WASTE MANAGEMENT OF TEXAS
A WASTE MANAGEMENT COMPANY
9708 Giles Lane
Austin, Texas 78781

February 21, 2018

Texas Commission on Environmental Quality
MSW Permits Section, Waste Permit Division
P.O. Box 13087, MC-124
Austin, Texas 78711-3087

Attn: Chance Goodin
Manager, MSW Permits Section

Re: Response to TCEQ Comments
Permit Modification Request – Changes to Final Cover Design to Include a Water Balance Alternative Final Cover
Waste Management of Texas, Inc.
Austin Community Recycling and Disposal Facility
Travis County, Texas
TCEQ Permit No. MSW 249D

Dear Mr. Goodin:

Waste Management of Texas, Inc. (WMTX) is submitting the attached response to comments pertaining to the Permit Modification (PM) request, prepared by Golder Associates Inc. (Golder), for changes to final cover design to include a water balance alternative final cover at the Austin Community Recycling and Disposal Facility. In accordance with the requirements of 30 Texas Administrative Code (TAC) Section 305.44(b):

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Enclosed with this letter are the original and one copy. An additional copy has been forwarded to Mr. David Mann, Waste Program Manager of the TCEQ Region 11 office in Austin, Texas.

If you have any questions concerning this letter, please contact Tim Champagne, PE of WMTX at (512) 731-9768 or me at (512) 272-6245.

ON BEHALF OF WASTE MANAGEMENT OF TEXAS, INC.

Steve Jacobs
Texas Area Director of Landfill Operations
9708 Giles Lane
Austin TX 78754

cc: David Mann – TCEQ Region 11

February 21, 2018 Our Ref.: 1782540

Texas Commission on Environmental Quality
MSW Section, Waste Permits Division
P.O. Box 13087, MC-124
Austin, Texas 78711-3087

Attn: Arten Avakian, Project Manager
Municipal Solid Waste Permits Section

RE: RESPONSE TO TCEQ COMMENTS
PERMIT MODIFICATION REQUEST
WATER BALANCE ALTERNATIVE FINAL COVER
AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D
TRACKING NO. 22075131; RN100215938/CN600127856

Dear Mr. Avakian:

On behalf of Waste Management of Texas, Inc. (WMTX), Golder Associates Inc. (Golder) is submitting this response to comments for the above-referenced Permit Modification (PM) request to the existing Texas Commission on Environmental Quality (TCEQ) Permit Number Municipal Solid Waste (MSW) 249D, at the Austin Community Recycling and Disposal Facility, located in Travis County, Texas. The TCEQ provided these comments on the PM request in a notice of deficiency (NOD) letter dated December 19, 2017.

The responses presented herein are cross-referenced to the TCEQ comments using the comment numbers and quoting the original comments.

1. Comment: Clarify what the proposed alternative final cover layer thicknesses and properties are to be. The final cover stability analysis in proposed new Appendix C.5A indicates the infiltration layer will be four feet thick, and the erosion layer one foot thick, whereas the proposed revisions to the closure plan state the cover will consist of an 18-inch (minimum) infiltration layer and six-inch thick (minimum) erosion layer. The final cover quality control plan, in proposed new Section 5.0 (Alternative Water Balance Cover System) suggests that you still need to investigate the properties of the construction materials before you can specify the final design.

   Response: The final cover stability analysis located in Appendix C.5C was performed to demonstrate cover stability for a worst case scenario.

   RG-494, Option 1 provides flexibility in thickness of the water balance cover storage layer and erosion layer to accommodate variability in site specific soil properties. This is determined based on the hydraulic conductivity of water balance cover soils in accordance with the TCEQ guidance document RG-494 at the time of construction. The procedures for determining final cover thickness has been added to Part III, Attachment 7, Appendix A, Section 5.2. The minimum thickness was incorrectly stated as 18-inches in the initial submittal and has been corrected to 20-inches in this submittal. While the minimum thickness of the storage layer is 20-inches, it may increase to up to 3-feet 11-inches depending upon the hydraulic conductivity of the soil used in the construction. In no case will it be less than 20-inches thick.

Golder Associates Inc.
500 Century Plaza Drive, Suite 190
Houston, TX 77073 USA
Tel: (281) 821-6868 Fax: (281) 821-6870 www.golder.com

The following two conditions will be ensured for all WBAFC design regardless of the specific thickness of the cover:

(1) The final grades, i.e. the top of the final cover, will be maintained per the TCEQ permitted final grading plan to ensure proper drainage and transition between existing and new final cover areas.

(2) Final waste grades will be maintained as necessary to be at or below the TCEQ permitted final elevation once the cover is installed.

To achieve the above two requirements, the subgrade of the Water Balance Alternative Final Cover (WBAFC) will be adjusted based on the WBAFC thickness.

The erosion layer thickness, in accordance with the guidance document RG-494, will be 6-inch thick at minimum. When high plasticity clay (liquid limit >50) is used as the storage layer, the erosion layer will be increased to 1 foot thick.

The following changes have been made in response to the question:

a) Section 2.1 of Attachment 7, Closure Plan has been revised to indicate the minimum thickness of the storage layer is 20-inches, and to more clearly state the ultimate thickness is dependent upon the hydraulic conductivity of the storage layer soils used in the construction.

b) Attachment 7, Appendix A, Final Cover Quality Control Plan, Sections 1.2 and 5.2 have been revised to more clearly state that the storage layer thickness is to be determined based on the hydraulic conductivity of the storage layer soils used in the construction.

2. Comment: Provide layer and interface stability analyses for each proposed final cover material, hydraulic conductivity and thickness configuration. If the demonstration uses material property values documented in other parts of the permit, identify precisely where those data are in the application.

   Response: Part III, Attachment 3, Appendix C.5A has been revised to address material properties, to discuss the final cover profile, and to add a new circular failure mode analysis.

3. Comment: Provide complete references for the document by Dr. Miland V. Khier, cited in the final cover quality control plan and for the sources of equations used in the stability analysis.

   Response: The reference to the document prepared by Dr. Miland V. Khire cited in Attachment 7, Appendix A, Final Cover Quality Control Plan, Sections 1.2 and 5.0 have been revised to reference the TCEQ document RG-494.

   The equation used in the stability analysis was derived based on the force equilibrium of the final cover soil layer. Please refer to Chapter 12.3 of "Principles of Geotechnical Engineering" by Braja M. Das. This reference has been added to Part III, Attachment 3, Appendix C.5A, Section 3.0 (under Block Failure Mode).

4. Comment: Provide a marked copy of the table of contents for Attachment 7 to show the changes to pagination.

Response: A marked copy of the table of contents for Attachment 7 has been added. There is no change to the pagination.

5. Comment: Provide marked copies of Figures ATT7-1A and ATT7-1B to show the proposed changes.

   Response: Marked copies of these figures have been added as requested.

6. Comment: Provide clean copies and marked copy of the table of contents for Attachment 7, Appendix A to show added section, and changes to section numbers and pagination.

   Response: Clean and marked copies of the table of contents for Attachment 7, Appendix A have been added as requested.

Three additional change were made. Part III, Attachment 7, Appendix A Section 5.3 was revised to show the proposed construction testing frequencies consistent with RG-494. Figure ATT7-1B was revised to more clearly show the West Hill expansion area. Figure ATT7-2 was revised to more clearly show the thickness of the erosion layer may vary.

The following documents are included in this submittal:

- Part III, cover page
- Part III, Attachment 3
  - Cover page
  - Table of contents
  - Appendix C.5A Final Cover Stability – Water Balance Alternative Final Cover
- Part III, Attachment 7
  - Cover page
  - Table of contents
  - Section 2.1
  - Figures ATT7-1A and ATT7-1B
  - Figure ATT7-2
- Part III, Attachment 7, Appendix A
  - Cover page
  - Table of Contents
  - Pages 2, 22, and 26 through 29.
- TCEQ-20650 Form
  - Page one and the signature page

CLOSING

If you have any questions, please do not hesitate to call either Mr. William E. (Chip) Gordon P.E. or Ms. May Xin, P.E. of Golder at (281) 821-6868.

Golder Associates

Sincerely,

GOLDER ASSOCIATES INC.

May Xin, PE
Senior Engineer

William Gordon, PE
Senior Engineer

Jeff Fassett, PE
Associate

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

Enclosures:
Enclosure 1 – Marked Copies
Enclosure 2 – Clean Copies
Enclosure 3 - TCEQ-20650 Form Page 1 and Signature Page

cc: Mr. Jayson Lang, WMTX
Mr. Tim Champagne, WMTX

Golder Associates

ENCLOSURES

ENCLOSURE 1

MARKED COPIES

WASTE MANAGEMENT, INC.

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

SITE DEVELOPMENT PLAN

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

Golder Associates

500 Century Plaza Drive
Suite 190
Houston, Texas 77073
(281) 821-6868

Permit Issued: May 10, 2010
Revised April 2011
Revised June 2011
Revised October 2017
Revised February 2018

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 3
WASTE MANAGEMENT UNIT DESIGN REPORT

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

500 Century Plaza Drive
Suite 190
Houston, Texas 77073
(281) 821-6868

August 2006
Revision 1 – May 2007
Revision 2 – August 2007
Revision 3 – December 2007
Revision 4 – February 2008
Revision 5 – March 2008
Revision 6 – May 2008
Revised October 2017
Revised February 2018

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 3
WASTE MANAGEMENT UNIT DESIGN REPORT

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

The interior waste slope stability analysis is presented in Appendix C.3.

4.3.2.4 Stability of Final Filled Configuration

The final filled configuration was considered across cells WD-11, WD-12, and WD-13, up to a maximum cover elevation of 740 feet. The configuration was analyzed using appropriate shear strength parameters and worst-case geometry. The results, based on analyses performed using SLIDE and included in Appendix C.4, indicate that the final waste slopes will be stable with a minimum factor of safety of 1.58.

4.3.2.5 Stability of Final Cover System

A stability analysis of the final cover liner system was performed using methods outlined by Soong and Koerner (1996) to estimate the potential for sliding to occur following closure of the landfill cells. A worst-case section, consisting of a 710-foot long, 25-percent slope was analyzed. Based on a review of the literature and unpublished data on similar materials under similar loading conditions, the critical interface shear strength within the final cover liner system was estimated to be 21º.

The analyses (included in Appendix C.5) indicate that, provided the geocomposite drainage layer is adequate to convey drainage without building up pore water pressures in the geocomposite, the factor of safety against sliding will be approximately 1.6.

Additional analyses (included in Appendix D) were performed to determine the geocomposite drainage layer transmissivity required to adequately convey surface water infiltration over the maximum final cover slope length. If the minimum measured transmissivity value reported in Appendix D is not met, the maximum flow length must be reduced (i.e., the geocomposite drainage layer must be "daylighted") in direct proportion to the ratio of the actual measured transmissivity and the required measured transmissivity. A detail depicting "daylighting" is included on Figure ATT7-2 in Attachment 7, the Closure Plan.

A stability analysis of the water balance final cover was also performed using the limit equilibrium analysis. The section analyzed consists of a 710-foot long, 25-percent slope, consistent with the section analyzed for the composite final cover system. Material parameters were selected based on review of literature and site data, which are also consistent with other slope stability analyses in Appendix C. The analysis (included in Appendix C.5A) indicate that the factor of safety against sliding will be approximately 2.6~~4.1~~.

APPENDIX C.5A

FINAL COVER STABILITY – WATER BALANCE ALTERNATIVE FINAL COVER

FINAL COVER STABILITY - WATER BALANCE ALTERNATIVE FINAL COVER

Made By: MX
Checked by: JBF
Reviewed by:

1.0 OBJECTIVE

To investigate the veneer slope stability of the water balance alternative final cover system.

2.0 GIVEN

Final cover slopes are as follows:

Future final cover area: 4H:1V (S = 25%) with a maximum length of slope conservatively assumed to be 710 ft.

Based on the "EPA Guide to Technical Resources for the Design of Land Disposal Facilities", the recommend factor of safety for the final cover slope is selected to be 1.5 at minimum.

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

3.0 ASSUMPTIONS

A worst-case, i.e. a thickest final cover profile is used for the slope stability analysis for conservative purposes:

1-ft erosion layer with the top 6 inches vegetative cover
4-ft storage layer ($K_{as\text{-}built} \leq$ 1.00*10-7 cm/sec - worst case, i.e. thickest final cover)
Subgrade

Soil source for the water balance final cover will be on-site clay soil materials.

Based on a review of available data, the following parameters were assigned to the materials.

Material	Strength Parameters		Unit Weight (pcf)		Reference
	ϕ (degree)	c (psf)	Moist	Saturated	
Final Cover Soil	0	1000	119	132	Part III, Attachment 3, Text Section 4.2.3, Tables 3.3 and 3.4
Interface Between Final Cover Soil & Subgrade	0	750	N/A	N/A	

Notes:

1. The shear strength of the final cover soil is estimated based on the on-site soil shear strength (Strata IA and IB). As shown in Part III, Attachment 3, Text Section 4.2.3, Tables 3.3 and 3.4, the mininum shear strengh of onsite clay materials is 2,100 psf. For conservative purposes, the shear strength of the final cover soil is assumed to be 1,000 psf and the interface is assumed to be even lower at 750 psf.

2. The final cover system, including both the top erosion layer and the storage layer, will be constructed of on-site clay materials . The storage layer will be compacted as described in the final cover quality control plan to reach the required permeability, and the erosion layer will be resonably compacted and vegetation will be established on the final cover. For slope stability analysis purposes, it is not necessary to analyze the top soil stability separately, rather, the entire final cover system is considered as one unit.

3.0 METHODS

Two slope stability analyses were performed for the final cover system:

- Circular failure for the final cover system
- Block (i.e. sliding) failure of the final cover system along the final cover/subgrade interface

Circular Failure Mode:

A slope stability software (SLIDE v7.029) was used to perform the analysis. The minimum factor of safety is shown below and output of stability analysis is attached.

Allow failure surface in the final cover only	**FS_{min} = 9.5**
Allow failure surface into the waste	**FS_{min} = 2.6**

Block Failure Mode:

A limit equilibrium analysis was performed to determine the minimum factor of safety against a sliding block failure along the interface. The equation below was derived based on the force equilibrium of the final cover soil layer. Please refer to Chapter 12.3 of "Principles of Geotechnical Engineering" by Braja M. Das.

$$FS = \frac{c + (\gamma b \cos\beta - \gamma_w d \cos\beta)\tan\phi}{\gamma b \sin\beta}$$

Potential Sliding of the Water Balance Final Cover

ϕ =	0	interface friction angle
c =	750	interface cohesion (psf)
β =	14.0	slope angle (degrees)
γ =	132	saturated unit weight of soil (pcf)
b =	5.0	soil thickness (ft)
d =	5	water depth in cover (conservatively assume the entire final cover is saturated) (ft)
γ_w =	62.4	unit weight of water (pcf)
FS =	**4.7**	**> 1.5**

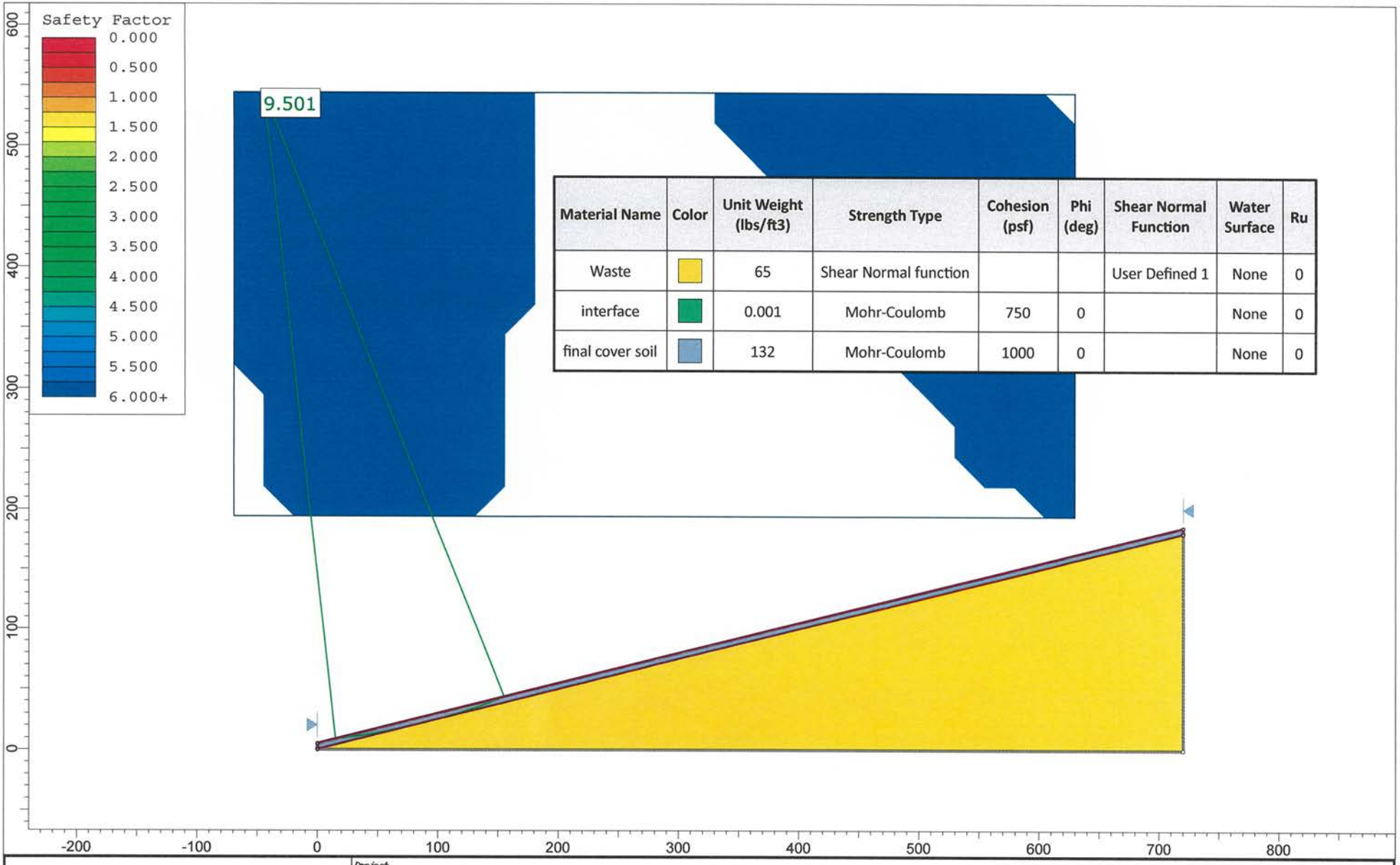
Factor of safety against sliding of the water balance final cover = **4.7** **> 1.5**

5.0 RESULTS

The future 4H:1V water balance alternative final cover slope will have a minimum factor of safety greater than 1.5.

6.0 CONCLUSION

The analysis demonstated that the proposed water balance alternative final cover will be stable.

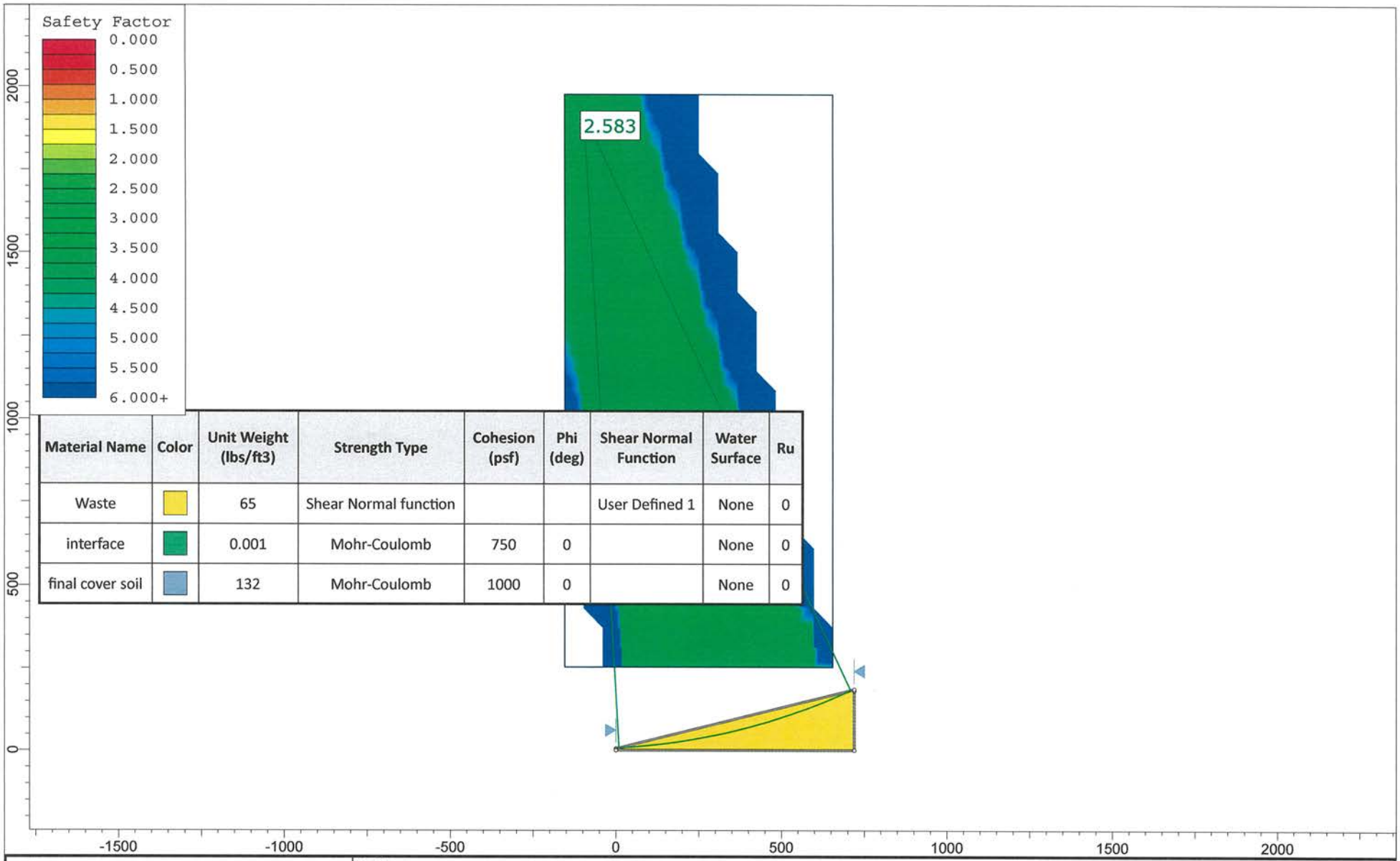


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Waste		65	Shear Normal function			User Defined 1	None	0
interface		0.001	Mohr-Coulomb	750	0		None	0
final cover soil		132	Mohr-Coulomb	1000	0		None	0

rocscience

SLIDEINTERPRET 7.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	Scale 1:1324	Company	
Date	1/25/2018, 11:03:43 AM	File Name	slide3 720 ft long.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Waste		65	Shear Normal function			User Defined 1	None	0
interface		0.001	Mohr-Coulomb	750	0		None	0
final cover soil		132	Mohr-Coulomb	1000	0		None	0

rocscience

SLIDEINTERPRET 7.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		Scale 1:4806	Company
Date	1/25/2018, 11:03:43 AM		File Name slide3 720 ft long.slim

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name:	slide3 720 ft long.slim
Slide Modeler Version:	7.029
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	1/25/2018, 11:03:43 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Waste	interface	final cover soil
Color			
Strength Type	Shear Normal function	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	65	0.001	132
Cohesion [psf]		750	1000
Friction Angle [deg]		0	0
Water Surface	None	None	None
Ru Value	0	0	0

Shear Normal Functions

Name: User Defined 1

Normal (psf)	Shear (psf)
0	400
800	400
6000	3900

Global Minimums

Method: bishop simplified

FS	9.501230
Center:	-44.515, 544.451
Radius:	538.991
Left Slip Surface Endpoint:	15.039, 8.760
Right Slip Surface Endpoint:	155.028, 43.757
Resisting Moment:	6.92928e+007 lb-ft
Driving Moment:	7.29304e+006 lb-ft
Total Slice Area:	466.864 ft2
Surface Horizontal Width:	139.989 ft
Surface Average Height:	3.335 ft

Method: janbu simplified

FS	9.481210
Center:	-44.515, 544.451
Radius:	538.991
Left Slip Surface Endpoint:	15.039, 8.760
Right Slip Surface Endpoint:	155.028, 43.757
Resisting Horizontal Force:	124310 lb
Driving Horizontal Force:	13111.2 lb
Total Slice Area:	466.864 ft2
Surface Horizontal Width:	139.989 ft
Surface Average Height:	3.335 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 3000
Number of Invalid Surfaces: 1785

Error Codes:

Error Code -102 reported for 2 surfaces
Error Code -106 reported for 20 surfaces
Error Code -108 reported for 36 surfaces
Error Code -1000 reported for 1727 surfaces

Method: janbu simplified

Number of Valid Surfaces: 2945
Number of Invalid Surfaces: 1840

Error Codes:

Error Code -102 reported for 2 surfaces
Error Code -106 reported for 20 surfaces
Error Code -108 reported for 91 surfaces
Error Code -1000 reported for 1727 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections, but resulting arc is actually outside soil region.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 9.50123

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.82691	71.8132	6.49482	final cover soil	1000	0	105.25	1000	13.4214	0	13.4214	25.4034	25.4034
2	2.82691	212.617	6.79736	final cover soil	1000	0	105.25	1000	62.6663	0	62.6663	75.2116	75.2116
3	2.82691	347.769	7.10009	final cover soil	1000	0	105.25	1000	109.911	0	109.911	123.021	123.021
4	2.82691	477.26	7.40302	final cover soil	1000	0	105.25	1000	155.152	0	155.152	168.827	168.827
5	2.82691	601.077	7.70616	final cover soil	1000	0	105.25	1000	198.385	0	198.385	212.627	212.627
6	2.82691	719.209	8.00952	final cover soil	1000	0	105.25	1000	239.606	0	239.606	254.415	254.415
7	2.82691	831.643	8.3131	final cover soil	1000	0	105.25	1000	278.809	0	278.809	294.188	294.188
8	2.82691	938.366	8.61691	final cover soil	1000	0	105.25	1000	315.991	0	315.991	331.941	331.941
9	2.82691	1039.37	8.92098	final cover soil	1000	0	105.25	1000	351.149	0	351.149	367.67	367.67
10	2.82691	1134.63	9.22529	final cover soil	1000	0	105.25	1000	384.273	0	384.273	401.368	401.368
11	2.82691	1224.13	9.52987	final cover soil	1000	0	105.25	1000	415.361	0	415.361	433.03	433.03
12	2.82691	1307.87	9.83472	final cover soil	1000	0	105.25	1000	444.405	0	444.405	462.651	462.651
13	2.82691	1385.83	10.1398	final cover soil	1000	0	105.25	1000	471.404	0	471.404	490.227	490.227
14	2.82691	1457.98	10.4453	final cover soil	1000	0	105.25	1000	496.35	0	496.35	515.753	515.753
15	2.72688	1439.79	10.7456	interface	750	0	78.9371	750	513.019	0	513.019	528	528
16	2.72688	1439.79	11.0408	interface	750	0	78.9371	750	512.597	0	512.597	527.999	527.999
17	2.72688	1439.79	11.3363	interface	750	0	78.9371	750	512.175	0	512.175	528	528
18	2.72688	1439.79	11.6321	interface	750	0	78.9371	750	511.75	0	511.75	527.999	527.999
19	2.72688	1439.79	11.9282	interface	750	0	78.9371	750	511.324	0	511.324	527.999	527.999
20	2.72688	1439.79	12.2246	interface	750	0	78.9371	750	510.898	0	510.898	528	528
21	2.72688	1439.79	12.5214	interface	750	0	78.9371	750	510.468	0	510.468	527.999	527.999
22	2.72688	1439.79	12.8185	interface	750	0	78.9371	750	510.042	0	510.042	528.002	528.002
23	2.72688	1439.79	13.1159	interface	750	0	78.9371	750	509.607	0	509.607	528	528
24	2.72688	1439.79	13.4138	interface	750	0	78.9371	750	509.176	0	509.176	528.001	528.001
25	2.72688	1439.79	13.7119	interface	750	0	78.9371	750	508.74	0	508.74	528	528
26	2.72688	1439.79	14.0105	interface	750	0	78.9371	750	508.303	0	508.303	528	528
27	2.72688	1439.79	14.3095	interface	750	0	78.9371	750	507.866	0	507.866	528	528
28	2.72688	1439.79	14.6088	interface	750	0	78.9371	750	507.427	0	507.427	528.001	528.001
29	2.72688	1439.79	14.9086	interface	750	0	78.9371	750	506.986	0	506.986	528.003	528.003
30	2.72688	1439.79	15.2088	interface	750	0	78.9371	750	506.541	0	506.541	528.001	528.001
31	2.72688	1439.79	15.5094	interface	750	0	78.9371	750	506.095	0	506.095	528	528
32	2.72688	1439.79	15.8104	interface	750	0	78.9371	750	505.65	0	505.65	528.002	528.002
33	2.72688	1439.79	16.1119	interface	750	0	78.9371	750	505.199	0	505.199	528.001	528.001
34	2.72688	1439.79	16.4139	interface	750	0	78.9371	750	504.747	0	504.747	528	528
35	2.72688	1439.79	16.7163	interface	750	0	78.9371	750	504.292	0	504.292	527.999	527.999
36	2.72688	1439.79	17.0192	interface	750	0	78.9371	750	503.838	0	503.838	528.001	528.001
37	2.72688	1439.79	17.3226	interface	750	0	78.9371	750	503.379	0	503.379	527.999	527.999
38	2.89957	1493.29	17.6361	final cover soil	1000	0	105.25	1000	481.544	0	481.544	515.004	515.004
39	2.89957	1414.46	17.9599	final cover soil	1000	0	105.25	1000	453.7	0	453.7	487.816	487.816
40	2.89957	1328.7	18.2842	final cover soil	1000	0	105.25	1000	423.464	0	423.464	458.239	458.239
41	2.89957	1235.96	18.6091	final cover soil	1000	0	105.25	1000	390.819	0	390.819	426.258	426.258
42	2.89957	1136.21	18.9347	final cover soil	1000	0	105.25	1000	355.747	0	355.747	391.853	391.853
43	2.89957	1029.4	19.2608	final cover soil	1000	0	105.25	1000	318.241	0	318.241	355.019	355.019
44	2.89957	915.497	19.5877	final cover soil	1000	0	105.25	1000	278.284	0	278.284	315.736	315.736
45	2.89957	794.454	19.9152	final cover soil	1000	0	105.25	1000	235.86	0	235.86	273.991	273.991
46	2.89957	666.228	20.2434	final cover soil	1000	0	105.25	1000	190.953	0	190.953	229.768	229.768
47	2.89957	530.773	20.5722	final cover soil	1000	0	105.25	1000	143.55	0	143.55	183.052	183.052
48	2.89957	388.042	20.9018	final cover soil	1000	0	105.25	1000	93.633	0	93.633	133.828	133.828
49	2.89957	237.988	21.2321	final cover soil	1000	0	105.25	1000	41.1856	0	41.1856	82.0772	82.0772
50	2.89957	80.5622	21.5632	final cover soil	1000	0	105.25	1000	-13.8088	0	-13.8088	27.7842	27.7842

Global Minimum Query (janbu simplified) - Safety Factor: 9.48121

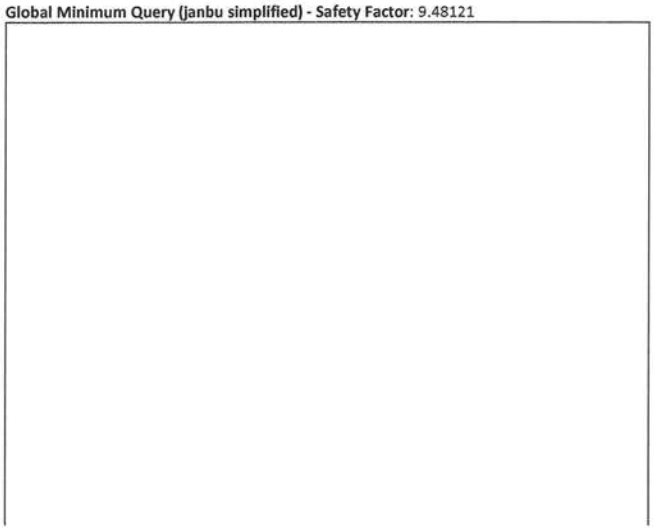
Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.82691	71.8132	6.49482	final cover soil	1000	0	105.472	1000	13.3955	0	13.3955	25.4029	25.4029
2	2.82691	212.617	6.79736	final cover soil	1000	0	105.472	1000	62.6393	0	62.6393	75.2111	75.2111
3	2.82691	347.769	7.10009	final cover soil	1000	0	105.472	1000	109.883	0	109.883	123.021	123.021
4	2.82691	477.26	7.40302	final cover soil	1000	0	105.472	1000	155.123	0	155.123	168.827	168.827
5	2.82691	601.077	7.70616	final cover soil	1000	0	105.472	1000	198.354	0	198.354	212.626	212.626
6	2.82691	719.209	8.00952	final cover soil	1000	0	105.472	1000	239.574	0	239.574	254.415	254.415
7	2.82691	831.643	8.3131	final cover soil	1000	0	105.472	1000	278.776	0	278.776	294.187	294.187
8	2.82691	938.366	8.61691	final cover soil	1000	0	105.472	1000	315.957	0	315.957	331.94	331.94
9	2.82691	1039.37	8.92098	final cover soil	1000	0	105.472	1000	351.11	0	351.11	367.666	367.666
10	2.82691	1134.63	9.22529	final cover soil	1000	0	105.472	1000	384.235	0	384.235	401.365	401.365
11	2.82691	1224.13	9.52987	final cover soil	1000	0	105.472	1000	415.323	0	415.323	433.029	433.029
12	2.82691	1307.87	9.83472	final cover soil	1000	0	105.472	1000	444.367	0	444.367	462.651	462.651
13	2.82691	1385.83	10.1398	final cover soil	1000	0	105.472	1000	471.362	0	471.362	490.225	490.225
14	2.82691	1457.98	10.4453	final cover soil	1000	0	105.472	1000	496.308	0	496.308	515.752	515.752
15	2.72688	1439.79	10.7456	interface	750	0	79.1038	750	512.987	0	512.987	527.999	527.999
16	2.72688	1439.79	11.0408	interface	750	0	79.1038	750	512.565	0	512.565	527.999	527.999
17	2.72688	1439.79	11.3363	interface	750	0	79.1038	750	512.139	0	512.139	527.998	527.998
18	2.72688	1439.79	11.6321	interface	750	0	79.1038	750	511.717	0	511.717	528.001	528.001
19	2.72688	1439.79	11.9282	interface	750	0	79.1038	750	511.288	0	511.288	527.999	527.999
20	2.72688	1439.79	12.2246	interface	750	0	79.1038	750	510.862	0	510.862	528.001	528.001
21	2.72688	1439.79	12.5214	interface	750	0	79.1038	750	510.433	0	510.433	528	528
22	2.72688	1439.79	12.8185	interface	750	0	79.1038	750	510.002	0	510.002	528.001	528.001
23	2.72688	1439.79	13.1159	interface	750	0	79.1038	750	509.568	0	509.568	527.999	527.999
24	2.72688	1439.79	13.4138	interface	750	0	79.1038	750	509.137	0	509.137	528.002	528.002
25	2.72688	1439.79	13.7119	interface	750	0	79.1038	750	508.701	0	508.701	528.002	528.002
26	2.72688	1439.79	14.0105	interface	750	0	79.1038	750	508.261	0	508.261	527.999	527.999
27	2.72688	1439.79	14.3095	interface	750	0	79.1038	750	507.823	0	507.823	528	528
28	2.72688	1439.79	14.6088	interface	750	0	79.1038	750	507.381	0	507.381	527.999	527.999
29	2.72688	1439.79	14.9086	interface	750	0	79.1038	750	506.94	0	506.94	528.001	528.001
30	2.72688	1439.79	15.2088	interface	750	0	79.1038	750	506.495	0	506.495	528	528
31	2.72688	1439.79	15.5094	interface	750	0	79.1038	750	506.049	0	506.049	528	528
32	2.72688	1439.79	15.8104	interface	750	0	79.1038	750	505.6	0	505.6	528	528
33	2.72688	1439.79	16.1119	interface	750	0	79.1038	750	505.15	0	505.15	528	528
34	2.72688	1439.79	16.4139	interface	750	0	79.1038	750	504.697	0	504.697	528	528
35	2.72688	1439.79	16.7163	interface	750	0	79.1038	750	504.243	0	504.243	528	528
36	2.72688	1439.79	17.0192	interface	750	0	79.1038	750	503.786	0	503.786	527.999	527.999
37	2.72688	1439.79	17.3226	interface	750	0	79.1038	750	503.326	0	503.326	527.999	527.999
38	2.89957	1493.29	17.6361	final cover soil	1000	0	105.472	1000	481.471	0	481.471	515.002	515.002
39	2.89957	1414.46	17.9599	final cover soil	1000	0	105.472	1000	453.628	0	453.628	487.816	487.816
40	2.89957	1328.7	18.2842	final cover soil	1000	0	105.472	1000	423.388	0	423.388	458.238	458.238
41	2.89957	1235.96	18.6091	final cover soil	1000	0	105.472	1000	390.74	0	390.74	426.254	426.254
42	2.89957	1136.21	18.9347	final cover soil	1000	0	105.472	1000	355.668	0	355.668	391.851	391.851
43	2.89957	1029.4	19.2608	final cover soil	1000	0	105.472	1000	318.162	0	318.162	355.017	355.017
44	2.89957	915.497	19.5877	final cover soil	1000	0	105.472	1000	278.203	0	278.203	315.734	315.734
45	2.89957	794.454	19.9152	final cover soil	1000	0	105.472	1000	235.777	0	235.777	273.989	273.989
46	2.89957	666.228	20.2434	final cover soil	1000	0	105.472	1000	190.87	0	190.87	229.766	229.766
47	2.89957	530.773	20.5722	final cover soil	1000	0	105.472	1000	143.465	0	143.465	183.051	183.051
48	2.89957	388.042	20.9018	final cover soil	1000	0	105.472	1000	93.546	0	93.546	133.826	133.826
49	2.89957	237.988	21.2321	final cover soil	1000	0	105.472	1000	41.0972	0	41.0972	82.0751	82.0751
50	2.89957	80.5622	21.5632	final cover soil	1000	0	105.472	1000	-13.8986	0	-13.8986	27.7823	27.7823

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 9.50123

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	15.039	8.75974	0	0	0
2	17.8659	9.08157	293.211	0	0
3	20.6928	9.41852	569.626	0	0
4	23.5197	9.77064	828.456	0	0
5	26.3466	10.1379	1069	0	0
6	29.1735	10.5205	1290.64	0	0
7	32.0004	10.9182	1492.86	0	0
8	34.8273	11.3313	1675.23	0	0
9	37.6542	11.7597	1837.4	0	0
10	40.4811	12.2034	1979.11	0	0
11	43.308	12.6626	2100.2	0	0
12	46.135	13.1371	2200.61	0	0
13	48.9619	13.6272	2280.36	0	0
14	51.7888	14.1328	2339.56	0	0
15	54.6157	14.6539	2378.42	0	0
16	57.3426	15.1714	2328.19	0	0
17	60.0694	15.7035	2270.7	0	0
18	62.7963	16.2502	2205.96	0	0
19	65.5232	16.8115	2133.95	0	0
20	68.2501	17.3875	2054.65	0	0
21	70.977	17.9783	1968.07	0	0
22	73.7038	18.5839	1874.18	0	0
23	76.4307	19.2044	1772.97	0	0
24	79.1576	19.8398	1664.44	0	0
25	81.8845	20.4901	1548.56	0	0
26	84.6114	21.1554	1425.32	0	0
27	87.3382	21.8359	1294.72	0	0
28	90.0651	22.5314	1156.72	0	0
29	92.792	23.2422	1011.32	0	0
30	95.5189	23.9682	858.501	0	0
31	98.2457	24.7095	698.241	0	0
32	100.973	25.4662	530.525	0	0
33	103.7	26.2384	355.333	0	0
34	106.426	27.026	172.646	0	0
35	109.153	27.8293	-17.5565	0	0
36	111.88	28.6483	-215.295	0	0
37	114.607	29.483	-420.592	0	0
38	117.334	30.3335	-633.469	0	0
39	120.233	31.2553	-772.182	0	0
40	123.133	32.1952	-893.43	0	0
41	126.033	33.1532	-993.952	0	0
42	128.932	34.1295	-1070.34	0	0
43	131.832	35.1242	-1119.02	0	0
44	134.731	36.1374	-1136.29	0	0
45	137.631	37.1692	-1118.24	0	0
46	140.53	38.2197	-1060.83	0	0
47	143.43	39.289	-959.842	0	0
48	146.33	40.3773	-810.885	0	0
49	149.229	41.4847	-609.391	0	0
50	152.129	42.6112	-350.61	0	0
51	155.028	43.7571	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 9.48121



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	15.039	8.75974	0	0	0
2	17.8659	9.08157	293.862	0	0
3	20.6928	9.41852	570.928	0	0
4	23.5197	9.77064	830.409	0	0
5	26.3466	10.1379	1071.6	0	0
6	29.1735	10.5205	1293.9	0	0
7	32.0004	10.9182	1496.78	0	0
8	34.8273	11.3313	1679.8	0	0
9	37.6542	11.7597	1842.62	0	0
10	40.4811	12.2034	1984.99	0	0
11	43.308	12.6626	2106.75	0	0
12	46.135	13.1371	2207.82	0	0
13	48.9619	13.6272	2288.23	0	0
14	51.7888	14.1328	2348.09	0	0
15	54.6157	14.6539	2387.61	0	0
16	57.3426	15.1714	2337.86	0	0
17	60.0694	15.7035	2280.86	0	0
18	62.7963	16.2502	2216.6	0	0
19	65.5232	16.8115	2145.07	0	0
20	68.2501	17.3875	2066.26	0	0
21	70.977	17.9783	1980.16	0	0
22	73.7038	18.5839	1886.76	0	0
23	76.4307	19.2044	1786.04	0	0
24	79.1576	19.8398	1678	0	0
25	81.8845	20.4901	1562.61	0	0
26	84.6114	21.1554	1439.87	0	0
27	87.3382	21.8359	1309.75	0	0
28	90.0651	22.5314	1172.25	0	0
29	92.792	23.2422	1027.35	0	0
30	95.5189	23.9682	875.024	0	0
31	98.2457	24.7095	715.263	0	0
32	100.973	25.4662	548.047	0	0
33	103.7	26.2384	373.357	0	0
34	106.426	27.026	191.173	0	0
35	109.153	27.8293	1.47578	0	0
36	111.88	28.6483	-195.757	0	0
37	114.607	29.483	-400.545	0	0
38	117.334	30.3335	-612.912	0	0
39	120.233	31.2553	-750.901	0	0
40	123.133	32.1952	-871.421	0	0
41	126.033	33.1532	-971.213	0	0
42	128.932	34.1295	-1046.87	0	0
43	131.832	35.1242	-1094.82	0	0
44	134.731	36.1374	-1111.34	0	0
45	137.631	37.1692	-1092.55	0	0
46	140.53	38.2197	-1034.39	0	0
47	143.43	39.289	-932.66	0	0
48	146.33	40.3773	-782.952	0	0
49	149.229	41.4847	-580.703	0	0
50	152.129	42.6112	-321.164	0	0
51	155.028	43.7571	0	0	0

List Of Coordinates

Focus Search Window

X	Y
720	180
720	185
0	5
0	0

External Boundary

X	Y
720	0
720	180
720	181
720	185
0	5
0	1
0	0

Material Boundary

X	Y
0	1
720	181

Material Boundary

X	Y
0	0
720	180

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name:	slide3 720 ft long.slim
Slide Modeler Version:	7.029
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	1/25/2018, 11:03:43 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Waste	interface	final cover soil
Color			
Strength Type	Shear Normal function	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	65	0.001	132
Cohesion [psf]		750	1000
Friction Angle [deg]		0	0
Water Surface	None	None	None
Ru Value	0	0	0

Shear Normal Functions

Name: User Defined 1

Normal (psf)	Shear (psf)
0	400
800	400
6000	3900

Global Minimums

Method: bishop simplified

FS	2.582720
Center:	-96.277, 1917.534
Radius:	1913.147
Left Slip Surface Endpoint:	9.184, 7.296
Right Slip Surface Endpoint:	709.605, 182.401
Resisting Moment:	1.44089e+009 lb-ft
Driving Moment:	5.57895e+008 lb-ft
Total Slice Area:	16563.8 ft2
Surface Horizontal Width:	700.421 ft
Surface Average Height:	23.6483 ft

Method: janbu simplified

FS	2.563790
Center:	-96.277, 1917.534
Radius:	1913.147
Left Slip Surface Endpoint:	9.184, 7.296
Right Slip Surface Endpoint:	709.605, 182.401
Resisting Horizontal Force:	727391 lb
Driving Horizontal Force:	283717 lb
Total Slice Area:	16563.8 ft2
Surface Horizontal Width:	700.421 ft
Surface Average Height:	23.6483 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 3472
Number of Invalid Surfaces: 1478

Error Codes:

Error Code -102 reported for 10 surfaces
Error Code -103 reported for 139 surfaces
Error Code -106 reported for 15 surfaces
Error Code -108 reported for 82 surfaces
Error Code -1000 reported for 1232 surfaces

Method: janbu simplified

Number of Valid Surfaces: 3403
Number of Invalid Surfaces: 1547

Error Codes:

Error Code -102 reported for 10 surfaces
Error Code -103 reported for 139 surfaces
Error Code -106 reported for 15 surfaces
Error Code -108 reported for 151 surfaces
Error Code -1000 reported for 1232 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections, but resulting arc is actually outside soil region.
-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.58272

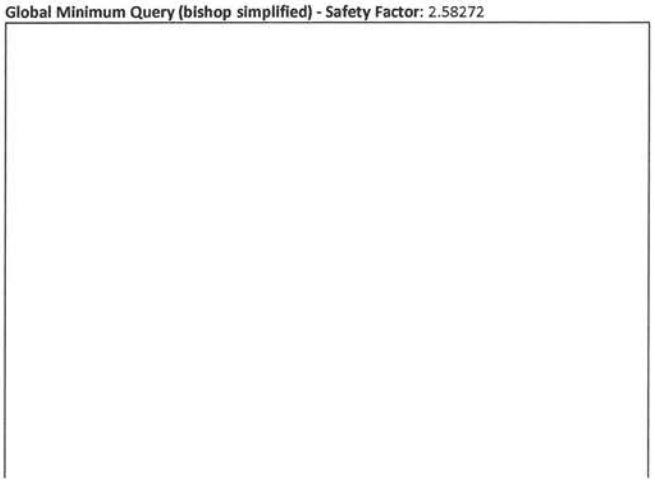
Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	21.1373	5580.25	3.47709	final cover soil	1000	0	387.189	1000	240.483	0	240.483	264.009	264.009
2	5.48733	2897.31	3.87654	interface	750	0	290.392	750	508.33	0	508.33	528.008	528.008
3	14.1201	8602.84	4.1709	Waste	400	0	154.875	400	597.971	0	597.971	609.266	609.266
4	14.1201	10849.4	4.59502	Waste	400	0	154.875	400	755.921	0	755.921	768.368	768.368
5	14.1201	12999.4	5.01939	Waste	-138.462	33.9436	182.145	470.429	904.641	0	904.641	920.639	920.639
6	14.1201	15052.6	5.44404	Waste	-138.462	33.9436	218.776	565.037	1045.2	0	1045.2	1066.05	1066.05
7	14.1201	17008.9	5.86899	Waste	-138.462	33.9436	253.524	654.782	1178.53	0	1178.53	1204.59	1204.59
8	14.1201	18868	6.29426	Waste	-138.462	33.9436	286.397	739.682	1304.67	0	1304.67	1336.26	1336.26
9	14.1201	20629.7	6.71988	Waste	-138.462	33.9436	317.398	819.75	1423.63	0	1423.63	1461.03	1461.03
10	14.1201	22293.7	7.14588	Waste	-138.462	33.9436	346.533	894.998	1535.43	0	1535.43	1578.88	1578.88
11	14.1201	23859.8	7.57227	Waste	-138.462	33.9436	373.811	965.448	1640.1	0	1640.1	1689.79	1689.79
12	14.1201	25327.7	7.99908	Waste	-138.462	33.9436	399.233	1031.11	1737.65	0	1737.65	1793.75	1793.75
13	14.1201	26697.2	8.42634	Waste	-138.462	33.9436	422.809	1092	1828.11	0	1828.11	1890.74	1890.74
14	14.1201	27967.8	8.85408	Waste	-138.462	33.9436	444.538	1148.12	1911.49	0	1911.49	1980.73	1980.73
15	14.1201	29139.2	9.28231	Waste	-138.462	33.9436	464.424	1199.48	1987.79	0	1987.79	2063.69	2063.69
16	14.1201	30211.2	9.71106	Waste	-138.462	33.9436	482.471	1246.09	2057.05	0	2057.05	2139.61	2139.61
17	14.1201	31183.2	10.1404	Waste	-138.462	33.9436	498.687	1287.97	2119.26	0	2119.26	2208.46	2208.46
18	14.1201	32055	10.5702	Waste	-138.462	33.9436	513.071	1325.12	2174.46	0	2174.46	2270.2	2270.2
19	14.1201	32826.1	11.0007	Waste	-138.462	33.9436	525.623	1357.54	2222.63	0	2222.63	2324.81	2324.81
20	14.1201	33496	11.4318	Waste	-138.462	33.9436	536.352	1385.25	2263.81	0	2263.81	2372.27	2372.27
21	14.1201	34064.4	11.8636	Waste	-138.462	33.9436	545.258	1408.25	2297.98	0	2297.98	2412.52	2412.52
22	14.1201	34530.8	12.2961	Waste	-138.462	33.9436	552.343	1426.55	2325.16	0	2325.16	2445.55	2445.55
23	14.1201	34894.5	12.7292	Waste	-138.462	33.9436	557.605	1440.14	2345.35	0	2345.35	2471.31	2471.31
24	14.1201	35155.2	13.1632	Waste	-138.462	33.9436	561.051	1449.04	2358.56	0	2358.56	2489.78	2489.78
25	14.1201	35312.3	13.5978	Waste	-138.462	33.9436	562.673	1453.23	2364.8	0	2364.8	2500.9	2500.9
26	14.1201	35365.3	14.0333	Waste	-138.462	33.9436	562.484	1452.74	2364.07	0	2364.07	2504.66	2504.66
27	14.1201	35313.5	14.4696	Waste	-138.462	33.9436	560.474	1447.55	2356.35	0	2356.35	2500.98	2500.98
28	14.1201	35156.3	14.9068	Waste	-138.462	33.9436	556.649	1437.67	2341.67	0	2341.67	2489.86	2489.86
29	14.1201	34893.1	15.3448	Waste	-138.462	33.9436	551.004	1423.09	2320.02	0	2320.02	2471.22	2471.22
30	14.1201	34523.2	15.7838	Waste	-138.462	33.9436	543.542	1403.82	2291.38	0	2291.38	2445.02	2445.02
31	14.1201	34046	16.2237	Waste	-138.462	33.9436	534.262	1379.85	2255.78	0	2255.78	2411.23	2411.23
32	14.1201	33460.8	16.6647	Waste	-138.462	33.9436	523.161	1351.18	2213.18	0	2213.18	2369.78	2369.78
33	14.1201	32766.8	17.1066	Waste	-138.462	33.9436	510.24	1317.81	2163.6	0	2163.6	2320.63	2320.63
34	14.1201	31963.2	17.5496	Waste	-138.462	33.9436	495.496	1279.73	2107.02	0	2107.02	2263.72	2263.72
35	14.1201	31049.2	17.9937	Waste	-138.462	33.9436	478.925	1236.93	2043.44	0	2043.44	2199	2199
36	14.1201	30024.1	18.4388	Waste	-138.462	33.9436	460.529	1189.42	1972.85	0	1972.85	2126.39	2126.39
37	14.1201	28886.9	18.8852	Waste	-138.462	33.9436	440.302	1137.18	1895.23	0	1895.23	2045.85	2045.85
38	14.1201	27636.8	19.3327	Waste	-138.462	33.9436	418.24	1080.2	1810.59	0	1810.59	1957.32	1957.32
39	14.1201	26272.8	19.7815	Waste	-138.462	33.9436	394.347	1018.49	1718.89	0	1718.89	1860.72	1860.72
40	14.1201	24794.1	20.2315	Waste	-138.462	33.9436	368.611	952.018	1620.14	0	1620.14	1755.99	1755.99
41	14.1201	23199.5	20.6829	Waste	-138.462	33.9436	341.031	880.788	1514.31	0	1514.31	1643.06	1643.06
42	14.1201	21488.2	21.1356	Waste	-138.462	33.9436	311.604	804.787	1401.4	0	1401.4	1521.86	1521.86
43	14.1201	19658.9	21.5897	Waste	-138.462	33.9436	280.325	724.002	1281.38	0	1281.38	1392.31	1392.31
44	14.1201	17710.7	22.0452	Waste	-138.462	33.9436	247.19	638.423	1154.23	0	1154.23	1254.33	1254.33
45	14.1201	15642.4	22.5021	Waste	-138.462	33.9436	212.193	548.035	1019.94	0	1019.94	1107.84	1107.84
46	14.1201	13452.7	22.9606	Waste	-138.462	33.9436	175.328	452.824	878.484	0	878.484	952.764	952.764
47	14.1201	11140.5	23.4207	Waste	400	0	154.875	400	721.918	0	721.918	789.005	789.005
48	14.1201	8704.54	23.8823	Waste	400	0	154.875	400	547.915	0	547.915	616.489	616.489
49	5.01674	2648.84	24.1959	interface	750	0	290.392	750	397.567	0	397.567	528.049	528.049
50	19.255	5083.31	24.5954	final cover soil	1000	0	387.189	1000	86.8334	0	86.8334	264.065	264.065

Global Minimum Query (janbu simplified) - Safety Factor: 2.56379

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	21.1373	5580.25	3.47709	final cover soil	1000	0	390.048	1000	240.311	0	240.311	264.01	264.01
2	5.48733	2897.31	3.87654	interface	750	0	292.536	750	508.187	0	508.187	528.009	528.009
3	14.1201	8602.84	4.1709	Waste	400	0	156.019	400	597.889	0	597.889	609.266	609.266
4	14.1201	10849.4	4.59502	Waste	400	0	156.019	400	755.829	0	755.829	768.368	768.368
5	14.1201	12999.4	5.01939	Waste	-138.462	33.9436	183.46	470.352	904.521	0	904.521	920.634	920.634
6	14.1201	15052.6	5.44404	Waste	-138.462	33.9436	220.352	564.937	1045.05	0	1045.05	1066.05	1066.05
7	14.1201	17008.9	5.86899	Waste	-138.462	33.9436	255.347	654.657	1178.35	0	1178.35	1204.6	1204.6
8	14.1201	18868	6.29426	Waste	-138.462	33.9436	288.452	739.53	1304.44	0	1304.44	1336.26	1336.26
9	14.1201	20629.7	6.71988	Waste	-138.462	33.9436	319.672	819.571	1423.37	0	1423.37	1461.03	1461.03
10	14.1201	22293.7	7.14588	Waste	-138.462	33.9436	349.014	894.798	1535.12	0	1535.12	1578.88	1578.88
11	14.1201	23859.8	7.57227	Waste	-138.462	33.9436	376.481	965.218	1639.75	0	1639.75	1689.8	1689.8
12	14.1201	25327.7	7.99908	Waste	-138.462	33.9436	402.08	1030.85	1737.26	0	1737.26	1793.76	1793.76
13	14.1201	26697.2	8.42634	Waste	-138.462	33.9436	425.814	1091.7	1827.67	0	1827.67	1890.75	1890.75
14	14.1201	27967.8	8.85408	Waste	-138.462	33.9436	447.692	1147.79	1911	0	1911	1980.74	1980.74
15	14.1201	29139.2	9.28231	Waste	-138.462	33.9436	467.713	1199.12	1987.26	0	1987.26	2063.7	2063.7
16	14.1201	30211.2	9.71106	Waste	-138.462	33.9436	485.881	1245.7	2056.47	0	2056.47	2139.62	2139.62
17	14.1201	31183.2	10.1404	Waste	-138.462	33.9436	502.205	1287.55	2118.64	0	2118.64	2208.47	2208.47
18	14.1201	32055	10.5702	Waste	-138.462	33.9436	516.684	1324.67	2173.79	0	2173.79	2270.21	2270.21
19	14.1201	32826.1	11.0007	Waste	-138.462	33.9436	529.321	1357.07	2221.92	0	2221.92	2324.82	2324.82
20	14.1201	33496	11.4318	Waste	-138.462	33.9436	540.118	1384.75	2263.05	0	2263.05	2372.27	2372.27
21	14.1201	34064.4	11.8636	Waste	-138.462	33.9436	549.077	1407.72	2297.18	0	2297.18	2412.52	2412.52
22	14.1201	34530.8	12.2961	Waste	-138.462	33.9436	556.203	1425.99	2324.32	0	2324.32	2445.55	2445.55
23	14.1201	34894.5	12.7292	Waste	-138.462	33.9436	561.496	1439.56	2344.48	0	2344.48	2471.32	2471.32
24	14.1201	35155.2	13.1632	Waste	-138.462	33.9436	564.956	1448.43	2357.66	0	2357.66	2489.79	2489.79
25	14.1201	35312.3	13.5978	Waste	-138.462	33.9436	566.582	1452.6	2363.87	0	2363.87	2500.91	2500.91
26	14.1201	35365.3	14.0333	Waste	-138.462	33.9436	566.383	1452.09	2363.1	0	2363.1	2504.66	2504.66
27	14.1201	35313.5	14.4696	Waste	-138.462	33.9436	564.351	1446.88	2355.36	0	2355.36	2501	2501
28	14.1201	35156.3	14.9068	Waste	-138.462	33.9436	560.49	1436.98	2340.66	0	2340.66	2489.87	2489.87
29	14.1201	34893.1	15.3448	Waste	-138.462	33.9436	554.803	1422.4	2318.99	0	2318.99	2471.23	2471.23
30	14.1201	34523.2	15.7838	Waste	-138.462	33.9436	547.279	1403.11	2290.34	0	2290.34	2445.04	2445.04
31	14.1201	34046	16.2237	Waste	-138.462	33.9436	537.929	1379.14	2254.71	0	2254.71	2411.24	2411.24
32	14.1201	33460.8	16.6647	Waste	-138.462	33.9436	526.747	1350.47	2212.12	0	2212.12	2369.8	2369.8
33	14.1201	32766.8	17.1066	Waste	-138.462	33.9436	513.727	1317.09	2162.54	0	2162.54	2320.65	2320.65
34	14.1201	31963.2	17.5496	Waste	-138.462	33.9436	498.874	1279.01	2105.96	0	2105.96	2263.73	2263.73
35	14.1201	31049.2	17.9937	Waste	-138.462	33.9436	482.188	1236.23	2042.39	0	2042.39	2199	2199
36	14.1201	30024.1	18.4388	Waste	-138.462	33.9436	463.657	1188.72	1971.81	0	1971.81	2126.4	2126.4
37	14.1201	28886.9	18.8852	Waste	-138.462	33.9436	443.288	1136.5	1894.22	0	1894.22	2045.86	2045.86
38	14.1201	27636.8	19.3327	Waste	-138.462	33.9436	421.071	1079.54	1809.6	0	1809.6	1957.33	1957.33
39	14.1201	26272.8	19.7815	Waste	-138.462	33.9436	397.009	1017.85	1717.94	0	1717.94	1860.73	1860.73
40	14.1201	24794.1	20.2315	Waste	-138.462	33.9436	371.094	951.408	1619.23	0	1619.23	1756	1756
41	14.1201	23199.5	20.6829	Waste	-138.462	33.9436	343.323	880.208	1513.46	0	1513.46	1643.07	1643.07
42	14.1201	21488.2	21.1356	Waste	-138.462	33.9436	313.695	804.248	1400.6	0	1400.6	1521.87	1521.87
43	14.1201	19658.9	21.5897	Waste	-138.462	33.9436	282.203	723.508	1280.64	0	1280.64	1392.31	1392.31
44	14.1201	17710.7	22.0452	Waste	-138.462	33.9436	248.841	637.977	1153.57	0	1153.57	1254.33	1254.33
45	14.1201	15642.4	22.5021	Waste	-138.462	33.9436	213.607	547.644	1019.36	0	1019.36	1107.85	1107.85
46	14.1201	13452.7	22.9606	Waste	-138.462	33.9436	176.494	452.494	877.995	0	877.995	952.769	952.769
47	14.1201	11140.5	23.4207	Waste	400	0	156.019	400	721.431	0	721.431	789.013	789.013
48	14.1201	8704.54	23.8823	Waste	400	0	156.019	400	547.413	0	547.413	616.494	616.494
49	5.01674	2648.84	24.1959	interface	750	0	292.536	750	396.612	0	396.612	528.058	528.058
50	19.255	5083.31	24.5954	final cover soil	1000	0	390.048	1000	85.5371	0	85.5371	264.077	264.077

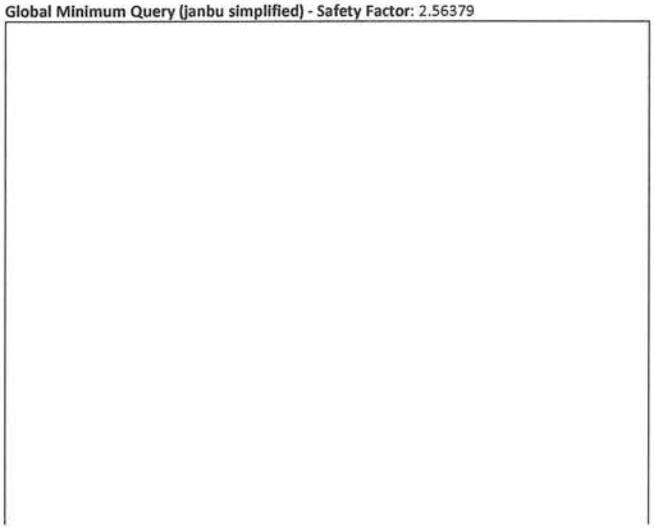
Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.58272



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	9.18358	7.29589	0	0	0
2	30.3209	8.58022	7872.28	0	0
3	35.8082	8.95206	9276.16	0	0
4	49.9283	9.98176	10846.5	0	0
5	64.0484	11.1166	12174.7	0	0
6	78.1685	12.3568	13623.8	0	0
7	92.2887	13.7025	15305.2	0	0
8	106.409	15.1539	17173.1	0	0
9	120.529	16.7114	19183.7	0	0
10	134.649	18.3751	21295.2	0	0
11	148.769	20.1453	23468.5	0	0
12	162.889	22.0224	25666.2	0	0
13	177.009	24.0066	27853.5	0	0
14	191.129	26.0983	29997.6	0	0
15	205.25	28.2978	32067.8	0	0
16	219.37	30.6056	34035.7	0	0
17	233.49	33.022	35875.1	0	0
18	247.61	35.5475	37562	0	0
19	261.73	38.1824	39074.4	0	0
20	275.85	40.9272	40392.8	0	0
21	289.97	43.7825	41499.6	0	0
22	304.09	46.7487	42379.6	0	0
23	318.21	49.8264	43019.8	0	0
24	332.33	53.0161	43409.5	0	0
25	346.451	56.3183	43540.1	0	0
26	360.571	59.7338	43405.3	0	0
27	374.691	63.263	43001.4	0	0
28	388.811	66.9068	42326.5	0	0
29	402.931	70.6656	41381.6	0	0
30	417.051	74.5403	40169.6	0	0
31	431.171	78.5316	38696.1	0	0
32	445.291	82.6402	36969	0	0
33	459.411	86.867	34998.9	0	0
34	473.532	91.2127	32798.5	0	0
35	487.652	95.6782	30383.6	0	0
36	501.772	100.264	27772	0	0
37	515.892	104.972	24984.6	0	0
38	530.012	109.802	22044.9	0	0
39	544.132	114.756	18979	0	0
40	558.252	119.835	15815.9	0	0
41	572.372	125.039	12587.6	0	0
42	586.492	130.369	9328.86	0	0
43	600.613	135.828	6077.51	0	0
44	614.733	141.416	2874.48	0	0
45	628.853	147.133	-236.149	0	0
46	642.973	152.983	-3207.04	0	0
47	657.093	158.965	-5987.53	0	0
48	671.213	165.081	-8217	0	0
49	685.333	171.333	-9456.49	0	0
50	690.35	173.587	-8896.39	0	0
51	709.605	182.401	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 2.56379



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	9.18358	7.29589	0	0	0
2	30.3209	8.58022	7932.37	0	0
3	35.8082	8.95206	9347.96	0	0
4	49.9283	9.98176	10934.4	0	0
5	64.0484	11.1166	12278.7	0	0
6	78.1685	12.3568	13746.3	0	0
7	92.2887	13.7025	15450	0	0
8	106.409	15.1539	17343.7	0	0
9	120.529	16.7114	19383.3	0	0
10	134.649	18.3751	21527.1	0	0
11	148.769	20.1453	23735.6	0	0
12	162.889	22.0224	25971.3	0	0
13	177.009	24.0066	28199.1	0	0
14	191.129	26.0983	30386.1	0	0
15	205.25	28.2978	32501.5	0	0
16	219.37	30.6056	34516.7	0	0
17	233.49	33.022	36405.2	0	0
18	247.61	35.5475	38142.8	0	0
19	261.73	38.1824	39707.5	0	0
20	275.85	40.9272	41079.5	0	0
21	289.97	43.7825	42241.1	0	0
22	304.09	46.7487	43176.8	0	0
23	318.21	49.8264	43873.6	0	0
24	332.33	53.0161	44320.4	0	0
25	346.451	56.3183	44508.6	0	0
26	360.571	59.7338	44431.7	0	0
27	374.691	63.263	44085.7	0	0
28	388.811	66.9068	43468.6	0	0
29	402.931	70.6656	42581.2	0	0
30	417.051	74.5403	41426.3	0	0
31	431.171	78.5316	40009.3	0	0
32	445.291	82.6402	38337.8	0	0
33	459.411	86.867	36422.3	0	0
34	473.532	91.2127	34275.3	0	0
35	487.652	95.6782	31912.3	0	0
36	501.772	100.264	29351.2	0	0
37	515.892	104.972	26612.4	0	0
38	530.012	109.802	23719.3	0	0
39	544.132	114.756	20697.8	0	0
40	558.252	119.835	17576.8	0	0
41	572.372	125.039	14387.9	0	0
42	586.492	130.369	11165.8	0	0
43	600.613	135.828	7948.01	0	0
44	614.733	141.416	4775.32	0	0
45	628.853	147.133	1691.56	0	0
46	642.973	152.983	-1256.17	0	0
47	657.093	158.965	-4017.44	0	0
48	671.213	165.081	-6227.91	0	0
49	685.333	171.333	-7448.27	0	0
50	690.35	173.587	-6875.36	0	0
51	709.605	182.401	0	0	0

List Of Coordinates

External Boundary

X	Y
720	0
720	180
720	181
720	185
0	5
0	1
0	0

Material Boundary

X	Y
0	1
720	181

Material Boundary

X	Y
0	0
720	180

WASTE MANAGEMENT, INC.

AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 7
CLOSURE PLAN

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

Golder Associates

500 Century Plaza Drive, Suite 190
Houston, Texas 77073
(281) 821-6868
Firm Registration Number F-2578

August 2005
Revision 1 – December 2005
Revision 2 – October 2006
Revision 3 – February 2008
Revision 4 – March 2008
Revised August 2016
Revised October 2017
Revised February 2018

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

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ATTACHMENT 7
CLOSURE PLAN

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FIGURES

APPENDICES

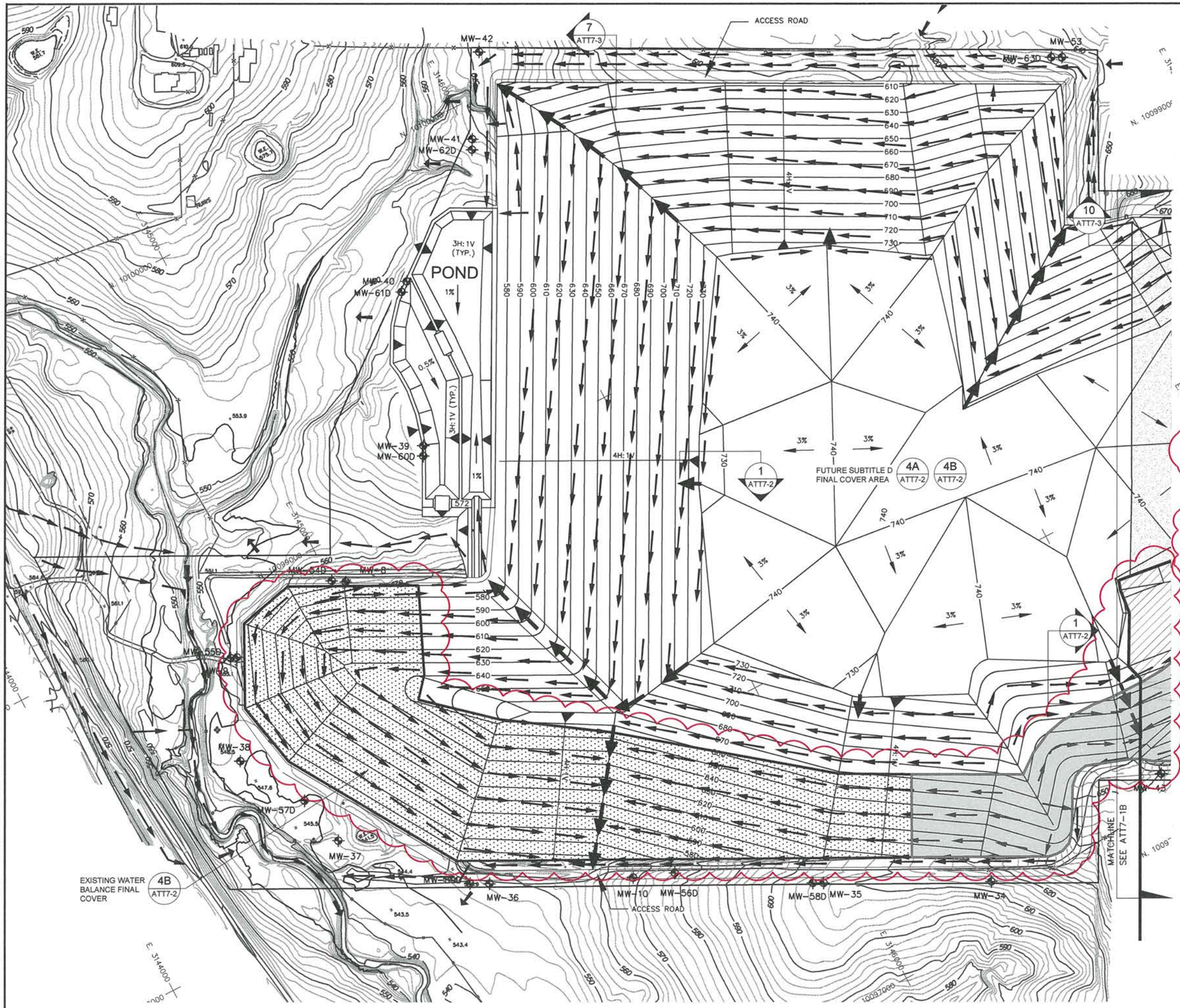
2.0 FINAL COVER

2.1 Final Cover Design

The final landfill contours and final cover details are provided on Figures ATT7-1A through ATT7-1C, ATT7-2, and ATT7-3. Landfill cross-sections are included as Figures ATT7-4 through ATT7-11. The final cap has side slopes ranging from 3 horizonal to 1 vertical (3H:1V) to 4H:1V to a maximum elevation of approximately 740 feet mean sea level (ft-msl). The upper portions of the final cover are sloped at a minimum 3-percent grade down to the crest of the 3H:1V or 4H:1V slopes to minimize erosion. The side slopes of the entire proposed expansion area will be 4H:1V with a short 3H:1V slope tying into the existing final cover crest. Add-on berms intercept runoff from the top surface and along the sideslopes of the cover and direct it to downchutes. These downchutes convey rainfall runoff down the sideslopes to the perimeter channels and detention ponds. Details of the surface water management features are included in Part III, Attachment 2.

The thickness and design of the final cover varies based on the design of the bottom liner. For existing disposal cells with no synthetic bottom liner (pre-Subtitle D cells), the final cover system is comprised of 18 inches of compacted earthen material with a coefficient of permeability (hydraulic conductivity) between $6.8x10^{-6}$ cm/sec and $8.1x10^{-6}$ cm/sec and 6 inches of soil capable of supporting native vegetation. For existing Subtitle D disposal cells with a synthetic bottom liner, the final cover system is comprised of 36 inches of compacted earthen material with a hydraulic conductivity of $1.0x10^{-7}$ cm/sec or less and 6 inches of soil capable of supporting native vegetation. The proposed final cover over existing pre-Subtitle D cells in the West Hill that have not yet been covered will be comprised of 18 inches of compacted earthen material with a coefficient of permeability (hydraulic conductivity) of $6.8x10^{-6}$ cm/sec or less and 6 inches of soil capable of supporting native vegetation. The final cover over existing and proposed Subtitle-D disposal cells in the expansion area of ~~and~~ the West Hill will (as shown on Figure ATT7-1B) consist of a water balance final cover or a composite system comprised of, from the bottom up; an infiltration layer of 18 inches of compacted earthen material with a hydraulic conductivity of $1x10^{-5}$ cm/sec or less; a 40-mil textured linear low density polyethylene (LLDPE) geomembrane that has a permeability less than or equal to the permeability of the bottom liner system; a geocomposite (geonet/geotextile) drainage layer; and an erosion layer consisting of 24 inches of protective soil cover, of which the uppermost 6 inches will be capable of supporting native vegetation. The LLDPE geomembrane and geocomposite may be replaced with an alternate material that incorporates both the geomembrane and drainage layer (e.g., Super Gripnet® by Agru America) provided material equivalency in terms of barrier and flow characteristics is demonstrated.

The water balance final cover will be comprised of a storage layer of ~~18~~ 20 inches thick (minimum) overlain by an erosion layer of 6 inches (minimum), in accordance with TCEQ Regulatory Guidance RG-494, Guidance for Requesting a Water Balance (WB) Alternative Final Cover for a Municipal Landfill, Revised March 2017. When using high plasticity clay (liquid limit >50) as the storage layer, the erosion layer will be increased to ~~one~~1-foot thick in accordance with Section 3 of RG-494. Hydraulic conductivity testing results of the storage layer soils may require a thicker storage layer in accordance with RG-494, as discussed in Appendix A, Section 5.2. The storage layer thickness ~~are~~ is determined from Table 3 in Section 10 of the RG-494 as follows:



LEGEND

- PERMIT BOUNDARY
- FENCE
- GRADE BREAKS
- 100-YEAR FLOODPLAIN
- MONITORING WELL
- GAS PROBE
- SURFACE WATER FLOW DIRECTION (CHANNELS/DITCHES/ADD-ON BERMS)
- SURFACE WATER DOWNCHUTE
- SURFACE WATER ENTRANCE OR DISCHARGE POINT
- STATE PLANE COORDINATE SYSTEM
- FINAL COVER ALREADY IN PLACE (AS OF AUGUST 2016)
- PIGGYBACK LINER AREA
- FUTURE PRE-SUBTITLE D FINAL COVER AREA
- 20-ACRE INTERMEDIATE COVER ALREADY IN PLACE (AS OF AUGUST 2017)

NOTES

1. TOP OF FINAL COVER GRADES ARE SHOWN ON THIS SHEET.
2. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED FEBRUARY 26, 2006.
3. THE 100-YEAR FLOODPLAIN IS BASED ON THE CURRENTLY PROPOSED FEMA FLOODPLAIN AS WELL AS THE CURRENTLY PROPOSED CITY OF AUSTIN FLOODPLAIN. SEE PART I/II, APPENDIX B (FLOODPLAIN LOCATION RESTRICTION).
4. SEE PART III, ATTACHMENT 2 FOR DETAILS OF STORMWATER MANAGEMENT FEATURES.

150 0 150 300
scale feet

INTENDED FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	BY	APP. BY
9	02/18	WATER BALANCE FINAL COVER PM	TNB	JY
8	02/12	STORMWATER SYSTEM REVISIONS	RF	JY
7	04/08	APRIL 2008 REVISIONS	CEI	CCD
6	02/08	2008 REVISIONS	CEI	CCD
5	08/07	RESPONSE TO TECHNICAL NOD DATED JULY 2, 2007	CEI	LAL
4	05/07	RESPONSE TO TECHNICAL NOD DATED APRIL 3, 2007	CEI	LAL
3	10/06	CHAPTER 330 RULE REVISION UPDATE	CEI	LAL
2	03/06	RESPONSE TO SECOND TECHNICAL NOD	CEI	LAL

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WASTE MANAGEMENT

PROJECT: MUNICIPAL SOLID WASTE EXPANSION APPLICATION
PERMIT MSW-249D
AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS

TITLE: FINAL CONTOUR MAP-WEST

DRAWN	CEI
REVIEWED	
CHECKED	
APPROVED	
DATE	JUNE 2005
SCALE	AS SHOWN
JOB NO.	033-4651
DWG. NO.	10394576G010

FIGURE NUMBER

ATT7-1A

Drawing File: P:\WM-ACL\083-94335-16 ACL 2016 PM For Closure Cost\FIGURES\ATT7-1B-1C\10394576G010.dwg | Layout: — | Modified: 2/14/2018 4:38:21 PM Tbookout | Plotted: Wednesday, February 21, 2018 8:59:25 AM Tbookout

PROPOSED COMPOSITE WEST HILL EXPANSION AREA OR WATER BALANCE FINAL COVER SYSTEM WEST OF THIS LINE SEE DETAIL 4A ATT7-2 4B ATT7-2

EXISTING WEST FINAL COVER SYSTEM EAST OF THIS LINE SEE DETAILS 5 ATT7-2 6 ATT7-2

MW-53 MW-63D MW-15 MW-50 MW-44 MW-43 MW-21 MW-11 MW-34 MW-38

ACCESS ROAD

FUTURE SUBTITLE D FINAL COVER AREA 4A ATT7-2 4B ATT7-2

PIGGYBACK LINER LIMIT 8 ATT-3

FUTURE PRE-SUBTITLE D FINAL COVER 5 ATT7-2

3 ATT-2 1 ATT-2

EXISTING NORTH POND

EXISTING SOUTH POND

LEACHATE EVAPORATION POND

INDUSTRIAL WASTE UNIT (CLOSED)

TRAVIS COUNTY LANDFILL (CLOSED)

MATCHLINE SEE ATT7-1A

MATCHLINE SEE ATT7-1C

E. 3148000 N. 10099000

E. 3150000 N. 10098000

E. 3144000 N. 10100000

E. 3147000 N. 10097000

E. 3145000 N. 10097000

E. 3148000 N. 10096000

E. 3147000 N. 10096000

LEGEND

- PERMIT BOUNDARY
- FENCE
- GRADE BREAKS
- 100-YEAR FLOODPLAIN
- CLOSED UNIT BOUNDARY
- MONITORING WELL
- GAS PROBE
- SURFACE WATER FLOW DIRECTION (CHANNELS/DITCHES/ADD-ON BERMS)
- SURFACE WATER DOWNCHUTE
- SURFACE WATER ENTRANCE OR DISCHARGE POINT
- STATE PLANE COORDINATE SYSTEM
- FINAL COVER ALREADY IN PLACE (AS OF AUGUST 2016)
- PIGGYBACK LINER AREA
- FUTURE PRE-SUBTITLE D FINAL COVER AREA
- 20-ACRE INTERMEDIATE COVER ALREADY IN PLACE (AS OF AUGUST 2017)

NOTES

1. TOP OF FINAL COVER GRADES ARE SHOWN ON THIS SHEET.
2. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED FEBRUARY 26, 2006.
3. THE 100-YEAR FLOODPLAIN IS BASED ON THE CURRENTLY PROPOSED FEMA FLOODPLAIN AS WELL AS THE CURRENTLY PROPOSED CITY OF AUSTIN FLOODPLAIN. SEE PART I/II, APPENDIX B (FLOODPLAIN LOCATION RESTRICTION).
4. SEE PART III, ATTACHMENT 2 FOR DETAILS OF STORMWATER MANAGEMENT FEATURES.
5. THE LIMITS OF THE INDUSTRIAL WASTE UNIT AND TRAVIS COUNTY LANDFILL ARE SHOWN AS APPROXIMATE.
6. GAS PROBE LAYOUT WAS REVISED BY TETRA TECH INC. JANUARY 2015.

150 0 150 300 scale feet

GOLDER ASSOCIATES, INC
TEXAS REGISTRATION F-2578

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	DATE	DESCRIPTION	BY	APP. BY
11	02/18	WATER BALANCE FINAL COVER PM	TNB	MK
10	09/16	UPDATED THE EXISTING FINAL COVER AREA	TNB	MK
9	01/15	2015 GAS PROBE LAYOUT REVISIONS	ARM	JCM
8	02/12	STORMWATER SYSTEM REVISIONS	RF	JT
7	04/08	APRIL 2008 REVISIONS	CEI	CGD
6	02/08	2008 REVISIONS	CEI	CGD
5	08/07	RESPONSE TO TECHNICAL NOD DATED JULY 2, 2007	CEI	LAL
4	05/07	RESPONSE TO TECHNICAL NOD DATED APRIL 3, 2007	CEI	CGD
3	10/06	CHAPTER 330 RULE REVISION UPDATE	CEI	LAL

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WASTE MANAGEMENT

PROJECT: MUNICIPAL SOLID WASTE EXPANSION APPLICATION
PERMIT MSW-249D
AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS

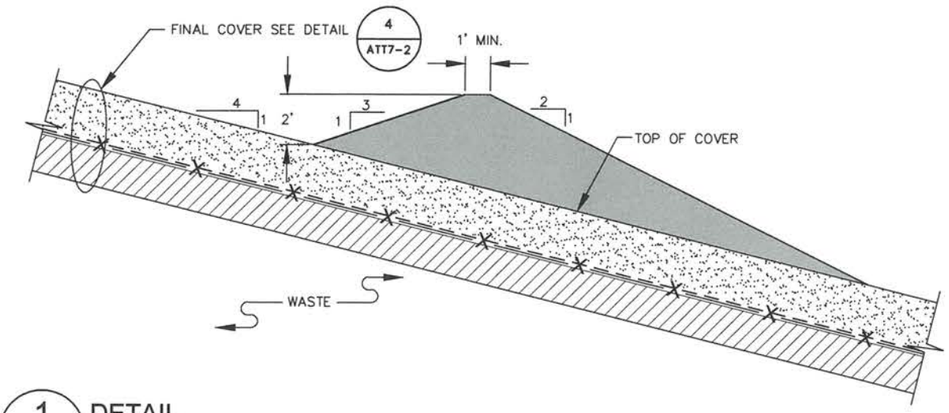
TITLE: FINAL CONTOUR MAP-CENTRAL

DRAWN	CEI
REVIEWED	
CHECKED	
APPROVED	
DATE	JUNE 2005
SCALE	AS SHOWN
JOB NO.	033-4651
DWG. NO.	10394576G010

FIGURE NUMBER

ATT7-1B

Drawing File: P:\WM-ACL\083-94335-16 ACL 2016 PM For Closure Cost\FIGURES\ATT7-1B-1C ATT7-1B-1C\10394576G010.dwg | Layout: — | Modified: 2/14/2018 4:38:21 PM Tbookout | Plotted: Wednesday, February 21, 2018 8:59:05 AM Tbookout



1 DETAIL ATT7-1
ADD-ON BERM

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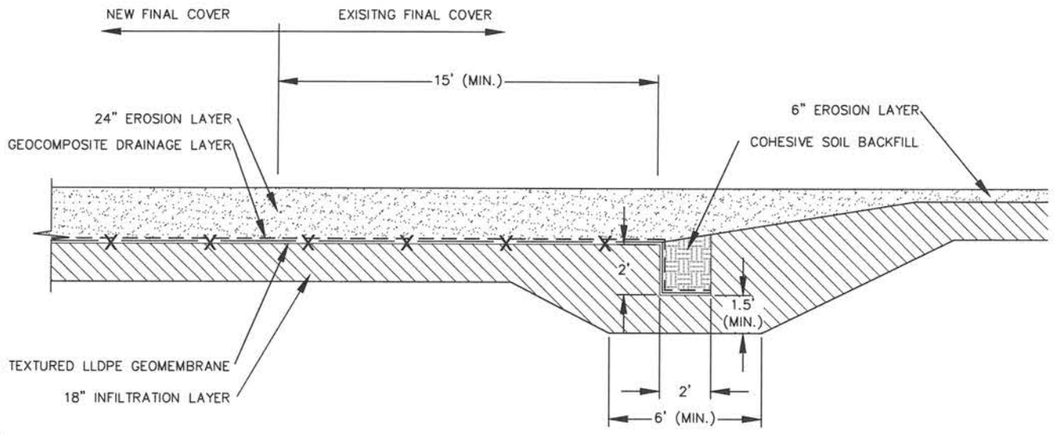

3 DETAIL ATT7-1
TIE-IN BETWEEN SUBTITLE D AND PRE-SUBTITLE D FINAL COVER AT SIDESLOPES

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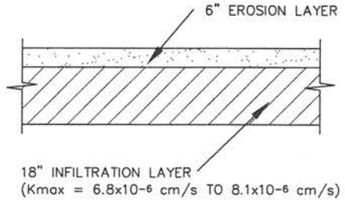

5 DETAIL ATT7-1
EXISTING AND PROPOSED FINAL COVER PRE-SUBTITLE D

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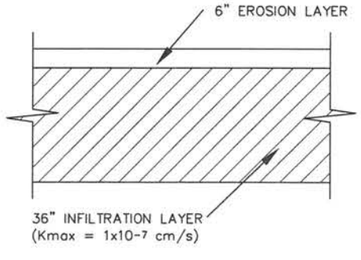
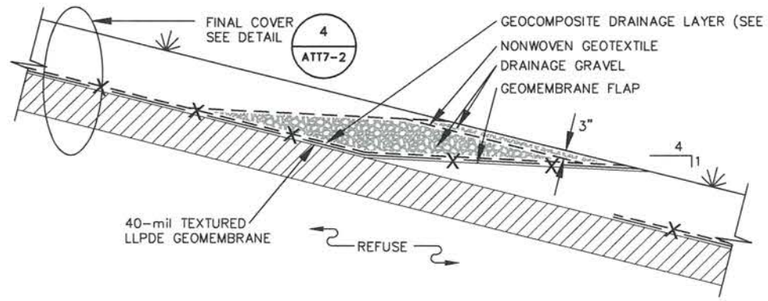


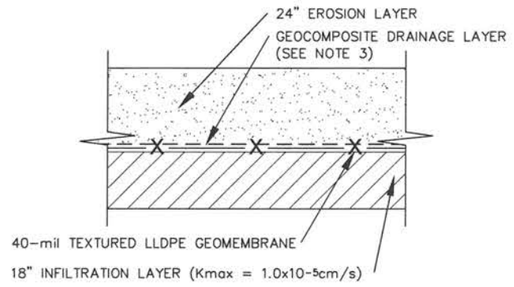
6 DETAIL ATT7-1
EXISTING FINAL COVER SUBTITLE D

scale 2 0 2 4 feet



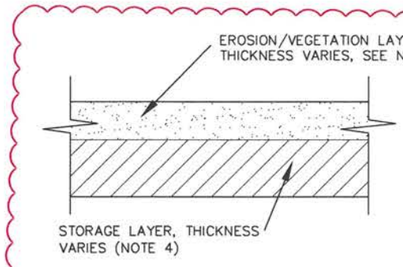
2 DETAIL ATT7-2
GEOCOMPOSITE DAYLIGHT DRAINAGE

scale 3 0 3 6 feet



4A DETAIL ATT7-1
FINAL COVER DETAIL

scale 2 0 2 4 feet



4B DETAIL ATT7-1
WATER BALANCE ALTERNATIVE FINAL COVER

scale 2 0 2 4 feet

NOTES

1. GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY.
2. SEE ATTACHMENT 2 FOR DETAILS OF STORMWATER MANAGEMENT FEATURES.
3. SEE ATTACHMENT 3, APPENDIX D FOR DESIGN OF THE GEOCOMPOSITE DRAINAGE LAYER.
4. THICKNESS AND PERMEABILITY OF THE WATER BALANCE COVER STORAGE LAYER AND EROSION LAYER MAY VARY. SEE SDP ATTACHMENT 7, APPENDIX A FOR GUIDANCE.

INTENDED FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	DR. BY	APP. BY
2	02/18	ADDED ALTERNATE DETAIL AND NOTE	TNB	WEG
1	10/06	CHAPTER 330 RULE REVISION UPDATE	CEI	LAL

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WASTE MANAGEMENT, INC.

PROJECT: MUNICIPAL SOLID WASTE EXPANSION APPLICATION
PERMIT MSW-249D
AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS

TITLE: FINAL COVER DETAILS I

DRAWN	ML
REVIEWED	
CHECKED	
APPROVED	
DATE	JUNE 2005
SCALE	AS SHOWN
JOB NO.	033-4651
DWG. NO.	033-4651-ATT7-2

FIGURE NUMBER

ATT7-2

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WASTE MANAGEMENT, INC.

AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 7, APPENDIX A
FINAL COVER QUALITY CONTROL PLAN

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

Golder Associates

500 Century Plaza Drive
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August 2005
Revision 1 – December 2005
Revision 2 – March 2006
Revision 3 – October 2006
Revised October 2017
Revised February 2018

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 7, APPENDIX A
FINAL COVER QUALITY CONTROL PLAN

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TABLES

FIGURES

In accordance with 30 TAC §330.457(a)(1) and 30 TAC §330.457(d), the ACRDF may choose to install an alternate final cover over portions of the Subtitle-D cells in the western and southwestern part of the expansion area and over the vertical expansion area of the West Hill. The alternate final cover would consist of a Water Balance (WB) Cover as described in the document "Geoclimatic Design of Water Balance Covers for Municipal Solid Waste Landfills in Texas" prepared by Miland V. Khier, Ph.D., P.E., dated August 4, 2016. The water balance cover consists of a layer of silty and clayey soils to store water and sustain vegetation until the water is removed by evapotranspiration. The thickness of this cover may vary in accordance with the TCEQ Guidance Document RG-494 dated March 2017 depending upon the soil properties used and the hydraulic conductivity of the constructed cover. TCEQ Guidance Document RG-494 ~~dated March 2017~~ provides for four options for the design and construction of water balance covers. The ACRDF will utilize Option 1 – Statewide Design Table for constructing water balance covers at the facility.

The owner/operator is responsible for fully implementing this FCQCP. The site manager (SM) or designated alternate will be responsible for contracting with a qualified independent quality assurance/quality control (QA/QC) professional prior to initiation of final cover construction. Each phase of the soil and geosynthetic evaluation shall be conducted by or under the supervision of the QA/QC Professional. The QA/QC Professional shall be an independent, licensed, professional engineer (P.E.) experienced in geotechnical engineering and soils testing.

A qualified engineering technician performing daily QA/QC observation and testing will be under the direct supervision of the QA/QC Professional. The engineering technician shall be NICET-certified at level 1 or higher, an engineering technician with a minimum of 2 years of directly related experience, a graduate engineer or geologist, or an engineering technician with other applicable certificates (e.g., Certified Engineering Technologist, CET) approved by the TCEQ.

Full-time quality assurance shall be provided by the QA/QC Professional or his/her qualified representative(s) as described in this plan. QA/QC documentation will be provided to the executive director, in accordance with Section 5.0 of this plan.

2.0 COHESIVE SOIL COVER EVALUATION

This section outlines generally acceptable construction practices and specifications and quality control testing requirements for cohesive soil cover used in the standard final cover. Construction practices for the ~~alternate~~ WB alternative final cover are presented in Section 5 of this FCQCP.

2.1 Preconstruction Material Evaluation

The first step in the construction of a cohesive soil cover is to pre-qualify the soil materials that are selected for final cover construction. Cohesive soil cover material may be obtained from in-situ soil strata which are typically stockpiled soils excavated as cells are constructed, or from a select borrow source. Representative samples from these sources shall be subject to the minimum preconstruction testing program shown in Table 7A.1.

Only the geocomposite should be placed in direct contact with the geomembrane. Light equipment such as low ground pressure dozers (less than 5 pounds per square inch contact pressure) shall be used to place the soil cover and a minimum of 12 inches of material shall be maintained between the dozer and the underlying geosynthetics. If possible, cover should be placed during the coolest weather available. Soil cover material shall be deployed in "fingers" along the geosynthetics to control the amount of slack and minimize wrinkles and prevent folds. Soil cover shall generally be placed in an up-slope direction on sideslopes.

The soil cover material shall consist of soils that are classified as SCS Hydrologic Soil Groups (HSG) A, B, or C. These soils have infiltration rates ranging approximately 0.05 inches/hour (3.5×10^{-5} cm/sec) to greater than 0.30 inches/hour (2.1×10^{-4} cm/sec), according to the Soil Conservation Service publication TR-55 (June 1986). Compaction of the soil cover material can affect the HSG, making a soil in a particular soil group less pervious and thus make it behave as another soil group. Because low ground pressure equipment will be used, compaction of the soil will be minimal.

Geosynthetic Cover System

The final thickness of the protective/erosion layer shall be a minimum of 24 inches directly above the geocomposite drainage layer. The required thickness of the layer shall be verified by survey techniques on an established grid system with not less than one verification point per 10,000 square feet of surface area. A minimum of two verification points is required.

The soil used as the soil cover layer will be capable of sustaining native plant growth and must be seeded or sodded immediately after completion of the final cover (weather permitting). Temporary or permanent erosion control materials (i.e. mulches, containment meshes, geomatting systems, etc.) may be used to minimize erosion and aid establishment of vegetation. An alternative erosion layer may also be constructed (subject of the approval of TCEQ) consisting of cobbles, riprap, or other hard armor systems for areas in which the establishment of vegetation cover has proven difficult.

Other quality assurance for the soil cover layer should consist of continuous observation by the QA/QC Professional or his representative during construction; inspection of any manufacturer's or supplier's material test data and certification; and performing any additional test believed necessary by the QA/QC Professional to verify that the layer has been constructed in accordance with the closure plan.

5.0 ~~Alternate~~ Water Balance Alternative Cover System

The purpose of these guidelines is to establish an approach for placement and compaction during construction of the WB final cover at the Austin Community Landfill that will meet the required standards presented in "~~Geoclimatic Design of Water Balance Covers for Municipal Solid Waste Landfills in Texas (Khire, 2016)~~TCEQ Guidance Document RG-494 dated March 2017.

5.1 Preconstruction Testing and Test Pad Construction

The goal of the preconstruction testing is to characterize the borrow soils and to define the "acceptance window" for each type of soil. The acceptance window is the range of unit weight/water content combinations that have been shown to produce a $k \leq 1 \times 10^{-7}$ cm/s in the 6-inch diameter remolded permeability samples, without falling above the line-of-optimums.

3. The QA/QC monitor will perform a minimum of 4 in-place moisture-density tests using a nuclear density gauge. If the water content/density falls within the acceptance window move to Step 4, otherwise compact the soil until passing results are obtained.
4. The QA/QC monitor will obtain bag samples from each in-place moisture-density test on the completed lift for water content testing in the lab.
5. The QA/QC monitor will obtain a 3 inch diameter Shelby tube sample from the completed lift.

The tube samples from each lift should be tested for the following:

- Water content
- Dry unit weight
- Atterberg limits
- Hydraulic conductivity

Once it has been determined that the construction practices and soil testing will provide a compacted clay cover with a $k \leq 1 \times 10^{-7}$ cm/s, construction of the WB cover may begin.

5.2 WB Cover Construction and Testing

Construction of the WB final cover must proceed in the same manner as the test pad construction or as determined in previous construction at the facility. The soil shall be spread in loose lift thickness of 10-inches of less. Compaction will be in accordance with the procedures identified either through previous construction or in test pad construction that produced a $k \leq 1 \times 10^{-7}$ cm/s.

The total thickness of the WB final cover may vary based upon the permeability of the constructed cover. The final cover thickness will be determined as follows:

- First, initial preconstruction testing data of the borrow source soil will be used to determine the target permeability and the thickness of the WB cover, based on TCEQ Guidance Document RG-494 (March 2017), Table 3.
- Second, during cover construction, soil samples of the as-built final cover will be taken and tested for hydraulic conductivity as described in Section 5.3. Hydraulic conductivity results of the as-built final cover samples will be used to verify that the geometric mean of the samples is no greater than the target hydraulic conductivity used to set the final cover thickness in accordance with TCEQ Guidance Document RG-494 (March 2017), Table 3. For areas exceeding the target hydraulic conductivity, additional compaction and re-testing will be performed to ensure that the geometric mean meets the target hydraulic conductivity.
- Last, the final cover thickness may be adjusted, as needed, based on the results of the preconstruction soil samples taken throughout the construction process and in accordance with TCEQ Guidance Document RG-494 (March 2017), Table 3. In no case will the thickness be decreased from the thickness determined in the preconstruction testing.
- Should the preconstruction testing indicate an increase to the final cover thickness is required, the subgrade shall be adjusted based on the thickness of the WB cover. For all WB cover constructions, the permitted top of final cover grades will be maintained per the TCEQ permitted final grading plan to ensure proper drainage and transition between existing and new final cover areas. The final top of waste grades will be at or below the permitted final elevation once the cover is installed. In no case will the increase in the thickness of the WB cover or the erosion layer raise the final surface of the cover above the permitted design elevations.

TCEQ Guidance Document RG-494 (March 2017), Table 3 provides the following guidance for WB cover thickness in the Austin area:

K (as-built), cm/sec	Minimum Storage Layer Thickness
1×10^{-8}	1 ft 8 in
5×10^{-8}	2 ft 7 in
1×10^{-7}	3 ft 11 in

5.3 Construction Testing

The goal of the construction testing is to demonstrate that the soil is being compacted within the acceptance window and that the in-place soil has a k that is at or less than ~~≤ 1 x 10^{-7} cm/s~~the target value determined during preconstruction testing (if less ≤ 1 x 10^{-7} cm/s). Both water content and unit weight will be determined in the field using the nuclear density gauge and in the lab using 3-inch diameter Shelby tubes. Minimum testing frequencies are presented below:

Construction Testing

Test	Method	Minimum Frequency
Field Moisture/Density Test(1)	ASTM D6938	1 per 8,000 ft², per 6-inch lift
Water Content	ASTM D2216	As needed to calibrate nuclear gauge. Use 60°C oven.
Percent Fines	ASTM D1140	1 per 100,000 ft², per 6-inch lift ~~(~ 1/2000 cy or 9 per lift)~~
Atterberg Limits	ASTM D4318	
Hydraulic Conductivity(1)	ASTM D5084	1 per 2.5 acres of cover per lift evenly distributed through all lifts ~~(~ 1/2,000 cy or 8 per lift)~~

Notes: (1) Increase cell pressure as necessary to control swell during saturation. Once saturation (B-value) reaches 95%, reduce effective confining pressure to 4 psi.

Key items:

- 90% of both the field and lab values must plot within the acceptance window.
- The geometric mean of the k values must be ≤ ~~1.0 x 10^{-7} cm/s~~the target permeability determined during preconstruction testing. The geometric mean is determined as the n^{th} root of the product of n numbers.

$$\left(\prod_{i=1}^{n} x_i\right)^{\frac{1}{n}} = \sqrt[n]{x_1 x_2 \cdots x_n}.$$

For example: for 3 k-values the geometric mean is $(X_1 \cdot X_2 \cdot X_3)^{0.333}$.

5.4 Protective Cover Soil

ENCLOSURE 2

CLEAN COPIES

WASTE MANAGEMENT, INC.

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

SITE DEVELOPMENT PLAN

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

Golder Associates

500 Century Plaza Drive
Suite 190
Houston, Texas 77073
(281) 821-6868

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

Permit Issued: May 10, 2010
Revised April 2011
Revised June 2011
Revised October 2017
Revised February 2018

WASTE MANAGEMENT, INC.

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 3
WASTE MANAGEMENT UNIT DESIGN REPORT

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

Golder Associates

500 Century Plaza Drive
Suite 190
Houston, Texas 77073
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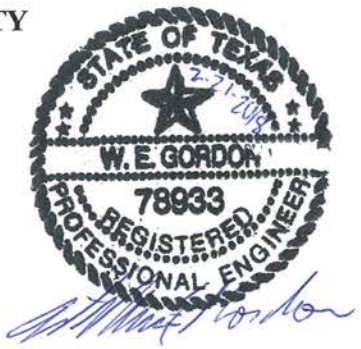
August 2006
Revision 1 – May 2007
Revision 2 – August 2007
Revision 3 – December 2007
Revision 4 – February 2008
Revision 5 – March 2008
Revision 6 – May 2008
Revised October 2017
Revised February 2018

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 3
WASTE MANAGEMENT UNIT DESIGN REPORT



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Revised October 2017
Revised February 2018

STATE OF TEXAS
2-27-18
W. E. GORDON
78933
REGISTERED
PROFESSIONAL ENGINEER

TABLES

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

GOLDER ASSOCIATES INC.
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Registration Number F-2578

FIGURES

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GOLDER ASSOCIATES INC.
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Registration Number F-2578

4.3.2.4 Stability of Final Filled Configuration

The final filled configuration was considered across cells WD-11, WD-12, and WD-13, up to a maximum cover elevation of 740 feet. The configuration was analyzed using appropriate shear strength parameters and worst-case geometry. The results, based on analyses performed using SLIDE and included in Appendix C.4, indicate that the final waste slopes will be stable with a minimum factor of safety of 1.58.

4.3.2.5 Stability of Final Cover System

A stability analysis of the final cover liner system was performed using methods outlined by Soong and Koerner (1996) to estimate the potential for sliding to occur following closure of the landfill cells. A worst-case section, consisting of a 710-foot long, 25-percent slope was analyzed. Based on a review of the literature and unpublished data on similar materials under similar loading conditions, the critical interface shear strength within the final cover liner system was estimated to be 21º.

The analyses (included in Appendix C.5) indicate that, provided the geocomposite drainage layer is adequate to convey drainage without building up pore water pressures in the geocomposite, the factor of safety against sliding will be approximately 1.6.

Additional analyses (included in Appendix D) were performed to determine the geocomposite drainage layer transmissivity required to adequately convey surface water infiltration over the maximum final cover slope length. If the minimum measured transmissivity value reported in Appendix D is not met, the maximum flow length must be reduced (i.e., the geocomposite drainage layer must be "daylighted") in direct proportion to the ratio of the actual measured transmissivity and the required measured transmissivity. A detail depicting "daylighting" is included on Figure ATT7-2 in Attachment 7, the Closure Plan.

A stability analysis of the water balance final cover was also performed using the limit equilibrium analysis. The section analyzed consists of a 710-foot long, 25-percent slope, consistent with the section analyzed for the composite final cover system. Material parameters were selected based on review of literature and site data, which are also consistent with other slope stability analyses in Appendix C. The analysis (included in Appendix C.5A) indicate that the factor of safety against sliding will be approximately 2.6.

APPENDIX C.5A

FINAL COVER STABILITY – WATER BALANCE ALTERNATIVE FINAL COVER

FINAL COVER STABILITY - WATER BALANCE ALTERNATIVE FINAL COVER

Made By: MX
Checked by: JBF
Reviewed by:

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

1.0 OBJECTIVE

To investigate the veneer slope stability of the water balance alternative final cover system.

2.0 GIVEN

Final cover slopes are as follows:

Future final cover area: 4H:1V (S = 25%) with a maximum length of slope conservatively assumed to be 710 ft.

Based on the "EPA Guide to Technical Resources for the Design of Land Disposal Facilities", the recommend factor of safety for the final cover slope is selected to be 1.5 at minimum.

3.0 ASSUMPTIONS

A worst-case, i.e. a thickest final cover profile is used for the slope stability analysis for conservative purposes:

1-ft erosion layer with the top 6 inches vegetative cover
4-ft storage layer ($K_{as\text{-}built} \leq$ 1.00*10-7 cm/sec - worst case, i.e. thickest final cover)
Subgrade

Soil source for the water balance final cover will be on-site clay soil materials.

Based on a review of available data, the following parameters were assigned to the materials.

Material	Strength Parameters		Unit Weight (pcf)		Reference
	ϕ (degree)	c (psf)	Moist	Saturated	
Final Cover Soil	0	1000	119	132	Part III, Attachment 3, Text Section 4.2.3, Tables 3.3 and 3.4
Interface Between Final Cover Soil & Subgrade	0	750	N/A	N/A	

Notes:

1. The shear strength of the final cover soil is estimated based on the on-site soil shear strength (Strata IA and IB). As shown in Part III, Attachment 3, Text Section 4.2.3, Tables 3.3 and 3.4, the mininum shear strengh of onsite clay materials is 2,100 psf. For conservative purposes, the shear strength of the final cover soil is assumed to be 1,000 psf and the interface is assumed to be even lower at 750 psf.
2. The final cover system, including both the top erosion layer and the storage layer, will be constructed of on-site clay materials . The storage layer will be compacted as described in the final cover quality control plan to reach the required permeability, and the erosion layer will be resonably compacted and vegetation will be established on the final cover. For slope stability analysis purposes, it is not necessary to analyze the top soil stability separately, rather, the entire final cover system is considered as one unit.

3.0 METHODS

Two slope stability analyses were performed for the final cover system:

- Circular failure for the final cover system
- Block (i.e. sliding) failure of the final cover system along the final cover/subgrade interface

Circular Failure Mode:

A slope stability software (SLIDE v7.029) was used to perform the analysis. The minimum factor of safety is shown below and output of stability analysis is attached.

Allow failure surface in the final cover only	**FS_{min} = 9.5**
Allow failure surface into the waste	**FS_{min} = 2.6**

Block Failure Mode:

A limit equilibrium analysis was performed to determine the minimum factor of safety against a sliding block failure along the interface. The equation below was derived based on the force equilibrium of the final cover soil layer. Please refer to Chapter 12.3 of "Principles of Geotechnical Engineering" by Braja M. Das.

$$FS = \frac{c + (\gamma b \cos\beta - \gamma_w d \cos\beta)\tan\phi}{\gamma b \sin\beta}$$

Potential Sliding of the Water Balance Final Cover

ϕ =	0	interface friction angle
c =	750	interface cohesion (psf)
β =	14.0	slope angle (degrees)
γ =	132	saturated unit weight of soil (pcf)
b =	5.0	soil thickness (ft)
d =	5	water depth in cover (conservatively assume the entire final cover is saturated) (ft)
γ_w =	62.4	unit weight of water (pcf)
FS =	**4.7**	**> 1.5**

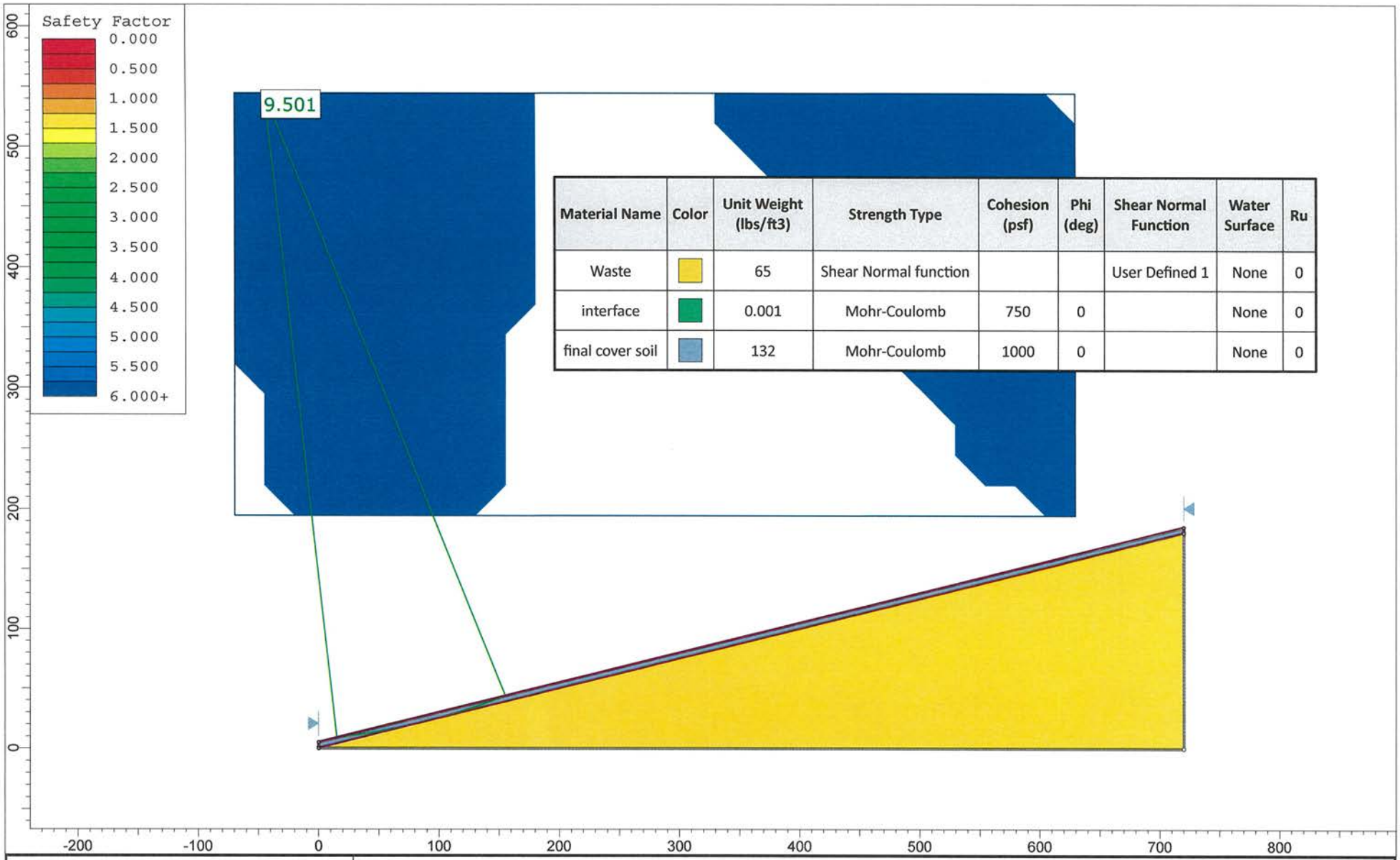
Factor of safety against sliding of the water balance final cover = **4.7** **> 1.5**

5.0 RESULTS

The future 4H:1V water balance alternative final cover slope will have a minimum factor of safety greater than 1.5.

6.0 CONCLUSION

The analysis demonstated that the proposed water balance alternative final cover will be stable.

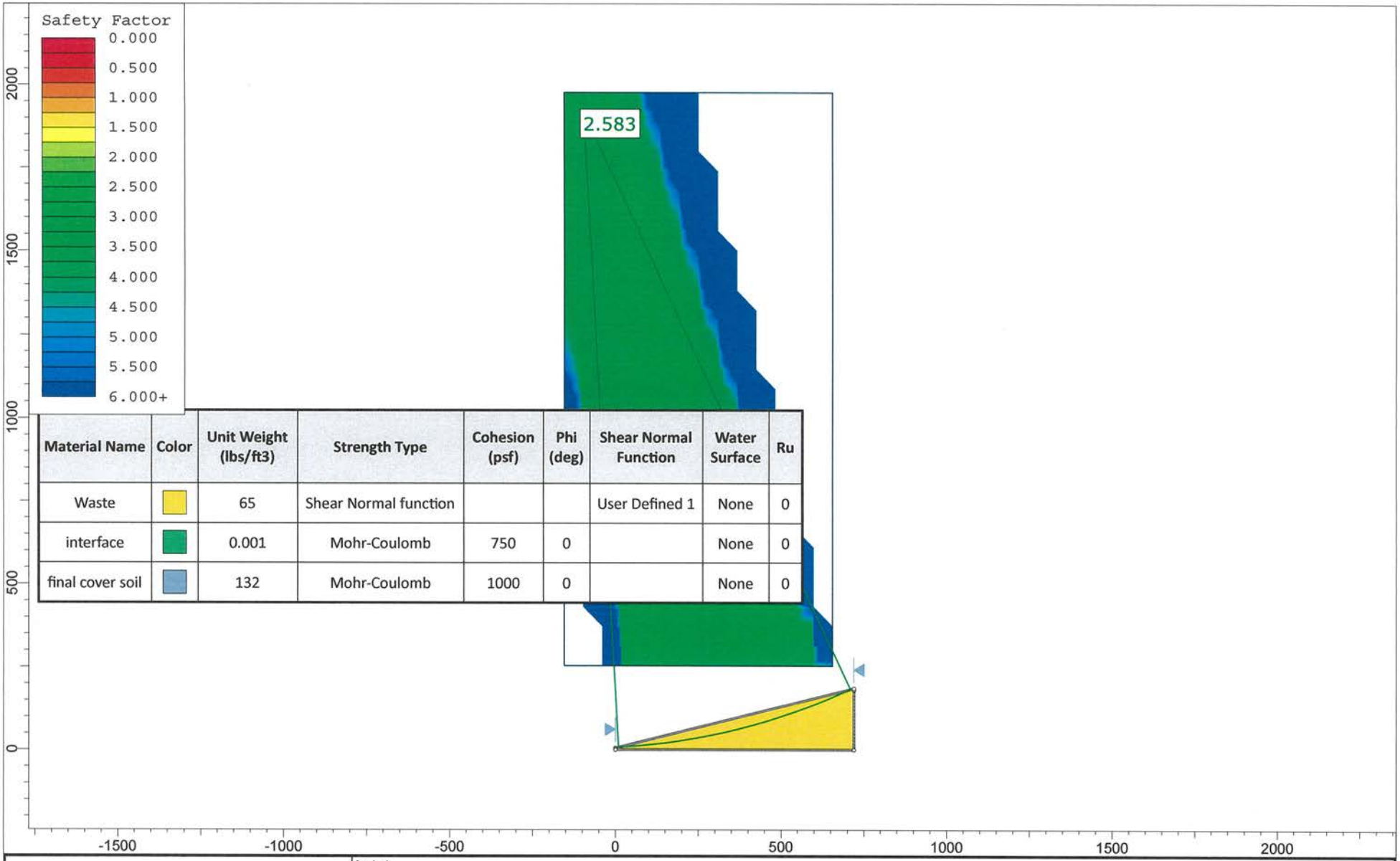


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Waste		65	Shear Normal function			User Defined 1	None	0
interface		0.001	Mohr-Coulomb	750	0		None	0
final cover soil		132	Mohr-Coulomb	1000	0		None	0

rocscience

SLIDEINTERPRET 7.029

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By		Scale 1:1324	Company
Date	1/25/2018, 11:03:43 AM		File Name slide3 720 ft long.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Shear Normal Function	Water Surface	Ru
Waste		65	Shear Normal function			User Defined 1	None	0
interface		0.001	Mohr-Coulomb	750	0		None	0
final cover soil		132	Mohr-Coulomb	1000	0		None	0

rocscience	Project: SLIDE - An Interactive Slope Stability Program		
	Analysis Description:		
	Drawn By:	Scale: 1:4806	Company:
SLIDEINTERPRET 7.029	Date: 1/25/2018, 11:03:43 AM		File Name: slide3 720 ft long.slim

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name:	slide3 720 ft long.slim
Slide Modeler Version:	7.029
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	1/25/2018, 11:03:43 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Waste	interface	final cover soil
Color			
Strength Type	Shear Normal function	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	65	0.001	132
Cohesion [psf]		750	1000
Friction Angle [deg]		0	0
Water Surface	None	None	None
Ru Value	0	0	0

Shear Normal Functions

Name: User Defined 1

Normal (psf)	Shear (psf)
0	400
800	400
6000	3900

Global Minimums

Method: bishop simplified

FS	9.501230
Center:	-44.515, 544.451
Radius:	538.991
Left Slip Surface Endpoint:	15.039, 8.760
Right Slip Surface Endpoint:	155.028, 43.757
Resisting Moment:	6.92928e+007 lb-ft
Driving Moment:	7.29304e+006 lb-ft
Total Slice Area:	466.864 ft2
Surface Horizontal Width:	139.989 ft
Surface Average Height:	3.335 ft

Method: janbu simplified

FS	9.481210
Center:	-44.515, 544.451
Radius:	538.991
Left Slip Surface Endpoint:	15.039, 8.760
Right Slip Surface Endpoint:	155.028, 43.757
Resisting Horizontal Force:	124310 lb
Driving Horizontal Force:	13111.2 lb
Total Slice Area:	466.864 ft2
Surface Horizontal Width:	139.989 ft
Surface Average Height:	3.335 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 3000
Number of Invalid Surfaces: 1785

Error Codes:

Error Code -102 reported for 2 surfaces
Error Code -106 reported for 20 surfaces
Error Code -108 reported for 36 surfaces
Error Code -1000 reported for 1727 surfaces

Method: janbu simplified

Number of Valid Surfaces: 2945
Number of Invalid Surfaces: 1840

Error Codes:

Error Code -102 reported for 2 surfaces
Error Code -106 reported for 20 surfaces
Error Code -108 reported for 91 surfaces
Error Code -1000 reported for 1727 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections, but resulting arc is actually outside soil region.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 9.50123

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.82691	71.8132	6.49482	final cover soil	1000	0	105.25	1000	13.4214	0	13.4214	25.4034	25.4034
2	2.82691	212.617	6.79736	final cover soil	1000	0	105.25	1000	62.6663	0	62.6663	75.2116	75.2116
3	2.82691	347.769	7.10009	final cover soil	1000	0	105.25	1000	109.911	0	109.911	123.021	123.021
4	2.82691	477.26	7.40302	final cover soil	1000	0	105.25	1000	155.152	0	155.152	168.827	168.827
5	2.82691	601.077	7.70616	final cover soil	1000	0	105.25	1000	198.385	0	198.385	212.627	212.627
6	2.82691	719.209	8.00952	final cover soil	1000	0	105.25	1000	239.606	0	239.606	254.415	254.415
7	2.82691	831.643	8.3131	final cover soil	1000	0	105.25	1000	278.809	0	278.809	294.188	294.188
8	2.82691	938.366	8.61691	final cover soil	1000	0	105.25	1000	315.991	0	315.991	331.941	331.941
9	2.82691	1039.37	8.92098	final cover soil	1000	0	105.25	1000	351.149	0	351.149	367.67	367.67
10	2.82691	1134.63	9.22529	final cover soil	1000	0	105.25	1000	384.273	0	384.273	401.368	401.368
11	2.82691	1224.13	9.52987	final cover soil	1000	0	105.25	1000	415.361	0	415.361	433.03	433.03
12	2.82691	1307.87	9.83472	final cover soil	1000	0	105.25	1000	444.405	0	444.405	462.651	462.651
13	2.82691	1385.83	10.1398	final cover soil	1000	0	105.25	1000	471.404	0	471.404	490.227	490.227
14	2.82691	1457.98	10.4453	final cover soil	1000	0	105.25	1000	496.35	0	496.35	515.753	515.753
15	2.72688	1439.79	10.7456	interface	750	0	78.9371	750	513.019	0	513.019	528	528
16	2.72688	1439.79	11.0408	interface	750	0	78.9371	750	512.597	0	512.597	527.999	527.999
17	2.72688	1439.79	11.3363	interface	750	0	78.9371	750	512.175	0	512.175	528	528
18	2.72688	1439.79	11.6321	interface	750	0	78.9371	750	511.75	0	511.75	527.999	527.999
19	2.72688	1439.79	11.9282	interface	750	0	78.9371	750	511.324	0	511.324	527.999	527.999
20	2.72688	1439.79	12.2246	interface	750	0	78.9371	750	510.898	0	510.898	528	528
21	2.72688	1439.79	12.5214	interface	750	0	78.9371	750	510.468	0	510.468	527.999	527.999
22	2.72688	1439.79	12.8185	interface	750	0	78.9371	750	510.042	0	510.042	528.002	528.002
23	2.72688	1439.79	13.1159	interface	750	0	78.9371	750	509.607	0	509.607	528	528
24	2.72688	1439.79	13.4138	interface	750	0	78.9371	750	509.176	0	509.176	528.001	528.001
25	2.72688	1439.79	13.7119	interface	750	0	78.9371	750	508.74	0	508.74	528	528
26	2.72688	1439.79	14.0105	interface	750	0	78.9371	750	508.303	0	508.303	528	528
27	2.72688	1439.79	14.3095	interface	750	0	78.9371	750	507.866	0	507.866	528	528
28	2.72688	1439.79	14.6088	interface	750	0	78.9371	750	507.427	0	507.427	528.001	528.001
29	2.72688	1439.79	14.9086	interface	750	0	78.9371	750	506.986	0	506.986	528.003	528.003
30	2.72688	1439.79	15.2088	interface	750	0	78.9371	750	506.541	0	506.541	528.001	528.001
31	2.72688	1439.79	15.5094	interface	750	0	78.9371	750	506.095	0	506.095	528	528
32	2.72688	1439.79	15.8104	interface	750	0	78.9371	750	505.65	0	505.65	528.002	528.002
33	2.72688	1439.79	16.1119	interface	750	0	78.9371	750	505.199	0	505.199	528.001	528.001
34	2.72688	1439.79	16.4139	interface	750	0	78.9371	750	504.747	0	504.747	528	528
35	2.72688	1439.79	16.7163	interface	750	0	78.9371	750	504.292	0	504.292	527.999	527.999
36	2.72688	1439.79	17.0192	interface	750	0	78.9371	750	503.838	0	503.838	528.001	528.001
37	2.72688	1439.79	17.3226	interface	750	0	78.9371	750	503.379	0	503.379	527.999	527.999
38	2.89957	1493.29	17.6361	final cover soil	1000	0	105.25	1000	481.544	0	481.544	515.004	515.004
39	2.89957	1414.46	17.9599	final cover soil	1000	0	105.25	1000	453.7	0	453.7	487.816	487.816
40	2.89957	1328.7	18.2842	final cover soil	1000	0	105.25	1000	423.464	0	423.464	458.239	458.239
41	2.89957	1235.96	18.6091	final cover soil	1000	0	105.25	1000	390.819	0	390.819	426.258	426.258
42	2.89957	1136.21	18.9347	final cover soil	1000	0	105.25	1000	355.747	0	355.747	391.853	391.853
43	2.89957	1029.4	19.2608	final cover soil	1000	0	105.25	1000	318.241	0	318.241	355.019	355.019
44	2.89957	915.497	19.5877	final cover soil	1000	0	105.25	1000	278.284	0	278.284	315.736	315.736
45	2.89957	794.454	19.9152	final cover soil	1000	0	105.25	1000	235.86	0	235.86	273.991	273.991
46	2.89957	666.228	20.2434	final cover soil	1000	0	105.25	1000	190.953	0	190.953	229.768	229.768
47	2.89957	530.773	20.5722	final cover soil	1000	0	105.25	1000	143.55	0	143.55	183.052	183.052
48	2.89957	388.042	20.9018	final cover soil	1000	0	105.25	1000	93.633	0	93.633	133.828	133.828
49	2.89957	237.988	21.2321	final cover soil	1000	0	105.25	1000	41.1856	0	41.1856	82.0772	82.0772
50	2.89957	80.5622	21.5632	final cover soil	1000	0	105.25	1000	-13.8088	0	-13.8088	27.7842	27.7842

Global Minimum Query (janbu simplified) - Safety Factor: 9.48121

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	2.82691	71.8132	6.49482	final cover soil	1000	0	105.472	1000	13.3955	0	13.3955	25.4029	25.4029
2	2.82691	212.617	6.79736	final cover soil	1000	0	105.472	1000	62.6393	0	62.6393	75.2111	75.2111
3	2.82691	347.769	7.10009	final cover soil	1000	0	105.472	1000	109.883	0	109.883	123.021	123.021
4	2.82691	477.26	7.40302	final cover soil	1000	0	105.472	1000	155.123	0	155.123	168.827	168.827
5	2.82691	601.077	7.70616	final cover soil	1000	0	105.472	1000	198.354	0	198.354	212.626	212.626
6	2.82691	719.209	8.00952	final cover soil	1000	0	105.472	1000	239.574	0	239.574	254.415	254.415
7	2.82691	831.643	8.3131	final cover soil	1000	0	105.472	1000	278.776	0	278.776	294.187	294.187
8	2.82691	938.366	8.61691	final cover soil	1000	0	105.472	1000	315.957	0	315.957	331.94	331.94
9	2.82691	1039.37	8.92098	final cover soil	1000	0	105.472	1000	351.11	0	351.11	367.666	367.666
10	2.82691	1134.63	9.22529	final cover soil	1000	0	105.472	1000	384.235	0	384.235	401.365	401.365
11	2.82691	1224.13	9.52987	final cover soil	1000	0	105.472	1000	415.323	0	415.323	433.029	433.029
12	2.82691	1307.87	9.83472	final cover soil	1000	0	105.472	1000	444.367	0	444.367	462.651	462.651
13	2.82691	1385.83	10.1398	final cover soil	1000	0	105.472	1000	471.362	0	471.362	490.225	490.225
14	2.82691	1457.98	10.4453	final cover soil	1000	0	105.472	1000	496.308	0	496.308	515.752	515.752
15	2.72688	1439.79	10.7456	interface	750	0	79.1038	750	512.987	0	512.987	527.999	527.999
16	2.72688	1439.79	11.0408	interface	750	0	79.1038	750	512.565	0	512.565	527.999	527.999
17	2.72688	1439.79	11.3363	interface	750	0	79.1038	750	512.139	0	512.139	527.998	527.998
18	2.72688	1439.79	11.6321	interface	750	0	79.1038	750	511.717	0	511.717	528.001	528.001
19	2.72688	1439.79	11.9282	interface	750	0	79.1038	750	511.288	0	511.288	527.999	527.999
20	2.72688	1439.79	12.2246	interface	750	0	79.1038	750	510.862	0	510.862	528.001	528.001
21	2.72688	1439.79	12.5214	interface	750	0	79.1038	750	510.433	0	510.433	528	528
22	2.72688	1439.79	12.8185	interface	750	0	79.1038	750	510.002	0	510.002	528.001	528.001
23	2.72688	1439.79	13.1159	interface	750	0	79.1038	750	509.568	0	509.568	527.999	527.999
24	2.72688	1439.79	13.4138	interface	750	0	79.1038	750	509.137	0	509.137	528.002	528.002
25	2.72688	1439.79	13.7119	interface	750	0	79.1038	750	508.701	0	508.701	528.002	528.002
26	2.72688	1439.79	14.0105	interface	750	0	79.1038	750	508.261	0	508.261	527.999	527.999
27	2.72688	1439.79	14.3095	interface	750	0	79.1038	750	507.823	0	507.823	528	528
28	2.72688	1439.79	14.6088	interface	750	0	79.1038	750	507.381	0	507.381	527.999	527.999
29	2.72688	1439.79	14.9086	interface	750	0	79.1038	750	506.94	0	506.94	528.001	528.001
30	2.72688	1439.79	15.2088	interface	750	0	79.1038	750	506.495	0	506.495	528	528
31	2.72688	1439.79	15.5094	interface	750	0	79.1038	750	506.049	0	506.049	528	528
32	2.72688	1439.79	15.8104	interface	750	0	79.1038	750	505.6	0	505.6	528	528
33	2.72688	1439.79	16.1119	interface	750	0	79.1038	750	505.15	0	505.15	528	528
34	2.72688	1439.79	16.4139	interface	750	0	79.1038	750	504.697	0	504.697	528	528
35	2.72688	1439.79	16.7163	interface	750	0	79.1038	750	504.243	0	504.243	528	528
36	2.72688	1439.79	17.0192	interface	750	0	79.1038	750	503.786	0	503.786	527.999	527.999
37	2.72688	1439.79	17.3226	interface	750	0	79.1038	750	503.326	0	503.326	527.999	527.999
38	2.89957	1493.29	17.6361	final cover soil	1000	0	105.472	1000	481.471	0	481.471	515.002	515.002
39	2.89957	1414.46	17.9599	final cover soil	1000	0	105.472	1000	453.628	0	453.628	487.816	487.816
40	2.89957	1328.7	18.2842	final cover soil	1000	0	105.472	1000	423.388	0	423.388	458.238	458.238
41	2.89957	1235.96	18.6091	final cover soil	1000	0	105.472	1000	390.74	0	390.74	426.254	426.254
42	2.89957	1136.21	18.9347	final cover soil	1000	0	105.472	1000	355.668	0	355.668	391.851	391.851
43	2.89957	1029.4	19.2608	final cover soil	1000	0	105.472	1000	318.162	0	318.162	355.017	355.017
44	2.89957	915.497	19.5877	final cover soil	1000	0	105.472	1000	278.203	0	278.203	315.734	315.734
45	2.89957	794.454	19.9152	final cover soil	1000	0	105.472	1000	235.777	0	235.777	273.989	273.989
46	2.89957	666.228	20.2434	final cover soil	1000	0	105.472	1000	190.87	0	190.87	229.766	229.766
47	2.89957	530.773	20.5722	final cover soil	1000	0	105.472	1000	143.465	0	143.465	183.051	183.051
48	2.89957	388.042	20.9018	final cover soil	1000	0	105.472	1000	93.546	0	93.546	133.826	133.826
49	2.89957	237.988	21.2321	final cover soil	1000	0	105.472	1000	41.0972	0	41.0972	82.0751	82.0751
50	2.89957	80.5622	21.5632	final cover soil	1000	0	105.472	1000	-13.8986	0	-13.8986	27.7823	27.7823

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 9.50123

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	15.039	8.75974	0	0	0
2	17.8659	9.08157	293.211	0	0
3	20.6928	9.41852	569.626	0	0
4	23.5197	9.77064	828.456	0	0
5	26.3466	10.1379	1069	0	0
6	29.1735	10.5205	1290.64	0	0
7	32.0004	10.9182	1492.86	0	0
8	34.8273	11.3313	1675.23	0	0
9	37.6542	11.7597	1837.4	0	0
10	40.4811	12.2034	1979.11	0	0
11	43.308	12.6626	2100.2	0	0
12	46.135	13.1371	2200.61	0	0
13	48.9619	13.6272	2280.36	0	0
14	51.7888	14.1328	2339.56	0	0
15	54.6157	14.6539	2378.42	0	0
16	57.3426	15.1714	2328.19	0	0
17	60.0694	15.7035	2270.7	0	0
18	62.7963	16.2502	2205.96	0	0
19	65.5232	16.8115	2133.95	0	0
20	68.2501	17.3875	2054.65	0	0
21	70.977	17.9783	1968.07	0	0
22	73.7038	18.5839	1874.18	0	0
23	76.4307	19.2044	1772.97	0	0
24	79.1576	19.8398	1664.44	0	0
25	81.8845	20.4901	1548.56	0	0
26	84.6114	21.1554	1425.32	0	0
27	87.3382	21.8359	1294.72	0	0
28	90.0651	22.5314	1156.72	0	0
29	92.792	23.2422	1011.32	0	0
30	95.5189	23.9682	858.501	0	0
31	98.2457	24.7095	698.241	0	0
32	100.973	25.4662	530.525	0	0
33	103.7	26.2384	355.333	0	0
34	106.426	27.026	172.646	0	0
35	109.153	27.8293	-17.5565	0	0
36	111.88	28.6483	-215.295	0	0
37	114.607	29.483	-420.592	0	0
38	117.334	30.3335	-633.469	0	0
39	120.233	31.2553	-772.182	0	0
40	123.133	32.1952	-893.43	0	0
41	126.033	33.1532	-993.952	0	0
42	128.932	34.1295	-1070.34	0	0
43	131.832	35.1242	-1119.02	0	0
44	134.731	36.1374	-1136.29	0	0
45	137.631	37.1692	-1118.24	0	0
46	140.53	38.2197	-1060.83	0	0
47	143.43	39.289	-959.842	0	0
48	146.33	40.3773	-810.885	0	0
49	149.229	41.4847	-609.391	0	0
50	152.129	42.6112	-350.61	0	0
51	155.028	43.7571	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 9.48121

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	15.039	8.75974	0	0	0
2	17.8659	9.08157	293.862	0	0
3	20.6928	9.41852	570.928	0	0
4	23.5197	9.77064	830.409	0	0
5	26.3466	10.1379	1071.6	0	0
6	29.1735	10.5205	1293.9	0	0
7	32.0004	10.9182	1496.78	0	0
8	34.8273	11.3313	1679.8	0	0
9	37.6542	11.7597	1842.62	0	0
10	40.4811	12.2034	1984.99	0	0
11	43.308	12.6626	2106.75	0	0
12	46.135	13.1371	2207.82	0	0
13	48.9619	13.6272	2288.23	0	0
14	51.7888	14.1328	2348.09	0	0
15	54.6157	14.6539	2387.61	0	0
16	57.3426	15.1714	2337.86	0	0
17	60.0694	15.7035	2280.86	0	0
18	62.7963	16.2502	2216.6	0	0
19	65.5232	16.8115	2145.07	0	0
20	68.2501	17.3875	2066.26	0	0
21	70.977	17.9783	1980.16	0	0
22	73.7038	18.5839	1886.76	0	0
23	76.4307	19.2044	1786.04	0	0
24	79.1576	19.8398	1678	0	0
25	81.8845	20.4901	1562.61	0	0
26	84.6114	21.1554	1439.87	0	0
27	87.3382	21.8359	1309.75	0	0
28	90.0651	22.5314	1172.25	0	0
29	92.792	23.2422	1027.35	0	0
30	95.5189	23.9682	875.024	0	0
31	98.2457	24.7095	715.263	0	0
32	100.973	25.4662	548.047	0	0
33	103.7	26.2384	373.357	0	0
34	106.426	27.026	191.173	0	0
35	109.153	27.8293	1.47578	0	0
36	111.88	28.6483	-195.757	0	0
37	114.607	29.483	-400.545	0	0
38	117.334	30.3335	-612.912	0	0
39	120.233	31.2553	-750.901	0	0
40	123.133	32.1952	-871.421	0	0
41	126.033	33.1532	-971.213	0	0
42	128.932	34.1295	-1046.87	0	0
43	131.832	35.1242	-1094.82	0	0
44	134.731	36.1374	-1111.34	0	0
45	137.631	37.1692	-1092.55	0	0
46	140.53	38.2197	-1034.39	0	0
47	143.43	39.289	-932.66	0	0
48	146.33	40.3773	-782.952	0	0
49	149.229	41.4847	-580.703	0	0
50	152.129	42.6112	-321.164	0	0
51	155.028	43.7571	0	0	0

List Of Coordinates

Focus Search Window

X	Y
720	180
720	185
0	5
0	0

External Boundary

X	Y
720	0
720	180
720	181
720	185
0	5
0	1
0	0

Material Boundary

X	Y
0	1
720	181

Material Boundary

X	Y
0	0
720	180

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name:	slide3 720 ft long.slim
Slide Modeler Version:	7.029
Project Title:	SLIDE - An Interactive Slope Stability Program
Date Created:	1/25/2018, 11:03:43 AM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Bishop simplified
	Janbu simplified
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Waste	interface	final cover soil
Color			
Strength Type	Shear Normal function	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	65	0.001	132
Cohesion [psf]		750	1000
Friction Angle [deg]		0	0
Water Surface	None	None	None
Ru Value	0	0	0

Shear Normal Functions

Name: User Defined 1

Normal (psf)	Shear (psf)
0	400
800	400
6000	3900

Global Minimums

Method: bishop simplified

FS	2.582720
Center:	-96.277, 1917.534
Radius:	1913.147
Left Slip Surface Endpoint:	9.184, 7.296
Right Slip Surface Endpoint:	709.605, 182.401
Resisting Moment:	1.44089e+009 lb-ft
Driving Moment:	5.57895e+008 lb-ft
Total Slice Area:	16563.8 ft2
Surface Horizontal Width:	700.421 ft
Surface Average Height:	23.6483 ft

Method: janbu simplified

FS	2.563790
Center:	-96.277, 1917.534
Radius:	1913.147
Left Slip Surface Endpoint:	9.184, 7.296
Right Slip Surface Endpoint:	709.605, 182.401
Resisting Horizontal Force:	727391 lb
Driving Horizontal Force:	283717 lb
Total Slice Area:	16563.8 ft2
Surface Horizontal Width:	700.421 ft
Surface Average Height:	23.6483 ft

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 3472
Number of Invalid Surfaces: 1478

Error Codes:

Error Code -102 reported for 10 surfaces
Error Code -103 reported for 139 surfaces
Error Code -106 reported for 15 surfaces
Error Code -108 reported for 82 surfaces
Error Code -1000 reported for 1232 surfaces

Method: janbu simplified

Number of Valid Surfaces: 3403
Number of Invalid Surfaces: 1547

Error Codes:

Error Code -102 reported for 10 surfaces
Error Code -103 reported for 139 surfaces
Error Code -106 reported for 15 surfaces
Error Code -108 reported for 151 surfaces
Error Code -1000 reported for 1232 surfaces

Error Codes

The following errors were encountered during the computation:

-102 = Two surface / slope intersections, but resulting arc is actually outside soil region.
-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-1000 = No valid slip surfaces are generated at a grid center. Unable to draw a surface.

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.58272

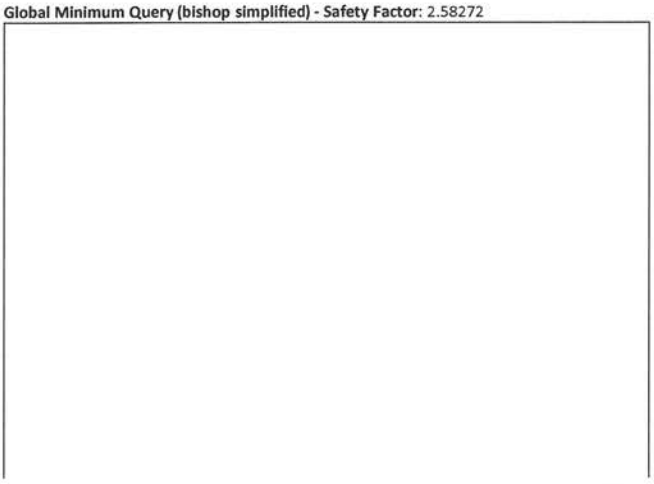
Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	21.1373	5580.25	3.47709	final cover soil	1000	0	387.189	1000	240.483	0	240.483	264.009	264.009
2	5.48733	2897.31	3.87654	interface	750	0	290.392	750	508.33	0	508.33	528.008	528.008
3	14.1201	8602.84	4.1709	Waste	400	0	154.875	400	597.971	0	597.971	609.266	609.266
4	14.1201	10849.4	4.59502	Waste	400	0	154.875	400	755.921	0	755.921	768.368	768.368
5	14.1201	12999.4	5.01939	Waste	-138.462	33.9436	182.145	470.429	904.641	0	904.641	920.639	920.639
6	14.1201	15052.6	5.44404	Waste	-138.462	33.9436	218.776	565.037	1045.2	0	1045.2	1066.05	1066.05
7	14.1201	17008.9	5.86899	Waste	-138.462	33.9436	253.524	654.782	1178.53	0	1178.53	1204.59	1204.59
8	14.1201	18868	6.29426	Waste	-138.462	33.9436	286.397	739.682	1304.67	0	1304.67	1336.26	1336.26
9	14.1201	20629.7	6.71988	Waste	-138.462	33.9436	317.398	819.75	1423.63	0	1423.63	1461.03	1461.03
10	14.1201	22293.7	7.14588	Waste	-138.462	33.9436	346.533	894.998	1535.43	0	1535.43	1578.88	1578.88
11	14.1201	23859.8	7.57227	Waste	-138.462	33.9436	373.811	965.448	1640.1	0	1640.1	1689.79	1689.79
12	14.1201	25327.7	7.99908	Waste	-138.462	33.9436	399.233	1031.11	1737.65	0	1737.65	1793.75	1793.75
13	14.1201	26697.2	8.42634	Waste	-138.462	33.9436	422.809	1092	1828.11	0	1828.11	1890.74	1890.74
14	14.1201	27967.8	8.85408	Waste	-138.462	33.9436	444.538	1148.12	1911.49	0	1911.49	1980.73	1980.73
15	14.1201	29139.2	9.28231	Waste	-138.462	33.9436	464.424	1199.48	1987.79	0	1987.79	2063.69	2063.69
16	14.1201	30211.2	9.71106	Waste	-138.462	33.9436	482.471	1246.09	2057.05	0	2057.05	2139.61	2139.61
17	14.1201	31183.2	10.1404	Waste	-138.462	33.9436	498.687	1287.97	2119.26	0	2119.26	2208.46	2208.46
18	14.1201	32055	10.5702	Waste	-138.462	33.9436	513.071	1325.12	2174.46	0	2174.46	2270.2	2270.2
19	14.1201	32826.1	11.0007	Waste	-138.462	33.9436	525.623	1357.54	2222.63	0	2222.63	2324.81	2324.81
20	14.1201	33496	11.4318	Waste	-138.462	33.9436	536.352	1385.25	2263.81	0	2263.81	2372.27	2372.27
21	14.1201	34064.4	11.8636	Waste	-138.462	33.9436	545.258	1408.25	2297.98	0	2297.98	2412.52	2412.52
22	14.1201	34530.8	12.2961	Waste	-138.462	33.9436	552.343	1426.55	2325.16	0	2325.16	2445.55	2445.55
23	14.1201	34894.5	12.7292	Waste	-138.462	33.9436	557.605	1440.14	2345.35	0	2345.35	2471.31	2471.31
24	14.1201	35155.2	13.1632	Waste	-138.462	33.9436	561.051	1449.04	2358.56	0	2358.56	2489.78	2489.78
25	14.1201	35312.3	13.5978	Waste	-138.462	33.9436	562.673	1453.23	2364.8	0	2364.8	2500.9	2500.9
26	14.1201	35365.3	14.0333	Waste	-138.462	33.9436	562.484	1452.74	2364.07	0	2364.07	2504.66	2504.66
27	14.1201	35313.5	14.4696	Waste	-138.462	33.9436	560.474	1447.55	2356.35	0	2356.35	2500.98	2500.98
28	14.1201	35156.3	14.9068	Waste	-138.462	33.9436	556.649	1437.67	2341.67	0	2341.67	2489.86	2489.86
29	14.1201	34893.1	15.3448	Waste	-138.462	33.9436	551.004	1423.09	2320.02	0	2320.02	2471.22	2471.22
30	14.1201	34523.2	15.7838	Waste	-138.462	33.9436	543.542	1403.82	2291.38	0	2291.38	2445.02	2445.02
31	14.1201	34046	16.2237	Waste	-138.462	33.9436	534.262	1379.85	2255.78	0	2255.78	2411.23	2411.23
32	14.1201	33460.8	16.6647	Waste	-138.462	33.9436	523.161	1351.18	2213.18	0	2213.18	2369.78	2369.78
33	14.1201	32766.8	17.1066	Waste	-138.462	33.9436	510.24	1317.81	2163.6	0	2163.6	2320.63	2320.63
34	14.1201	31963.2	17.5496	Waste	-138.462	33.9436	495.496	1279.73	2107.02	0	2107.02	2263.72	2263.72
35	14.1201	31049.2	17.9937	Waste	-138.462	33.9436	478.925	1236.93	2043.44	0	2043.44	2199	2199
36	14.1201	30024.1	18.4388	Waste	-138.462	33.9436	460.529	1189.42	1972.85	0	1972.85	2126.39	2126.39
37	14.1201	28886.9	18.8852	Waste	-138.462	33.9436	440.302	1137.18	1895.23	0	1895.23	2045.85	2045.85
38	14.1201	27636.8	19.3327	Waste	-138.462	33.9436	418.24	1080.2	1810.59	0	1810.59	1957.32	1957.32
39	14.1201	26272.8	19.7815	Waste	-138.462	33.9436	394.347	1018.49	1718.89	0	1718.89	1860.72	1860.72
40	14.1201	24794.1	20.2315	Waste	-138.462	33.9436	368.611	952.018	1620.14	0	1620.14	1755.99	1755.99
41	14.1201	23199.5	20.6829	Waste	-138.462	33.9436	341.031	880.788	1514.31	0	1514.31	1643.06	1643.06
42	14.1201	21488.2	21.1356	Waste	-138.462	33.9436	311.604	804.787	1401.4	0	1401.4	1521.86	1521.86
43	14.1201	19658.9	21.5897	Waste	-138.462	33.9436	280.325	724.002	1281.38	0	1281.38	1392.31	1392.31
44	14.1201	17710.7	22.0452	Waste	-138.462	33.9436	247.19	638.423	1154.23	0	1154.23	1254.33	1254.33
45	14.1201	15642.4	22.5021	Waste	-138.462	33.9436	212.193	548.035	1019.94	0	1019.94	1107.84	1107.84
46	14.1201	13452.7	22.9606	Waste	-138.462	33.9436	175.328	452.824	878.484	0	878.484	952.764	952.764
47	14.1201	11140.5	23.4207	Waste	400	0	154.875	400	721.918	0	721.918	789.005	789.005
48	14.1201	8704.54	23.8823	Waste	400	0	154.875	400	547.915	0	547.915	616.489	616.489
49	5.01674	2648.84	24.1959	interface	750	0	290.392	750	397.567	0	397.567	528.049	528.049
50	19.255	5083.31	24.5954	final cover soil	1000	0	387.189	1000	86.8334	0	86.8334	264.065	264.065

Global Minimum Query (janbu simplified) - Safety Factor: 2.56379

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]	Base Vertical Stress [psf]	Effective Vertical Stress [psf]
1	21.1373	5580.25	3.47709	final cover soil	1000	0	390.048	1000	240.311	0	240.311	264.01	264.01
2	5.48733	2897.31	3.87654	interface	750	0	292.536	750	508.187	0	508.187	528.009	528.009
3	14.1201	8602.84	4.1709	Waste	400	0	156.019	400	597.889	0	597.889	609.266	609.266
4	14.1201	10849.4	4.59502	Waste	400	0	156.019	400	755.829	0	755.829	768.368	768.368
5	14.1201	12999.4	5.01939	Waste	-138.462	33.9436	183.46	470.352	904.521	0	904.521	920.634	920.634
6	14.1201	15052.6	5.44404	Waste	-138.462	33.9436	220.352	564.937	1045.05	0	1045.05	1066.05	1066.05
7	14.1201	17008.9	5.86899	Waste	-138.462	33.9436	255.347	654.657	1178.35	0	1178.35	1204.6	1204.6
8	14.1201	18868	6.29426	Waste	-138.462	33.9436	288.452	739.53	1304.44	0	1304.44	1336.26	1336.26
9	14.1201	20629.7	6.71988	Waste	-138.462	33.9436	319.672	819.571	1423.37	0	1423.37	1461.03	1461.03
10	14.1201	22293.7	7.14588	Waste	-138.462	33.9436	349.014	894.798	1535.12	0	1535.12	1578.88	1578.88
11	14.1201	23859.8	7.57227	Waste	-138.462	33.9436	376.481	965.218	1639.75	0	1639.75	1689.8	1689.8
12	14.1201	25327.7	7.99908	Waste	-138.462	33.9436	402.08	1030.85	1737.26	0	1737.26	1793.76	1793.76
13	14.1201	26697.2	8.42634	Waste	-138.462	33.9436	425.814	1091.7	1827.67	0	1827.67	1890.75	1890.75
14	14.1201	27967.8	8.85408	Waste	-138.462	33.9436	447.692	1147.79	1911	0	1911	1980.74	1980.74
15	14.1201	29139.2	9.28231	Waste	-138.462	33.9436	467.713	1199.12	1987.26	0	1987.26	2063.7	2063.7
16	14.1201	30211.2	9.71106	Waste	-138.462	33.9436	485.881	1245.7	2056.47	0	2056.47	2139.62	2139.62
17	14.1201	31183.2	10.1404	Waste	-138.462	33.9436	502.205	1287.55	2118.64	0	2118.64	2208.47	2208.47
18	14.1201	32055	10.5702	Waste	-138.462	33.9436	516.684	1324.67	2173.79	0	2173.79	2270.21	2270.21
19	14.1201	32826.1	11.0007	Waste	-138.462	33.9436	529.321	1357.07	2221.92	0	2221.92	2324.82	2324.82
20	14.1201	33496	11.4318	Waste	-138.462	33.9436	540.118	1384.75	2263.05	0	2263.05	2372.27	2372.27
21	14.1201	34064.4	11.8636	Waste	-138.462	33.9436	549.077	1407.72	2297.18	0	2297.18	2412.52	2412.52
22	14.1201	34530.8	12.2961	Waste	-138.462	33.9436	556.203	1425.99	2324.32	0	2324.32	2445.55	2445.55
23	14.1201	34894.5	12.7292	Waste	-138.462	33.9436	561.496	1439.56	2344.48	0	2344.48	2471.32	2471.32
24	14.1201	35155.2	13.1632	Waste	-138.462	33.9436	564.956	1448.43	2357.66	0	2357.66	2489.79	2489.79
25	14.1201	35312.3	13.5978	Waste	-138.462	33.9436	566.582	1452.6	2363.87	0	2363.87	2500.91	2500.91
26	14.1201	35365.3	14.0333	Waste	-138.462	33.9436	566.383	1452.09	2363.1	0	2363.1	2504.66	2504.66
27	14.1201	35313.5	14.4696	Waste	-138.462	33.9436	564.351	1446.88	2355.36	0	2355.36	2501	2501
28	14.1201	35156.3	14.9068	Waste	-138.462	33.9436	560.49	1436.98	2340.66	0	2340.66	2489.87	2489.87
29	14.1201	34893.1	15.3448	Waste	-138.462	33.9436	554.803	1422.4	2318.99	0	2318.99	2471.23	2471.23
30	14.1201	34523.2	15.7838	Waste	-138.462	33.9436	547.279	1403.11	2290.34	0	2290.34	2445.04	2445.04
31	14.1201	34046	16.2237	Waste	-138.462	33.9436	537.929	1379.14	2254.71	0	2254.71	2411.24	2411.24
32	14.1201	33460.8	16.6647	Waste	-138.462	33.9436	526.747	1350.47	2212.12	0	2212.12	2369.8	2369.8
33	14.1201	32766.8	17.1066	Waste	-138.462	33.9436	513.727	1317.09	2162.54	0	2162.54	2320.65	2320.65
34	14.1201	31963.2	17.5496	Waste	-138.462	33.9436	498.874	1279.01	2105.96	0	2105.96	2263.73	2263.73
35	14.1201	31049.2	17.9937	Waste	-138.462	33.9436	482.188	1236.23	2042.39	0	2042.39	2199	2199
36	14.1201	30024.1	18.4388	Waste	-138.462	33.9436	463.657	1188.72	1971.81	0	1971.81	2126.4	2126.4
37	14.1201	28886.9	18.8852	Waste	-138.462	33.9436	443.288	1136.5	1894.22	0	1894.22	2045.86	2045.86
38	14.1201	27636.8	19.3327	Waste	-138.462	33.9436	421.071	1079.54	1809.6	0	1809.6	1957.33	1957.33
39	14.1201	26272.8	19.7815	Waste	-138.462	33.9436	397.009	1017.85	1717.94	0	1717.94	1860.73	1860.73
40	14.1201	24794.1	20.2315	Waste	-138.462	33.9436	371.094	951.408	1619.23	0	1619.23	1756	1756
41	14.1201	23199.5	20.6829	Waste	-138.462	33.9436	343.323	880.208	1513.46	0	1513.46	1643.07	1643.07
42	14.1201	21488.2	21.1356	Waste	-138.462	33.9436	313.695	804.248	1400.6	0	1400.6	1521.87	1521.87
43	14.1201	19658.9	21.5897	Waste	-138.462	33.9436	282.203	723.508	1280.64	0	1280.64	1392.31	1392.31
44	14.1201	17710.7	22.0452	Waste	-138.462	33.9436	248.841	637.977	1153.57	0	1153.57	1254.33	1254.33
45	14.1201	15642.4	22.5021	Waste	-138.462	33.9436	213.607	547.644	1019.36	0	1019.36	1107.85	1107.85
46	14.1201	13452.7	22.9606	Waste	-138.462	33.9436	176.494	452.494	877.995	0	877.995	952.769	952.769
47	14.1201	11140.5	23.4207	Waste	400	0	156.019	400	721.431	0	721.431	789.013	789.013
48	14.1201	8704.54	23.8823	Waste	400	0	156.019	400	547.413	0	547.413	616.494	616.494
49	5.01674	2648.84	24.1959	interface	750	0	292.536	750	396.612	0	396.612	528.058	528.058
50	19.255	5083.31	24.5954	final cover soil	1000	0	390.048	1000	85.5371	0	85.5371	264.077	264.077

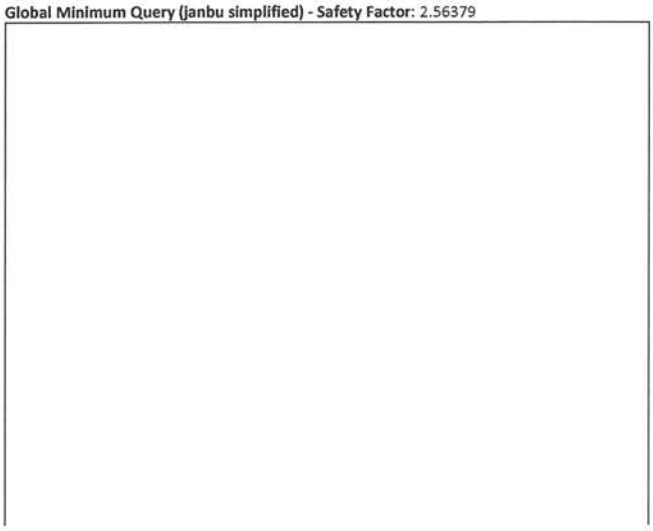
Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.58272



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	9.18358	7.29589	0	0	0
2	30.3209	8.58022	7872.28	0	0
3	35.8082	8.95206	9276.16	0	0
4	49.9283	9.98176	10846.5	0	0
5	64.0484	11.1166	12174.7	0	0
6	78.1685	12.3568	13623.8	0	0
7	92.2887	13.7025	15305.2	0	0
8	106.409	15.1539	17173.1	0	0
9	120.529	16.7114	19183.7	0	0
10	134.649	18.3751	21295.2	0	0
11	148.769	20.1453	23468.5	0	0
12	162.889	22.0224	25666.2	0	0
13	177.009	24.0066	27853.5	0	0
14	191.129	26.0983	29997.6	0	0
15	205.25	28.2978	32067.8	0	0
16	219.37	30.6056	34035.7	0	0
17	233.49	33.022	35875.1	0	0
18	247.61	35.5475	37562	0	0
19	261.73	38.1824	39074.4	0	0
20	275.85	40.9272	40392.8	0	0
21	289.97	43.7825	41499.6	0	0
22	304.09	46.7487	42379.6	0	0
23	318.21	49.8264	43019.8	0	0
24	332.33	53.0161	43409.5	0	0
25	346.451	56.3183	43540.1	0	0
26	360.571	59.7338	43405.3	0	0
27	374.691	63.263	43001.4	0	0
28	388.811	66.9068	42326.5	0	0
29	402.931	70.6656	41381.6	0	0
30	417.051	74.5403	40169.6	0	0
31	431.171	78.5316	38696.1	0	0
32	445.291	82.6402	36969	0	0
33	459.411	86.867	34998.9	0	0
34	473.532	91.2127	32798.5	0	0
35	487.652	95.6782	30383.6	0	0
36	501.772	100.264	27772	0	0
37	515.892	104.972	24984.6	0	0
38	530.012	109.802	22044.9	0	0
39	544.132	114.756	18979	0	0
40	558.252	119.835	15815.9	0	0
41	572.372	125.039	12587.6	0	0
42	586.492	130.369	9328.86	0	0
43	600.613	135.828	6077.51	0	0
44	614.733	141.416	2874.48	0	0
45	628.853	147.133	-236.149	0	0
46	642.973	152.983	-3207.04	0	0
47	657.093	158.965	-5987.53	0	0
48	671.213	165.081	-8217	0	0
49	685.333	171.333	-9456.49	0	0
50	690.35	173.587	-8896.39	0	0
51	709.605	182.401	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 2.56379



Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	9.18358	7.29589	0	0	0
2	30.3209	8.58022	7932.37	0	0
3	35.8082	8.95206	9347.96	0	0
4	49.9283	9.98176	10934.4	0	0
5	64.0484	11.1166	12278.7	0	0
6	78.1685	12.3568	13746.3	0	0
7	92.2887	13.7025	15450	0	0
8	106.409	15.1539	17343.7	0	0
9	120.529	16.7114	19383.3	0	0
10	134.649	18.3751	21527.1	0	0
11	148.769	20.1453	23735.6	0	0
12	162.889	22.0224	25971.3	0	0
13	177.009	24.0066	28199.1	0	0
14	191.129	26.0983	30386.1	0	0
15	205.25	28.2978	32501.5	0	0
16	219.37	30.6056	34516.7	0	0
17	233.49	33.022	36405.2	0	0
18	247.61	35.5475	38142.8	0	0
19	261.73	38.1824	39707.5	0	0
20	275.85	40.9272	41079.5	0	0
21	289.97	43.7825	42241.1	0	0
22	304.09	46.7487	43176.8	0	0
23	318.21	49.8264	43873.6	0	0
24	332.33	53.0161	44320.4	0	0
25	346.451	56.3183	44508.6	0	0
26	360.571	59.7338	44431.7	0	0
27	374.691	63.263	44085.7	0	0
28	388.811	66.9068	43468.6	0	0
29	402.931	70.6656	42581.2	0	0
30	417.051	74.5403	41426.3	0	0
31	431.171	78.5316	40009.3	0	0
32	445.291	82.6402	38337.8	0	0
33	459.411	86.867	36422.3	0	0
34	473.532	91.2127	34275.3	0	0
35	487.652	95.6782	31912.3	0	0
36	501.772	100.264	29351.2	0	0
37	515.892	104.972	26612.4	0	0
38	530.012	109.802	23719.3	0	0
39	544.132	114.756	20697.8	0	0
40	558.252	119.835	17576.8	0	0
41	572.372	125.039	14387.9	0	0
42	586.492	130.369	11165.8	0	0
43	600.613	135.828	7948.01	0	0
44	614.733	141.416	4775.32	0	0
45	628.853	147.133	1691.56	0	0
46	642.973	152.983	-1256.17	0	0
47	657.093	158.965	-4017.44	0	0
48	671.213	165.081	-6227.91	0	0
49	685.333	171.333	-7448.27	0	0
50	690.35	173.587	-6875.36	0	0
51	709.605	182.401	0	0	0

List Of Coordinates

External Boundary

X	Y
720	0
720	180
720	181
720	185
0	5
0	1
0	0

Material Boundary

X	Y
0	1
720	181

Material Boundary

X	Y
0	0
720	180

WASTE MANAGEMENT, INC.

AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 7
CLOSURE PLAN

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

Golder Associates

500 Century Plaza Drive, Suite 190
Houston, Texas 77073
(281) 821-6868
Firm Registration Number F-2578

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

August 2005
Revision 1 – December 2005
Revision 2 – October 2006
Revision 3 – February 2008
Revision 4 – March 2008
Revised August 2016
Revised October 2017
Revised February 2018

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 7
CLOSURE PLAN

TABLE OF CONTENTS

FIGURES

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

August 2005
Revision 1 – December 2005
Revision 2 – October 2006
Revision 3- February 2008
Revision 4 – March 2008
Revised August 2016
Revised October 2017
Revised February 2018

APPENDICES

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

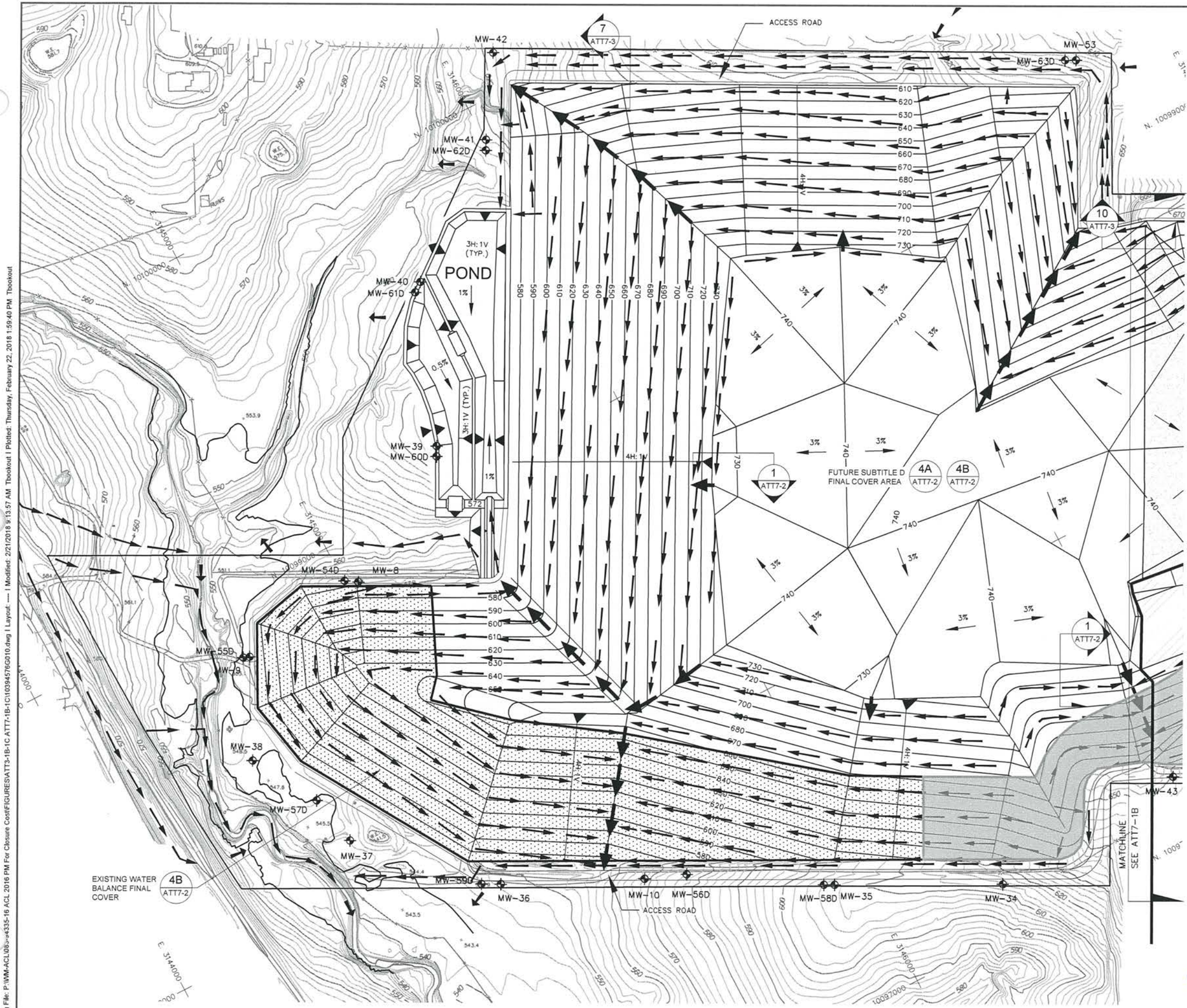
2.0 FINAL COVER

2.1 Final Cover Design

The final landfill contours and final cover details are provided on Figures ATT7-1A through ATT7-1C, ATT7-2, and ATT7-3. Landfill cross-sections are included as Figures ATT7-4 through ATT7-11. The final cap has side slopes ranging from 3 horizonal to 1 vertical (3H:1V) to 4H:1V to a maximum elevation of approximately 740 feet mean sea level (ft-msl). The upper portions of the final cover are sloped at a minimum 3-percent grade down to the crest of the 3H:1V or 4H:1V slopes to minimize erosion. The side slopes of the entire proposed expansion area will be 4H:1V with a short 3H:1V slope tying into the existing final cover crest. Add-on berms intercept runoff from the top surface and along the sideslopes of the cover and direct it to downchutes. These downchutes convey rainfall runoff down the sideslopes to the perimeter channels and detention ponds. Details of the surface water management features are included in Part III, Attachment 2.

The thickness and design of the final cover varies based on the design of the bottom liner. For existing disposal cells with no synthetic bottom liner (pre-Subtitle D cells), the final cover system is comprised of 18 inches of compacted earthen material with a coefficient of permeability (hydraulic conductivity) between $6.8x10^{-6}$ cm/sec and $8.1x10^{-6}$ cm/sec and 6 inches of soil capable of supporting native vegetation. For existing Subtitle D disposal cells with a synthetic bottom liner, the final cover system is comprised of 36 inches of compacted earthen material with a hydraulic conductivity of $1.0x10^{-7}$ cm/sec or less and 6 inches of soil capable of supporting native vegetation. The proposed final cover over existing pre-Subtitle D cells in the West Hill that have not yet been covered will be comprised of 18 inches of compacted earthen material with a coefficient of permeability (hydraulic conductivity) of $6.8x10^{-6}$ cm/sec or less and 6 inches of soil capable of supporting native vegetation. The final cover over existing and proposed Subtitle-D disposal cells in the expansion area of the West Hill will (as shown on Figure ATT7-1B) consist of a water balance final cover or a composite system comprised of, from the bottom up; an infiltration layer of 18 inches of compacted earthen material with a hydraulic conductivity of $1x10^{-5}$ cm/sec or less; a 40-mil textured linear low density polyethylene (LLDPE) geomembrane that has a permeability less than or equal to the permeability of the bottom liner system; a geocomposite (geonet/geotextile) drainage layer; and an erosion layer consisting of 24 inches of protective soil cover, of which the uppermost 6 inches will be capable of supporting native vegetation. The LLDPE geomembrane and geocomposite may be replaced with an alternate material that incorporates both the geomembrane and drainage layer (e.g., Super Gripnet® by Agru America) provided material equivalency in terms of barrier and flow characteristics is demonstrated.

The water balance final cover will be comprised of a storage layer of 20 inches thick (minimum) overlain by an erosion layer of 6 inches (minimum), in accordance with TCEQ Regulatory Guidance RG-494, Guidance for Requesting a Water Balance (WB) Alternative Final Cover for a Municipal Landfill, Revised March 2017. When using high plasticity clay (liquid limit >50) as the storage layer, the erosion layer will be increased to 1-foot thick in accordance with Section 3 of RG-494. Hydraulic conductivity testing results of the storage layer soils may require a thicker storage layer in accordance with RG-494, as discussed in Appendix A, Section 5.2. The storage layer thickness is determined from Table 3 in Section 10 of the RG-494 as follows:



LEGEND

- PERMIT BOUNDARY
- FENCE
- GRADE BREAKS
- 100-YEAR FLOODPLAIN
- MONITORING WELL
- GAS PROBE
- SURFACE WATER FLOW DIRECTION (CHANNELS/DITCHES/ADD-ON BERMS)
- SURFACE WATER DOWNCHUTE
- SURFACE WATER ENTRANCE OR DISCHARGE POINT
- STATE PLANE COORDINATE SYSTEM
- FINAL COVER ALREADY IN PLACE (AS OF AUGUST 2016)
- PIGGYBACK LINER AREA
- FUTURE PRE-SUBTITLE D FINAL COVER AREA
- 20-ACRE INTERMEDIATE COVER ALREADY IN PLACE (AS OF AUGUST 2017)

NOTES

1. TOP OF FINAL COVER GRADES ARE SHOWN ON THIS SHEET.
2. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED FEBRUARY 26, 2006.
3. THE 100-YEAR FLOODPLAIN IS BASED ON THE CURRENTLY PROPOSED FEMA FLOODPLAIN AS WELL AS THE CURRENTLY PROPOSED CITY OF AUSTIN FLOODPLAIN. SEE PART I/II, APPENDIX B (FLOODPLAIN LOCATION RESTRICTION).
4. SEE PART III, ATTACHMENT 2 FOR DETAILS OF STORMWATER MANAGEMENT FEATURES.

150 0 150 300 feet

STATE OF TEXAS
W. E. GORDON
78933
REGISTERED
PROFESSIONAL ENGINEER

GOLDER ASSOCIATES INC
TEXAS REGISTRATION F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	BY	APP. BY
9	02/18	WATER BALANCE FINAL COVER PM	TNB	JY
8.	02/12	STORMWATER SYSTEM REVISIONS	RF	JY
7.	04/08	APRIL 2008 REVISIONS	CEI	CGD
6.	02/08	2008 REVISIONS	CEI	CGD
5.	08/07	RESPONSE TO TECHNICAL NOD DATED JULY 2, 2007	CEI	LAL
4.	05/07	RESPONSE TO TECHNICAL NOD DATED APRIL 3, 2007	CEI	LAL
3.	10/06	CHAPTER 330 RULE REVISION UPDATE	CEI	LAL
2.	03/06	RESPONSE TO SECOND TECHNICAL NOD	CEI	LAL

Golder Associates
500 Century Plaza Drive, Suite 190
Houston, TX USA 77073
Tel: (281) 821-6868
Fax: (281) 821-6870

WASTE MANAGEMENT

PROJECT: MUNICIPAL SOLID WASTE EXPANSION APPLICATION
PERMIT MSW-249D
AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS

TITLE: FINAL CONTOUR MAP-WEST

DRAWN	CEI
REVIEWED	
CHECKED	
APPROVED	
DATE	JUNE 2005
SCALE	AS SHOWN
JOB NO.	033-4651
DWG. NO.	103945760010

FIGURE NUMBER

ATT7-1A

Drawing File: P:\WM-ACL\08\x-x4335-16 ACL 2016 PM For Closure Cost\FIGURES\ATT3-1B-1C ATT7-1B-1C\103945760010.dwg | Layout: — | Modified: 2/21/2018 9:13:57 AM Tbookout | Plotted: Thursday, February 22, 2018 1:59:40 PM Tbookout

PROPOSED COMPOSITE WEST HILL EXPANSION AREA OR WATER BALANCE FINAL COVER SYSTEM WEST OF THIS LINE SEE DETAIL 4A ATT7-2 4B ATT7-2

EXISTING WEST FINAL COVER SYSTEM EAST OF THIS LINE SEE DETAILS 5 ATT7-2 6 ATT7-2

ACCESS ROAD

FUTURE SUBTITLE D FINAL COVER AREA 4A ATT7-2 4B ATT7-2

PIGGYBACK LINER LIMIT 8 ATT-3

FUTURE PRE-SUBTITLE D FINAL COVER 5 ATT7-2

MATCHLINE SEE ATT7-1A

MATCHLINE SEE ATT7-1C

EXISTING NORTH POND

EXISTING SOUTH POND

LEACHATE EVAPORATION POND

INDUSTRIAL WASTE UNIT (CLOSED)

TRAVIS COUNTY LANDFILL (CLOSED)

MW-53 MW-630 MW-15 MW-50 MW-30 MW-44 MW-43 MW-21 MW-11 MW-34

E. 3148000 N. 10099000

E. 3150000 N. 10098000

E. 3144000 N. 10100000

E. 3147000 N. 10097000

E. 3145000 N. 10097000

E. 3148000 N. 10096000

E. 3150000 N. 10096000

LEGEND

- PERMIT BOUNDARY
- FENCE
- GRADE BREAKS
- 100-YEAR FLOODPLAIN
- CLOSED UNIT BOUNDARY
- MONITORING WELL
- GAS PROBE
- SURFACE WATER FLOW DIRECTION (CHANNELS/DITCHES/ADD-ON BERMS)
- SURFACE WATER DOWNCHUTE
- SURFACE WATER ENTRANCE OR DISCHARGE POINT
- STATE PLANE COORDINATE SYSTEM
- FINAL COVER ALREADY IN PLACE (AS OF AUGUST 2016)
- PIGGYBACK LINER AREA
- FUTURE PRE-SUBTITLE D FINAL COVER AREA
- 20-ACRE INTERMEDIATE COVER ALREADY IN PLACE (AS OF AUGUST 2017)

NOTES

1. TOP OF FINAL COVER GRADES ARE SHOWN ON THIS SHEET.
2. TOPOGRAPHY COMPILED BY PHOTOGRAMMETRIC METHODS FROM AERIAL PHOTOGRAPHY DATED FEBRUARY 26, 2006.
3. THE 100-YEAR FLOODPLAIN IS BASED ON THE CURRENTLY PROPOSED FEMA FLOODPLAIN AS WELL AS THE CURRENTLY PROPOSED CITY OF AUSTIN FLOODPLAIN. SEE PART I/II, APPENDIX B (FLOODPLAIN LOCATION RESTRICTION).
4. SEE PART III, ATTACHMENT 2 FOR DETAILS OF STORMWATER MANAGEMENT FEATURES.
5. THE LIMITS OF THE INDUSTRIAL WASTE UNIT AND TRAVIS COUNTY LANDFILL ARE SHOWN AS APPROXIMATE.
6. GAS PROBE LAYOUT WAS REVISED BY TETRA TECH INC. JANUARY 2015.

STATE OF TEXAS
W. E. GORDON
78933
REGISTERED PROFESSIONAL ENGINEER

GOLDER ASSOCIATES, INC
TEXAS REGISTRATION F-2578

INTENDED FOR PERMITTING PURPOSES ONLY

150 0 150 300 scale feet

NO.	DATE	DESCRIPTION	BY	APP. BY
11	02/18	WATER BALANCE FINAL COVER PM	TNB	MX
10	09/16	UPDATED THE EXISTING FINAL COVER AREA	TNB	MX
9	01/15	2015 GAS PROBE LAYOUT REVISIONS	ARM	JCM
8	02/12	STORMWATER SYSTEM REVISIONS	RF	JY
7	04/08	APRIL 2008 REVISIONS	CEI	CGD
6	02/08	2008 REVISIONS	CEI	CGD
5	08/07	RESPONSE TO TECHNICAL NOD DATED JULY 2, 2007	CEI	LAL
4	05/07	RESPONSE TO TECHNICAL NOD DATED APRIL 3, 2007	CEI	CGD
3	10/06	CHAPTER 330 RULE REVISION UPDATE	CEI	LAL

Golder Associates
500 Century Plaza Drive, Suite 190
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Tel: (281) 821-6868
Fax: (281) 821-6870

WASTE MANAGEMENT

PROJECT: MUNICIPAL SOLID WASTE EXPANSION APPLICATION
PERMIT MSW-249D
AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS

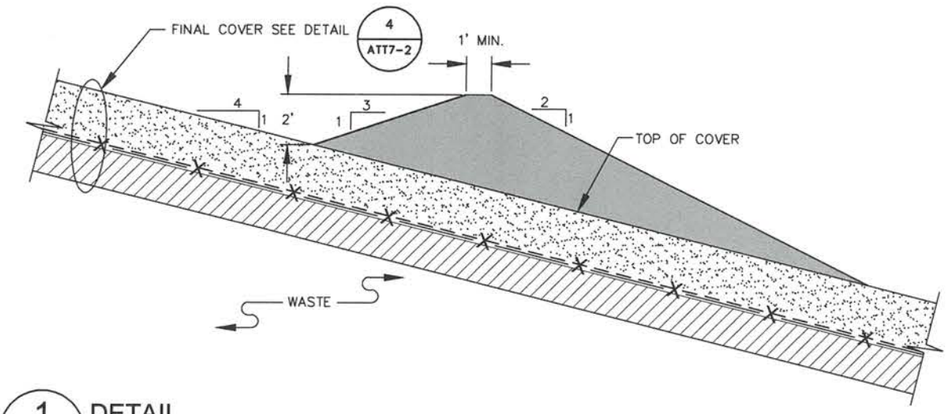
TITLE: FINAL CONTOUR MAP-CENTRAL

DRAWN	CEI
REVIEWED	
CHECKED	
APPROVED	
DATE	JUNE 2005
SCALE	AS SHOWN
JOB NO.	033-4651
DWG. NO.	10394576G010

FIGURE NUMBER

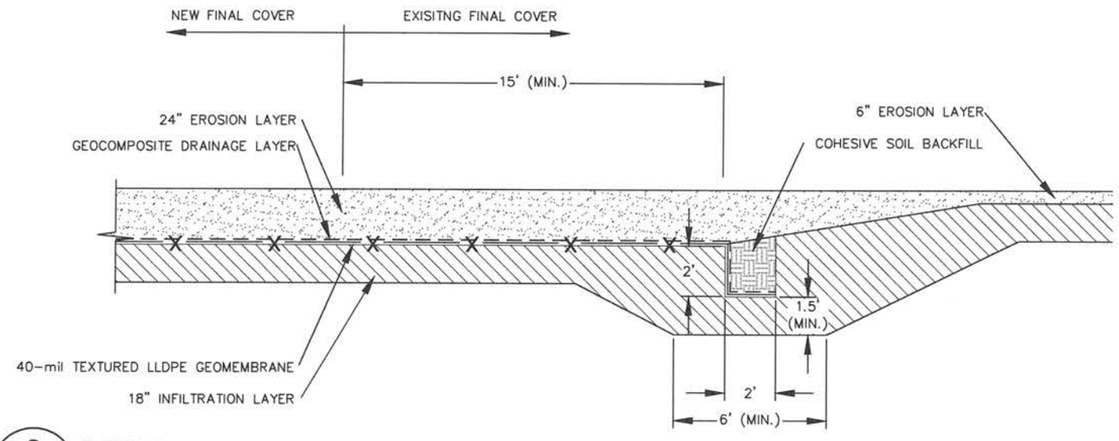
ATT7-1B

Drawing File: P:\WM-ACL\083-94335-16 ACL 2016 PM For Closure Cost\FIGURES\ATT3-1B-1C ATT7-1B-1C\10394576G010.dwg | Layout: — | Modified: 2/14/2018 4:38:21 PM Tbookout | Plotted: Wednesday, February 21, 2018 8:59:39 AM Tbookout



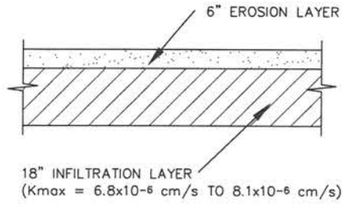
1 DETAIL ATT7-1 ADD-ON BERM

scale 3 0 3 6 feet



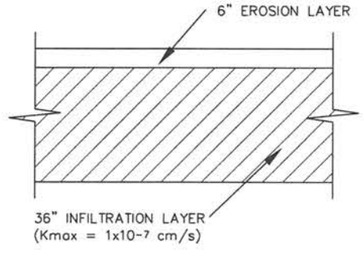
3 DETAIL ATT7-1 TIE-IN BETWEEN SUBTITLE D AND PRE-SUBTITLE D FINAL COVER AT SIDESLOPES

scale 3 0 3 6 feet



5 DETAIL ATT7-1 EXISTING AND PROPOSED FINAL COVER PRE-SUBTITLE D

scale 2 0 2 4 feet



6 DETAIL ATT7-1 EXISTING FINAL COVER SUBTITLE D

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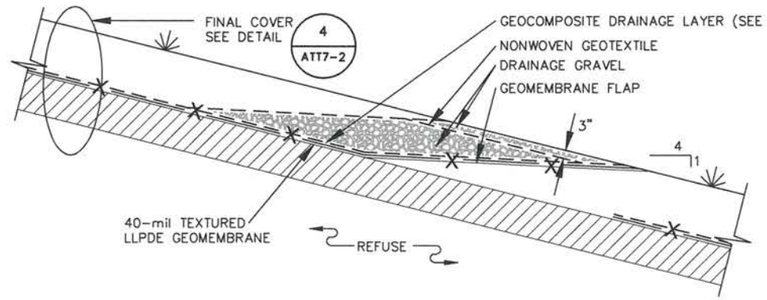
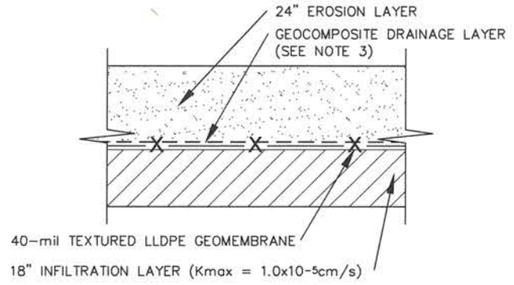


2 DETAIL ATT7-2 GEOCOMPOSITE DAYLIGHT DRAINAGE

scale 3 0 3 6 feet



4A DETAIL ATT7-1 FINAL COVER DETAIL

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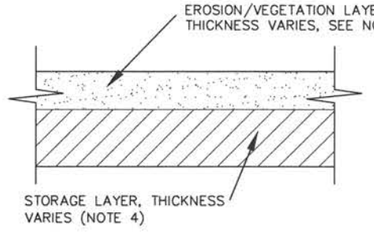

4B DETAIL ATT7-1 WATER BALANCE ALTERNATIVE FINAL COVER

scale 2 0 2 4 feet

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

NOTES

1. GEOSYNTHETICS SHOWN EXAGGERATED FOR CLARITY.
2. SEE ATTACHMENT 2 FOR DETAILS OF STORMWATER MANAGEMENT FEATURES.
3. SEE ATTACHMENT 3, APPENDIX D FOR DESIGN OF THE GEOCOMPOSITE DRAINAGE LAYER.
4. THICKNESS AND PERMEABILITY OF THE WATER BALANCE COVER STORAGE LAYER AND EROSION LAYER MAY VARY. SEE SDP ATTACHMENT 7, APPENDIX A FOR GUIDANCE.

INTENDED FOR PERMITTING PURPOSES ONLY

REV.	DATE	DESCRIPTION	DR. BY	APP. BY
2	02/18	ADDED ALTERNATE DETAIL AND NOTE	TNB	WEG
1	10/08	CHAPTER 330 RULE REVISION UPDATE	CEI	LAL

Golder Associates
500 Century Plaza Drive, Suite 190
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Fax. (281) 821-6870

WASTE MANAGEMENT, INC.

PROJECT: MUNICIPAL SOLID WASTE EXPANSION APPLICATION
PERMIT MSW-249D
AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS

TITLE: FINAL COVER DETAILS I

DRAWN ML	REVIEWED
CHECKED	APPROVED
DATE	JUNE 2005
SCALE	AS SHOWN
JOB NO.	033-4651
DWG. NO.	033-4651-ATT7-2

FIGURE NUMBER

ATT7-2

P:_2009 PROJECT FOLDERS\093-94428 WM ACL & TEMPLE DIGITAL DRAWINGS\ACL EXPANSION APPLICATION\ATT7\033-4651-ATT7-2 REV2.DWG

WASTE MANAGEMENT, INC.

AUSTIN COMMUNITY RECYCLING AND DISPOSAL FACILITY
AUSTIN, TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 7, APPENDIX A
FINAL COVER QUALITY CONTROL PLAN

Prepared for:

Waste Management of Texas, Inc.

Prepared by:

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

Golder Associates

500 Century Plaza Drive
Suite 190
Houston, Texas 77073
(281) 821-6868

August 2005
Revision 1 – December 2005
Revision 2 – March 2006
Revision 3 – October 2006
Revised October 2017
Revised February 2018

AUSTIN COMMUNITY RECYCLING & DISPOSAL FACILITY
TRAVIS COUNTY, TEXAS
TCEQ PERMIT NO. MSW-249D

PERMIT AMENDMENT APPLICATION

PART III

ATTACHMENT 7, APPENDIX A
FINAL COVER QUALITY CONTROL PLAN

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

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FIGURES

GOLDER ASSOCIATES INC.
Professional Engineering Firm
Registration Number F-2578

In accordance with 30 TAC §330.457(a)(1) and 30 TAC §330.457(d), the ACRDF may choose to install an alternate final cover over portions of the Subtitle-D cells in the western and southwestern part of the expansion area and over the vertical expansion area of the West Hill. The alternate final cover would consist of a Water Balance (WB) Cover as described in the document "Geoclimatic Design of Water Balance Covers for Municipal Solid Waste Landfills in Texas" prepared by Miland V. Khier, Ph.D., P.E., dated August 4, 2016. The water balance cover consists of a layer of silty and clayey soils to store water and sustain vegetation until the water is removed by evapotranspiration. The thickness of this cover may vary in accordance with the TCEQ Guidance Document RG-494 dated March 2017 depending upon the soil properties used and the hydraulic conductivity of the constructed cover. TCEQ Guidance Document RG-494 provides for four options for the design and construction of water balance covers. The ACRDF will utilize Option 1 – Statewide Design Table for constructing water balance covers at the facility.

The owner/operator is responsible for fully implementing this FCQCP. The site manager (SM) or designated alternate will be responsible for contracting with a qualified independent quality assurance/quality control (QA/QC) professional prior to initiation of final cover construction. Each phase of the soil and geosynthetic evaluation shall be conducted by or under the supervision of the QA/QC Professional. The QA/QC Professional shall be an independent, licensed, professional engineer (P.E.) experienced in geotechnical engineering and soils testing.

A qualified engineering technician performing daily QA/QC observation and testing will be under the direct supervision of the QA/QC Professional. The engineering technician shall be NICET-certified at level 1 or higher, an engineering technician with a minimum of 2 years of directly related experience, a graduate engineer or geologist, or an engineering technician with other applicable certificates (e.g., Certified Engineering Technologist, CET) approved by the TCEQ.

Full-time quality assurance shall be provided by the QA/QC Professional or his/her qualified representative(s) as described in this plan. QA/QC documentation will be provided to the executive director, in accordance with Section 5.0 of this plan.

2.0 COHESIVE SOIL COVER EVALUATION

This section outlines generally acceptable construction practices and specifications and quality control testing requirements for cohesive soil cover used in the standard final cover. Construction practices for the WB alternative final cover are presented in Section 5 of this FCQCP.

2.1 Preconstruction Material Evaluation

The first step in the construction of a cohesive soil cover is to pre-qualify the soil materials that are selected for final cover construction. Cohesive soil cover material may be obtained from in-situ soil strata which are typically stockpiled soils excavated as cells are constructed, or from a select borrow source. Representative samples from these sources shall be subject to the minimum preconstruction testing program shown in Table 7A.1.

Only the geocomposite should be placed in direct contact with the geomembrane. Light equipment such as low ground pressure dozers (less than 5 pounds per square inch contact pressure) shall be used to place the soil cover and a minimum of 12 inches of material shall be maintained between the dozer and the underlying geosynthetics. If possible, cover should be placed during the coolest weather available. Soil cover material shall be deployed in "fingers" along the geosynthetics to control the amount of slack and minimize wrinkles and prevent folds. Soil cover shall generally be placed in an up-slope direction on sideslopes.

The soil cover material shall consist of soils that are classified as SCS Hydrologic Soil Groups (HSG) A, B, or C. These soils have infiltration rates ranging approximately 0.05 inches/hour (3.5×10^{-5} cm/sec) to greater than 0.30 inches/hour (2.1×10^{-4} cm/sec), according to the Soil Conservation Service publication TR-55 (June 1986). Compaction of the soil cover material can affect the HSG, making a soil in a particular soil group less pervious and thus make it behave as another soil group. Because low ground pressure equipment will be used, compaction of the soil will be minimal.

Geosynthetic Cover System

The final thickness of the protective/erosion layer shall be a minimum of 24 inches directly above the geocomposite drainage layer. The required thickness of the layer shall be verified by survey techniques on an established grid system with not less than one verification point per 10,000 square feet of surface area. A minimum of two verification points is required.

The soil used as the soil cover layer will be capable of sustaining native plant growth and must be seeded or sodded immediately after completion of the final cover (weather permitting). Temporary or permanent erosion control materials (i.e. mulches, containment meshes, geomatting systems, etc.) may be used to minimize erosion and aid establishment of vegetation. An alternative erosion layer may also be constructed (subject of the approval of TCEQ) consisting of cobbles, riprap, or other hard armor systems for areas in which the establishment of vegetation cover has proven difficult.

Other quality assurance for the soil cover layer should consist of continuous observation by the QA/QC Professional or his representative during construction; inspection of any manufacturer's or supplier's material test data and certification; and performing any additional test believed necessary by the QA/QC Professional to verify that the layer has been constructed in accordance with the closure plan.

5.0 Water Balance Alternative Cover System

The purpose of these guidelines is to establish an approach for placement and compaction during construction of the WB final cover at the Austin Community Landfill that will meet the required standards presented in "TCEQ Guidance Document RG-494 dated March 2017.

5.1 Preconstruction Testing and Test Pad Construction

The goal of the preconstruction testing is to characterize the borrow soils and to define the "acceptance window" for each type of soil. The acceptance window is the range of unit weight/water content combinations that have been shown to produce a $k \leq 1 \times 10^{-7}$ cm/s in the 6-inch diameter remolded permeability samples, without falling above the line-of-optimums.

TCEQ Guidance Document RG-494 (March 2017), Table 3 provides the following guidance for WB cover thickness in the Austin area:

K (as-built), cm/sec	Minimum Storage Layer Thickness
1×10^{-8}	1 ft 8 in
5×10^{-8}	2 ft 7 in
1×10^{-7}	3 ft 11 in

5.3 Construction Testing

The goal of the construction testing is to demonstrate that the soil is being compacted within the acceptance window and that the in-place soil has a k that is at or less than the target value determined during preconstruction testing (if less $\leq 1 \times 10^{-7}$ cm/s). Both water content and unit weight will be determined in the field using the nuclear density gauge and in the lab using 3-inch diameter Shelby tubes. Minimum testing frequencies are presented below:

Construction Testing

Test	Method	Minimum Frequency
Field Moisture/Density Test(1)	ASTM D6938	1 per 8,000 ft^2, per 6-inch lift
Water Content	ASTM D2216	As needed to calibrate nuclear gauge. Use 60°C oven.
Percent Fines	ASTM D1140	1 per 100,000 ft^2, per 6-inch lift
Atterberg Limits	ASTM D4318	
Hydraulic Conductivity(1)	ASTM D5084	1 per 2.5 acres of cover per lift evenly distributed through all lifts

Notes: (1) Increase cell pressure as necessary to control swell during saturation. Once saturation (B-value) reaches 95%, reduce effective confining pressure to 4 psi.

Key items:

- 90% of both the field and lab values must plot within the acceptance window.
- The geometric mean of the k values must be $\leq$ the target permeability determined during preconstruction testing. The geometric mean is determined as the n^{th} root of the product of n numbers.

$$\left(\prod_{i=1}^{n} x_i\right)^{\frac{1}{n}} = \sqrt[n]{x_1 x_2 \cdots x_n}.$$

For example: for 3 k-values the geometric mean is $(X_1 \bullet X_2 \bullet X_3)^{0.333}$.

5.4 Protective Cover Soil

3. The QA/QC monitor will perform a minimum of 4 in-place moisture-density tests using a nuclear density gauge. If the water content/density falls within the acceptance window move to Step 4, otherwise compact the soil until passing results are obtained.
4. The QA/QC monitor will obtain bag samples from each in-place moisture-density test on the completed lift for water content testing in the lab.
5. The QA/QC monitor will obtain a 3 inch diameter Shelby tube sample from the completed lift.

The tube samples from each lift should be tested for the following:

- Water content
- Dry unit weight
- Atterberg limits
- Hydraulic conductivity

Once it has been determined that the construction practices and soil testing will provide a compacted clay cover with a $k \leq 1 \times 10^{-7}$ cm/s, construction of the WB cover may begin.

5.2 WB Cover Construction and Testing

Construction of the WB final cover must proceed in the same manner as the test pad construction or as determined in previous construction at the facility. The soil shall be spread in loose lift thickness of 10-inches of less. Compaction will be in accordance with the procedures identified either through previous construction or in test pad construction that produced a $k \leq 1 \times 10^{-7}$ cm/s.

The total thickness of the WB final cover may vary based upon the permeability of the constructed cover. The final cover thickness will be determined as follows:

- First, initial preconstruction testing data of the borrow source soil will be used to determine the target permeability and the thickness of the WB cover, based on TCEQ Guidance Document RG-494 (March 2017), Table 3.
- Second, during cover construction, soil samples of the as-built final cover will be taken and tested for hydraulic conductivity as described in Section 5.3. Hydraulic conductivity results of the as-built final cover samples will be used to verify that the geometric mean of the samples is no greater than the target hydraulic conductivity used to set the final cover thickness in accordance with TCEQ Guidance Document RG-494 (March 2017), Table 3. For areas exceeding the target hydraulic conductivity, additional compaction and re-testing will be performed to ensure that the geometric mean meets the target hydraulic conductivity.
- Last, the final cover thickness may be adjusted, as needed, based on the results of the preconstruction soil samples taken throughout the construction process and in accordance with TCEQ Guidance Document RG-494 (March 2017), Table 3. In no case will the thickness be decreased from the thickness determined in the preconstruction testing.
- Should the preconstruction testing indicate an increase to the final cover thickness is required, the subgrade shall be adjusted based on the thickness of the WB cover. For all WB cover constructions, the permitted top of final cover grades will be maintained per the TCEQ permitted final grading plan to ensure proper drainage and transition between existing and new final cover areas. The final top of waste grades will be at or below the permitted final elevation once the cover is installed. In no case will the increase in the thickness of the WB cover or the erosion layer raise the final surface of the cover above the permitted design elevations.

ENCLOSURE 3

TCEQ-20650 FORM PAGE 1 AND SIGNATURE PAGE

Facility Name: Austin Community Recycling and Disposal Facility
Permittee/Registrant Name: Waste Management of Texas, Inc.
MSW Authorization #: 249D
Initial Submittal Date: 10/2017
Revision Date: 02/2018

Texas Commission on Environmental Quality

Permit/Registration Modification and Temporary Authorization Application Form for an MSW Facility

1. Reason for Submittal

☐ Initial Submittal ☒ Notice of Deficiency (NOD) Response

2. Authorization Type

☒ Permit ☐ Registration

3. Application Type

☒ Modification with Public Notice ☐ Modification without Public Notice
☐ Temporary Authorization (TA) ☐ Modification for Name Change/Transfer

4. Application Fees

☐ Pay by Check ☒ Online Payment

If paid online, e-Pay Confirmation Number: 582EA000273761

5. Application URL

Is the application submitted for a permit/registration modification with public notice?

☒ Yes ☐ No

If the answer is "Yes", enter the URL address of a publicly accessible internet web site where the application and all revisions to that application will be posted in the space provided: http://**http://www0.wm.com/wm/texas/permits.asp**

6. Confidential Documents

Does the application contain confidential documents?

☐ Yes ☒ No

If "Yes", cross-reference the confidential documents throughout the application and submit as a separate attachment in a binder clearly marked "CONFIDENTIAL."

Signature Page

I, Steve Jacobs, Texas Area Director of Landfill Operations,
(Site Operator (Permittee/Registrant)'s Authorized Signatory) (Title)

certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: _____ Date: 2-21-18

TO BE COMPLETED BY THE OPERATOR IF THE APPLICATION IS SIGNED BY AN AUTHORIZED REPRESENTATIVE FOR THE OPERATOR

I, _____, hereby designate _____
(Print or Type Operator Name) (Print or Type Representative Name)

as my representative and hereby authorize said representative to sign any application, submit additional information as may be requested by the Commission; and/or appear for me at any hearing or before the Texas Commission on Environmental Quality in conjunction with this request for a Texas Water Code or Texas Solid Waste Disposal Act permit. I further understand that I am responsible for the contents of this application, for oral statements given by my authorized representative in support of the application, and for compliance with the terms and conditions of any permit which might be issued based upon this application.

_____
Printed or Typed Name of Operator or Principal Executive Officer

_____
Signature

SUBSCRIBED AND SWORN to before me by the said Steve Jacobs

On this 21st day of February, 2018

My commission expires on the 20th day of January, 2022

_____
Notary Public in and for

Travis County, Texas
(Note: Application Must Bear Signature & Seal of Notary Public)

IMELDA GALLEGOS
Notary Public, State of Texas
Comm. Expires 01-20-2022
Notary ID 123927680