	C-6
G	SPRACE WATER DIVERSION	C-7
H	ENVIRONMENTAL MONITORING PLAN	C-8
I	PLANS	C-9

ATTACHMENT C

NOTICE OF INTENT FOR COVERAGE UNDER THE GENERAL CLOSURE PERMIT

TABLE OF CONTENTS

A. PERMIT APPLICATION FORM..... C-3

B. INTRODUCTION C-3

C. LEGAL DESCRIPTION C-4

D. SITE SPECIFIC DATA DESCRIBING UNDERLYING SOILS,
GEOLOGY, AND GROUNDWATER C-5

E. POST-CLOSURE LAND USE C-7

F. FINAL COVER SYSTEM..... C-8

G. STRUCTURES DESIGNED TO PREVENT THE
ACCUMULATION OF METHANE C-11

H. SURFACE WATER DIVERSION C-11

I. ENVIRONMENTAL MONITORING PLAN C-12

J. PLANS C-14

**NOTICE OF INTENT FOR COVERAGE
UNDER THE GENERAL CLOSURE PERMIT
FOR MUNICIPAL SOLID WASTE LANDFILL CLOSURE
AND POST-CLOSURE CARE**

This form constitutes an application for coverage under the general closure permit for municipal solid waste landfills. This form is a checklist indicating the information required for a general closure permit application for a municipal solid waste landfill with a surface area less than thirty (30) acres. Some of the information needed may be included in the existing operating permit application. This information may be reproduced, updated as necessary to comply with these application requirements, and submitted with the general closure permit application. Alternatively, the applicant may reference the sections and page numbers in the existing facility permit where the information may be found, if the information in the existing facility permit is complete and accurate. The applicant shall provide the Administrator with a minimum of two (2) complete paper copies and an electronic copy of the general closure permit application information specified below. The application shall be organized in three-ring binders.

A. Permit Application Form

(See Attachment B of the General Permit and Solid Waste Guideline #3)

Enclosed

B. Introduction:

1. Facility Information

Facility Name: _____ DEQ File No.: _____

Owner/Operator (City/Town, County, etc.): _____

Facility Location/Address: _____

Mailing Address: _____

Facility Manager Name: _____ Phone: _____ Email: _____

2. Description of solid waste manager training and examination program to be used by the operator;

Enclosed

Provided Below

See operating permit Date: _____ Chapter _____, Section _____,
Page No. _____

- Refer to _____ (Document Name) Date: _____,
Page No. _____ previously submitted to the DEQ

3. Narrative description describing the site operating history including the dates of operation, the disposal methods used, the types and amounts of wastes, the types of liner, leachate collection, and final cover systems installed; and

- Enclosed
- Provided Below

4. A map or aerial photograph of the area shall be submitted showing land ownership, and land use and zoning within one (1) mile of the disposal site. The map or photograph shall be of sufficient scale to show all city boundaries, each occupied dwelling house, schools, hospitals, industrial buildings, water wells, water courses, roads and other applicable details and shall indicate the general topography.

- Enclosed
- See operating permit Date: _____ Chapter _____, Section _____,
Page No. _____
- Refer to _____ (Document Name) Date: _____,
Page No. _____ previously submitted to the DEQ

C. Legal Description

1. Legal description of the property used as a disposal site. The complete legal description shall consist of a plat and legal description, monumented and signed in accordance with Wyoming Statutes by a licensed land surveyor; and

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____,
Page No. _____
- Refer to _____ (Document Name) Date: _____,
Page No. _____ previously submitted to the DEQ

2. All facility boundary corners shall be surveyed and marked with permanent survey caps.

D. Site Specific Data describing underlying soils, geology, and groundwater

1. A description of the soil types according to the Unified Soil Classification System, and the estimated thickness of the unconsolidated soil materials;

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

2. Information on the geologic conditions, including structure, bedrock types, estimated thickness and attitude, and fracture patterns;

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

3. Identification of unstable areas caused by natural features or man-made features or events, and which may result in geologic hazards including, but not limited to, slope failures, landslides, rockfalls, differential and excessive settling or severe erosion;

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____,

- Page No. _____
- Refer to _____ (Document Name) Date: _____,
- Page No. _____ previously submitted to the DEQ

4. Identification of any seismic impact zones, fault areas, floodplains, and wetlands;

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____,
- Page No. _____
- Refer to _____ (Document Name) Date: _____,
- Page No. _____ previously submitted to the DEQ

5. Depth to the uppermost groundwater. Information on groundwater aquifer thickness and hydrologic properties such as the groundwater flow direction and rate, and the potentiometric surface;

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____,
- Page No. _____
- Refer to _____ (Document Name) Date: _____,
- Page No. _____ previously submitted to the DEQ

6. Existing quality of groundwater beneath the facility; identification of background water quality data of the uppermost aquifer; and

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____,
- Page No. _____
- Refer to _____ (Document Name) Date: _____,
- Page No. _____ previously submitted to the DEQ

7. Supporting documentation such as well completion logs, geologic cross-sections, soil boring lithologic logs, potentiometric surface maps and soil or groundwater testing data should be submitted in an associated appendix.

- Enclosed
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

E. Post-Closure Land Use

1. Identify land use after closure;

- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

2. Identify length of post-closure care period;

- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

- 3. Facility shall be returned post-closure land use specified, unless an alternative is approved by the administrator; and
- 4. Waste containment systems, including but not limited to liners, leachate detection, collection, and management systems and final cover systems shall be maintained throughout the closure and post-closure periods.

F. Final Cover System

1. The final cover system shall include either Linear Low Density Polyethylene (LLDPE) geomembrane or Polyvinyl Chloride (PVC) geomembrane and the following components and corresponding minimum thicknesses, from top to bottom:

Vegetative Cover Layer – 2.5 feet
Drainage Layer - Geotextile Drainage Net
LLDPE (40-mil) or PVC (30-mil) Geomembrane Layer, textured both sides –Gas
Control Layer - Geocomposite Drainage Net
Foundation Layer (Intermediate Cover) – 12 inches

2. Final Slopes – Minimum slope of 2% (1 foot rise:50 feet run), after settlement, and maximum slope of 33% (1 foot rise:3 feet run), prior to settlement;
3. The application shall include a slope stability analysis – to include both static global and interface stability analyses (See Solid Waste Guideline 18). If the facility is located in a seismic impact zone, the stability assessment shall include a pseudo static analysis for all critical global stability sections as well as the limiting interfaces that compose the final cover system;

Enclosed

4. Settlement, subsidence, and displacement calculations – The application shall address potential cover settlement, subsidence, and displacement, considering immediate settlement, primary consolidation, secondary consolidation, and liquefaction. Include potential waste consolidation resulting from waste dewatering, biological oxidation and decomposition, and chemical conversion of solids to liquids;

Enclosed

5. The application shall include an evaluation of the availability of cover material sufficient to properly operate (if applicable) and close the facility;

Enclosed

Provided Below

See operating permit Date: _____ Chapter _____, Section _____,
Page No. _____

Refer to _____ (Document Name) Date: _____,
Page No. _____ previously submitted to the DEQ

6. Revegetation

At closure, any portion of the facility that has been disturbed by solid waste disposal activities shall be revegetated to minimize wind and water erosion of the final cover, consistent with the post-closure land use. Vegetation shall be a diverse mix selected to be compatible with the climatic conditions, require little maintenance, and have root depths that will not exceed the depth of final cover.

- Enclosed
- Provided Below
- Intend to Use Procedures Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

If the operating permit does not include approved revegetation plans that can be incorporated into the general closure permit application, the following procedures may be used.

Prior to seeding, the surface will be prepared to provide a firm seed bed using a spring-tooth harrow, cultipacker, roller harrow, or other CQA Engineer-approved equipment. The following seed mix will be applied by drill seeding methods.

Recommended Seed Mix

Common Name	Variety	lb PLS/Ac
Thickspike wheatgrass	Critana	3.00
Slender wheatgrass	Pryor	2.50
Prairie sandreed	Goshen	4.00
Indian ricegrass	Rimrock	2.50
Western wheatgrass	Rosana	4.00
Bottlebrush squirreltail	VNS, Northern	2.50
Bluebunch wheatgrass	Secar	2.00
Sheep fescue	Covar	2.00
Sand dropseed	VNS, Northern	0.50
TOTAL		23.00

*PLS – Pure live seed = bulk seed x % purity x % germination

Sheep fescue and sand dropseed will be planted in a different drill box than the other species and planted very shallow (less than 0.25 inches) and not in the drill rows with other species. If broadcast seeded with the drill (not seeded through discopeners), then it will be covered lightly with a light chain drag or equal. The other species will be drill seeded between 0.33 and 0.5 inches in depth and drill rows packed with a wheel packer attachment on the drill or equal. Broadcast seeding is not allowed except for areas inaccessible with drill seeding equipment.

All seed will meet requirements of the Wyoming Seed Law (W.S. Title 11 Chapter 12), including a label with all information required by W.S. § 11-12-105 and noxious weed limits specified in department of Agriculture Rule 51 (Regulations Pertaining to Seed Law).

The preferred time of seeding is late fall (after about October 1 and before the soil is frozen), to take advantage of winter and spring moisture. If seeding is not possible in the fall, spring seeding (after soil thaws and before May 15) may be allowed. However, some of the seeded species require overwintering to break dormancy. If spring seeding is performed, Indian ricegrass should be manually scarified to simulate the stratification required to break dormancy.

Immediately following seeding, Certified Noxious Weed-free (CWF) hay or straw mulch will be applied using a mulch-blower at a rate of 4,000 pounds per acre and crimped perpendicular to the slope to anchor the mulch. The crimper shall be run perpendicular to the slope on steeper areas (i.e., final cover sideslopes), and perpendicular to the prevailing wind on flatter slopes. An agricultural disc with sharp blades shall not be acceptable for crimping. The crimper shall not sever the mulch. The mulch will be accompanied by certification that it is CWF. Immediately following crimping, a tackifier will be applied at the Manufacturer's recommended rate; and

7. Passive Gas Venting System

The application shall include the design of landfill gas vents. Pipe shall be six inch diameter SDR 17 HDPE topped with an aluminum turbine ventilator. Vents shall be constructed to a depth that reaches five feet into waste with 3/4 inch diameter holes every three inches at 120 degrees beginning below the geomembrane and extending for the entire perforated length. The perforated pipe shall be surrounded by 3/4 inch washed pea gravel to facilitate the collection of gases. The vents shall be constructed in a manner compatible with the installation of the final cover system, referencing the Construction Quality Assurance (CQA) Plan as appropriate. Gas vents shall be evenly spaced with a minimum of 1 passive vent per acre.

Enclosed

G. Structures designed to prevent the accumulation of methane.

The application shall include a demonstration that all structures on the landfill facility are designed to prevent the accumulation of methane such that the concentration of methane gas in facility structures does not exceed twenty-five (25) % of the lower explosive limit (LEL) for methane.

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

H. Surface Water Diversion

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

1. The application shall include the design of temporary and permanent surface water diversion systems, including assumptions and design calculations for surface water control structures and a map of contributing drainage basins;
2. Surface water structures shall be designed and constructed to control surface water run-on and run-off as follows:
 - a. Temporary structures anticipated to be used for periods less than five (5) years shall accommodate a 25-year, 24-hour precipitation event;
 - b. Permanent structures and temporary structures anticipated to be used for five (5) years or longer shall accommodate 100-year, 24-hour and a 25-year, 2-hour precipitation events; and
 - c. Sediment control structures shall be designed and constructed in accordance with Chapter 11 of the Water Quality Division Rules and Regulations.
3. The facility shall be engineered to inhibit future problems with erosion or ponding of surface water over filled areas. Calculations and supporting documentation shall

include evaluation of erosion using the latest version of the Revised Universal Soil Loss Equation (RUSLE) or similar method;

4. Surface water structures shall be maintained and operated throughout the closure and post-closure periods.

I. Environmental Monitoring Plan

The application shall include a detailed description of the environmental monitoring program and submitted in an associated appendix to the general closure permit application, including the following information:

1. Groundwater Monitoring

- a. A description of the monitoring well location, design, construction, and development; and
- b. A description of the groundwater sampling program including sampling frequency, test parameters, sampling procedures, test methods and quality control as provided in the facility's groundwater monitoring and sampling and analysis plans, in accordance with SWRR, Chapter 2, Section 6(b).

- Enclosed
- Provided Below
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

2. Methane Monitoring at the Facility Boundary

- a. A description of the methane monitoring system, including probe location, design and construction details, in accordance with SWRR, Chapter 2, Sections 6(c)(i) and (ii);
- b. Description of Migration Potential - Discuss the probable gas migration paths, accounting for site specific characteristics.
- c. Probe Location

Methane monitoring probes shall generally be located at or near the facility boundary. The operator may propose monitoring locations closer to the waste mass requiring fewer probes, based on site specific factors. The entire perimeter of the landfill may not warrant the installation of monitoring probes based upon the migration potential above. In this case, the operator shall demonstrate to the satisfaction of the administrator that gas migration could not occur along a specific pathway owing to geologic or hydraulic barriers, and that no inhabitable

structure or other off-site use of property within 1,000 feet of the landfill facility boundary is threatened by gas migration. If conditions change, the operator shall immediately notify the administrator. Gas monitoring shall be required at a minimum frequency of quarterly for three years prior to termination of the post-closure period to demonstrate that closure is protective of human health and the environment.

The location of the perimeter gas monitoring network at the facility shall be provided on the Environmental Monitoring Plan, which shall be submitted with the Closure Design Plans, described below;

- d. Probe Spacing - The plan shall show the spacing of all gas monitoring probes;
- e. Probe Depth - The depth of the methane monitoring probes shall at least equal the maximum depth of refuse as measured within 1,000 feet of the monitoring point;
- f. Monitoring Probe Construction

Methane monitoring probes shall be screened from five (5) feet below ground surface to the total depth of the probe. The application shall include a description of the monitoring probe construction, referencing the CQA Plan for landfill gas probe construction. Boring / As-Built logs, shall be included as probe as the names of the person(s) logging the hole, the probe material and depth, extent and type of filter pack, thickness and material used for seals, extent and materials used for backfill, size and interval of perforations, and a description of any shutoff valves or covers;

- g. Methane Monitoring Frequency - Methane monitoring shall be conducted at least quarterly;
- h. Response Requirements

Facilities shall ensure that the concentration of methane gas in facility structures and at the facility boundary does not exceed twenty-five percent (25%) of the lower explosive limit (LEL) for methane. If methane levels exceed twenty-five percent (25%) of the LEL, the operator shall:

- 1. Immediately notify the administrator and take steps to protect human health;
- 2. Within seven (7) days of detection, place a copy of the methane test data in the operating record, and a written description of the steps taken to protect human health; and
- 3. Within sixty (60) days of detection, implement a remediation plan which has been approved by the administrator, and place a copy of that plan in the operating record.

The administrator may establish alternative schedules for demonstrating compliance with the requirements of items 2 and 3 above;

- 3. All monitoring records shall be maintained in the facility operating record.

J. Plans

At a minimum, the following plans shall be included in the application:

1. General facility plot plan – Provided at a scale not greater than 200 feet to the inch with maximum five (5) foot contour intervals. The general plot plan shall illustrate the following features:
 - Facility boundaries, including any buffer zones proposed between the solid waste boundary and the property boundary;
 - Points of access;
 - Location of soil borings, groundwater monitoring wells, and methane monitoring wells;
 - Locations of any facility buildings to house equipment or for other uses;
 - Perimeter fence; and
 - Location of on-site borrow sources.

- Enclosed
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

2. Phased Reclamation Grading Plans (If applicable)
Provide a series of plan sheets showing the progression of site development and closure through time.

- Enclosed
- Not Applicable
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

3. Final Cover Grading Plan
Final contours of the finished landfill shall be specified. Design of final contours shall consider subsequent site uses, existing natural contours, surface water management requirements, and the nature of the surrounding area. The final elevation of the landfill shall be limited by the structural capacity of the liner and leachate collection and removal system and by stability of foundation and slopes. The final contour shall not cause structural damage or collapse of the leachate collection system.

- Enclosed
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____,

Page No. _____ previously submitted to the DEQ

4. Stormwater Control Plan

Design plan showing location and design of all temporary and permanent stormwater control features.

- Enclosed
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

5. Leachate management system plan and profile (If applicable)

- Enclosed
- Not Applicable
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

6. Leachate management system details (If applicable)

- Enclosed
- Not Applicable
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____
- Refer to _____ (Document Name) Date: _____, Page No. _____ previously submitted to the DEQ

7. Cross-sections

Provide a minimum of two cross-sections per solid waste management unit. The location of the cross section shall be shown on the plan sheets. Each cross-section shall show the following:

- Existing grades and proposed final grades
- Soil borings and monitoring wells that the section passes through or is adjacent to
- Soil types, bedrock, and water table
- Leachate control, collection, and monitoring systems (if applicable)
- Limits of filling (horizontal and vertical) for disposal unit
- Access roads and ramps on the site perimeter
- Sequence of phased reclamation
- Other site features, as necessary

- Enclosed
- See operating permit Date: _____ Chapter _____, Section _____, Page No. _____

- Refer to _____ (Document Name) Date: _____,
Page No. _____ previously submitted to the DEQ

8. Detail Drawing Plan Sheets

Show detail drawings and typical section for the final cover systems, drainage control structures, access roads on final cover, fencing, leachate collection and control (if applicable), methane control systems and monitoring devices, signs, and other construction details.

- Enclosed
 See operating permit Date: _____ Chapter _____, Section _____,
Page No. _____
 Refer to _____ (Document Name) Date: _____,
Page No. _____ previously submitted to the DEQ

9. Environmental Monitoring Plan

Show locations of the following:

- Devices for the monitoring of leachate production and detection (required, not required)
- Groundwater monitoring wells
- Methane monitoring wells

- Enclosed
 See operating permit Date: _____ Chapter _____, Section _____,
Page No. _____
 Refer to _____ (Document Name) Date: _____,
Page No. _____ previously submitted to the DEQ

TABLE OF CONTENTS

D-1	IN PRODUCTION
D-2	PRE-CONSTRUCTION MEETING
D-3	PROGRESS MEETINGS
D-4	DEFECTS REPORT
D-5	DEFECTS
D-6	DEFECTS REPORT
D-7	DEFECTS REPORT
D-8	DEFECTS REPORT
D-9	DEFECTS REPORT
D-10	DEFECTS REPORT
D-11	DEFECTS REPORT
D-12	DEFECTS REPORT
D-13	DEFECTS REPORT
D-14	DEFECTS REPORT
D-15	DEFECTS REPORT
D-16	DEFECTS REPORT
D-17	DEFECTS REPORT
D-18	DEFECTS REPORT
D-19	DEFECTS REPORT
D-20	DEFECTS REPORT
D-21	DEFECTS REPORT
D-22	DEFECTS REPORT
D-23	DEFECTS REPORT
D-24	DEFECTS REPORT
D-25	DEFECTS REPORT
D-26	DEFECTS REPORT
D-27	DEFECTS REPORT
D-28	DEFECTS REPORT
D-29	DEFECTS REPORT
D-30	DEFECTS REPORT
D-31	DEFECTS REPORT

**ATTACHMENT D
CONSTRUCTION QUALITY ASSURANCE PLAN**

TABLE OF CONTENTS

1.0	INTRODUCTION.....	D-4
2.0	PRE-CONSTRUCTION MEETING.....	D-5
3.0	PROGRESS MEETINGS.....	D-6
4.0	DEFICIENCY MEETINGS.....	D-6
5.0	DEFICIENCIES.....	D-6
6.0	DOCUMENTATION.....	D-7
6.1	Daily Record Keeping.....	D-7
6.2	Soils Observation and Testing Data Sheets.....	D-7
6.3	Geosynthetic Observation.....	D-7
6.4	Construction Problem and Solution Sheets.....	D-8
6.5	Photo Documentation.....	D-8
6.6	Design and Specification Clarifications or Modifications.....	D-8
6.7	Certification Report.....	D-9
7.0	LINES OF AUTHORITY, RESPONSIBILITY, AND PERSONNEL	
	QUALIFICATIONS.....	D-9
7.1	Personnel Requirements.....	D-10
7.2	Project Manager.....	D-10
7.3	Design Engineer.....	D-11
7.4	Certifying Engineer.....	D-11
7.5	Construction Quality Assurance Consultant.....	D-11
7.6	CQA Surveyor.....	D-14
7.7	Independent CQA Laboratory.....	D-15
8.0	GEOSYNTHETICS MANUFACTURERS.....	D-16
9.0	INSTALLATION CONTRACORS.....	D-17
9.1	Earthworks Contractor.....	D-17
9.2	Geosynthetics Installer.....	D-17
10.0	LINES OF COMMUNICATION.....	D-19
11.0	FINAL COVER SYSTEM INSTALLATION.....	D-19
11.1	Foundation Layer.....	D-19
11.2	Gas Control Layer.....	D-20
11.2.1	Product Delivery, Storage, and Handling.....	D-20
11.2.2	Surface Preparation.....	D-20
11.2.3	Installation.....	D-21

11.2.4	Field Seaming.....	D-21
11.2.5	Repairs.....	D-21
11.3	PVC Geomembrane (Textured Both Sides) Cover Material	D-22
11.3.1	Purpose	D-22
11.3.2	Geomembrane Manufacturing.....	D-22
11.3.3	Geomembrane Fabrication	D-22
11.3.4	Packaging, Handling and Transportation	D-23
11.3.5	Installation	D-24
11.3.6	Field Quality Assurance	D-30
11.4	LLDPE Geomembrane(Textured on Both Sides) Geomembrane Cover Layer.....	D-34
11.4.1	Purpose	D-34
11.4.2	Geomembrane Manufacturing.....	D-34
11.4.3	Installation	D-36
11.4.4	Field Quality Assurance	D-42
11.5	Vegetative Support Layer and Protective Cover Layer	D-46
11.6	Gas Vents.....	D-47
12.0	References	D-47

LIST OF ATTACHMENTS

TABLE 1	CQA TESTING REQUIREMENTS.....	D-48
FIGURE 1	LINE OF COMMUNICATION	D-51
ATTACHMENT 1	TYPICAL CQA FORMS.....	D-53

1.0 INTRODUCTION

This manual addresses the construction quality assurance (CQA) procedures for the installation of the soil and geosynthetic components used for the construction of the final cover and surface water control structures. This CQA Plan has been developed to help ensure that the construction of the landfill closure components is in compliance with applicable state and federal regulations and to substantiate that the construction meets or exceeds design criteria requirements. This document has been prepared in general accordance with various guidelines and standards involving construction quality assurance and quality control of solid waste landfill liners and final cover systems. These documents and standards have continued to evolve within the industry as new quality assurance/control techniques and methods are developed (See *Section 12.0* for specific references). This CQA Plan is intended to address closure of waste disposal systems covered by the general design standards eligible for coverage under the general permit. Alternate design standards and associated construction quality assurance methodology may be considered outside the general permit program as a separate individual permit.

Soil components to be used in the final cover include an intermediate cover (foundation) layer and a vegetative support layer. Geosynthetic components include geomembrane (Polyvinyl Chloride (PVC) or Linear Low Density Polyethylene (LLDPE)), textured both sides, geocomposite, and geotextile. Tests to establish the adequacy of the materials shall be performed for each source, at the discretion of the Certifying Engineer. Construction materials will be accepted or rejected based on the results of these tests.

The objective of this CQA Plan is to help assure that proper materials, construction techniques, and procedures are followed by the Contractor and that the intent of the design is met. This program also intends to identify problems that may occur during construction and provide the means for resolution of these problems.

This program addresses quality assurance, not quality control. This CQA Plan is independent of the quality control (QC) programs conducted by the Manufacturers and Contractors. The intent of the CQA Plan is to provide independent third-party verification and testing, as well as demonstrate that the Contractors have met their obligations in the supply and installation of soil and geosynthetic components according to the design, and contractual and regulatory requirements. Quality control is provided by the Manufacturers and Contractors and refers only to those actions taken to help ensure that materials and workmanship meet the requirements of the plans and project specifications. The *CQA Monitor(s)* will test, observe, and document the activities outlined in each section of this manual.

2.0 PRE-CONSTRUCTION MEETING

A pre-construction meeting will be held at the site prior to the start of each phase or module of construction. The Design Engineer, Project Manager (employee of the owner), Certifying Engineer, CQA Monitor, Geosynthetics Contractor, Earthworks Contractor, as applicable, and others designated by the Owner should attend the pre-construction meeting. The WDEQ will be notified in advance of, and invited to attend, the pre-construction meeting. The purpose of the pre-construction meeting will be to:

- Provide each organization with relevant CQA documentation and supporting information;
- Review the construction drawings, CQA Plan, and project specifications;
- Review work area safety protocol;
- Define the responsibilities of each party and coordination that will be required;
- Define lines of communication and authority;
- Review method of documentation, testing procedures, and reporting inspection data;
- Establish testing protocols and procedures for correcting and documenting construction deficiencies;
- Discuss any changes that may be needed to help ensure that construction will meet or exceed the design;
- Conduct a site inspection to discuss work areas, work plans, adverse weather procedures, stockpiling, laydown areas, access roads, haul roads, and related items; and
- Review the project schedule.

This meeting will be documented by the Project Manager or his designee and copies of the minutes will be distributed to the parties in attendance. A copy of the project schedule will be provided to WDEQ prior to each phase or module of construction and updated as necessary.

3.0 PROGRESS MEETINGS

Informal progress meetings will be held at least weekly, either before the start of work or at the completion of work. At a minimum, these meetings will be attended by the CQA Monitor and the Contractor. The purpose of these meetings will be to:

- Review scheduled work activities,
- Review the previous week's activities and discuss problems, and
- Review test data.

These meetings will be documented by the CQA Monitor.

4.0 DEFICIENCY MEETINGS

Special meetings will be held, as needed, to discuss potential problems or deficiencies. At a minimum, these meetings will be attended by the CQA Monitor, the Contractor(s), and the Project Manager. If the problem relates to a design issue, the Certifying Engineer and/or Design Engineer should also be present. The meeting will be documented by the CQA Monitor.

5.0 DEFICIENCIES

When deficiencies (items that do not meet project requirements) are discovered, the CQA Monitor will immediately determine the nature and extent of the deficiency and notify the Contractor. If unsatisfactory test results identify a deficiency, additional tests will be performed to define the extent of the deficient area.

The Contractor shall correct the deficiency to the satisfaction of the CQA Monitor. If unable to correct the problem, the CQA Monitor will notify the Project Manager, who will assist during problem resolution. If the solution involves a design revision, the Design Engineer and/or Certifying Engineer, and also the WDEQ if appropriate, shall also be contacted (see also Section 6.6 of this Plan).

The corrected deficiency will be re-tested and approved before any additional related work is performed by the Contractor. All re-tests and related documentation will be recorded by the CQA Monitor and included in the final report documentation.

6.0 DOCUMENTATION

An effective quality assurance program depends on thorough monitoring of construction activities. This is most effectively accomplished by observation and documentation during each phase of construction. Documentation will consist of daily record-keeping, construction problem resolutions, design and specification clarifications or modifications, photographic records, weekly progress reports, chain-of-custody forms for test sample tracking, and a certification and summary report.

6.1 Daily Record Keeping

Daily records will consist of field notes, observation and testing data sheets, summary of the daily meeting with the Contractor(s), and reporting of construction problems and resolutions. This information will be submitted on a regular basis to the Project Manager for review. Table 1 provides a summary of CQA testing and surveying requirements.

6.2 Soils Observation and Testing Data Sheets

Soils observation and testing data sheets generally include the following information:

- Date, project name, location, and weather data;
- A reduced-scale site plan showing work areas and test locations;
- Descriptions of ongoing construction;
- Summary of test results and samples taken, with locations and elevations;
- Off-site materials received, including quarry certificates;
- Test equipment calibrations, if necessary;
- The thickness of soil layers; and
- Signature of the CQA Monitor.

6.3 Geosynthetic Observation

Geosynthetic observation and testing forms generally include the following information:

- Date, project name, location, and weather data;
- Identification of panel or seam number;

- Numbering system identifying test or sample number;
- Dates, locations, and identification of repairs;
- Length and width of geosynthetic panels or seams and seam overlaps;
- Welding machine temperatures and settings;
- Welding machine and technician identifications;
- Locations of tests and test results; and
- Signature or initials of the CQA Monitor.

6.4 Construction Problem and Solution Sheets

Construction problem and solution sheets generally include the following information:

- Detailed description of the problem,
- Location and cause of the problem,
- How and when the situation or deficiency was identified,
- How the problem was resolved,
- Any measures taken to prevent similar problems in the future, and
- Signature of the CQA Monitor and Project Manager.

6.5 Photo Documentation

Critical phases of construction will be documented with photographs. Photographs shall be identified by location (including direction of view when applicable), subject description, time, date, and name of the person taking the photograph.

6.6 Design and Specification Clarifications or Modifications

During construction, the need to address design and specification changes may arise. In such cases the CQA Monitor will notify the Project Manager, who will in turn notify the Design Engineer and/or Certifying Engineer. Minor design and specification changes, i.e., those that do not modify the intent of the subject design or specification, may be made with the written approval of the CQA Monitor,

Project Manager, and Design Engineer and/or Certifying Engineer. Significant design and specification changes must also include written approval from the WDEQ.

6.7 Certification Report

At the completion of the project, the Certifying Engineer will submit to the Project Manager a certification report. This report will certify that the work has been performed in substantial conformance with the design drawings and project specifications and will contain the following information:

- Summary of construction activities;
- Observation and test data sheets;
- Photographic documentation;
- Sampling and testing locations and laboratory and field test results;
- A description of significant construction problems and the resolution of these problems;
- Deviations from specifications or design;
- Changes to the design drawings or project specifications and the justification for these changes;
- Record drawings, signed and sealed by a land surveyor licensed in the State of Wyoming; and
- The signature and seal of an engineer registered in the State of Wyoming.

The record drawings will accurately locate construction items such as the extent and thickness of all layers. Surveying and base maps required for the development of the record drawings shall be prepared by a surveyor registered in the State of Wyoming.

7.0 LINES OF AUTHORITY, RESPONSIBILITY, AND PERSONNEL QUALIFICATIONS

The following section defines the responsibilities, qualifications, and terms for personnel referenced in this quality assurance manual.

7.1 Personnel Requirements

The CQA personnel will be allocated to the site to monitor construction based on the number of major items being constructed or separate crews constructing major items on each work day, as described below. Major items include foundation layer, gas control layer, geomembrane deployment, drainage layer placement, protective cover layer placement, vegetative support layer placement, surface water feature(s) installation, and soil testing. The CQA personnel and the Certifying Engineer must be employed by an organization that operates independently of the owner's contract operator(s) (if applicable), Contractor(s), Owner, and permit holder (if different from Owner).

7.2 Project Manager

The Project Manager is the official representative of the Owner responsible for construction activities, including oversight and direction during construction. The Project Manager is also responsible for coordinating construction and CQA activities for the project.

The Project Manager will serve as communications coordinator for the project, initiating pre-construction and resolution meetings. As communications coordinator, the Project Manager will serve as a liaison between the parties involved in the project to help ensure that an appropriate level of communication is maintained.

Selection of the Project Manager is the responsibility of the Owner. Duties for the Project Manager include the following:

- Review and approval of design drawings and project specifications;
- Pre-construction coordination with the CQA firm to help ensure that the CQA personnel assigned to the project have performed adequate reviews of the design drawings and project specifications and to verify that the CQA Plan can be implemented;
- Selection of the Contractor(s) and the administration of the construction contracts, including any associated changes that occur during the course of construction;
- Coordination of construction activities associated with the various Contractors;
- Scheduling and coordinating construction activities with required CQA testing and activities;
- Overseeing the QC operations performed by the Contractors;

- Help ensure that required quality assurance testing has been performed in accordance with the CQA Plan and to the satisfaction of the CQA Monitor and Certifying Engineer; and
- Help ensure that the CQA personnel are provided with the documentation required in the CQA Plan and project specifications.

7.3 Design Engineer

The Design Engineer, also referred to as “the Designer,” is the individual or firm responsible for the design and preparation of the project construction drawings (Drawings) and project specifications (Specifications). The Design Engineer is responsible for approving design and project specification changes or clarifications encountered during construction.

7.4 Certifying Engineer

The Certifying Engineer, also referred to as the “CQA Engineer”, is a registered Professional Engineer (P.E.) in the State of Wyoming who will certify the construction (i.e., apply P.E. stamp to the CQA Certification Report), and is responsible for confirming that the CQA Monitor(s) is/are adequately instructed on proper performance of CQA tasks. The CQA Monitor(s) will report to the Certifying Engineer. The Certifying Engineer is responsible for ensuring that the necessary CQA Monitor activities (as described in Section 7.5 below) are carried out. The Certifying Engineer shall not be affiliated with the Owner or Contractor. The Certifying Engineer will communicate with the Project Manager regarding scheduling of field CQA personnel, and also regarding any deficiencies or changes encountered during the project. All design or specification modifications are subject to approval by the Certifying Engineer.

7.5 Construction Quality Assurance Consultant

The Construction Quality Assurance Consultant (CQA Consultant), shall include the CQA Manager, who operates from the office of the CQA Consultant and visits the site as required and the CQA Site Superintendent, who is located at the site.

The CQA Manager reviews all design plans, specifications, QC programs, and the CQA Plan. The CQA Manager also reviews all other site-specific documentation, including bid documents, proposed panel layouts, submittals, roll certification reports, and other geomembrane manufacturer and installer literature, for correctness, constructability, level of quality and potential conflicts. The CQA Manager will attend the preconstruction meeting. The CQA Manager will ensure that the manufacturer and

installer have reviewed, and can comply, with the design plans and CQA Plan. The CQA Manager will administer the CQA program, i.e., assigns and manages all CQA personnel, reviews all field reports, and provides engineering review of all CQA-related issues. The CQA Manager will also provide quality control of the CQA personnel, including making site visits and review all changes to the design plans, CQA Plan, specifications, and installation procedures. The CQA Manager will proactively recommend quality improvements to the Project Manager and review record drawings and prepare the final CQA Report.

The CQA Site Superintendent acts as the on-site representative of the CQA Consultant and will be familiar with all CQA monitors for the site, the CQA requirements, and health and safety requirements for the project. The CQA Site Superintendent will:

- Manage the daily activities of the CQA monitor;
- Attend all CQA-related meetings (e.g., resolution, preconstruction, weekly);
- Verify the calibration and condition of on-site testing equipment;
- Review all CQA monitors' daily reports and logs, report to the Project Manager, and log daily reports, including any relevant observations;
- Prepare their own daily reports;
- Oversee the collection and shipping of all laboratory test samples;
- Review results of laboratory testing and make appropriate recommendations;
- Report any unresolved deviations from the CQA Plan to the Project Manager
- Prepare or oversee the ongoing preparation of the Record Drawings, and assist with the preparation of the final report;
- Review all supplier, manufacturer, and installer certifications and documentation, and make appropriate recommendations;
- Review the installer's personnel qualifications for conformance with those pre-approved for work on-site;

- Ensure that the manufacturer and installer have reviewed and can comply with the design plans and CQA Plan;
- Note and report to the Project Manager any on-site activities that could result in damage to the geomembrane and other geosynthetics;
- Make recommendations for improvements in the liner quality; and
- Contribute to the solution of all geosynthetic problems.

The CQA Site Superintendent shall, during the course of construction and following completion of the project, develop a project file for maintaining and storing the originals or copies of originals of CQA data sheets and reports generated during the course of construction (a complete file of this documentation will be maintained on-site), and report to the Certifying Engineer any deficiencies that are not corrected to the satisfaction of the CQA Manager, including design or project specification changes.

The CQA Consultant shall be experienced with the subject geosynthetics and be knowledgeable of LLDPE and PVC geomembrane performance characteristics. The CQA Consultant shall be experienced in the preparation of CQA information, including CQA manuals, forms, reports, certifications.

The CQA Consultant will provide the following, in writing, to the Owner:

- Corporate background and information;
- A summary of the firm's experience in CQA of LLDPE or PVC geomembranes (as appropriate for the selected geomembrane), including a list of at least 10 completed facilities totaling a minimum of 6,000,000 square feet (ft²) in area, for which the CQA Monitor has provided CQA services. For each facility the following information shall be provided:
 - Owner, purpose of facility, area, contact person.
 - A summary of CQA documentation and methods used by the firm, including sample CQA forms prepared by the firm.
- Quality control manual or a summary of quality control practices;

- A list of 5 completed facilities on which the proposed CQA Manager has worked;
 - The CQA Manager, responsible for the overall CQA project management, shall be an individual with adequate field experience. The CQA Manager shall have been responsible for geosynthetics CQA on over 6,000,000 ft² of geomembrane lining systems;
- The name of the CQA Site Superintendent proposed for the project, and a list of 5 PVC or 5 LLDPE projects (as appropriate for the selected geomembrane) on which the Superintendent has previously worked, including 2 as Site Supervisor. The Site Supervisor must have excellent technical communication skills. Appointment of the Site Supervisor must be approved by the Project Manager.
 - The CQA Site Superintendent, responsible for on-site activities, shall be specifically familiar with the installation of LLDPE or PVC geomembranes (as appropriate for the selected geomembrane) and must have been trained and certified in the duties of a CQA Site Superintendent. The CQA Site Superintendent shall have CQA experience with over 5,000,000 ft² of LLDPE or PVC geomembrane (as appropriate for the selected geomembrane).
- Resumes of personnel to be involved in the project, including the CQA Manager and CQA Site Superintendent.

7.6 CQA Surveyor

The CQA Surveyor is the firm or individual responsible for performing the quality assurance surveying tasks outlined in this plan including the preparation of stamped as-built survey record drawings to be included in the CQA Certification Report. CQA surveying shall be performed under the direction of a Wyoming Licensed Professional Land Surveyor. The CQA Surveyor may be contracted with the Earthworks Contractor or the Owner. The CQA Surveyor will communicate directly with the Earthworks Contractor or Owner.

At least one permanent elevation benchmark and at least two horizontal control benchmarks will be established for the project in a location convenient for reference during construction. The reference control points will be consistent with State Plane Coordinates and the established facility grid/survey coordinate system. The vertical and horizontal control for the benchmarks shall be established within normal land surveying standards. The survey shall have a precision of 0.1 feet with a setting accuracy of ± 0.8 sec (2.2×10^{-3} degrees).

The following surfaces and features shall be surveyed by the CQA Surveyor and verified by the CQA Consultant to document the lines and grades achieved during placement and compaction:

- Existing pre-construction contours and site features
- Top of foundation layer
- Extent of geosynthetics including location of anchor trenches, panel locations, patches, and repairs
- Top of geomembrane layer (if engineered equivalent gas control layer is used)
- Top of drainage layer (if engineered equivalent is used)
- Top of protective cover layer
- Top of vegetative cover layer
- Location and as-built elevation of all perimeter drainage features and elements
- Location and elevation of all perimeter access roads and related site features
- Location of improvements in relation to property boundaries
- Location of all landfill gas collection, ventilation, and treatment systems (if applicable)
- Location of all groundwater monitoring wells
- Location of all onsite buildings and structures in the vicinity of the improvements

All surveying shall be carried out immediately upon completion of a given installation to facilitate progress and avoid delaying commencement of the next installation. All surveying shall be conducted to verify of construction but shall not alleviate the contractor from their responsibilities for insuring that all construction is within the required lines and grades shown in the design plans and CQA Plan. All surfaces shall be surveyed on a 100 foot grid and at significant breaks in slope.

7.7 Independent CQA Laboratory

The Independent CQA Laboratory (CQA Lab) is the third party responsible for performing the quality assurance soils and/or geosynthetics laboratory testing tasks listed in this plan. The CQA Lab is directed by the CQA Engineer and/or CQA Monitor(s) and may be affiliated with the CQA firm or company. The geosynthetics-testing laboratory shall be accredited by the Geosynthetics Accreditation

Institute Laboratory Accreditation Program (GAI-LAP). The CQA Lab shall not be affiliated with the Earthworks Contractor or Geosynthetics Installer. The CQA Lab will communicate directly with the CQA personnel.

8.0 GEOSYNTHETICS MANUFACTURERS

The Geosynthetics Manufacturers, also referred to as the “Manufacturer(s)”, are responsible for production of PVC and LLDPE geomembranes, geocomposites, and geotextiles, as outlined in this manual. The Manufacturer may be affiliated with the Geosynthetics Installer (Installer). Each Manufacturer must pre-qualify by demonstrating the capability to produce materials that meet the requirements outlined in project specifications. Each Manufacturer is responsible for providing the necessary QC certificates for each roll, batch, or lot of material delivered to the site (see Table 1). In addition, each Manufacturer is responsible for the condition of the materials until acceptance is given by the Project Manager after off-loading in the designated staging area.

The geomembrane manufacturer shall be able to provide sufficient production capacity and qualified personnel to meet the demands of the project.

The manufacturer shall be pre-qualified and approved by the Engineer and the Owner. The qualifications presented by the manufacturer shall, as a minimum, include:

- Corporate background and information
 - Manufacturing capabilities:
 - Information on plant size, equipment, number of shifts per day, and capacity per shift.
 - Quality control manual for manufacturing.
 - List of material (resin and geosynthetic) properties, including certified test results, together with material and seam samples.
- A list of at least 10 completed facilities totaling a minimum area of 22,000,000 ft², for which the manufacturer has manufactured the subject geosynthetic material (LLDPE or PVC) from the same type of resin or components as that proposed to be used for this project. For each facility, the following information shall be provided:

- Purpose of installation, its location, and start/finish dates.
- Name of facility owner, project manager, and engineer.
- Type, thickness, and surface area of the installed geomembrane.

9.0 INSTALLATION CONTRACTORS

9.1 Earthworks Contractor

The Earthworks Contractor, or "Contractor," is responsible for proper delivery and placement of earthwork components as outlined in the Closure Plan. The Contractor may place the soil overtop of the geosynthetics and may install geosynthetics other than the geomembrane and geocomposite layers. The Contractor may subcontract the Geosynthetics Installer(s) and may be affiliated with the Owner. The Earthworks Contractor will be responsible for retaining a surveyor to set lines and grades required for excavation and construction. The Earthworks Contractor will be contracted with the Owner and will communicate directly with the Project Manager.

9.2 Geosynthetics Installer

The Geosynthetics Installer, or "Installer," also referred to as the "Geosynthetics Installation Contractor," is responsible for proper storage, handling, on-site transport, deployment, seaming, testing, protection of installed work, and repair (as necessary) of the geosynthetics required for the project in accordance with the Project Drawings and Specifications, until acceptance is given by the CQA Monitor. The installer may be affiliated with the Manufacturer. The installer may work as a subcontractor to the Earthworks Contractor or may be contracted directly by the Owner. The installer must meet the experience requirements outlined in the design plans and CQA Plan. The installer shall provide a qualified Superintendent who will provide full-time technical guidance to the field crew. The Superintendent will represent the installer at all site meetings and will act as the spokesman for the installer on the project. Welding technicians will be evaluated based on performance. The CQA Engineer, through the Project Manager, reserves the right to reject any welding technician whose performance is unsatisfactory.

The installer shall be trained and qualified to install the subject geosynthetics.

The installer will be approved and/or licensed by the manufacturer. A copy of the approval letter or license will be submitted by the installer to the Project Manager and CQA Manager.

Prior to confirmation of any contractual agreements, the geomembrane installer shall provide the Project Manager and CQA Manager the following written information:

- Corporate background and information;
- Installation capabilities:
 - Information on equipment and personnel;
 - Anticipated daily production;
 - Quality control manual for installation;
 - Samples of field seams and certified test results; and
 - Written confirmation that all design features, specifications, and CQA Plan requirements can be complied with.
- A list of at least 10 completed facilities totaling a minimum area of 22,000,000 ft², for which the installer has installed LLDPE or PVC geomembrane (as appropriate for the selected geomembrane). For each installation, the following information will be provided:
 - Purpose of installation, its location, and start/finish dates;
 - Name of facility owner, project manager, and engineer;
 - Type, thickness, and surface area of the installed geomembrane; and
 - Type of seaming apparatus used.

All personnel performing seaming operations will be qualified by experience. At least one seamer per crew will have experience seaming a minimum of 600,000 ft² of seams using the same method of seaming proposed for use on this project. The most experienced seamer, the “Master Seamer,” will provide direct supervision, as required, over less experienced seamers. The Master Seamer, or his designee with equivalent experience, will be on site whenever seaming is being performed.

At least two weeks prior to the start of installation, the installer will provide the Project Manager with a list of proposed seaming personnel and their professional records. This document will be reviewed

by the Project Manager and the CQA Consultant. Any proposed seaming personnel deemed insufficiently experienced will not be accepted by the Project Manager.

The installer will designate one representative as his Site Supervisor who will represent the installer at all site meetings and be responsible for acting as the installer's spokesman on site. The Site Supervisor will be qualified by experience and must have supervised the installation of a minimum of 5,000,000 ft² of the geomembrane installations (LLDPE or PVC). He will also exhibit good management and communication skills. His appointment will be approved by the Project Manager.

The installer will also designate one representative with responsibility for Quality Control and signing all QC documents.

10.0 LINES OF COMMUNICATION

The typical lines of communication necessary during a project are illustrated in Figure 1. The Certifying Engineer and CQA Monitor(s) will be capable of direct communication with the Project Manager at any time. Deficiencies that can be easily remedied, such as unsatisfactory test results, will be dealt with directly between the CQA personnel and Contractor(s).

11.0 FINAL COVER SYSTEM INSTALLATION

The final cover system will consist of a minimum one-foot-thick intermediate cover (foundation) layer, gas control layer (as shown on the Drawings), a 30-mil PVC or 40-mil LLDPE geomembrane (textured on both sides), a drainage layer, an 18-inch protective cover layer, and a 6-inch vegetative support layer (topsoil). A CQA Certification Report will be submitted to the WDEQ after construction of each portion of cover is complete to summarize installation procedures and test results for the completed cover system.

The work shall be performed in strict accordance with the lines, grades, cross-sections, and dimensions on the Drawings, or as directed by the CQA Monitor or CQA Engineer. The work shall conform to the Specifications. Table 1 summarizes the minimum final cover CQA tests and testing frequencies.

11.1 Foundation Layer

The foundation layer will be tested to help ensure proper structural support of the overlying geomembrane. In-situ density tests (ASTM D6938-10 or ASTM D1556) will be performed at a frequency of one test per 10,000 ft² of surface area to confirm that the in-place dry unit weight of the

soil is at least 90 percent of the standard Proctor maximum dry unit weight. The surface of the layer shall be graded to provide a smooth, workable surface on which to deploy the geomembrane. Placement of frozen soil and placement of soil onto frozen material shall be prohibited. The thickness of the layer shall be verified by “before-and-after” survey on a minimum 100-foot grid. The surface of the completed foundation layer will be surveyed on a minimum 100-foot grid to ensure that the permitted final grade has been achieved and that there are no “low spots.” Any deficient areas, in terms of thickness or slope, shall be corrected and re-surveyed prior to commencing placement of the gas collection layer (geocomposite drainage net).

11.2 Gas Control Layer

The gas control layer (geocomposite or engineered equivalent) will be placed to the lines and grades on the drawings, or as directed by the Certifying Engineer. If a geocomposite is used, the geocomposite shall consist of a 200-mil HDPE geonet that is thermally bonded on both sides to a geotextile having a weight per unit area of at least eight ounces per square yard. The geocomposite placed during construction shall be handled and installed in accordance with the following sections.

11.2.1 Product Delivery, Storage, and Handling

The CQA Monitor will verify the following:

- The equipment used to unload the rolls will not damage the geocomposite;
- Care is used in unloading;
- The following Manufacturer-supplied information has been received and is acceptable: Manufacturer’s name, a written statement and test results indicating that product has been tested and meets or exceeds transmissivity requirements, roll number, batch or lot number, and roll dimensions; and
- The geocomposite is covered with the geomembrane the same day as it is deployed to minimize contact with dirt and other contaminants.

Damaged rolls will be rejected and removed from the site or stored at a location separate from the accepted rolls, or as designated by the Owner.

11.2.2 Surface Preparation

Prior to geocomposite installation, the CQA Monitor will verify the following:

- Construction of underlying foundation layer and the related documentation have been completed; and
- The underlying surface is free of deleterious material or debris.

11.2.3 *Installation*

During roll placement, the CQA Monitor will perform the following activities:

- Observe the geocomposite as it is deployed and record defect locations and the disposition of the defects;
- Verify that the equipment does not damage the geocomposite or underlying materials by handling, trafficking, leakage of hydrocarbons, or by other means;
- Verify that installation workers do not smoke, wear damaging shoes, or engage in activities that could damage the geocomposite or underlying foundation/gas collection layer soils;
- Verify that the geocomposite is anchored to prevent movement by the wind (Contractor is responsible for any damage resulting from wind);
- Verify that the geocomposite remains free of contaminants such as soil, grease, and fuel; and

11.2.4 *Field Seaming*

During geocomposite placement, the CQA Monitor will verify that it is overlapped at the end a minimum of six inches and shall be fastened in accordance with Manufacturer's recommendations or as approved by the Certifying Engineer. At a minimum, fastening of geocomposite panels shall involve connecting the geonet portion of the geonet with plastic ties at a minimum of one tie per 6 feet of seam on slopes and 1 tie per 10 feet of seam on flat areas. The upper geotextile portion of the geocomposite shall be fastened to the adjacent geocomposite panel using heat bonding (lyster) or continuous sewing.

11.2.5 *Repairs*

Repair procedures will be observed by the CQA Monitor and will include patching to repair holes, tears, and defects.

11.3 PVC Geomembrane (Textured Both Sides) Cover Material

11.3.1 Purpose

The purpose of this section is to provide details of Manufacturing Quality Control (MQC), Manufacturing Quality Assurance (MQA), Construction Quality Control (CQC), and Construction Quality Assurance (CQA) for the manufacture, fabrication, and installation of 30-mil PVC geomembrane (textured on both sides) cover material.

11.3.2 Geomembrane Manufacturing

11.3.2.1 Raw Materials

All PVC manufacturers shall certify that their PVC sheeting is formulated and manufactured from 100 percent virgin raw materials that are specifically compounded for use in hydraulic structures. Only first quality phthalate and/or phosphate plasticizers shall be used. The use of water soluble ingredients is prohibited. The compound must also contain a biocide at a viable formulation level.

11.3.2.2 Roll Goods

All roll goods received from the PVC supplier shall be visually inspected for imperfections and contaminants. Materials tested must meet or exceed the values specified by ASTM D7176 or as indicated in Table 1. The certified and index properties listed in ASTM D7176 are to be evaluated and certified by the Manufacturer at the frequency specified in Table 1.

11.3.3 Geomembrane Fabrication

11.3.3.1 Factory Fabrication

Individual calendared widths of PVC are factory-fabricated into large panels to minimize seaming during installation. Factory-fabricated seams are a minimum one inch wide and extend to the edge of the sheet. Factory seams are produced using either chemical, dielectric, or thermal methods.

Factory fabrication production records identify each panel by panel number, size, date of fabrications, material lot number and seam station identification. Each panel is prominently marked with the panel number and panel size to coincide with production records.

11.3.3.2 In-Factory Seam Testing

Visual and non-destructive inspection is performed on 100 percent of factory-fabricated seams. In addition, the Fabricator shall perform destructive testing on factory-fabricated seams in order to verify compliance.

Samples of factory seams are taken at the beginning and at the end of each production shift. All seams are tested for compliance and the results shall be made available to the CQA Engineer.

11.3.3.3 Factory Seam Requirements

All factory seams shall meet or exceed the following requirements:

- a) Seam Strengths - Shear
Requirement: 80% of specified directional sheet tensile strength
Test Method: ASTM D 4545
- b) Seam Strength - Peel
Requirement: 15 pounds per inch minimum
Test Method: ASTM D 4545

11.3.4 *Packaging, Handling and Transportation*

11.3.4.1 Packaging and Handling

After factory fabrication, the PVC panels are double-accordion-folded and placed on a pallet or rolled on a cardboard core. Shipping cartons are shrink-wrapped using a water and UV resistant polymer sheeting and packaged to minimize handling at the site and damage to the contents. All cartons are labeled by the fabricator and shall have the manufacturer's name, material thickness, and panel identification and dimensions. PVC panels delivered to the job site are to be unloaded on level ground and stored in their original, unopened containers in a secure, dry area, and protected from weathering. Whenever possible, a 6-inch minimum air space between the cartons should be maintained, especially when the PVC panels are to be stored over an extended period of time. Pallets must not be stacked.

11.3.4.2 Transportation

Transportation of the PVC will be through an independent trucking firm, and will be shipped via a closed or flatbed trailer. Adequate tarps are recommended during transport via flat-bed truck.

The Manufacturer will be responsible for repairing or replacing any material damaged during shipment at no cost to the Owner; however, the Owner's representative (CQA Monitor) is responsible for noting and recording any damage at the time of delivery and immediately reporting same to the shipper and Manufacturer.

11.3.5 Installation

Construction of the PVC cover will be in accordance with the Drawings and Specifications. CQA monitoring of the materials supplied and the installation of the PVC cover material will include the following activities:

- Review of the required installer's submittals;
- Compilation and review of Manufacturer's conformance testing on the materials; and
- Observation and documentation of destructive and non-destructive testing during construction.

Conformance testing shall include testing of materials during manufacturing, as well as testing upon or after delivery to the site but prior to installation. Construction testing shall include all test procedures related to the activities during or following installation of the PVC. Testing of the PVC cover materials shall be in accordance with this CQA Plan. Documentation of all testing shall meet the requirements of this CQA Plan.

The CQA Monitor(s) will be present when the PVC cover material is delivered to the site. The CQA Monitor(s) shall verify that:

- The proper equipment is used to unload the PVC cover material from the delivery vehicle.
- The proper technique and care is used during the unloading of the materials and that materials are properly stored prior to use.
- The Manufacturer of the PVC cover material has included the following data on each roll delivered:
 - Roll or pallet identification number;
 - Date of production;
 - Size of panel (width and length);

- Resin content;
- Material thickness; and
- Manufacturer identification.

The CQA Monitor will log the delivery of all PVC cover materials to the site. Rolls which have been damaged during shipment or unloading operations shall be marked and stored in a separate area. Rolls or pallets shall be subject to rejection by the CQA Monitor. All rolls or pallets delivered to the site without the proper identification by the Manufacturer shall be subject to rejection.

11.3.5.1 Foundation Soil

11.3.5.1.1 Preparation

Surfaces to be lined will be free of all rocks, roots, vegetation, sharp objects, and/or debris of any kind. The surface shall provide a firm, unyielding foundation for the geomembrane with no sharp or abrupt changes in grade.

If an herbicide is required, it must be suitable for use with geomembranes and shall be applied as per the Manufacturer's recommendations. Suitability for use with the geomembrane shall be confirmed by the herbicide manufacturer.

11.3.5.1.2 Repair and Maintenance

Prior to PVC cover material installation, the surfaces to be covered shall be inspected for acceptability by the installer (See Attachment 1). Any necessary repairs will be made by the Owner or Contractor. It is the responsibility of the Owner or Earthworks Contractor to maintain the integrity of the foundation soil prior to, and during the PVC cover geomembrane installation.

11.3.5.2 PVC Cover Material Panel Placement

11.3.5.2.1 Panel Placement

The installer shall submit to the Owner, CQA Monitor, and WDEQ a detailed drawing indicating a layout of the panels on the proposed site. The installer shall assign each panel an identification number. This number shall be used by the installer, CQA firm, and other individuals for documentation and record drawings of the panel installation. The installer shall not modify the panel layout drawing without notification and approval from the CQA Monitor.

During installation of the PVC cover material, the CQA Monitor shall perform the following activities:

- Observe each panel of the PVC as it is deployed. Any areas which appear to be damaged or defective shall be brought to the attention of the installer. Damaged areas shall be repaired according to this manual and the Manufacturer's specifications. The CQA Monitor will document all areas of repair.
- Observe the equipment used for the deployment of the PVC material to ensure there is no damage.
- Note the weather conditions at the start of deployment operations each day and also record any changing conditions during the day.
- Verify that the individuals who are deploying the PVC cover material are not smoking, wearing shoes potentially damaging to the PVC, or engaging in any other activities that may cause damage to the surface of the PVC.
- Record the ambient temperature measured within 6 inches of the PVC surface, and ensure that the proper procedures are being followed for cold weather deployment, if applicable.
- Ensure that the requirements of Section 11.3.5.2.3 below are met.

During the placement of the PVC cover materials, the CQA Monitor shall document all testing, including:

- Test strips/trial seams
- Non-destructive testing of seams
- Destructive testing of seams
- Testing of repaired areas

The seam testing shall bear a number or coordinate to identify the area of the test. The same shall be indicated on an "as-built" (record) drawing supplied to the Owner and CQA Engineer at the end of the project. The as-built drawing shall also bear the size and number of each panel deployed during installation of the PVC cover material.

The daily log, which will be kept by the CQA Monitor, shall indicate any other unusual problems encountered during the installation of the PVC cover material and indicate the resolution. A copy of the daily log shall be made available to the Owner and WDEQ at the end of the project.

11.3.5.2.2 Weather Conditions

The PVC cover material panels shall be stored in their original packing until ready for use. The PVC cover material shall not be deployed during the presence of excess moisture such as mist, fog, heavy dew, etc. The geomembrane panels shall not be positioned when ambient temperatures are below 40°F. Panel deployment when ambient temperatures are below 40°F will require special handling and storage of the panels at a controlled temperature of at least 50°F. During low temperature installations, care must be taken to avoid “cold shock” impacting of the PVC cover material.

11.3.5.2.3 PVC Panel Deployment – The number of panels to be deployed in any day shall be limited to the number of panels which can be seamed or secured that day.

The PVC cover material shall be installed in a relaxed manner and free of tension and stress. In areas where grade transitions occur, “bridging” or “trampolining” of the geomembrane shall not be allowed. To accommodate grade transition, adequate slack is necessary. Some wrinkling of the PVC is acceptable and indicates proper slack consideration.

The PVC panels shall be deployed with a minimum panel overlap of 6 inches for all types of seams.

The PVC panels shall be shingled in the down-gradient direction whenever possible.

11.3.5.2.4 Preparation for Seaming – A Manufacturer-trained installer shall verify the following:

All personnel walking on the PVC cover material shall wear smooth-soled shoes. Personnel working on the PVC shall not smoke and shall not engage in activities that could damage the PVC geomembrane.

Tools used in the installation process shall be properly stored and carried. Knives and other sharp objects shall be secured when not in use and carried in protective sheaths.

The method used to unfold PVC panels shall not cause damage to the PVC.

Adequate temporary anchoring shall be placed and maintained by the installer to prevent wind uplift of the PVC panels. Typical items are sand bags, ballast tubes, or whole tires. In cases of high wind, continuous loading is recommended along the edges of the PVC panels.

High traffic areas may require temporary wear surfaces, i.e. additional geotextile and PVC, etc.)

Vehicles shall not be allowed on the PVC unless approved by the installer and CQA Monitor. Small rubber-tired equipment with a ground pressure not exceeding 5 psi, and a total weight not exceeding 750 lbs, will normally be allowed, i.e. air compressors, generators, etc. that would be required during installation and testing.

Chemical fusion seaming agents, fuels and chemical cleaning agents shall be stored separately, away from PVC panels. Spill resistant containers shall be used while working directly on the PVC and shall be stored upon a sacrificial material such as scrap PVC or heavy cardboard.

11.3.5.3 Field Seaming

11.3.5.3.1 Seam Preparation

The overlapped PVC panels must be clean at the surfaces to be joined. Any foreign material (e.g., dirt, moisture) must be removed with clean, dry rags before seaming commences.

If seaming must be conducted over rough substrate, seaming boards are recommended. A one-foot by eight- or ten-foot pine board will work well as a seaming platform.

11.3.5.3.2 Repairs

Fish mouths shall be slit, laid flat, bonded, then patched with a round or oval patch of the same PVC material. The patch shall extend a minimum of 6 inches beyond the repair area in all directions, and shall be seamed a minimum of 1 inch along its perimeter.

11.3.5.3.3 Cold Weather Thermal Fusion Field Seaming

For cold weather seaming, when the PVC surface is below 40°F, the surfaces to be joined must be preheated unless preheating is expressly waived by the CQA Monitor.

If the soil beneath the PVC is frozen, the application of heat to the area to be seamed may result in condensation of moisture between the surfaces to be joined. This condition may be eliminated by placing a seaming board, or slip sheet made from the same PVC cover material, between the frozen surface and the PVC to be seamed.

11.3.5.3.4 *Thermal Fusion Field Seaming (Continuous Width)*

The two acceptable panel seaming methods are Hot Wedge single-track and Hot Wedge dual-track. Either method is capable of producing a quality seam. These units are equipped with speed and temperature controls with digital (LED) readout along with pressure adjustment.

- Actual seam widths shall be minimum 1.5 inches for single-track hot wedge method or minimum 0.5 inches for dual-track hot wedge method.
- Hot Air (hand-held leister) or equal method can be used for pipe boots, details and patching.
- Each method must be capable of producing sufficient amount of controlled heat and pressure applied to the seam overlap contact zone, resulting in a continuous thermal weld.
- Pressure “squeeze-out” along seam edge shall be kept to a minimum.
- Caution shall be exercised when operating welder in direct contact with foundation soil; drive (pressure) rollers must be kept clean at all times.

11.3.5.3.5 *Pipe Penetrations*

Penetrations are to be sealed via the use of factory-fabricated pipe seals whenever possible. Pipe seals are to be constructed of the same material and thickness as the specified PVC, and are bonded to the PVC via one of the aforementioned methods or by chemical fusion (using minimum 2-inch wide seam).

11.3.5.4 *Lining System Acceptance*

Installer shall retain responsibility for the PVC installation until:

- the installation of the PVC is complete;
- verification of the integrity of all seams and repairs, as required by the Specifications, has been made; and
- all documentation pertaining to the PVC installation is completed and submitted to the Owner and CQA Engineer.

At this point, acceptance of the PVC Installer's work will be made by the CQA Engineer and Owner. The Earthworks Contractor then assumes responsibility for the PVC until all soil materials overlying the PVC have been placed and any identified damage has been repaired.

11.3.6 Field Quality Assurance

11.3.6.1 Overview

Field seam quality shall be demonstrated by traditional non-destructive (NDT) and destructive (DT) test methods.

The primary purpose of the non-destructive tests is to demonstrate continuity along the entire seam length and to validate 100 percent of the field seams. NDT methodology is described in Section 11.3.6.3 below.

The purpose of the destructive tests is to determine the quality of a given seam by removing a representative seam sample, and testing the given sample for compliance with accepted applicable industry standards. Testing may be conducted either at the job site, or at an independent testing laboratory. DT methodology is discussed in Section 11.3.6.4 below.

11.3.6.2 Test Strips/Trial Seams

Trial seams shall be prepared and tested in accordance with ASTM 6392 for each welding machine and tested by the Installer to verify that the seaming parameters are adequate. Trial seams shall be made by each seaming technician or crew at least once per day, or every time equipment is changed, or when significant changes in site conditions are noted, whichever is more frequent. Test seaming shall be conducted under the same conditions and with the same equipment and operator as production seaming. Each trial weld shall be 5 feet in length for all types of field welds and tested to meet ASTM D6392. For shear and peel testing, see the Destructive Seam Testing section below. If a test seam fails, an additional test seam shall be completed immediately. If the additional test seam fails, the seaming apparatus shall be rejected and not used until the deficiencies are corrected and a successful test seam can be produced.

11.3.6.3 Non-Destructive Seam Testing

11.3.6.3.1 Air Lance Method

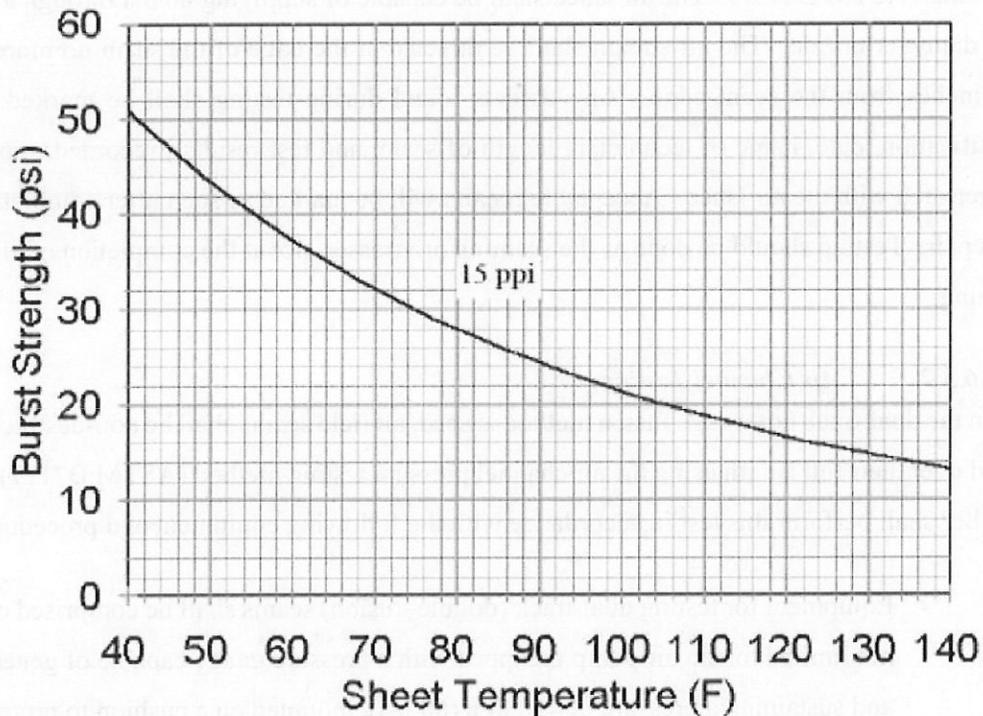
When single-track hot wedge fusion, hot-air, or chemical bonding methods of seaming are used, all field seams shall be non-destructively tested over their full length using an air lance

apparatus (ASTM D4437). The air lance shall be capable of supplying 80 psi through a 3/16-inch diameter nozzle. The air stream shall be directed at the edge of the seam no more than two inches from the seam edge. Any defects found during testing shall be marked (with identification, date, name of technician, length of seam, and test results), recorded, repaired, and retested with the air lance. Acceptable repairs will be marked as such after completion of the repair. Testing should be done as the seaming progresses, not at the completion of all field seaming.

11.3.6.3.2 *Air Channel Testing*

When the dual-track hot wedge fusion method is used, all field seams shall be non-destructively tested over their full length using the air channel pressure testing method (ASTM D7177). The Installer shall perform this test in accordance with the following equipment and procedures:

- Equipment for testing dual-track (double-fusion) seams shall be comprised of, but not limited to: an air pump equipped with a pressure gauge capable of generating and sustaining a pressure of 420 kPa (60 psi), mounted on a cushion to protect the geomembrane; and a manometer equipped with an approved pressure feed device.
- The testing activities shall be performed by the geomembrane installer in accordance ASTM D7177. Both ends of the seam to be tested shall be sealed and an approved pressure feed device inserted into the channel created by the double-fusion weld. The air pump shall be adjusted to a pressure corresponding to the following chart based on the temperature of the geomembrane and pressurized to the appropriate pressure. If air is held for the 2-minute test, the test is considered passing. If loss exceeds the acceptable level, the faulty area shall be located, repaired, and retested by the installer. Results of the air pressure testing shall be marked on the seam tested and logged on the air pressure testing record. Testing should be done as the seaming progresses, not at the completion of all field seaming.



Note: ppi = pound per inch

11.3.6.3 Remedial Action

Any other suspect locations (both in geomembrane seam and non-seam areas) shall be non-destructively tested using an air lance test method to identify whether a repair is necessary. If a repair is necessary, it shall be marked (with identification, date, name of technician, length of seam, and test results), recorded, repaired, and retested with the air lance. Acceptable repairs will be marked as such after completion of the repair.

11.3.6.4 Destructive Seam Testing

Sampling Frequency – When single-track hot wedge fusion, hot-air, or chemical bonding methods of field seaming are used, a minimum of one destructive test every 500 lineal feet of field seam shall be performed. No destructive testing will be required when air channel testing is performed on double-track hot wedge fusion welds.

- a) Sampling Procedure – Destructive samples shall be removed from the completed PVC seam by the installer from a location specified by the CQA Monitor. The installer shall not be informed in advance of the sample location. The sample shall be labeled in a clear and logical manner. The sample location must be identified and recorded.

Holes in the PVC cover material resulting from destructive seam sample shall be immediately repaired by patching the sampled area with identical PVC cover material. The patch must extend a minimum of six inches beyond the repair area in all directions. The continuity of repaired sampling locations shall be confirmed using the air lance method.

- b) Sample Geometry – The minimum sample geometry shall be as follows:
 - i) Sample width shall be determined as the width of the field seam plus six inches on both sides of the seam.
 - ii) Sample length shall be forty-eight (48) inches.
- c) Disposition of Samples – The sample described above shall be cut into three equal segments. One segment of the sample shall be submitted for laboratory (or field) testing; one segment to the installer, and the remaining segment to the Owner for archiving.
- d) Sample Preparation for Testing
 - i) Sampling – Test specimens shall be prepared from the samples obtained. For field testing, the installer shall cut ten identical 1-inch-wide specimens from his sample.
 - ii) Testing – Specimens shall be tested in order to determine bonded seam strength and peel adhesion. Five will be tested for peel strength and the other five shall be tested for shear strength. If performed on dual-track welds, peel tests shall be performed on both the inside and outside welds. The testing shall proceed as described by ASTM D6392 for thermal fusion seams and by ASTM D6214 for chemical seams.
- f) Acceptance of Destructive Test Results – Destructive test results that demonstrate a minimum of 80 percent of the directional tensile/shear strength of the PVC material and a value of 15 lbs. per inch minimum peel strength shall be accepted as evidence of the geomembrane’s viability.
- g) Remedial Action for Destructive Test Failure – One of the following procedures shall apply whenever a sample fails a destructive test:

- i) The field seam shall be reconstructed between two test locations shown to have acceptable results; one located on either side of the failed sample.
- ii) The seam shall be traced outward to intermediate points a maximum of 10 feet from the failed sample in each direction and sampled for additional testing. If the samples are found to provide acceptable test results, the seam is reconstructed between these two sample locations. If an intermediate sample fails, the process is repeated to establish the zone in which the seam is to be reconstructed. All reconstructed seams shall be defined by two locations from which samples passing other destructive tests have been taken.

Reconstruction of field seams shall be accomplished either by removing the suspect seam, repositioning panels and re-seaming, or by installing a cap strip to cover the seam under reconstruction. Cap stripping shall extend a minimum of six inches beyond the reconstructed seam in all directions.

- h) Verification of Repairs – Any repair requiring a patch or cap strip shall be identified on the as-built panel drawing. Each repair shall undergo non-destructive testing as described in Section 11.3.6.3 above. Repairs which pass the NDT shall be taken as an indication of proper repair. Failed NDT's will result in reconstruction and re-testing of the repair area until a passing result is obtained.

11.4 LLDPE Geomembrane (Textured on Both Sides) Geomembrane Cover Layer

11.4.1 *Purpose*

The purpose of this section is to provide details of MQC, MQA, CQC, and CQA for the manufacture, fabrication, and installation of LLDPE geomembrane cover material (minimum thickness 40-mil).

11.4.2 *Geomembrane Manufacturing*

11.4.2.1 Raw Materials

All LLDPE manufacturers shall certify that their LLDPE sheeting is formulated and manufactured from virgin materials with no more than 10% rework.. If rework is used it must be of the same formulation (or other approved formulation) as the parent material that are specifically compounded for use in hydraulic structures. No post-consumer resin (PCR) of any type shall be added to the formulation.

Raw materials (resin, carbon black, and additives) may be mixed during the production stage using a “master batch” carrier resin containing carbon black and other additives or during a compounding process prior to production. Raw materials used shall be tested for specific gravity (ASTM D1505 or ASTM D792, Method B) and Melt Flow Index (ASTM D1238, Condition E) at a frequency of 1 sample per batch.

Prior to the installation of any geomembrane material, the Manufacturer shall provide the Project Manager and the Geosynthetics Consultant with the following information:

1. The origin (resin supplier’s name and resin production plant), identification (brand name, number), and production date of resin.
2. A copy of the quality control certificates issued by the Resin Supplier to include specific gravity (ASTM D1505 or ASTM D792, Method B) and melt index (ASTM D1238, Condition E).
3. A statement that no reclaimed polymer is added to the resin (however, the use of polymer recycled during the manufacturing process may be permitted if done with appropriate cleanliness and if recycled polymer does not exceed 10% by weight).

The CQA Consultant shall review these documents and shall report any discrepancies with the above requirements to the Project Manufacturer.

11.4.2.2 Roll Goods

All roll goods received from the LLDPE supplier shall be visually inspected for imperfections and contaminants. Materials tested must meet or exceed the values specified by the Geosynthetics Institute – GRI Test Method GM17 (<http://www.geosynthetic-institute.org/specs.htm>) or as indicated in Table 1. The certified and index properties listed in GM17 are to be evaluated and certified by the Manufacturer at the frequency specified in Table 2(a) of GM17.

11.4.2.3 Transportation

Transportation of the LLDPE will be through an independent trucking firm, and will be shipped via a flatbed trailer. The Manufacturer will be responsible for repairing or replacing any material damaged during shipment at no cost to the owner; however, the owner’s representative (CQA monitor) is responsible for noting and recording any damage at the time of delivery and immediately reporting same to the shipper and Manufacturer.

11.4.3 Installation

Construction of the LLDPE cover will be in accordance with the Drawings and Specifications. CQA monitoring of the materials supplied and the installation of the LLDPE cover material will include the following activities:

- Review of the required installer's submittals;
- Compilation and review of Manufacturer's conformance testing on the materials; and
- Observation and documentation of destructive and non-destructive testing during construction.

Conformance testing shall include testing of materials during manufacturing by the Manufacturer, as well as testing upon or after delivery to the site but prior to installation. Construction testing shall include all test procedures related to the activities during or following installation of the LLDPE. Testing of the LLDPE cover materials shall be in accordance with this CQA Plan. Documentation of all testing shall meet the requirements of this CQA Plan. Conformance testing upon or after delivery shall be conducted independently of the geosynthetics installer/manufacturer.

The CQA Monitor(s) will be present when the LLDPE cover material is delivered to the site. The CQA Monitor(s) shall verify that:

- The proper equipment is used to unload the LLDPE cover material from the delivery vehicle
- The proper technique and care is used during the unloading of the materials and that materials are properly stored prior to use
- The Manufacturer of the LLDPE cover material has included the following data on each roll delivered:
 - Roll identification number;
 - Date of production;
 - Size of panel (width and length);
 - Resin content;

- Material thickness; and
- Manufacturer identification.

The CQA Monitor will log the delivery of all LLDPE cover materials to the site. Rolls which have been damaged during shipment or unloading operations shall be marked and stored in a separate area. Rolls shall be subject to rejection by the CQA Monitor. All rolls or pallets delivered to the site without the proper identification by the Manufacturer shall be subject to rejection.

11.4.3.1 Foundation Soil

11.4.3.1.1 Preparation

Surfaces to be lined will be free of all rocks, roots, vegetation, sharp objects, and/or debris of any kind. The surface shall provide a firm, unyielding foundation for the geomembrane with no sharp or abrupt changes in grade.

If an herbicide is required, it must be suitable for use with geomembranes and shall be applied as per the Manufacturer's recommendations. Suitability for use with the geomembrane shall be confirmed by the herbicide manufacturer.

11.4.3.1.2 Repair and Maintenance

Prior to LLDPE cover material installation, the surfaces to be covered shall be inspected for acceptability by the installer (See Attachment 1). Any necessary repairs will be made by the Owner or Contractor. It is the responsibility of the Owner or Earthworks Contractor to maintain the integrity of the foundation soil prior to, and during the LLDPE cover geomembrane installation.

11.4.3.2 LLDPE Panel Placement

11.4.3.2.1 Panel Placement

The installer shall submit to the Owner and CQA Monitor a detailed drawing indicating a layout of the panels on the proposed site. The installer shall assign each panel an identification number. This number shall be used by the installer, CQA firm, and other individuals for documentation and record drawings of the panel installation. The installer shall not modify the panel layout drawing without notification and approval from the CQA Monitor.

During installation of the LLDPE cover material, the CQA Monitor shall perform the following activities:

- Observe each panel of the LLDPE as it is deployed on the foundation soil. Any areas which appear to be damaged or defective shall be brought to the attention of the installer. Damaged areas shall be repaired according to this CQA Plan and the Manufacturer's specifications. The CQA Monitor will document all areas of repair.
- Observe the equipment used for the deployment of the LLDPE material to ensure there is no damage.
- Note the weather conditions at the start of deployment operations each day and also record any changing conditions during the day.
- Verify that the individuals who are deploying the LLDPE cover material are not smoking, wearing shoes potentially damaging to the LLDPE, or engaging in any other activities that may cause damage to the surface of the LLDPE.
- Record the ambient temperature measured within 6 inches of the LLDPE surface, and ensure that the proper procedures are being followed for cold weather deployment, if applicable.
- Ensure that the requirements of Section 11.4.3.2.2 below are met.

During the placement of the LLDPE cover materials, the CQA Monitor shall document all testing, including:

- Test strips/trial seams
- Non-destructive testing of seams
- Destructive testing of seams
- Testing of repaired areas

The seam testing shall bear a number or coordinate to identify the area of the test. The same shall be indicated on an "as-built" (record) drawing supplied to the Owner and CQA Engineer at the end of the project. The as-built drawing shall also bear the size and number of each panel deployed during installation of the LLDPE cover material.

The daily log, which will be kept by the CQA Monitor, shall indicate any other unusual problems encountered during the installation of the LLDPE cover material and indicate the

resolution. A copy of the daily log shall be made available to the Owner and WDEQ at the end of the project.

11.4.3.2.2 Weather Conditions

The LLDPE cover material shall not be deployed during the presence of excess moisture such as mist, fog, heavy dew, etc. The geomembrane panels shall not be positioned when ambient temperatures are below 40°F or above 100°F unless approved by the CQA Engineer.

11.4.3.2.3 LLDPE Panel Deployment

The number of panels to be deployed in any day shall be limited to the number of panels which can be seamed or secured that day.

The LLDPE cover material shall be installed in a relaxed manner and free of tension and stress. In areas where grade transitions occur, “bridging” or “trampolining” of the geomembrane shall not be allowed. To accommodate grade transition, adequate slack is necessary. Some wrinkling of the LLDPE is acceptable and indicates proper slack consideration.

The LLDPE panels shall be deployed with a minimum panel overlap of 6 inches for all types of seams.

The LDPE panels shall be shingled in the down-gradient direction whenever possible.

11.4.3.2.4 Preparation for Seaming

A Manufacturer-trained installer shall verify the following:

- All personnel walking on the LLDPE cover material shall wear smooth-soled shoes. Personnel working on the LLDPE shall not smoke and shall not engage in activities that could damage the LLDPE geomembrane.
- Tools used in the installation process shall be properly stored and carried. Knives and other sharp objects shall be secured when not in use and carried in protective sheaths.
- The method used to unfold LLDPE panels shall not cause damage to the LLDPE.
- Adequate temporary anchoring shall be placed and maintained by the installer to prevent wind uplift of the LLDPE panels. Typical items are sand bags, ballast tubes, or whole tires. In cases of high wind, continuous loading is recommended along the edges of the LLDPE panels.

- High traffic areas may require temporary wear surfaces, i.e. geotextile, additional LLDPE, clean fill, etc.)
- Vehicles shall not be allowed on the LLDPE unless approved by the installer and CQA Monitor. Small rubber-tired equipment with a ground pressure not exceeding 5 psi, and a total weight not exceeding 750 lbs, will normally be allowed, i.e. air compressors, generators, etc. that would be required during installation and testing.
- Chemical fusion seaming agents, fuels and chemical cleaning agents shall be stored separately, away from LLDPE panels. Spill resistant containers shall be used while working directly on the LLDPE and shall be stored upon a sacrificial material such as scrap LLDPE or heavy cardboard.

11.4.3.3 Field Seaming

11.4.3.3.1 Seam Preparation

The overlapped LLDPE panels must be clean at the surfaces to be joined. Any foreign material (e.g., dirt, moisture) must be removed with clean, dry rags before seaming commences.

If seaming must be conducted over rough substrate, seaming boards are recommended. A one-foot by eight- or ten-foot pine board will work well as a seaming platform.

11.4.3.3.2 Repairs

Fish mouths shall be slit, laid flat, bonded, then patched with a round or oval patch of the same LLDPE material. The patch shall extend a minimum of 6 inches beyond the repair area in all directions, and shall be seamed a minimum of 1 inch along its perimeter.

11.4.3.3.3 Cold Weather Thermal Fusion Field Seaming

For cold weather seaming, when the LLDPE surface is below 40°F, the surfaces to be joined must be preheated unless preheating is expressly waived by the CQA Monitor.

If the soil beneath the LLDPE is frozen, the application of heat to the area to be seamed may result in condensation of moisture between the surfaces to be joined. This condition may be eliminated by placing a seaming board, or slip sheet made from the same LLDPE cover material, between the frozen surface and the LLDPE to be seamed.

11.4.3.3.4 Thermal Fusion Field Seaming

The acceptable panel seaming methods are Hot Wedge single-track and Hot Wedge dual-track. Either method is capable of producing a quality seam. These units are equipped with speed and temperature controls with digital (LED) readout along with pressure adjustment.

- Actual seam widths shall be minimum 0.5 inches for dual-track hot wedge method
- Hot Air (hand-held leister) or equal method can be used for heat tacking pipe boots, details and patching prior to extrusion welding
- Pressure “squeeze-out” along seam edge shall be kept to a minimum
- Caution shall be exercised when operating welder in direct contact with foundation soil; drive (pressure) rollers must be kept clean at all times

11.4.3.3.5 *Pipe Penetrations*

Penetrations are to be sealed via the use of factory-fabricated pipe seals whenever possible. Pipe seals are to be constructed of the same material and thickness as the specified LLDPE, and are bonded to the LLDPE via one of the aforementioned methods.

11.4.3.4 *Lining System Acceptance*

Installer shall retain responsibility for the LLDPE installation until:

- The installation of the LLDPE is complete
- Verification of the integrity of all seams and repairs, as required by the Specifications, has been made
- All documentation pertaining to the LLDPE installation is completed and submitted to the Owner and CQA Engineer

At this point, acceptance of the LLDPE installer’s work will be made by the CQA Engineer and the Owner. The Earthworks Contractor then assumes responsibility for the LLDPE until all soil materials overlying the LLDPE have been placed, and any identified damage has been repaired.

11.4.4 *Field Quality Assurance*

11.4.4.1 Overview

Field seam quality shall be demonstrated by traditional non-destructive (NDT) and destructive (DT) test methods, and also through the implementation of an electrical leak location survey (ELLS).

The primary purpose of the non-destructive tests is to demonstrate continuity along the entire seam length and to validate 100 percent of the field seams. NDT methodology is described in Section 11.4.4.3 below.

The purpose of the destructive tests is to determine the quality of a given seam by removing a representative seam sample, and testing the given sample for compliance with accepted applicable industry standards. Testing may be conducted either at the job site, or at an independent testing laboratory. DT methodology is discussed in Section 11.4.4.4 below.

11.4.4.2 Test Strips/Trial Seams

Trial seams shall be prepared and tested in accordance with ASTM 6392 for each welding machine and tested by the installer to verify that the seaming parameters are adequate. Trial seams shall be made by each seaming technician or crew at the beginning of each seaming period (in the morning and evening), and every five hours as directed by the CQA monitor, for each production seaming apparatus/operator combination used that day. Test seaming shall be conducted under the same conditions and with the same equipment and operator as production seaming. Trial seams are made in the event that the ambient temperature varies by more than 25°F. Each trial weld shall be 5 feet by 12 inches wide (after seaming) with the seam centered lengthwise. For shear and peel testing, see the Destructive Seam Testing section below. If a test seam fails, an additional test seam shall be completed immediately. If the additional test seam fails, the seaming apparatus shall be rejected and not used until the deficiencies are corrected and a successful test seam can be produced.

11.4.4.3 Non-Destructive Seam Testing

11.4.4.3.1 *Air Pressure Testing (For Double-Fusion Seams Only)*

When the dual-track hot wedge fusion method is used, all field seams shall be non-destructively tested over their full length using the air channel pressure testing method (ASTM D5820). The installer shall perform this test in accordance with the following equipment and procedures:

- Equipment for testing dual-track (double-fusion) seams shall be comprised of, but not limited to: an air pump (manual or motor driven) equipped with a pressure gauge capable of generating and sustaining a pressure of at least 30 psi, mounted on a cushion to protect the geomembrane; a rubber hose with fittings and connections; and a sharp hollow needle, or other approved pressure feed device.
- The testing activities shall be performed by the geomembrane installer. The following procedures shall be followed:
 - Seal both ends of the seam section to be tested
 - Insert needle, or other approved pressure feed device, into one end of the tunnel created by the dual track fusion weld
 - Insert a protective cushion between the air pump and the geomembrane; energize the air pump to a gauge pressure between 25 and 30 psi, close the valve, and sustain the pressure for not less than 5 minutes
 - If loss of pressure exceeds 2 psi, or does not stabilize, locate faulty area and repair
 - At the end of the test period, cut the air channel at the end of the seam opposite the needle and verify airflow to ensure that the entire seam length was tested
 - Remove needle, or other approved pressure feed device, and repair both ends of the tested seam section

11.4.4.3.2 *Vacuum Testing (For Extrusion Seams Only)*

When the extrusion welding method is used, all field seams shall be non-destructively tested over their full length using the vacuum testing method (ASTM D5641). The installer shall perform this test in accordance with the following equipment and procedures:

- Equipment for testing extrusion seams shall be comprised of, but not limited to:
 - A vacuum box assembly consisting of a rigid housing
 - A transparent viewing window
 - A soft neoprene gasket attached to the bottom port hole or valve assembly, and a vacuum gauge

- A steel vacuum tank and pump assembly equipped with a pressure controller and pipe connections
- A rubber pressure/vacuum hose with fittings and connections
- A bucket and applicator
- A soapy solution
- The testing activities shall be performed by the geomembrane installer. The following procedures shall be followed:
 - Energize the vacuum pump and reduce the tank pressure to approximately 5 psi gauge
 - Wet a strip of geomembrane seam approximately 4 inches by 48 inches with the soapy solution
 - Place the box over the wetted area
 - Close the bleed valve and open the vacuum valve
 - Ensure that a leak-tight seal is created as evidenced by a negative box pressure of 5 psi gauge
 - Examine the geomembrane through the viewing window for the presence of soap bubbles for not less than 10 seconds
 - If no bubbles appear after 10 seconds, close the vacuum valve and open the bleed valve, move the box over the next adjoining area with a minimum 3 inches of overlap, and repeat the process
 - All areas where soap bubbles appear shall be marked with a marker that shall not damage the geomembrane, be repaired, then re-tested

11.4.4.4 Destructive Seam Testing

11.4.4.4.1 *Sampling Frequency*

When the dual-track hot wedge fusion method of field seaming is used, a minimum of one destructive test every 500 lineal feet of field seam shall be performed.

11.4.4.4.2 *Sampling Procedure*

Destructive samples shall be removed from the completed LLDPE seam by the installer from a location specified by the CQA Monitor. The installer shall not be informed in advance of the

sample location. The sample shall be labeled in a clear and logical manner. The sample location must be identified and recorded.

Holes in the LLDPE cover material resulting from the destructive seam sample shall be immediately repaired by patching the sampled area with identical LDPE cover material. The patch must extend a minimum of six inches beyond the repair area in all directions. The continuity of repaired sampling locations shall be confirmed using the vacuum test method.

11.4.4.4.3 *Sample Geometry*

The minimum sample geometry shall be as follows:

- Sample width shall be determined as the width of the field seam plus six inches on both sides of the seam.
- Sample length shall be forty-eight (48) inches.

11.4.4.4.4 *Disposition of Samples*

The sample described above shall be cut into three equal segments. One segment of the sample shall be submitted for laboratory (or field) testing; one segment to the installer, and the remaining segment to the Owner for archiving.

11.4.4.4.5 *Sample Preparation for Testing*

- Sampling – Test specimens shall be prepared from the samples obtained. For field testing, the installer shall cut ten identical 1-inch-wide specimens from his sample.
- Testing – Specimens shall be tested in order to determine bonded seam strength and peel adhesion. Five will be tested for peel strength and the other five shall be tested for shear strength. If performed on dual-track welds, peel tests shall be performed on both the inside and outside welds. The testing shall proceed as described by ASTM D6392 for thermal fusion seams.

11.4.4.4.6 *Acceptance of Destructive Test Results*

The minimum acceptable values to be obtained in these tests are those indicated in Table 1. At least 5 specimens shall be tested for each mode (shear and peel). Specimens shall be selected alternately by test from the samples (i.e., peel, shear, peel, shear . . .). A sample passes the laboratory tests when at least 4 out of 5 of the sample specimens pass the test or as otherwise indicated using the methods established in GRI Test Method GM19.

11.4.4.4.7 *Remedial Action for Destructive Test Failure*

One of the following procedures shall apply whenever a sample fails a destructive test:

- The field seam shall be reconstructed between two test locations shown to have acceptable results; one located on either side of the failed sample.
- The seam shall be traced outward to intermediate points a maximum of 10 feet from the failed sample in each direction and sampled for additional testing. If the samples are found to provide acceptable test results, the seam is reconstructed between these two sample locations. If an intermediate sample fails, the process is repeated to establish the zone in which the seam is to be reconstructed. All reconstructed seams shall be defined by two locations from which samples passing other destructive tests have been taken.

Reconstruction of field seams shall be accomplished either by removing the suspect seam, repositioning panels and re-seaming, or by installing a cap strip to cover the seam under reconstruction. Cap stripping shall extend a minimum of six inches beyond the reconstructed seam in all directions.

11.4.4.4.8 Verification of Repairs

Any repair requiring a patch or cap strip shall be identified on the as-built panel drawing. Each repair shall undergo non-destructive testing as described in Section 11.4.4.3 above. Repairs which pass the NDT shall be taken as an indication of proper repair. Failed NDT's will result in reconstruction and re-testing of the repair area until a passing result is obtained.

11.5 Vegetative Support Layer and Protective Cover Layer

The vegetative support layer will be six inches thick. This layer shall consist of soil capable of supporting vegetative growth. Suitable topsoil which has been stripped off of excavation areas shall be stockpiled as directed by the Engineer and later used before additional topsoil is hauled on to the work site. Unsuitable material shall not be included in these stockpiles. Topsoil shall consist of soils adapted to the sustenance of plant life, and such topsoil shall be neither excessively acid nor alkaline. Topsoil shall be free from foreign material such as hard pan, stones larger than one inch diameter, concrete, cinders, brick asphalt, or other undesirable materials. It shall also be reasonably free from weeds and objectionable plant material.

The protective cover layer will be 18 inches thick. The protective cover layer shall be placed over the drainage layer in 6 to 12-inch loose lifts. The protective cover layer shall be placed in a manner that prevents damage to underlying final cover components and excessive compaction. This layer shall consist of soil capable of supporting vegetative growth. Low ground pressure equipment (i.e.,

equipment that exerts less than 5 psi ground pressure) shall be used to spread the earthen material over the geosynthetics while maintaining a minimum thickness of 12 inches between the equipment and geosynthetics. The material shall be placed or rolled over radially instead of pushing longitudinally. For slopes greater than 4:1, earthen material shall be spread from the bottom of the slope upward.

The thickness of the vegetative support layer and protective cover layer will be verified by survey on a minimum 100-foot grid. The Contractor shall employ a professional surveyor licensed in the State of Wyoming to verify that the required lines and grades and thickness of the final cover are being met. Additionally, the CQA Monitor will observe lift thicknesses and double-check the survey data to ensure that the design criteria are met.

11.6 Gas Vents

Gas vents and associated pipe boots through the geomembrane are to be installed as shown on the Drawings.

12.0 References

United States Environmental Protection Agency, 2003. Technical Guidance Document, *Quality Assurance and Quality Control for Waste Containment Facilities*, EPA/600/R-93/182, September 1993.

Waste Containment Facilities- Guidance for Construction Quality Assurance and Construction Quality Control of Liner and Cover Systems, 2nd Edition; Prepared for ASCE; by David E. Daniel and Robert M. Keener; 2007.

GRI Test Method GM17, "Test Methods, Test Properties and Testing Frequency for Linear Low Density Polyethylene (LLDPE) Smooth and Textured Geomembranes" Geosynthetic Institute, latest revision.

GRI Test Method GM19, "Seam strength and Related Properties of Thermally Bonded Polyolefin Geomembranes" Geosynthetics Institute, latest revision.

TABLE 1
CONSTRUCTION QUALITY ASSURANCE TESTING REQUIREMENTS

ITEM	PARAMETER	SPECIFICATION	TEST METHOD	CONSTRUCTION FREQUENCY	PRECONSTRUCTION FREQUENCY	SURVEY COMMENTS
Foundation Layer	Placement thickness/profiling	Minimum 12 inches thick	Observation	Continuous	N/A	Thickness of foundation layer tolerance 0 to +0.2 ft. Top of foundation layer will be surveyed to confirm proper slopes
	In-place density	≥ 90% Std Proctor max dry unit wt	ASTM D1556 or ASTM D6938	1 per 10,000 sq ft per lift	N/A	
Protective Cover Layer	Moisture-Density Relationship	N/A	ASTM D698	1 per 10,000 cubic yards with at least 1 per material type	N/A	Thickness of vegetative support layer on 100-ft spacing by survey. Top of vegetative support layer will be surveyed to confirm proper slopes
	Lift Thickness	Approx 9 to 12 inches	Observation	Continuous	N/A	
Geocomposite	Mass per unit area	8 oz/sq yd min avg	ASTM D5261	As provided by Manufacturer	1/100,000 sf	Confirm material conformance based on Manufacturer's QC sheets
	Apparent opening size (Geotextile fabric only)	To be determined by Design Engineer	ASTM D4751	As provided by Manufacturer	1/100,000 sf	
	Transmissivity	4 x 10 ³ m ² s 2.0 lbin/avg (1.0 lbin/min)	ASTM D4716	As provided by Manufacturer	See note 1	
	Geotextile-Coarset ply Adhesion		GRI GC 8	As provided by Manufacturer	1/100,000 sf	
LLDPE Geomembrane Cover (Testured on both sides)	Subgrade Deployment	Firm, free of rocks or other protrusions See COA Plan	Observation	Continuous	N/A	Document locations of all destructive tests on panel layout record drawing
	Trail Seams	See COA Plan	Observation: ASTM D6392	See COA Plan	N/A	
	Seam overlap	Minimum 6 inches	Observation	Continuous	N/A	
	Nondestructive testing	Observation, See COA Plan	ASTM D5820 - Air pressure testing (dual-track fusion weld), ASTM 4437 - Extrusion welds	Continuous	N/A	
	Seam destructive testing: Peel Strength ^{a)}	38 lbs/in (min) (Hot wedge seams) 34 lbs/in (min) (Cold seam (hot seams))	ASTM D6392	1 per 500 linear feet	N/A	
	Seam destructive testing: Shear Strength ^{b)}	45 lbs/in (min)	ASTM D5894	1 per 500 linear feet	N/A	
	Thickness ^{c)}	40 mil (min avg) -10% -15%	ASTM D5894		1 roll	
	Tensile strength at break ^{d)}	45 lbs/in (min avg)	ASTM D6693 Type IV		1/20,000 lbs	
	Axis-symmetric break resistance	250% (min avg)				
	Asymmetric break resistance	30% min				
Tear Resistance	16 lbs (min, avg)	ASTM D5617	As provided by Manufacturer	1/formulation		
Density	0.939 g/ml (maximum)	ASTM D1104		1/45,000 lbs		
Asperity height ^{e)}	10 mil (min avg)	ASTM D1568/D792		1/200,000 lbs		
Puncture resistance	33 lbs (min avg)	ASTM D7466		Every 2nd roll ^{f)}		
Carbon black content	2.0 - 3.0 %	ASTM D4833		1/45,000 lbs		
Carbon black dispersion	See note 7	ASTM D4218 ^{g)}		1/45,000 lbs		
% modulus	1800 lbin	ASTM D5196		1/formulation		
Residue: Induction time (GIT) ^{h)}	100 minutes (min avg)	ASTM D3895		1/200,000 lbs		
High pressure GIT	400 minutes (min avg)	ASTM D5885				
Oven aging at 85°C ⁹⁾		ASTM D5721				
Standard GIT	35% retained after 90 days (min avg)	ASTM D3895		1/formulation		

Draw Date: March 10, 2014

High pressure OIT	60% retained after 90 days (min avg) 3.5% retained after 1600 hours (min avg)	ASTM D5885	1/formation	
UV resistance ^(90, 10)		ASTM D5885	1/formation	
Shrinkage	Firm, free of folds or other protrusions	Observation	N/A	
Deployment	See COA Plan 1.5 lbs/in (feet) 58.4 lbs/in (shear)	Observation	N/A	
Factory seams: peel and shear		ASTM D4545	100% of seams	
Trial seams	See COA Plan	Observation; ASTM D6214 and ASTM D6392	See COA Plan	
Seam overlap	Minimum 6 inches	ASTM D4447 - Air Inlet (single-track fusion); or ASTM D 7177 - Air Channel (dual-track fusion)	Continuous	
Nondestructive testing	Observation; See COA Plan	ASTM D6392 (thermal fusion seams) or ASTM D6214 (chemical seams)	N/A	
Seam destructive testing: Tecl	1.5 lbs/in (min)	ASTM D6392 (thermal fusion seams) or ASTM D6214 (chemical seams)	1/500 linear feet (not required for dual-track welds)	
Seam destructive testing: Shear	80% of tensile strength (58.4 lbs/in - min)	ASTM D6392 (thermal fusion seams) or ASTM D6214 (chemical seams)	1/500 linear feet (not required for dual-track welds)	
Thickness	0.030 +/- 0.0015 in	ASTM D5199	N/A	Document locations of all destructive tests on panel layout record drawing
Tensile properties:				
Tensile strength at break				
Elongation	72 lbs/in (min avg)	ASTM D882		
Modulus at 100%	380% (min avg) 50 lbs (min avg)			
Tear strength	8 lbs (min avg)	ASTM D1104		
Dimensional stability	3% (max change)	ASTM D124		
Low temperature impact	-20°F (50% of specimens must pass)	ASTM D1790		
Specific gravity	1.2 g/cc (max loss)	ASTM D972		
Water extraction	0.15% (max loss)	ASTM D1239		
AVG. plasticizer molecular weight	400 (min)	ASTM D2124		
Volatiles loss (max % loss)	0.7% (max loss)	ASTM D1208		
Soil burial (max change in properties after 30 days burial)			As provided by manufacturer	
Break strength	5% (max change)	ASTM G160		
Elongation	20% (max change)			
Modulus at 100%	20% (max change)			
Hydrasol resistance	100 psi (min)	ASTM D751		

Notes:

- The design transmissivity is the hydraulic transmissivity of the geocomposite using water at 68°F ±3°F with a hydraulic gradient of not less than 0.1 under a compressive stress of 20,000 psf. For the test, the geocomposite shall be sandwiched between actual project materials.
- The minimum test duration will be 100 hours and the report for the test results shall include measurements at intervals over the entire test duration.
- Values listed for shear and peel strengths are 4 out of 5 test specimens, the fifth specimen can be as low as 80% of the listed values.
- Machine direction (MD) and cross machine direction (CMD) average values should be on the basis of 5 test specimens each direction.
- Break elongation is calculated using a gauge length of 2.0 in at 2.0 in minimum.
- Of 10 readings, 8 out of 10 must be \geq 7 mils, and lowest individual reading must be \geq 5 mils.
- Alternate the measurement side for double textured sheet.
- Other methods such ASTM D 603 (tube furnace) or ASTM D6370 (TGA) are acceptable if an appropriate correlation to ASTM D4218 (muffle furnace) can be established.
- Carbon black dispersion (only near spherical agglomerates) for 10 different views.
- 9 in Categories 1 or 2 and 1 in Category 3.
- The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomebrane.
- It is also recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.
- The condition of the test should be 20 hr UV cycle at 75°C followed by 4 hr condensation at 60°C.
- UV resistance is based on percent retained value regardless of the original IIP-OIT value.
- For PVC geomebrane physical properties and test requirements, see ASTM D2176, current version.
- All values are minimum average roll value, except UV resistance, which is a minimum value.
- Evaluation to be on 2.0 inch strip tensile specimens after 168 hours exposure.

Draft Date: March 10, 2014

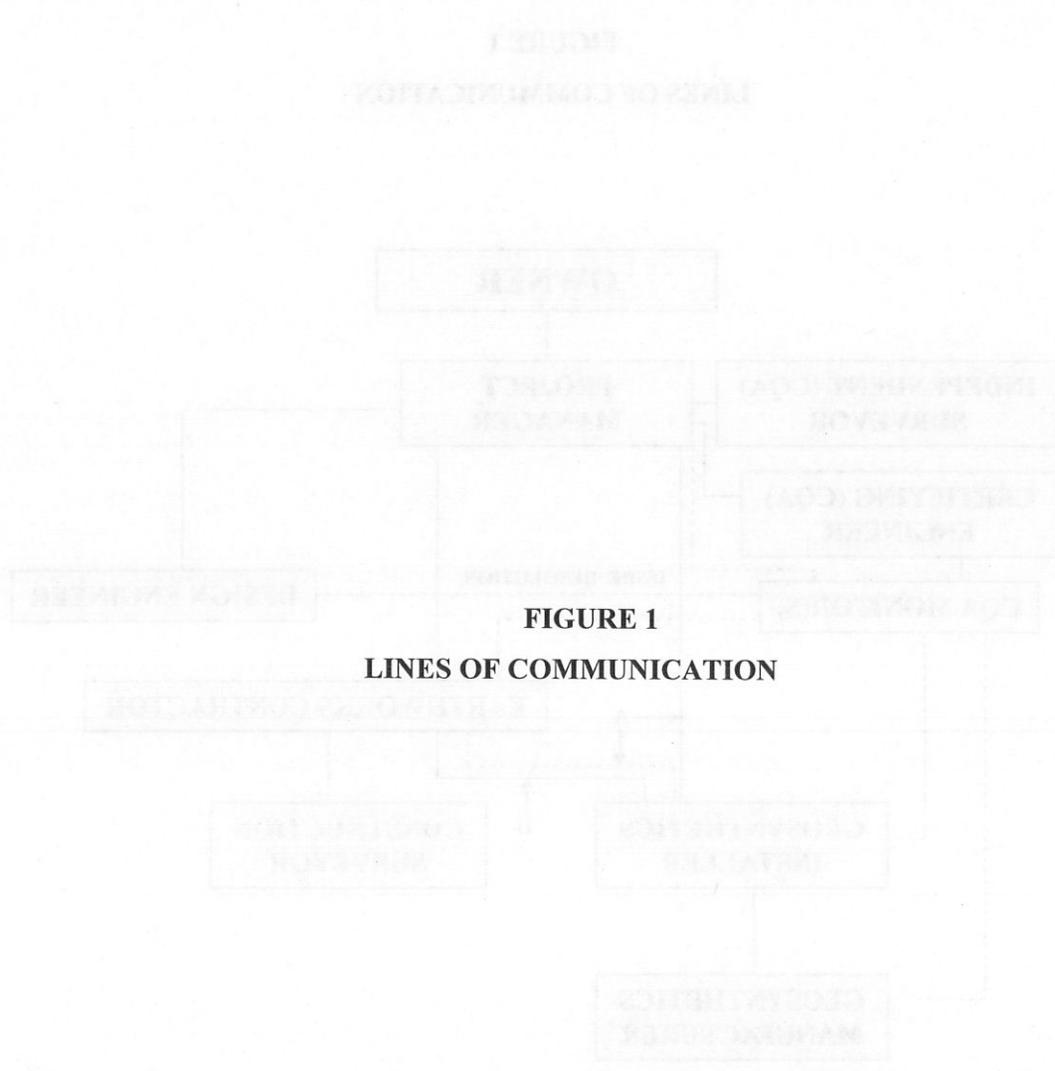
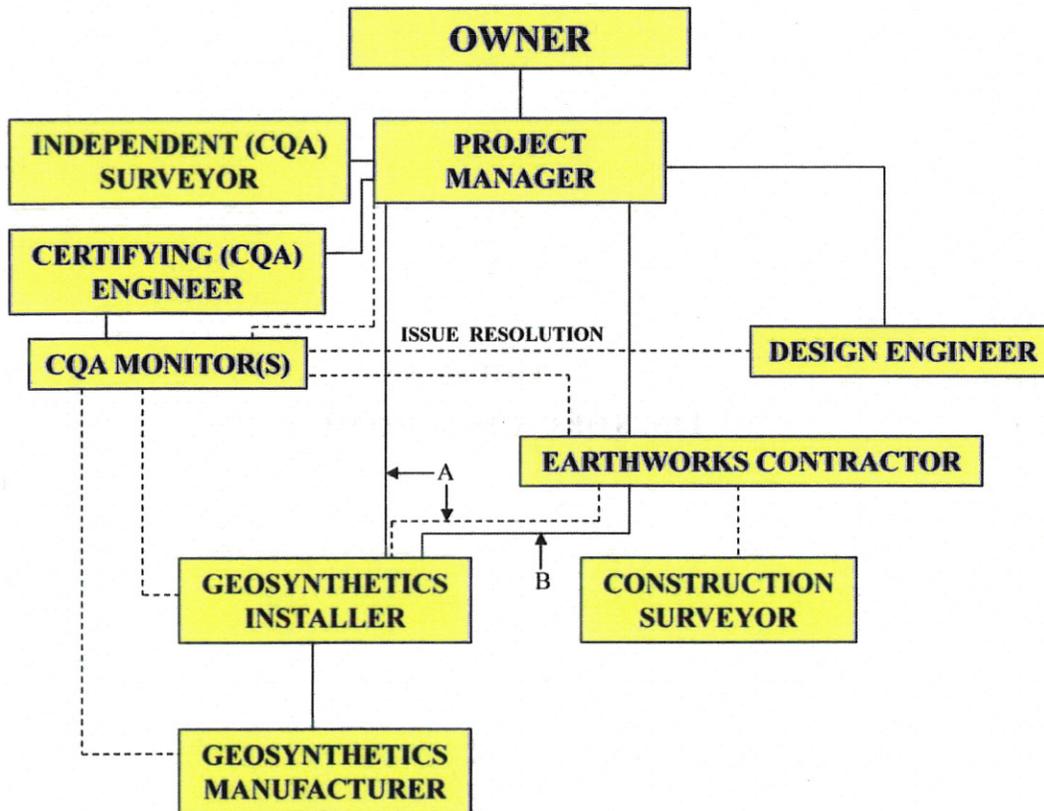


FIGURE 1
LINES OF COMMUNICATION

FIGURE 1
LINES OF COMMUNICATION



Note: Either lines labeled "A" or line labeled "B" are acceptable.

FIELD MONITORING SUMMARY

SHEET 1 OF 2

PROJECT NUMBER: _____ PROJECT TITLE: _____

OWNER: _____ CONTRACTOR: _____

LOCATION: _____

S M T W T F S

DATE

WEATHER TEMPERATURE (F): LOW _____ @ _____ HIGH _____ @ _____

CLOUD COVER _____ PRECIPITATION _____ WIND _____

GCS PERSONNEL ON-SITE: _____

SUMMARY OF CONSTRUCTION PROGRESS: _____

GCS ACTIVITIES AND TEST RESULTS: _____

SUBMITTED BY GCS

RESIDENT MANAGER

FIELD MONITORING SUMMARY

SHEET 2 OF 2

PROJECT NUMBER: _____ PROJECT TITLE: _____

OWNER: _____ CONTRACTOR: _____

LOCATION: _____

S M T W T F S

DATE

SUMMARY OF SURVEYOR'S ACTIVITIES: _____

SUMMARY OF PROBLEMS AND RESOLUTIONS: _____

SUMMARY OF MEETINGS AND DISCUSSIONS HELD: (ATTENDEES AND ISSUES)

SUMMARY OF INCIDENTS/ACCIDENTS/HEALTH AND SAFETY ISSUES: _____

SUBMITTED BY GCS

RESIDENT MANAGER

SPECIFICATION / DESIGN CLARIFICATION FORM

PROJECT NUMBER: _____
OWNER: _____
LOCATION: _____

PROJECT TITLE: _____
CONTRACTOR: _____

FORM NUMBER

LOCATION / REFERENCE OF CLARIFICATION :

CLARIFICATION MADE :

APPROVED BY DESIGNER: _____
NAME COMPANY DATE

ACKNOWLEDGED BY OWNER: _____
NAME COMPANY DATE

ACKNOWLEDGED BY REGULATOR: _____
NAME AGENCY DATE

RECEIVED BY THE GCS REPRESENTATIVE: _____
NAME DATE

REMARKS : _____

ATTACHMENTS: _____

GEOSYNTHETIC INSTALLATION MONITORING REPORT

PAGE _____ OF _____

PROJECT NUMBER: _____

PROJECT TITLE: _____

OWNER: _____

CONTRACTOR: _____

LOCATION: _____

DATE

S M T W T F S

GEOSYNTHETIC DEPLOYMENT:

TRIAL SEAMING:

SEAMING:

NON-DESTRUCTIVE TESTING:

DESTRUCTIVE SAMPLING:

GENERAL REMARKS:

SUBMITTED BY

MONITOR

GEOSYNTHETIC INSTALLATION MONITORING SUMMARY

PROJECT NUMBER: _____ PROJECT TITLE: _____
 OWNER: _____ CONTRACTOR: _____
 LOCATION: _____

COMPILED BY _____ DATE _____ PAGE _____ OF _____
S M T W T F S

INSTALLER ON SITE _____ INSTALLER OFF SITE _____ INSTALLER'S CREW SIZE _____ NUMBER OF LABORERS _____ # OF OPERABLE FUSION WELDERS _____ # OF OPERABLE EXTRUSION WELDERS _____	<h3 style="text-align: center;">WEATHER</h3> TEMPERATURE (F) MORNING _____ CLOUD COVER _____ AFTERNOON _____ WIND _____ EVENING _____ RAIN / SNOW _____
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------

	DEPLOYMENT SUMMARY (SQ FT)		SUMMARY OF DESTRUCTIVE TEST RESULTS		
	DAILY	CUMMULATIVE	DESTRUCTIVE TEST NUMBER	MACHINE NUMBER	TEST STATUS
BENTONITE MAT	_____	_____	_____	_____	_____
GEOMEMBRANE	_____	_____	_____	_____	_____
GEONET	_____	_____	_____	_____	_____
GEOTEXTILE 1	_____	_____	_____	_____	_____
GEOTEXTILE 2	_____	_____	_____	_____	_____
OTHER	_____	_____	_____	_____	_____
GEOMEMBRANE PANELS DEPLOYED					
_____ THRU _____					
_____ THRU _____					

SUMMARY OF CURRENT DESTRUCTIVE FAILURES

DESTR. # _____ MACHINE # _____	DESTR. # _____ MACHINE # _____	DESTR. # _____ MACHINE # _____																																																																																																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TRACKING DESTRUCTIVE NUMBER</th> <th>SEAM NUMBER</th> <th>TEST STATUS</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	TRACKING DESTRUCTIVE NUMBER	SEAM NUMBER	TEST STATUS																																		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TRACKING DESTRUCTIVE NUMBER</th> <th>SEAM NUMBER</th> <th>TEST STATUS</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	TRACKING DESTRUCTIVE NUMBER	SEAM NUMBER	TEST STATUS																																		<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>TRACKING DESTRUCTIVE NUMBER</th> <th>SEAM NUMBER</th> <th>TEST STATUS</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table>	TRACKING DESTRUCTIVE NUMBER	SEAM NUMBER	TEST STATUS																																	
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REMARKS: _____ _____	REMARKS: _____ _____	REMARKS: _____ _____																																																																																																												
IS DESTRUCTIVE BOUNDED BY PASSING TESTS? YES NO	IS DESTRUCTIVE BOUNDED BY PASSING TESTS? YES NO	IS DESTRUCTIVE BOUNDED BY PASSING TESTS? YES NO																																																																																																												

GEOSYNTHETIC INVENTORY CONTROL LOG

PROJECT NUMBER: _____ PROJECT TITLE: _____
 OWNER: _____ CONTRACTOR: _____
 LOCATION: _____

SHEET NUMBER _____

MATERIAL TYPE: GEOMEMBRANE GEONET GEOTEXTILE OTHER _____
 DATE OF ARRIVAL _____ DATE OF INVENTORY _____
 MATERIAL MANUFACTURER: _____ INVENTORY MONITOR _____
 PRODUCT IDENTIFICATION _____ CONDITION IN TRUCK _____
 TRUCK TYPE _____ UNLOADING METHOD _____

ROLL NUMBER	BATCH OR LOT NO.	MATERIAL DIMENSIONS			QC	CONF	OTHER	REMARKS
		LENGTH (FT)	WIDTH (FT)	THICKNESS OR WEIGHT	CERT Y/N	SAMP. Y/N		
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

REVIEWED BY: _____ DATE _____

CERTIFICATE OF ACCEPTANCE OF SOIL SURFACE

<p style="text-align: center;">GEOSYNTHETIC INSTALLER</p> <p>COMPANY _____</p> <p>ADDRESS _____</p> <p>_____</p> <p>_____</p>	<p style="text-align: center;">PROJECT</p> <p>LOCATION _____</p> <p>PROJECT _____</p> <p>OWNER _____</p>
-----------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------

I, the Undersigned, the duly authorized representative of _____

do hereby accept the area of soil surface bounded by _____

and shall be responsible for maintaining its integrity and suitability in accordance with the project specifications from this date to the completion of the installation.

NAME	SIGNATURE	TITLE	DATE
------	-----------	-------	------

CERTIFICATE OF ACCEPTANCE RECEIVED BY QA/QC MANAGER

NAME	SIGNATURE	TITLE	DATE
------	-----------	-------	------

CERTIFICATE OF ACCEPTANCE RECEIVED BY OWNER

NAME	SIGNATURE	TITLE	DATE
------	-----------	-------	------

GEOMEMBRANE PANEL LOG

PROJECT NUMBER: _____
 OWNER: _____
 LOCATION: _____

PROJECT TITLE: _____
 CONTRACTOR: _____

SHEET NUMBER _____

	PANEL NUMBER	ROLL NUMBER	DEPLOYMENT DATE	MON.	VISUAL PANEL CONDITION	VERIFICATION OF REPAIRS		REMARKS
						DATE	QA MON.	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

REVIEWED BY _____ DATE _____

GEOMEMBRANE PANEL DEPLOYMENT LOG

PROJECT NUMBER: _____ PROJECT TITLE: _____
 OWNER: _____ CONTRACTOR: _____
 LOCATION: _____

GEOMEMBRANE : SECONDARY PRIMARY CLOSURE OTHER _____
 SUBGRADE CONDITION (SURFACE COMPACTION, PROTRUSIONS, DESICCATION, EXCESSIVE MOISTURE):
 REMARKS : _____

DATE _____

TRANSPORT EQUIPMENT _____

SHEET NUMBER _____

DESCRIPTION	PANEL NUMBER _____	PANEL NUMBER _____	PANEL NUMBER _____
ROLL NUMBER	_____	_____	_____
DEPLOYED LENGTH	_____	_____	_____
AMBIENT AIR TEMP.	_____	_____	_____
VISUAL OBSERVATION	_____	_____	_____
OBSERVED OVERLAP	_____	_____	_____
MONITOR	_____	_____	_____
REMARKS	_____	_____	_____
SHEET THICKNESS (MILS)	LEAD L SIDE R SIDE TRAIL	LEAD L SIDE R SIDE TRAIL	LEAD L SIDE R SIDE TRAIL
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
AVERAGE			

DESCRIPTION	PANEL NUMBER _____	PANEL NUMBER _____	PANEL NUMBER _____
ROLL NUMBER	_____	_____	_____
DEPLOYED LENGTH	_____	_____	_____
AMBIENT AIR TEMP.	_____	_____	_____
VISUAL OBSERVATION	_____	_____	_____
OBSERVED OVERLAP	_____	_____	_____
MONITOR	_____	_____	_____
REMARKS	_____	_____	_____
SHEET THICKNESS (MILS)	LEAD L SIDE R SIDE TRAIL	LEAD L SIDE R SIDE TRAIL	LEAD L SIDE R SIDE TRAIL
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
	_____	_____	_____
AVERAGE			

REVIEWED BY: _____ DATE _____

GEOMEMBRAL : SEAM LOG

PROJECT NUMBER: _____
 OWNER: _____
 LOCATION: _____
 PROJECT TITLE: _____
 CONTRACTOR: _____

PASSING TRIAL SEAMS
 NO. _____ TIME _____ TECH ID _____
 FUSION
 EXTRUSION
 MACHINE # _____

DATE _____
 SHEET NUMBER _____

DESTRUCTIVE LENGTH CARRY-OVER
 FROM PREVIOUS LOG _____

SEAM NUMBER	SEAM SECTION *		APPROX. START TIME	AMB. AIR TEMP.	WELD TECH.	PREHEAT OR MACH. SPEED	MACHINE TEMPERATURES			APPROX. LENGTH WELDED	LENGTH FROM PREVIOUS DESTR.	DESTR. NUMBER	REMARKS	NON-DESTRUCTIVE TEST		
	START POINT	FINISH POINT					DIGITAL SET	WEDGE OR BARREL NOZZLE	INDICATOR WEDGE OR BARREL NOZZLE					TEST DATE	MON.	
1	/	-														
2	/	-														
3	/	-														
4	/	-														
5	/	-														
6	/	-														
7	/	-														
8	/	-														
9	/	-														
10	/	-														
11	/	-														
12	/	-														
13	/	-														
14	/	-														
15	/	-														
16	/	-														
17	/	-														

* REFERENCE SEAM ENDPOINTS FROM AN END OF SEAM (EOS).
 A REPAIR NUMBER, OR A POINT LOCATION ON THE SEAM.
 DAILY TOTAL _____
 DESTRUCTIVE LENGTH CARRY-OVER _____
 ** COLUMNS TO BE USED BY THE DATA REVIEWER ONLY
 REVIEWED BY: _____ DATE _____

GEOMEMBRANE DEFECT LOG

PROJECT NUMBER: _____
 OWNER: _____
 LOCATION: _____

PROJECT TITLE: _____
 CONTRACTOR: _____

SHEET NUMBER _____

DEFECT CODE	DEFECT LOCATION		DEFECT TYPE	LOG DATE	MON.	REMARKS	**	**
	SEAM, PANEL OR REPAIR NO.	DEFECT LOCATION DESCRIPTION					REPAIR DATE	TEST DATE
A								
B								
C								
D								
E								
F								
G								
H								
I								
J								
K								
M								
N								
P								
Q								
R								
S								
T								
W								
X								

AD - ANIMAL RELATED DAMAGE
 B - UNDISPERSED RESIN BEAD
 BO - FUSION WELDER BURR
 BS - SCOT/SHORT FOR FILL PENETRATION
 CO - CHANGE OF OVERLAP
 CR - CREASE
 D - INSTALLATION DAMAGE
 DS-# - DESTRUCTIVE TEST NUMBER

EE - EARTHWORK EQUIPMENT DAMAGE
 EXT - EXTENSION
 FM - FISHMOUTH
 FS - FAILED SEAM LENGTH
 FTS - FIELD TEST STRIP
 HT - HEAT TACK BURR
 IO - INSUFFICIENT OVERLAP (UNDER SPEC.)
 MD - MANUFACTURER/ DELIVERY DAMAGE

PT - PRESSURE TEST CUT
 SI - SOIL SURFACE IRREGULARITY
 SL - SLAG ON TEXTURED SHEET
 T - THREE PANEL INTERSECTION
 VL - VACUUM TEST LEAK
 WR - WRINKLE
 WD - WELDER RESTART
 OTHER _____

** COLUMNS TO BE USED BY
 THE DATA REVIEWER ONLY.

REVIEWED BY: _____ DATE _____

GEOMEMBRANE REPAIR LOG

PROJECT NUMBER: _____
 OWNER: _____
 LOCATION: _____

PROJECT TITLE: _____
 CONTRACTOR: _____

PASSING TRIAL SEAMS

NO.	TIME	TECH. ID

MACHINE NUMBER _____

DATE _____

SHEET NUMBER _____

	DEFECT CODE	REPAIR DATE	APPROX. TIME	REPAIR TYPE	APPROX. DIMENSION	WELD TECH.	MON.	REMARKS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								

REPAIR TYPE: P - PATCH, C - CAP, RS - RECONSTRUCTED SEAM, G&W - GRIND WELD

REVIEWED BY: _____ DATE _____

CLOSURE CERTIFICATION FORM

In accordance with the condition of the Wastewater Department of Environmental Quality/Solid and Hazardous Waste Division (HW) File No. _____, requiring abatement of the Closure Certification Form within sixty (60) days of completion of the facility. I hereby certify:

1. Construction of the permitted facility was completed on _____ (DATE)

2. Construction was completed in accordance with the following: (Check the appropriate options)

- The facility was constructed in compliance with all terms and conditions of the permit including the resource plans and Construction Quality Assurance (CQA) Plan, design data, or other information submitted in support of the application.
- The facility was constructed with changes or modifications in accordance with the provisions of Chapter 1, Sections 3 and 4, Wastewater/Solid Waste Rules and Regulations. /a-bulk plan and specifications certified by a professional engineer registered in the State of Wyoming, and enclosed. Highlight all modifications or deviations from the authorized plans.

**ATTACHMENT E
CLOSURE CERTIFICATION FORM**

Facility Owner (print or type)

Owner's Signature

Project (print or type)

Engineer's Signature

Engineer Seal

CLOSURE CERTIFICATION FORM

In accordance with the condition of the Wyoming Department of Environmental Quality/Solid and Hazardous Waste Division SHWD File No. ____ - _____, requiring submittal of this Closure Certification Form within sixty (60) days of completion of the facility, I hereby certify:

1. Construction of the permitted facility was completed on _____ (DATE).
2. Construction was completed in accordance with the following: (Check the appropriate option)
 - The facility was constructed in compliance with all terms and conditions of the permit including the closure plans and Construction Quality Assurance (CQA) Plan, design data or other information submitted in support of the application.
 - The facility was constructed with changes or modifications in accordance with the provisions of Chapter 1, Sections 3 and 4, Wyoming Solid Waste Rules and Regulations. As-built plans and specifications, certified by a professional engineer registered in the State of Wyoming, are enclosed. Highlight all modifications or deviations from the authorized plans.
3. Submit the CQA Report (see Attachment D of the General Closure Permit)

Facility Owner (print or type)

Owners Signature

Date

Engineer (print or type)

Engineers Signature

Date

Engineer Seal:

DATE OF INSPECTION

Date of Inspection (if necessary)	Action Taken (if necessary)	Observations	Items to be Inspected and Evaluated
			Final Cover - is well constructed any damage due to erosion sufficient for downy growth holes, slope failures, ruts, cracks, obstacles, and subsidence
			Vegetation - is seed areas with good growth performance
			Mowing - only if necessary to control invasive weeds, must be done prior to invasive weeds going to seed
			Woody growth - must be removed
			Revegetation Monitoring Notes - report as required
			Gas Vents and Probes - report as required
			Surface Water Discharge equipment and channels - report as required
			Perimeter Roads and Final Cover Disturbance Areas Road - report on erosion required to allow access for maintenance and monitoring
			Perimeter Fencing and Gates - report as required to prevent unauthorized access to the facility

ATTACHMENT F

POST-CLOSURE INSPECTION CHECKLIST

Additional comments:

Inspector's Name Printed

Inspector's Signature

ANNUAL POST-CLOSURE INSPECTION CHECKLIST

DATE OF INSPECTION:

Items to be Inspected and Evaluated	Observations	Action Taken (if necessary)	Date of Reinspection (if necessary)
Final Cover – repair/revegetate any damage due to erosion, settlement, burrowing animal holes, slope failures, leachate outbreaks, and subsidence.			
Vegetation – re-seed areas with poor growth performance			
Mowing – only if necessary to control invasive weeds, must be done prior to invasive weeds “going to seed”			
Woody growths – must be removed			
Groundwater Monitoring Wells – repair as required			
Gas Vents and Probes – repair as required			
Surface Water Basin (if applicable) and Channels – repair as required			
Perimeter Roads and Final Cover Maintenance Access Road – repair and grade as required to allow access for maintenance and monitoring			
Perimeter Fencing and Gates – repair as required to prevent unauthorized access to the facility			

Additional comments:

Inspector’s Signature:

Inspector’s Name Printed:
