SKYLINE LANDFILL
CITY OF FERRIS
DALLAS AND ELLIS COUNTIES, TEXAS
TCEQ PERMIT APPLICATION NO. MSW 42D

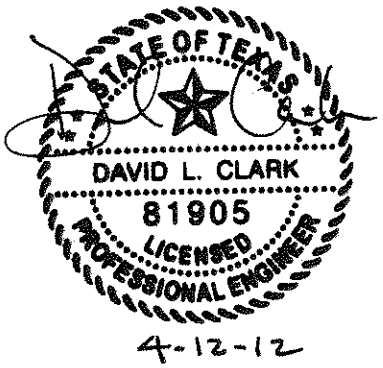
PERMIT AMENDMENT APPLICATION

PART III – FACILITY INVESTIGATION AND DESIGN
ATTACHMENT D8
FINAL COVER QUALITY CONTROL PLAN

Prepared for

Waste Management of Texas, Inc.

April 2012



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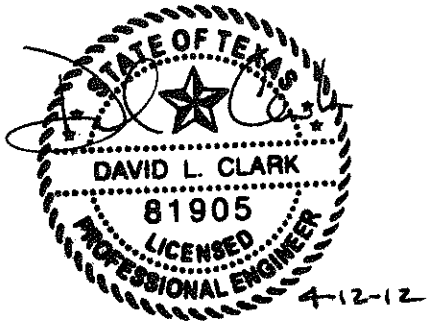

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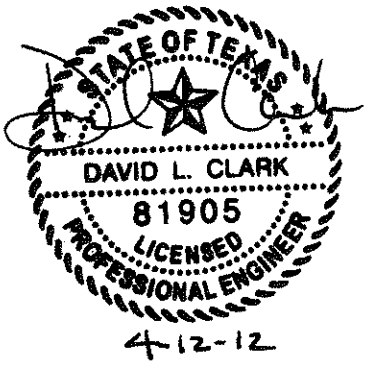

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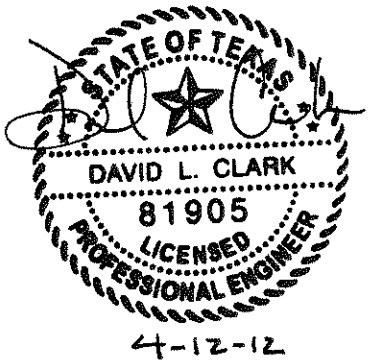

1 INTRODUCTION

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1.1 Purpose

This Final Cover Quality Control Plan (FCQCP) has been prepared in accordance with 30 TAC §330.457. This FCQCP establishes the procedures for the design, construction, testing, and documentation of the final cover system.

1.2 Definitions

Specific terms and acronyms that are used in this FCQCP are defined below.

ASTM – American Society for Testing and Material

Construction Quality Assurance (CQA) – CQA is a planned system of activities that provides the owner and permitting agency assurance that the facility was constructed as specified in the design. CQA includes the observations, evaluations, and testing necessary to assess and document the quality of the constructed facility. CQA includes measures taken by the CQA organization to assess whether the work is in compliance with the plans, specifications, and permit requirements for a project.

Geotechnical Professional (GP) – The GP is the authorized representative of the owner who is responsible for all CQA activities for the project. The GP must be registered as a Professional Engineer in Texas. Experience and education should include geotechnical engineering, engineering geology, soil mechanics, geotechnical laboratory testing, construction quality assurance and quality control testing, and hydrogeology. The GP must also have competency and experience in certifying similar projects.

The GP may also be known in applicable regulations and guidelines as the CQA engineer, resident project representative, geotechnical quality control/quality assurance professional (GQCP), or professional of record (POR).

CQA Monitors – CQA monitors are representatives of the GP who work under direct supervision of the GP. The CQA monitor is responsible for quality assurance monitoring and performing on-site tests and observations. The CQA monitor must be NICET-certified at Level 2 for soils and geosynthetics, an engineering technician with a minimum of four years directly related experience, or a graduate engineer or geologist with one year of directly related experience.

Owner's Representative – The owner's representative is an official representative of the owner responsible for planning, organizing, and controlling the design and construction activities.

Quality Assurance – Quality assurance is a planned program that is designed to assure that the work meets the requirements of the plans, specifications, and permit for a project. Quality assurance includes procedures, quality control activities, and documentation that are performed by the GP and CQA monitor.

Quality Control – Quality control includes the activities that implement the quality assurance program. The GP, CQA monitor, and contractor will perform quality control.

2 FINAL COVER SYSTEM

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2.1 Final Cover System

The alternate final cover system will consist of an infiltration layer, a drainage layer, and an erosion control layer. The infiltration layer will consist of a minimum of 18 inches of compacted soil with a coefficient of permeability of less than or equal to 1×10^{-7} cm/sec. The drainage layer will consist of a double-sided geocomposite. The erosion layer will consist of a minimum of 36 inches of soil, of which the upper 6 inches is capable of sustaining native plant growth. The final cover will be vegetated following the construction of the final cover to minimize erosion.

The final cover plan is included in Attachment D3 – Construction Design Details, Drawing D3.9. Details of the final cover system are provided in Drawing D3.10. The components of the final cover system are listed from top to bottom in Table D8-1.

Table D8-1
Skyline Landfill
Components of the Final Cover System

ALTERNATE FINAL COVER SYSTEM		
Cover System Component	**Description**	**Thickness**
Erosion Layer	Soil that is capable of sustaining native plant growth	36 inches
Drainage Layer	Double-sided geocomposite	0.2 inches
Infiltration Layer	Compacted soil with a maximum coefficient of permeability less than or equal to 1×10^{-7} cm/sec	18 inches

2.2 Construction Monitoring

Continuous on-site monitoring is necessary to assure that the components of the final cover system are constructed in accordance with this FCQCP. The CQA monitor shall provide continuous on-site observation during the following construction activities:

- Infiltration layer placement, processing, compaction, and testing
- Drainage layer deployment and seaming
- Erosion layer placement
- Any work that could damage the installed components of the final cover system

The GP will document and certify that the final cover system was constructed in accordance with this FCQCP. The GP shall make sufficient site visits to observe critical construction activities and to verify that the construction and quality assurance activities are performed in accordance with this FCQCP.

3 INTERMEDIATE COVER AND GRADING

§330.165(c)

3.1 General

The proposed landfill completion plan for the Skyline Landfill is provided in Attachment D3 – Construction Design Details, Drawing D3.9. The final lift of waste will be covered by intermediate cover that is placed in accordance with Part IV – Site Operating Plan.

3.2 Materials

Intermediate cover will consist of general fill that has not previously come into contact with waste.

3.3 Slopes

The slope stability analyses are provided in Attachment D5 – Geotechnical Design, Appendix D5-B – Slope Stability Analyses. The slope stability analyses are only valid for the conditions that were analyzed. Any changes to the final cover system or landfill completion plan will require that the slope stability analyses be revised to reflect the actual conditions. Interim 3H:1V waste slopes shall not exceed 210 feet in height. Temporary construction slopes shall not be steeper than the interim slopes and concentrated loadings, such as heavy equipment and soil stockpiles, and shall not be placed near the crest of slopes unless additional slope stability analyses are performed.

3.4 Testing and Verification

Intermediate cover placement and grading will be observed and documented by the landfill staff in accordance with Part IV – Site Operating Plan.

4 INFILTRATION LAYER

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4.1 General

The infiltration layer consists of an 18-inch-thick layer of compacted, relatively homogeneous, cohesive material. The CQA monitor shall provide continuous on-site observation during infiltration layer placement, processing, compaction, and testing. The GP shall make sufficient site visits during infiltration layer construction to document the construction activities, testing, and thickness verification in the Final Cover System Report, in accordance with Section 7.

4.2 Materials

Infiltration layer material shall consist of soil that is free from debris, rubbish, frozen materials, foreign objects, and organic material. The required infiltration layer material properties are summarized in Table D8-2.

Table D8-2
Skyline Landfill
Infiltration Layer Material Properties

Test	Standard	Required Property
Plasticity Index	ASTM D 4318	15 or greater
Liquid Limit	ASTM D 4318	30 or greater
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	30 or greater
Percent Passing 1-inch Sieve	ASTM D 422	100
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	Less than or equal to 1×10^{-7} cm/sec

Preconstruction testing procedures and frequencies for infiltration layer materials are listed in Section 4.8.1.

4.3 Subgrade Preparation

Prior to placing infiltration layer material, the subgrade should be proof rolled with heavy, rubber-tired construction equipment to detect soft areas. The GP or CQA monitor must

observe the proof-rolling operation. Soft areas should be compacted and then be proof rolled again.

The subgrade elevations shall be verified in accordance with the requirements of Section 4.8.3 prior to the placement of infiltration layer.

4.4 Placement and Processing

The infiltration layer subgrade and surface of each lift should be roughened prior to placement of the next lift of the infiltration layer. The infiltration layer material should be placed in maximum 8-inch loose lifts to produce a compacted lift thickness of approximately 6 inches. The material should be processed to a maximum particle size of 1 inch or less before water is added. Rocks and clods less than 1 inch in diameter should not total more than 10 percent by weight.

If additional water is necessary to adjust the moisture content, it should be applied after initial processing but prior to compaction. Water should be applied evenly across the lift and worked into the material. Waste or any objectionable material must not contaminate compaction water.

4.5 Compaction

The infiltration layer shall be compacted with a pad/tamping-foot or prong-foot roller. A footed roller is necessary to bond the lifts, distribute the water, and blend the soil matrix through kneading action. The infiltration layer shall not be compacted with a bulldozer, rubber-tired roller, flat-wheel roller, scrapers, or any track equipment unless it is used to pull a footed roller. The compactor should weigh at least 40,000 pounds. The lift thickness shall be controlled to achieve total penetration into the top of the previously compacted lift; therefore, the lift thickness must not be greater than the pad or prong length. Cleaning devices on the roller must be in place and maintained to prevent the prongs or pad feet from becoming clogged to the point that they cannot achieve full penetration.

The compactor shall make at least four passes across the area being compacted. A pass is defined as one pass of the compactor, front and rear drums. The material should be compacted to a minimum of 95 percent of the maximum dry density determined by standard Proctor (ASTM D 698) at a moisture content at or above optimum moisture. Areas with failing tests shall be reworked, recompacted, and retested, and passing tests must be achieved before another lift is added.

After a lift is compacted, it must be watered to prevent drying and desiccation until the next lift can be placed. If desiccation occurs, the GP must determine if the lift can be rehydrated by surface application of water or if the lift must be scarified, watered, and recompacted. Following compaction and fine grading of the final lift, the surface of the infiltration layer shall be smooth drum rolled.

4.6 Protection

The completed infiltration layer must be protected from drying, desiccation, rutting, erosion and ponded water until the geocomposite is installed. Areas that undergo excessive desiccation or damage shall be scarified, reworked, recompacted, and retested as directed by the GP.

4.7 Tie In to Existing Covers

The edge of existing infiltration layers shall be cut back on either a slope or step to prevent the formation of a vertical joint. Details for the tie in to existing cover are provided in Attachment D3, Drawing D3.3 – Liner Details.

4.8 Testing and Verification

4.8.1 Preconstruction Testing

Table D8-3 lists the minimum testing required for material proposed for use as the infiltration layer.

Table D8-3
Skyline Landfill
Infiltration Layer Material Preconstruction Tests

Test	Standard	Frequency
Plasticity Index	ASTM D 4318	1 per material type
Liquid Limit	ASTM D 4318	1 per material type
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	1 per material type
Percent Passing 1-inch Sieve	ASTM D 422	1 per material type
Standard Proctor Test	ASTM D 698	1 per material type
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	1 per material type

After the moisture density relationship has been determined for a material type, a soil sample should be remolded to about 95 percent of the maximum dry density at the optimum moisture content. This sample will be tested to determine if the soil can be compacted to achieve a suitable coefficient of permeability. Either falling head or constant head laboratory permeability tests may be performed to determine the coefficient of permeability. The permeant fluid for testing must be tap water or 0.005N calcium sulfate solution. Distilled or deionized water shall not be used as the permeant fluid.

4.8.2 Construction Testing

Table D8-4 lists the minimum testing required for material used as the infiltration layer.

Table D8-4
Skyline Landfill
Infiltration Layer Material Construction Tests

Test	Standard	Frequency
Field Density	ASTM D 2922	1/8,000 sf per 6-inch lift
Plasticity Index	ASTM D 4318	1 per acre
Liquid Limit	ASTM D 4318	1 per acre
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	1 per acre
Standard Proctor Test	ASTM D 698	1 per material type
Coefficient of Permeability	ASTM D 5084 or COE EM 1110-2-1906 Appendix VII	1 per acre

The Atterberg limits of the in-place infiltration layer must be compared to the Atterberg limits of the Proctor curve sample to assure that the Proctor curve represents the in-place material. Any variance of more than 10 points between the liquid limit or plasticity index of the in-place soil and those of the Proctor curve sample will require that a new Proctor curve be developed.

4.8.3 Thickness Verification

The as-built thickness of the infiltration layer shall be determined by standard survey methods. Prior to the placement of infiltration layer material, the subgrade elevations will be determined at a minimum rate of 1 survey point per 5,000 square feet of lined area. After the infiltration layer is completed, the top of infiltration layer elevations will be determined at the same locations as the subgrade elevations.

5 DRAINAGE LAYER

30 TAC §330.457

5.1 General

The drainage layer consists of a double-sided geocomposite. The CQA monitor shall provide on-site observation during geocomposite drainage layer installation. The GP shall make sufficient site visits during geocomposite drainage layer installation to document the installation in the Final Cover Evaluation Report.

5.2 Materials

5.2.1 Geocomposite

Double-sided geocomposite (nonwoven geotextile bonded to the top and bottom of HDPE drainage net) will be installed on all slopes. The geocomposite shall have the minimum properties listed in Table D8-5.

Table D8-5
Skyline Landfill
Geocomposite Properties

Material	Test	Standard	Required Property
Geotextile	Material		Nonwoven polypropylene or polyester
	Apparent Opening Size	ASTM D 4751	70 sieve
HDPE Drainage Net	Specific Gravity	ASTM D 1505	0.93 g/cm^3
	Thickness	ASTM D 5199	0.2 inch (200 mil)
	Carbon Black	ASTM D 1603	Minimum 2%, maximum 3%
Geocomposite	Transmissivity	ASTM D 4716	5 x 10^{-4} m^2/sec

Manufacturer quality control testing procedures for geocomposite are listed in Section 5.5.

5.2.2 Delivery and Storage

Geocomposite shall be shipped in rolls labeled with the manufacturer's name, roll number, and lot or batch number. The CQA monitor shall inspect the rolls for shipping damage and complete a geosynthetics receipt log for all materials delivered to the site. Damaged rolls shall be rejected.

The geocomposite shall be unloaded and handled with equipment that does not cause damage to the geocomposite rolls. Rolls should not be pushed, slid, or dragged to the storage location. The geocomposite must not be stored on wet, soft, or rocky subgrade, but must be stored on a stable subgrade. Geocomposite must not be stacked more than five rolls high to avoid crushing the roll cores. The stored geocomposite must be protected from puncture, grease, dirt, excessive heat, or other damage.

5.3 Preparation

Prior to installation of the drainage layer, the infiltration layer shall be tested and verified in accordance with Section 4.8. The CQA monitor shall observe that the surface to receive the geocomposite is free of debris, stones, and dirt and verify that the conformance documentation has been submitted and approved.

5.4 Installation

Double-sided geocomposite shall be installed on all slopes. Geocomposite shall be deployed by equipment that will unroll the geocomposite without damaging, crimping, or stretching it and deployment equipment must not damage the underlying infiltration layer. All panels must be anchored with adequate ballast to prevent uplift from wind. Smoking and wearing shoes that could damage the geocomposite shall not be permitted on the geocomposite and only low-ground pressure supporting equipment shall be allowed on the geocomposite. Adjacent rolls of geocomposite shall be securely tied through the drainage net with plastic fasteners every 5 feet along the length of the panel and every 6 inches along the ends of the panels.

During drainage layer placement, the CQA monitor must:

- Provide full time observation.
- Record weather conditions.
- Observe the condition of the geocomposite and note any defects. All defects must be repaired or replaced.
- Observe that people working on the geocomposite do not smoke, wear shoes that could damage the geocomposite, or engage in activities that could damage the geocomposite or infiltration layer.
- Observe that the deployment method minimizes wrinkles in the geocomposite.
- Observe that the geocomposite panels have been properly tied and seamed.

Any panels that are not installed in accordance with this section shall be marked by the CQA monitor and be repaired or removed and replaced by the installer.

5.5 Testing and Verification

The manufacturer shall test the geocomposite to assure the quality of the drainage layer materials. Material property requirements are provided in Section 6.2. Minimum manufacturer's testing requirements are provided in Table D8-6. Manufacturer's testing shall be performed at a minimum frequency of one test per 100,000 sf.

Table D8-6
Skyline Landfill
Geocomposite Manufacturer's Tests

Material	Test	Standard
Geotextile	Weight	ASTM D 5261
	Apparent Opening Size	ASTM D 4751
HDPE Drainage Net	Specific Gravity	ASTM D 1505
	Thickness	ASTM D 5199
	Carbon Black	ASTM D 1603
Geocomposite	Transmissivity	ASTM D 4716

6 EROSION LAYER

30 TAC §330.457

6.1 General

The erosion layer consists of a 36-inch-thick layer of soil with the upper six inches capable of sustaining native plant growth. The CQA monitor shall provide continuous on-site observation during erosion layer placement to assure that erosion layer placement does not damage underlying geocomposite or infiltration layer. The GP shall make sufficient site visits during erosion layer placement to document the construction activities and thickness verification in the Final Cover Evaluation Report.

6.2 Materials

Erosion layer material shall consist of soil that is free from debris, rubbish, frozen materials, foreign objects, and organic material, or any material that could damage the underlying geocomposite. The required erosion layer material properties are summarized in Table D8-7.

Table D8-7
Skyline Landfill
Erosion Layer Material Properties

Test	Standard	Required Property
Plasticity Index	ASTM D 4318	15 or greater
Liquid Limit	ASTM D 4318	30 or greater
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	30 or greater

6.3 Preparation

Prior to placing the erosion layer material, the top of infiltration layer elevations shall be verified in accordance with the requirements of Section 4.8.3 and all testing on the underlying geocomposite shall be completed.

6.4 Placement

The erosion layer shall be placed in a manner that minimizes the potential to damage the underlying geocomposite. Hauling equipment shall be restricted to haul roads of sufficient thickness to protect the underlying geocomposite. The erosion layer shall be dumped from the haul road and spread by low ground pressure equipment in a manner that minimizes wrinkles and stress in the geocomposite. On side slopes, erosion layer shall be placed from the bottom to the top, not across or down. Erosion layer shall not be placed over geocomposite that are stretched across the toes of slopes. The minimum separation distance between construction equipment and the geocomposite are listed in Table D8-8.

The erosion layer will be vegetated following the application of final cover in order to minimize erosion.

Table D8-8
Skyline Landfill
Minimum Separation Distance

Equipment Ground Pressure (psi)	Minimum Separation Distance (in)
< 4	12
4 - 8	18
8 - 16	24
> 16	36

Any geocomposite that, in the opinion of the CQA monitor, has been damaged by the erosion layer placement must be repaired and retested in accordance with Sections 5 and 6.

6.5 Testing and Verification

6.5.1 Preconstruction Testing

Table D8-9 lists the minimum testing required for material proposed for use as the infiltration layer.

Table D8-9
Skyline Landfill
Erosion Layer Material Preconstruction Tests

Test	Standard	Frequency
Plasticity Index	ASTM D 4318	1 per material type
Liquid Limit	ASTM D 4318	1 per material type
Percent Passing No. 200 Mesh Sieve	ASTM D 1140	1 per material type

6.5.2 Thickness Verification

The as-built thickness of the erosion layer shall be determined by standard survey methods. Prior to the placement of erosion layer, the top of infiltration layer elevations will be determined at a minimum rate of 1 survey point per 5,000 square feet of lined area. After the erosion layer is completed, the top of the erosion layer elevations will be determined at the same locations as the top of infiltration layer elevations.

7 DOCUMENTATION

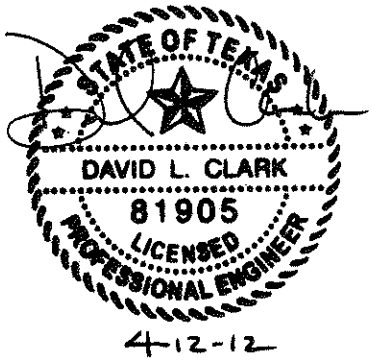
After construction of the final cover system, the GP will submit a Final Cover Evaluation Report to the TCEQ on behalf of the owner. The purpose of the Final Cover Evaluation Report is to document that the construction methods and test procedures are consistent with this FCQCP.

At a minimum, the Final Cover Evaluation Report will contain the following:

- A summary of all construction activities
- A summary of all laboratory and field test results
- Sampling and testing location drawings
- A description of significant construction problems and the resolution of these problems
- Record drawings
- A statement of compliance with the FCQCP
- The seal and signature of the GP and assistant GP, if applicable, in accordance with the Texas Engineering Practice Act

SKYLINE LANDFILL

APPENDIX D8-A
GEOCOMPOSITE TRANSMISSIVITY CALCULATION



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Skyline Landfill
Geocomposite Design

Required: Determine the minimum transmissivity for the final cover geocomposite.

References:

1) Giroud, J.P., Zornberg, J.G., and Zhao, A., 2000, "Hydraulic Design of Geosynthetic and Granular Liquid Collection Layer", *Geosynthetics International,* Special Issue on Liquid Collection Systems, Vol. 7, Nos. 4-6, pp. 285-380.

Assumptions:

1) The liquid supply to the geocomposite will be limited to the hydraulic conductivity of the overlying erosion layer since the rate of infiltrating stormwater cannot exceed the soil's hydraulic conductivity.

Solution:

1) Calculate the ultimate transmissivity value for the final cover geocomposite from Reference 1.

$$T_{ult} = q_h L/\sin\beta \quad \text{[Ref 1., Eq. 35]}$$

where:

q_h = rate of liquid supply
L = horizontal drainage layer distance
β = slope angle of drainage layer, measured from horizontal

q_h = hydraulic conductivity of overlying erosion layer
= 1×10^{-6} cm/sec
= 0.0036 in/hour

Slope Designation	q_h in/hour	L ft	Sideslope %	β deg	T_{ult} m^2/sec	T_{ult} m^2/sec
Topslope	0.0036	720	2.5	1.4	2.3E-04	5.0E-04
Sideslope	0.0036	980	25	14.0	3.1E-05	5.0E-04