SCS ENGINEERS

Unstable Areas Compliance Demonstration Cells 1 and 2

Sandy Creek Solid Waste Disposal Facility

Prepared for:

SANDY CREEK ENERGY STATION
2161 Rattlesnake Road
Riesel, TX 76682

Prepared by:

SCS ENGINEERS
TBPE Registration No. F-3407
1901Central Drive, Suite 550
Bedford, Texas 76021

October 1, 2018
File No. 16215106.00

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Table of Contents

Figures

Appendices

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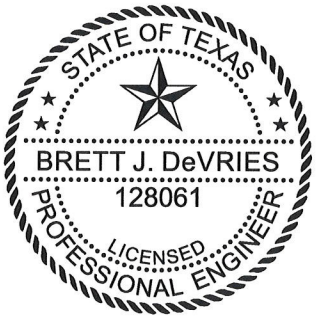
P.E. Certification



I, Brett DeVries, Ph.D., P.E., hereby certify that the unstable areas demonstration prepared for the Sandy Creek Solid Waste Disposal Facility Cells 1 and 2 at the Sandy Creek Energy Station meets the requirements in 40 CFR 257.64(a). This certification is based on the enclosed October 2018 Unstable Areas Compliance Demonstration for the Sandy Creek Solid Waste Disposal Facility Cells 1 and 2 prepared by SCS Engineers. I am a duly licensed Professional Engineer under the laws of the State of Texas.

10/1/2018

(signature) (date)

Brett DeVries, Ph.D., P.E.

(printed or typed name)

License number 128061

My license renewal date is 9/30/2019.

Pages or sheets covered by this seal:
Pages 1, 2; Figure 1; Appendix A, B, D, and E

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1.0 INTRODUCTION AND PROJECT SUMMARY

On behalf of Sandy Creek Energy Station, LLC, SCS Engineers (SCS) has prepared the enclosed Unstable Areas Restriction Compliance Demonstration for the Sandy Creek Solid Waste Disposal Facility existing Cells 1 and 2 (existing coal combustion residual [CCR] landfill) as required by 40 CFR §257.64.

Future proposed CCR units (Cells 3 and 4) have not been developed. When developed, Cells 3 and 4 will be classified as a lateral expansion of an existing CCR landfill, as defined in 40 CFR §257.53. This document addresses exclusively Cells 1 and 2. Future CCR units beyond Cells 1 and 2 are not addressed and are not discussed further herein; thereby, in accordance with §257.64, additional unstable areas restriction compliance demonstration will be required prior to placing CCR in cells 3 and 4.

Figure 1 shows the site location. **Figure 2** shows the Cells 1 and 2 locations.

2.0 UNSTABLE AREAS RESTRICTIONS

§257.64 *"Unstable areas."*

"(a) An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted."

"(b) The owner or operator must consider all of the following factors, at a minimum, when determining whether an area is unstable:

(1) On-site or local soil conditions that may result in significant differential settling;"

As discussed in **Appendices A** and **B**, and as shown by the geologic cross section from the 2010 Engineering Report prepared by Black & Veatch Corp. (see **Appendix C**), the Cells 1 and 2 CCR units are not located in on-site or local soil conditions that may result in significant differential settling. The site soils consist primarily of stiff to hard clays overlaying hard clayshale weathered from shale bedrock. Because the clays are stiff to hard, they are not susceptible to appreciable differential settlement that would affect the performance of the CCR landfill.

"(2) On-site or local geologic or geomorphologic features; and"

As discussed in **Appendices A**, **B**, and **E**, and as shown by the geologic cross section in **Appendix C**, the Cells 1 and 2 CCR units are not located in on-site or local geologic or geomorphologic features that are unstable. The cross section

shows stiff to hard clays overlaying hard clayshale weathered from shale bedrock. These geologic features provide a stable foundation for the CCR landfill. This assessment is confirmed by the slope stability analysis in **Appendix D** that indicates the slope stability safety factors are acceptable.

(3) "*On-site or local human-made features or events (both surface and subsurface).*"

As shown by the geologic cross section in **Appendix C**, the Cells 1 and 2 CCR units are not located in on-site or local human-made features or events (both surface and subsurface) that are unstable. Prior to development for the landfill, the historical site use was agricultural with minimal site disturbance.

As discussed in **Appendix E**, groundwater or surface water is unlikely to cause instability. The facility is designed with adequate run-on and run-off control systems, and is constructed above the water table.

3.0 REFERENCES

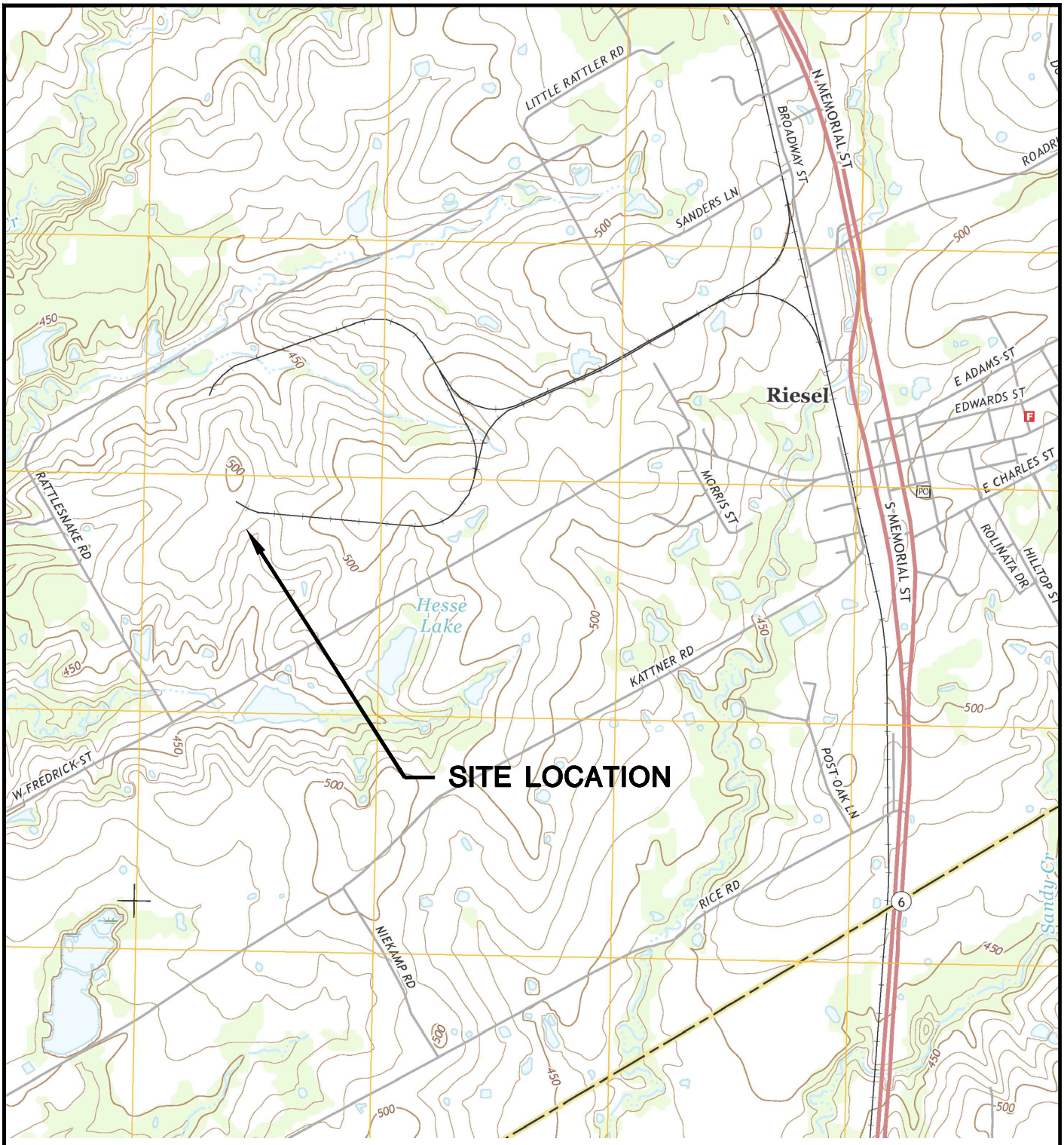
Black & Veatch Corp., 2009, Geotechnical Design Report, Sandy Creek Energy Station, Riesel, Texas, Sandy Creek Power Partners.

Black & Veatch Corp., 2010, Engineering Report, Solid Waste Disposal Facility, Sandy Creek Energy Station, Sandy Creek Services, LLC.

SCS Engineers, 2018, June 2018 Semiannual Groundwater Monitoring Report Submittal, Sandy Creek Energy Station, McLennan County, Texas.

USGS seismic impact zones map website:
https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf

FIGURES



N

RIESEL QUADRANGLE
TEXAS–MCLENNAN CO.
7.5 MINUTE SERIES (TOPOGRAPHIC)
2016
SCALE: 1" = 2,000'

CLIENT	LS POWER DEVELOPMENT, LLC	SITE	UNSTABLE AREAS COMPLIANCE DEMONSTRATION REPORT SANDY CREEK SOLID WASTE DISPOSAL FACILITY RIESEL, TEXAS

SITE LOCATION MAP

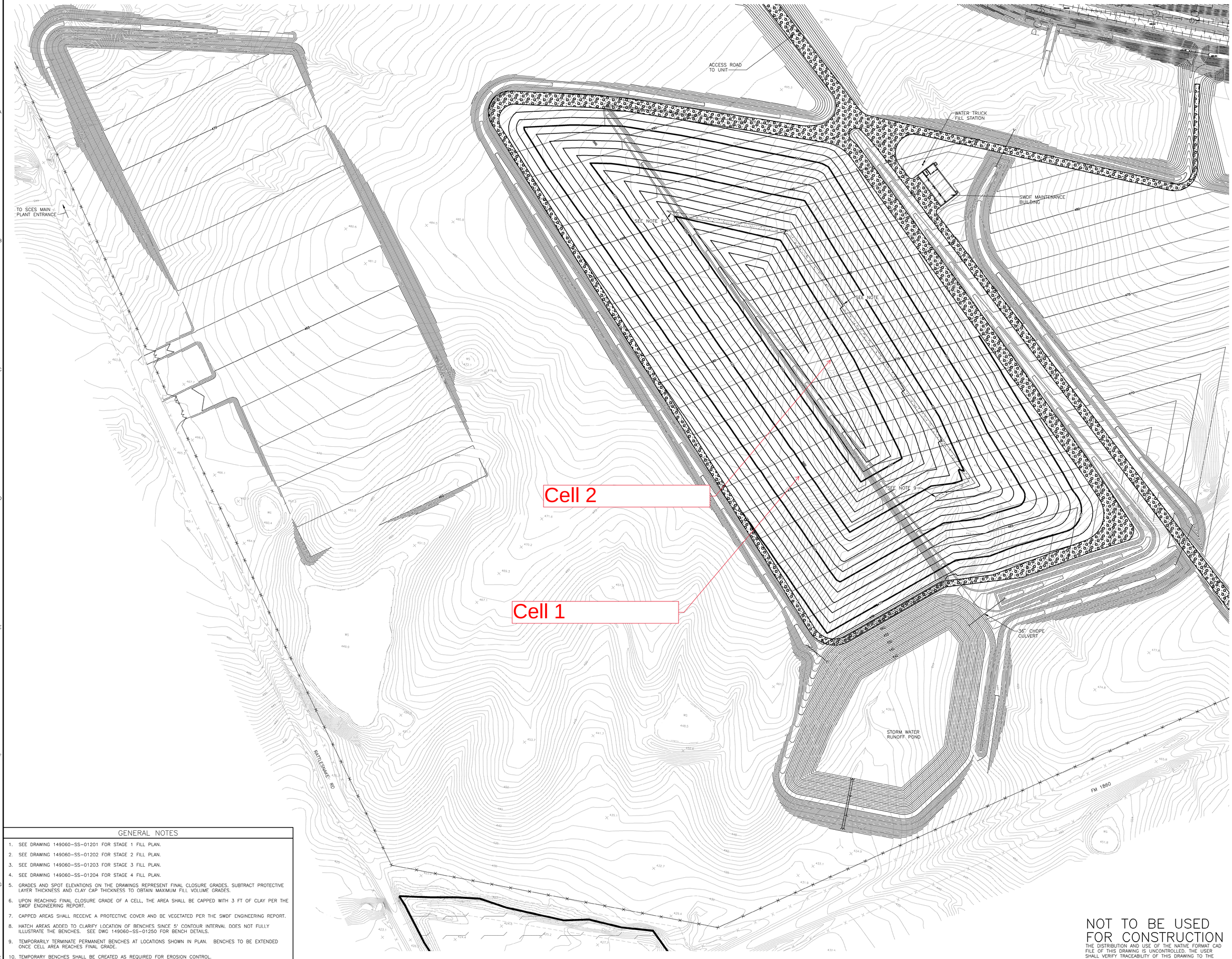
PROJECT NO.	16215106.00	DRAWN BY:	ZB
DRAWN:	09/07/18	CHECKED BY:	DN
REVISED:	09/25/18	APPROVED BY:	

ENGINEER

SCS ENGINEERS
2830 DAIRY DRIVE MADISON, WI 53718-6751
PHONE: (608) 224-2830

FIGURE 1

I:\16215106\Drawings\Site Location Map.dwg, 9/25/2018 7:16:44 AM



GENERAL NOTES

1. SEE DRAWING 149060-SS-01201 FOR STAGE 1 FILL PLAN.
2. SEE DRAWING 149060-SS-01202 FOR STAGE 2 FILL PLAN.
3. SEE DRAWING 149060-SS-01203 FOR STAGE 3 FILL PLAN.
4. SEE DRAWING 149060-SS-01204 FOR STAGE 4 FILL PLAN.
5. GRADES AND SPOT ELEVATIONS ON THE DRAWINGS REPRESENT FINAL CLOSURE GRADES. SUBTRACT PROTECTIVE LAYER THICKNESS AND CLAY CAP THICKNESS TO OBTAIN MAXIMUM FILL VOLUME GRADES.
6. UPON REACHING FINAL CLOSURE GRADE OF A CELL, THE AREA SHALL BE CAPPED WITH 3 FT OF CLAY PER THE SWDF ENGINEERING REPORT.
7. CAPPED AREAS SHALL RECEIVE A PROTECTIVE COVER AND BE VEGETATED PER THE SWDF ENGINEERING REPORT.
8. HATCH AREAS ADDED TO CLARIFY LOCATION OF BENCHES SINCE 5' CONTOUR INTERVAL DOES NOT FULLY ILLUSTRATE THE BENCHES. SEE DWG 149060-SS-01250 FOR BENCH DETAILS.
9. TEMPORARILY TERMINATE PERMANENT BENCHES AT LOCATIONS SHOWN IN PLAN. BENCHES TO BE EXTENDED ONCE CELL AREA REACHES FINAL GRADE.
10. TEMPORARY BENCHES SHALL BE CREATED AS REQUIRED FOR EROSION CONTROL.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

PLANT GRID — STATE PLANE 6°46'31.01"

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PE	APP
1	18/OCT/10	GENERAL REVISIONS	SAJ	JCB	BAG	BAG	MWM
0	30/JUN/09	INITIAL ISSUE	SAC	JCB	BMH	BTM	MWM

80' 40' 0 80' 160'
1"=80'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF TEXAS
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION TEXAS FIRM NO. F-28 | SCPP SANDY CREEK ENERGY STATION

ENGINEER	JCB	DRAWN	SAC
CHECKED	BMH	DATE	29/JUN/09

SANDY CREEK ENERGY STATION
UNIT 1
SOLID WASTE DISPOSAL FACILITY
FILL PLAN – STAGE 2

PROJECT 149060-SS-01202 | DRAWING NUMBER | REV 1
CODE
AREA

JOH57765
A1ASL017
10/08/10 13:24:20
ACAD 16.1s (LMS Tech)
E1
1=1

APPENDIX A

Site Description and Geologic Summary

Site Description and Geologic Summary

Site Information

The Sandy Creek Solid Waste Disposal Facility encompasses approximately 69 acres, and is located in an agricultural area historically used for pasture and open land. The site location is west of the City of Riesel, McLennan County, Texas. The facility is located near Highway 1860 and Rattlesnake Road.

Regional Geology

The disposal facility site is located in the Blackland Prairies province of the Texas Gulf Coastal plains. The site is underlain by the Lower Taylor Marl Formation (Ozan Formation). In general, the subsurface stratigraphy consists predominantly of high plasticity yellow-brown clays, weathered clayshale, and marl units of fluvial and shallow marine origin (Geotechnical Design Report Revision 0. Sandy Creek Power Partners, Apr. 2009). Shallow groundwater occurs approximately 10 to 20 feet below ground. Regionally, the Lower Taylor Marl Formation is not known for karst features. No karst features were identified in site investigations.

Previous Geologic Investigations

The disposal facility area was investigated by Sandy Creek Power Partners prior to construction by performing 11 borings within and adjacent to the facility footprint. One boring was instrumented with a piezometer. The borings extended to depths of up to 73 feet. Split spoon and Shelby tube soil samples were collected from these 11 borings, and from 40 nearby borings for investigation of the generating station, for laboratory testing that includes:

- Moisture content
- Atterberg limits
- Grain size analyses
- Permeability
- Consolidation
- Unconfined compressive strength
- Triaxial compression (unconsolidated undrained and consolidated undrained with pore water pressure measurement)

The boring locations and a geologic cross section are shown in **Appendix C**.

Based on the results of the subsurface investigation performed prior to disposal facility construction, the soils below the liner system within the facility footprint consist primarily of stiff to hard, fissured, fat clays overlying hard clayshale weathered from shale bedrock. The overconsolidation ratio of the clays is in the range of 2 to 4.

References

Black & Veatch Corp., 2009, Geotechnical Design Report, Sandy Creek Energy Station, Riesel, Texas, Sandy Creek Power Partners.

Black & Veatch Corp., 2010, Engineering Report, Solid Waste Disposal Facility, Sandy Creek Energy Station, Sandy Creek Services, LLC.

SCS Engineers, 2018, June 2018 Semiannual Groundwater Monitoring Report Submittal, Sandy Creek Energy Station, McLennan County, Texas.

DLN/JL/jsn/MRH

APPENDIX B

Liquefaction and Settlement Potential Evaluation

Liquefaction and Settlement Potential Evaluation

Based on the results of the site investigation borings and laboratory soil test results, the disposal facility soils are not subject to liquefaction or settlement concerns for the performance of the disposal facility.

Liquefaction is the process by which a saturated, loose, cohesionless soil influenced by external forces suddenly loses its shear strength and behaves as a fluid. The external forces result from ground motion from an earthquake. The disposal facility site soils in borings consist primarily of stiff to hard clay that is not subject to liquefaction. In addition, liquefaction is not a concern given the low magnitude (<0.04g, 2 percent in 50 years) of maximum ground accelerations expected in the area; see **Attachment B1.**

Settlement below a disposal facility can be a concern if the facility is underlain by extensive soft, fine-grained soils. Soft soils are subject to consolidation settlement depending on the load over the soft soils. The disposal facility soils consist of stiff to hard clay. Because the clays are stiff to hard rather than soft, consolidation settlement is not a concern for the performance of the disposal facility.

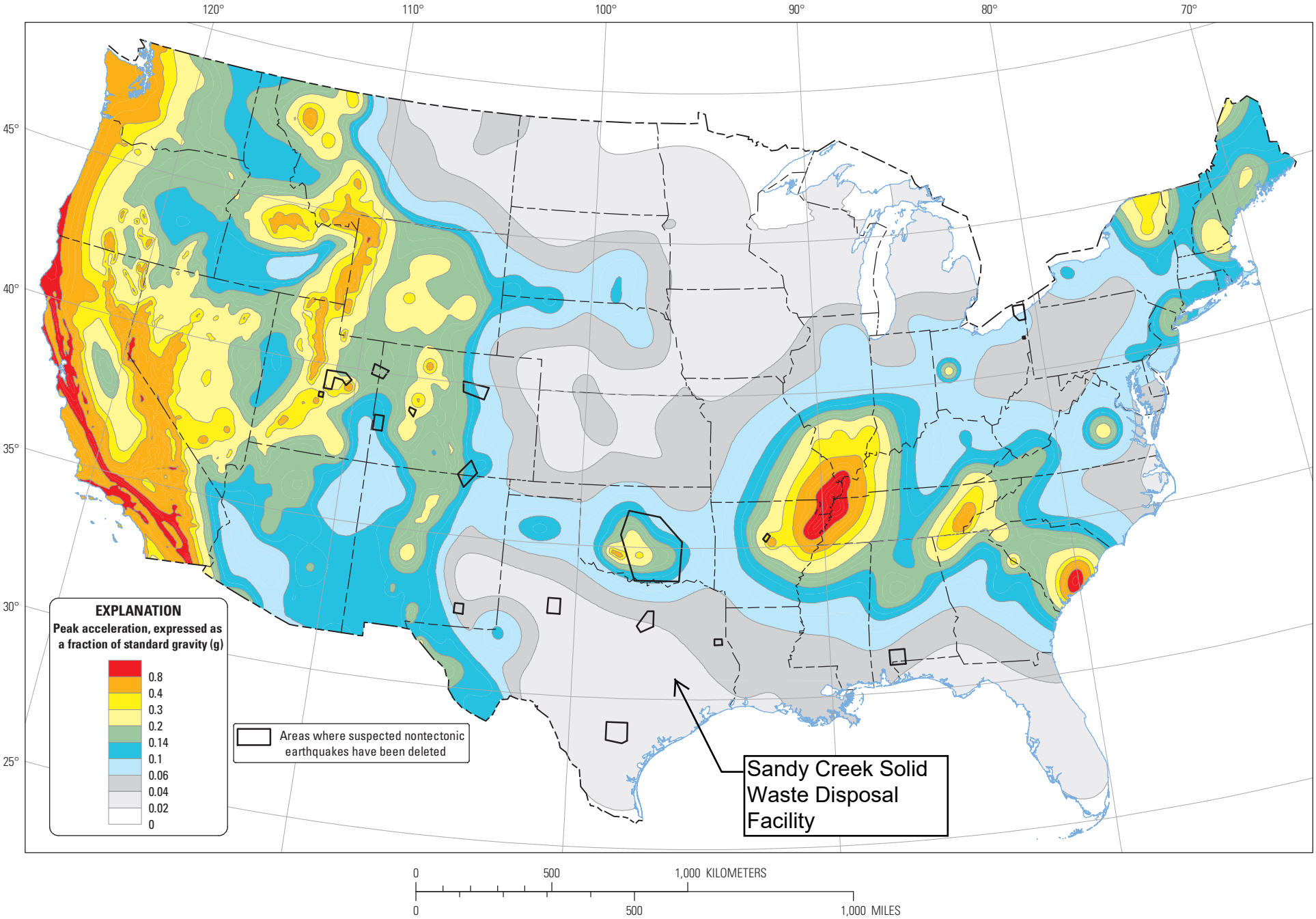
References

Black & Veatch Corp., 2009, Geotechnical Design Report, Sandy Creek Energy Station, Riesel, Texas, Sandy Creek Power Partners.

Black & Veatch Corp., 2010, Engineering Report, Solid Waste Disposal Facility, Sandy Creek Energy Station, Sandy Creek Services, LLC.

USGS seismic impact zones map website:
https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf

DLN/jsn/MRH

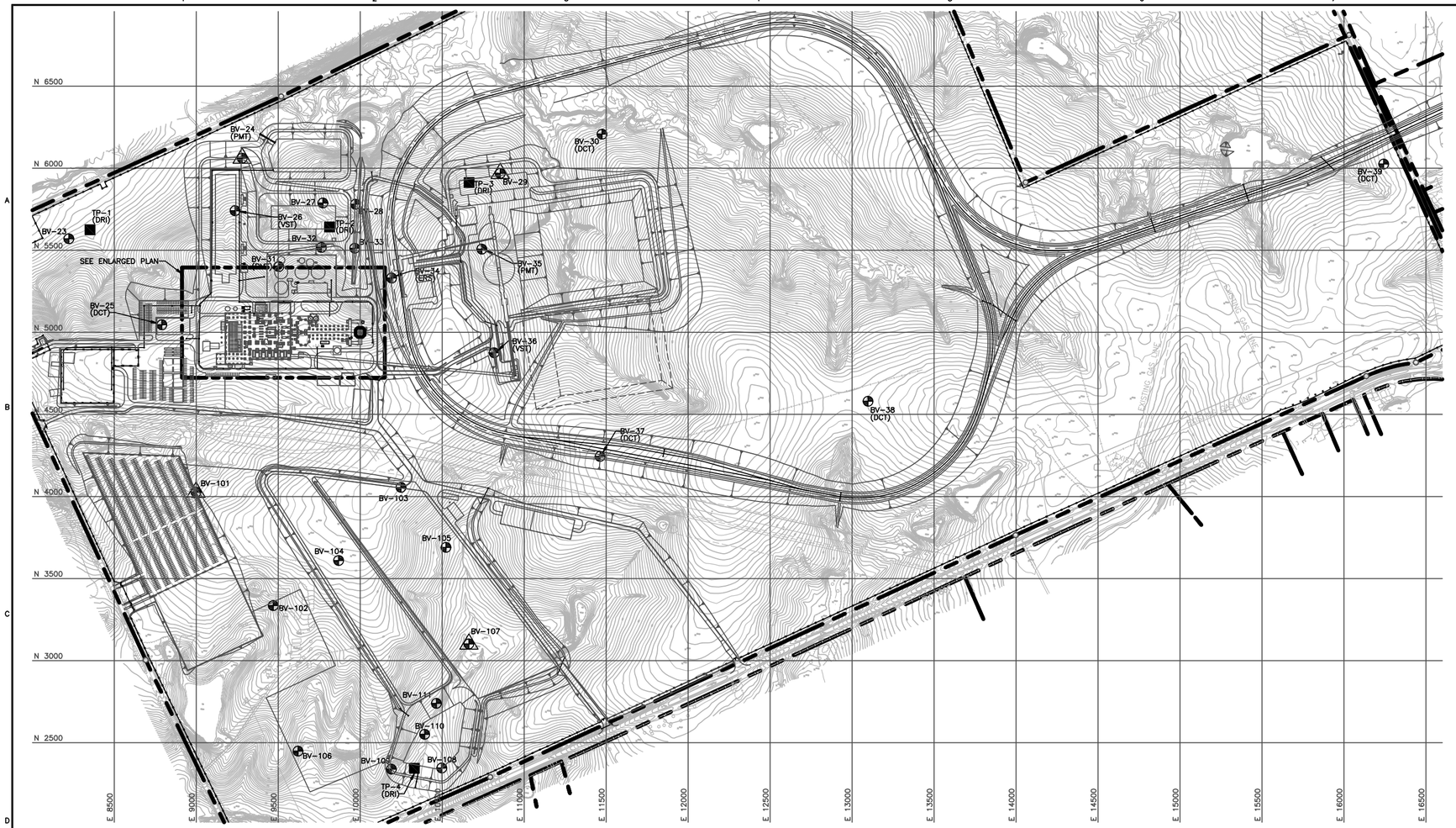


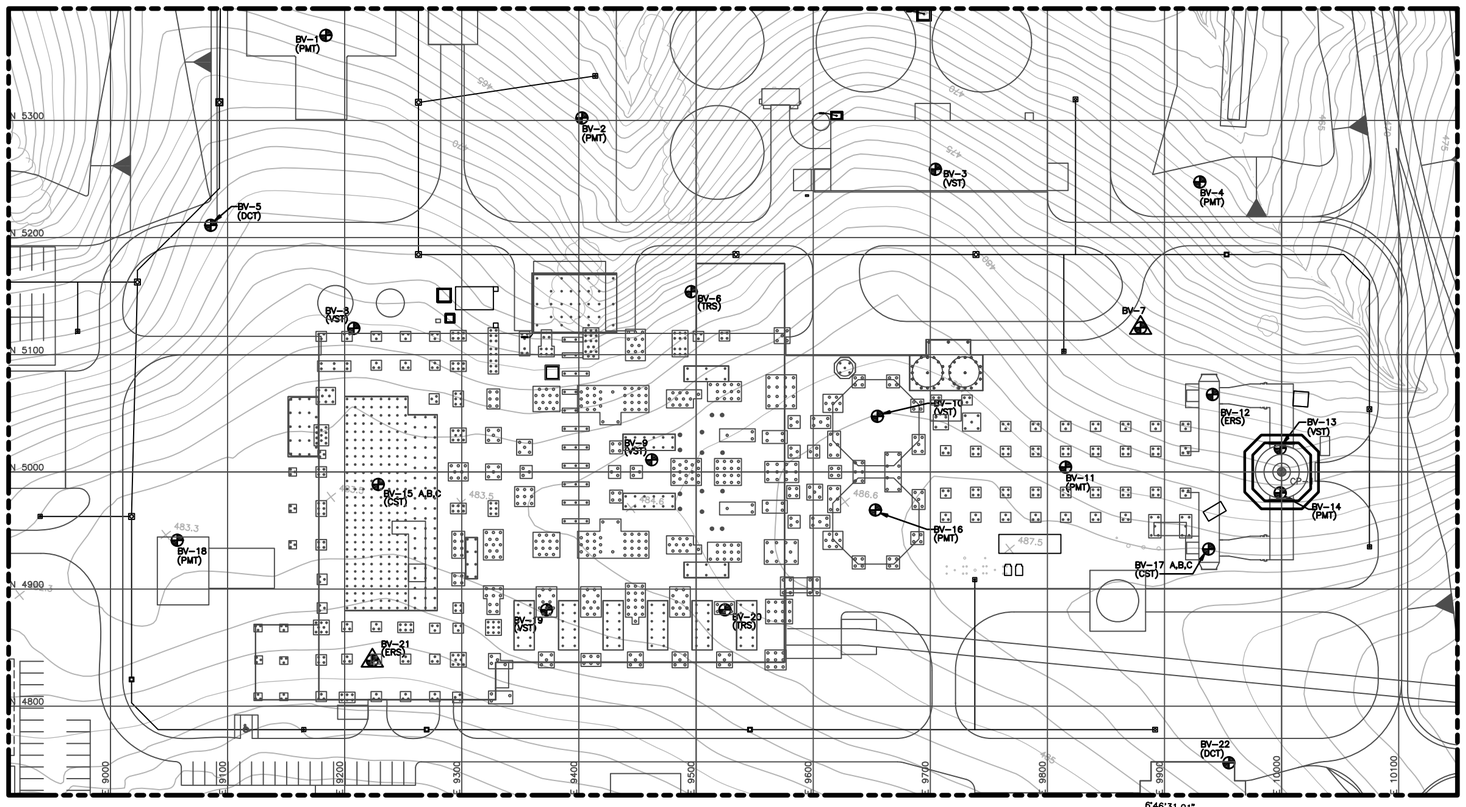
Two-percent probability of exceedance in 50 years map of peak ground acceleration

Source: USGS seismic impact zones map - https://earthquake.usgs.gov/static/lfs/nshm/conterminous/2014/2014pga2pct.pdf

APPENDIX C

Boring Locations, Geologic Cross Section, and Boring Logs





6°46'31.01"

PLANT GRID

STATE PLANE

300' 150' 0 300' 600'
1"=300'

50' 25' 0 50' 100'
1"=50'

BORING LOCATIONS

LOCATION NO.	PLANT GRID NORTHING	PLANT GRID EASTING	STATE PLANE NORTHING	STATE PLANE EASTING	SOIL DRILLING (FT)	ROCK/MARL DRILLING (FT)	REMARKS
BV-1	5372.69	9183.98	10516296.99	3348576.40	50	TOP	PRESSUREMETER TESTING
BV-2	5302.16	9402.55	10516252.73	3348801.76	50	30	PRESSUREMETER TESTING
BV-3	5258.34	9704.39	10516244.84	3349106.65	50	TOP	VANE SHEAR TEST
BV-4	5247.51	9930.16	10516260.72	3349332.13	50	TOP	PRESSUREMETER TESTING
BV-5	5210.50	9085.63	10516124.33	3348497.86	10	–	DYNAMIC CONE TEST
BV-6	5153.86	9495.83	10516116.47	3348911.88	50	30	THERMAL RESISITIVITY SAMPLE
BV-7	5123.01	9879.53	10516131.11	3349296.54	50	TOP	PIEZOMETER
BV-8	5122.58	9207.76	10516051.43	3348629.51	50	30	VANE SHEAR TEST
BV-9	5010.34	9462.12	10515969.98	3348895.34	50	30	VANE SHEAR TEST
BV-10	5047.43	9654.83	10516029.54	3349082.33	50	30	VANE SHEAR TEST
BV-11	5004.06	9815.58	10516005.45	3349247.07	50	30	PRESSURE METER TEST
BV-12	5066.09	9940.97	10516081.83	3349364.26	50	TOP	ELECTRICAL RESISTIVITY SAMPLE
BV-13	5020.13	9998.74	10516043.01	3349427.06	50	TOP	VANE SHEAR TEST
BV-14	4982.05	9998.74	10516005.20	3349431.55	50	30	PRESSUREMETER TESTING
BV-15 A,B,C	4989.27	9228.63	10515921.52	3348665.96	50	50	CROSSHOLE SEISMIC TEST; SAMPLE BORING "A"
BV-16	4967.44	9653.13	10515949.92	3349090.07	50	TOP	PRESSUREMETER TESTING
BV-17 A,B,C	4934.12	9937.68	10515950.40	3349376.57	50	50	CROSSHOLE SEISMIC TEST; SAMPLE BORING "A"
BV-18	4941.61	9057.00	10515853.94	3348501.16	50	TOP	PRESSUREMETER TESTING
BV-19	4882.26	9372.41	10515832.21	3348821.37	50	TOP	VANE SHEART TEST
BV-20	4882.26	9524.72	10515850.18	3348972.62	50	30	THERMAL RESISTIVITY SAMPLE
BV-21	4838.92	9223.59	10515771.61	3348678.70	50	30	ELECTRICAL RESISTIVITY SAMPLE
BV-22	4751.65	9954.93	10515771.24	3349415.22	10	–	DYNAMIC CONE TEST
BV-23	5570.30	8223.48	10516379.91	3347599.29	60	TOP	
BV-24	6061.39	9280.50	10516992.27	3348590.98	50	30	PRESSUREMETER TESTING; PIEZOMETER
BV-25	5046.39	8790.72	10515926.57	3348224.38	10	–	DYNAMIC CONE TEST
BV-26	5741.22	9237.12	10516669.21	3348585.69	50	TOP	VANE SHEAR TEST
BV-27	5788.27	9772.89	10516779.15	3349112.17	50	TOP	
BV-28	5781.05	9971.82	10516795.44	3349310.56	50	TOP	
BV-29	5968.82	10854.20	10517086.00	3350164.62	50	TOP	PIEZOMETER
BV-30	6207.80	11475.28	10517396.58	3350753.17	10	–	DYNAMIC CONE TEST
BV-31	5400.92	9503.72	10516362.74	3348890.57	50	30	PRESSUREMETER TESTING
BV-32	5517.78	9763.70	10516509.46	3349134.95	50	TOP	
BV-33	5512.53	9967.23	10516528.26	3349337.67	50	TOP	
BV-34	5331.33	10191.76	10516374.81	3349582.02	50	30	ELECTRICAL RESISTIVITY SAMPLE
BV-35	5507.28	10741.94	10516614.44	3350107.59	50	TOP	PRESSUREMETER TESTING
BV-36	4875.69	10816.78	10515996.09	3350256.42	50	30	VANE SHEAR TEST
BV-37	4244.12	11462.80	10515445.14	3350972.45	10	–	DYNAMIC CONE TEST
BV-38	4580.25	13097.57	10515971.80	3352556.14	10	–	DYNAMIC CONE TEST
BV-39	6025.94	16242.36	10517778.39	3355508.42	10	–	DYNAMIC CONE TEST
BV-101	4026.14	8999.50	10514938.08	3348552.06	50	TOP	PIEZOMETER
BV-102	3335.46	9470.07	10514307.74	3349100.83	50	TOP	
BV-103	4055.68	10248.88	10515114.81	3349789.23	50	TOP	
BV-104	3609.90	9868.75	10514627.29	3349464.35	50	TOP	
BV-105	3689.96	10523.55	10514784.05	3350105.13	50	TOP	
BV-106	2448.49	9621.23	10513444.80	3349355.58	50	TOP	
BV-107	3101.00	10663.15	10514216.41	3350313.15	50	TOP	PIEZOMETER
BV-108	2345.42	10497.71	10513445.85	3350238.09	50	TOP	
BV-109	2338.85	10190.45	10513403.08	3349933.75	50	TOP	
BV-110	2550.91	10393.32	10513637.59	3350110.19	50	TOP	
BV-111	2739.34	10464.88	10513833.14	3350159.02	50	TOP	
TP-1	5625.45	8352.16	10516449.85	3347720.56	15	–	
TP-2	5642.52	9813.60	10516639.22	3349169.78	15	–	
TP-3	5913.13	10663.96	10517008.25	3349982.28	15	–	
TP-4	2344.08	10330.80	10513424.83	3350072.50	15	–	

LEGEND

BV-1	BORING LOCATION
BV-1	BORING WITH PIEZOMETER LOCATION
TP-1	TEST PIT LOCATION
(PMT)	PRESSUREMETER TESTING
(VST)	VANE SHEAR TEST
(CST)	CROSSHOLE SEISMIC TEXT, SAMPLE BORING "A"
(DCT)	DYNAMIC CONE TEST
(TRS)	THERMAL RESISITIVITY SAMPLE
(ERS)	ELECTRICAL RESISITIVITY SAMPLE
(DRI)	DOUBLE RING INFILTROMETER

NOTES

1. ELECTRICAL RESISTIVITY SAMPLE TO BE TAKEN AT DESIGNATED LOCATIONS AT APPROXIMATE DEPTHS OF 2', 4', 10', 15', 20', 30', AND BOTTOM OF BORING.
2. CROSSHOLE SEISMIC TEST REQUIRES 3–100' CASED HOLES LOCATED IN A LINE AT 10' SPACING.
3. THERMAL RESISTIVITY SAMPLE TO BE TAKEN AT DESIGNATED LOCATIONS AT DEPTHS INDICATED BY PURCHASER. SAMPLE TO BE PLACED IN SEALED 5 GALLON BUCKET.

FOR ENGINEERING REPORT
FIGURE 3-1
BORING LOCATION AND INSITU TEST PLAN

NOT TO BE USED
FOR CONSTRUCTION

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
C	04/11/2008	GENERAL REVISIONS	BEZ	JJD			
B	07/27/2007	REVISED TABLE	SLS	JJD			
A	07/20/2007	ISSUED FOR CONTRACT	SLS	JJD			

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF TEXAS
SIGNED
DATE REG NO.

BLACK & VEATCH CORPORATION SCPP SANDY CREEK ENERGY STATION

SANDY CREEK ENERGY STATION
UNIT 1

SUBSURFACE INVESTIGATION
BORING LOCATION AND ISITU TEST PLAN

ENGINEER	JCB	DRAWN	SLS
CHECKED		DATE	

PROJECT 149060-DS-0001
DRAWING NUMBER
REV C
CODE
AREA

ACAD 16.1s (LMS Tech)
SEA3930
A1-1
04/11/08 11:24:18

STORMWATER RUNOFF POND

SOLID WASTE DISPOSAL AREA

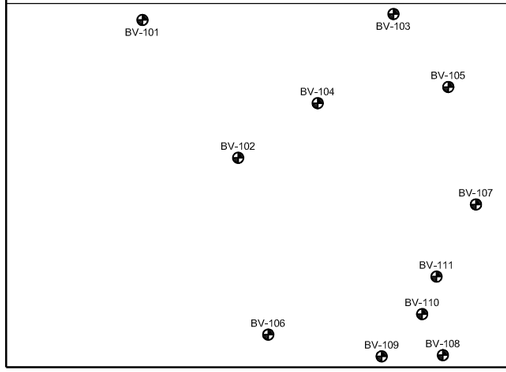
ELEVATION IN FEET

500
480
460
440
420
400
380

BV-111: 5 - 9 - 11 | YELLOW-BROWN CLAY | 34 - 65 - 85 - 87
BV-110: 4 - 11 - 6 - 13 - 62 - 76 | BROWN CLAY
BV-109: 4 - 12 - 27 - 64 - 73 - 73 - 85
BV-108: 6 - 13 - 19 - 64 - 79
BV-107: 13 | YELLOW-BROWN CLAY | 48 - 61
BV-106: 4 - 10 - 16 - 59 - CLAYSHALE - 57 - 78 | BROWN CLAY
BV-105: 5 - 7 - 18 - 39 - 74 - 88 ?
BV-104: 4 - 10 - 15 - 15 - 22 - 22 - 21 - 33 - 36
BV-103: 3 - 13 - 19 - 18 - 23 - 27 - 37
BV-102: 6 - 16 - 16 - 20 | YELLOW-BROWN CLAY | 27 - 25 - 41 | BROWN CLAY
BV-101: 3 - 15 - 23 - 27

This cross section is included as part of the report and is based on interpretations of the soil borings presented in the report. Actual subsurface conditions may vary from those in this cross section due to conditions not detected during the subsurface investigation. Groundwater levels were generally not measured due to the use of rotary wash drilling.

PLAN VIEW



LEGEND

- CLAY/CLAYSHALE
- Standard penetration test
- Undisturbed thin wall Shelby tube

1 — N-VALUE
NR — N-VALUE NOT RECORDED
80 — RQD Value
– – – INDICATES AN APPROXIMATE OR GRADUAL CHANGE

Horizontal	Vertical
Scale: 1"=(proportional)'	Scale: 1"=20'

PROJECT	LOCATION
Sandy Creek Energy Station	Reisel, Texas

CLIENT: Sandy Creek Energy Associates

PROJECT NO: 149060

FOR ENGINEERING REPORT
FIGURE 5-1
SOLID WASTE DISPOSAL FACILITY (SWDF)
AREA CROSS SECION

GENERAL NOTES

1. SEE DRAWING 149060-SS-01101 FOR STAGE 1 BASE PLAN.
2. SEE DRAWING 149060-SS-01102 FOR STAGE 2 BASE PLAN.
3. SEE DRAWING 149060-SS-01103 FOR STAGE 3 BASE PLAN.
4. DISTURBED AREAS OF NON-ACTIVE CELLS SHALL BE VEGETATED IN ACCORDANCE WITH STATE AND LOCAL BEST MANAGEMENT GUIDELINES FOR STORM WATER POLLUTION PREVENTION.
5. SEE DRAWING 149060-SS-01250 FOR DRAWN DOWN PIPE SECTIONS AND DETAILS.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FORMAT CAD FILE OF THIS DRAWING IS UNCONTROLLED. THE USER SHALL VERIFY TRACEABILITY OF THIS DRAWING TO THE LATEST CONTROLLED VERSION.

6°46'31.01" PLANT GRID / STATE PLANE

NO	DATE	REVISIONS AND RECORD OF ISSUE	DRN	DES	CHK	PDE	APP
1	18/OCT/10	GENERAL REVISIONS	JCB	JCB	BAG	BAG	MWN
0	29/JUN/09	INITIAL ISSUE	SAC	JCB	BMH	BTM	MWN

80' 40' 0 80' 160'
1"=80'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF TEXAS.
SIGNED _____
DATE _____ REG NO. _____

BLACK & VEATCH CORPORATION TEXAS FIRM NO. F-237 — SCPP SANDY CREEK ENERGY STATION

ENGINEER	JCB	DRAWN	SAC
CHECKED	BMH	DATE	29/JUN/09

SANDY CREEK ENERGY STATION
UNIT 1

SOLID WASTE DISPOSAL FACILITY
35 YEAR BASE PLAN

PROJECT 149060 | DRAWING NUMBER -SS-01100 | REV 1
CODE
AREA

JOH57765
A1/A3LO17
10/08/10

ACAD 16.1s (LMS Tech)
E:1
12:54:54
1=1

Appendix A

Boring and Piezometer Logs

BLACK & VEATCH

BORING LOG

BORING NO. BV-101

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 4026.0' E 8990.0'	473.2 ft (MSL)	44.8 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Side of hill; weed cover	PLANT	08/08/2007	08/08/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	2	1	2	3	0.2								0		472		CLAY; brown; soft; moist; low plasticity; w/some sand & gravel (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. @4' PP=4.5 tsf
TW	2	1.8	-	-	-	1.5								2		470		grading yellow-brown; stiff; w/some gypsum seams; trace cemented clay seams	
														4		468			
														6		466			
														8		464			
SPT	3	6	7	8	15	1.5								10		462		grading w/1/4" cemented clay nodules	
TW	4	2.0	-	-	-	2.0								12		460		cemented clay nodules grades out	PP=4.25 tsf
														14		458			
														16		456			
SPT	5	7	11	12	23	1.5								18		454		grading w/some cementation	
														20		452			
														22		450			
														24		448			
														26		446			
TW	6	2.0	-	-	-	1.4								28		444		grading mottled gray	

BLACK & VEATCH

BORING LOG

BORING NO. BV-101

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 4026.0' E 8990.0'	473.2 ft (MSL)	44.8 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Side of hill; weed cover	PLANT	08/08/2007	08/08/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	7	10	13	14	27	1.5								38		434		grading very stiff	
TW	8	1.8	-	-	-	1.8								44		428		grading dark gray; fissile	Bottom of boring @ 44.8'. Water level not recorded. Boring backfilled w/ bentonite chips.

BLACK & VEATCH

BORING LOG

BORING NO. BV-102

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3335.0' E 9470.0'		49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
High weeds; boring offset 150' east	Plant	8/3/07	8/3/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	3	3	3	6	0.9								0				CLAY: brown; firm; moist; high plasticity (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. @4' PP>4.5 tsf
																472			
TW	2	2.0	-	-	-	2.0								2					
																470		@ 3.0' grading gray-brown; very stiff; w/some sand & 1" subrounded gravel	
SPT	3	7	8	8	16	1.5								4				sand grades out	
																468			
TW	4	2.0	-	-	-	2.0								6					
																466			
SPT	5	7	8	8	16	1.3								8					
																464			
														10					
																462			
														12					
TW	6	2.0	-	-	-	2.0										460			
														14					
																458			
														16					
																456			
SPT	7	7	9	11	20	1.5								18				grading mottled yellow-brown-gray	
																454			
														20					
																452			
														22					
TW	8	2.0	-	-	-	2.0										450			
														24					
																448			
														26					
																446			
SPT	9	10	12	15	27	1.5								28				grading w/occasional white cemented clay seams	
																444			

BLACK & VEATCH

BORING LOG

BORING NO. BV-102

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3335.0' E 9470.0'		49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
High weeds; boring offset 150' east	Plant	8/3/07	8/3/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	10	2.0	-	-	-	2.0								30					
														32		442			
														34		440			
														36		438			
														38		436			
SPT	11	9	11	14	25	1.5								40		434			
														42		432			
TW	12	2.0	-	-	-	2.0								44		430			
														46		428			
														48		426		grading hard	
SPT	13	15	18	23	41	1.5													
														50		424			Bottom of boring at 49.5'. Water level not recorded. Boring backfilled w/ bentonite chips.
														52		422			
														54		420			
														56		418			
														58		416			
																414			

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BORING LOG

BORING NO. BV-103

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 4056.0' E 10249.0'	493.2 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Rolling hills, tall weeds	Plant	8/1/07	8/1/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	JJ Deeken	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	2	2	1	3	0.8								0		492		CLAY: brown; soft; moist; high plasticity (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. @2' PP=2.0 tsf @4' PP=2.5 tsf
TW	2	2.0	-	-	-	2.0								2		490		grading stiff	@6' PP=4.5 tsf
SPT	3	2	5	8	13	1.5								4		488		grading yellow-brown & gray seams	Reacts w/HCL
TW	4	2.0	-	-	-	1.6								6		486			PP=4.5 tsf
SPT	5	5	8	11	19	1.5								8		484		grading very stiff	
TW	6	2.0	-	-	-	2.0								10		482			
SPT	7	6	8	10	18	1.5								12		480			
TW	8	2.0	-	-	-	2.0								14		478			
SPT	9	7	11	12	23	1.5								16		476			
														18		474			
														20		472			
														22		470			
														24		468			
														26		466			
														28		464		grading w/quartz seams	

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BORING LOG

BORING NO. BV-103

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 4056.0' E 10249.0'	493.2 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Rolling hills, tall weeds	Plant	8/1/07	8/1/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	JJ Deeken	BL Christensen

SOIL SAMPLING							ROCK CORING									
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	10	2.0	-	-	-	2.0								30		462		grading iron oxide staining	PP=4.5 tsf
														32					
														34		460			
														36		458		@ 36.0' quartz seams grades out	
														38		456			
SPT	11	7	12	15	27	1.5								40		454			
														42		452			
TW	12	2.0	-	-	-	2.0								44		450		grading blue-gray	PP=4.5 tsf
														46		448			
														48		446		grading hard	
SPT	13	11	17	20	37	1.5								50		444			Bottom of boring at 49.5'. Water level not recorded. Boring backfilled with bentonite chips.
														52		442			
														54		440			
														56		438			
														58		436			
																434			

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BORING LOG

BORING NO. BV-104

SHEET 1 OF 3

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3609.0' E 9869.0'	490.3 ft (MSL)	73.0 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Top of hill, tall weeds	Plant	8/1/07	8/1/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	2	2	2	4	1.2								0		490		CLAY: brown; soft; moist; high plasticity (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. @2' PP=1.75 tsf @4' PP=2.0 tsf
														2		488		grading stiff	
TW	2	2.0	-	-	-	1.7								4		486			
SPT	3	2	4	6	10	1.5												grading yellow-brown & occasional gray clay seams	
														6		484			
TW	4	2.0	-	-	-	2.0													
														8		482			PP>4.5 tsf
SPT	5	5	6	9	15	1.5													
														10		480			
														12		478			
TW	6	2.0	-	-	-	2.0								14		476			
														16		474			
SPT	7	6	6	9	15	1.5								18		472			
														20		470			
														22		468			
TW	8	2.0	-	-	-	2.0												grading fissile	
														24		466			
														26		464			
SPT	9	7	10	12	22	1.5								28		462		grading very stiff; w/1/4" quartz seams	

BLACK & VEATCH

BORING LOG

BORING NO. BV-104

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3609.0' E 9869.0'	490.3 ft (MSL)	73.0 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Top of hill, tall weeds	Plant	8/1/07	8/1/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	10	2.0	-	-	-	2.0								30		460		grading w/some 1/8" quartz grains	PP>4.5 tsf
														32		458			
														34		456			
														36		454			
SPT	11	7	10	12	22	1.5								38		452		grading iron oxide staining	
														40		450			
														42		448			
TW	12	2.0	-	-	-	2.0								44		446			PP>4.5 tsf
														46		444			
SPT	13	8	9	12	21	1.5								48		442			
														50		440			
														52		438			
TW	14	2.0	-	-	-	2.0								54		436			
														56		434			
SPT	15	10	14	19	33	1.5								58		432		grading hard; w/occasional quartz seams	

BLACK & VEATCH

BORING LOG

BORING NO. BV-104

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3609.0' E 9869.0'	490.3 ft (MSL)	73.0 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Top of hill, tall weeds	Plant	8/1/07	8/1/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING									
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	16	2.0	-	-	-	2.0								60		430		grading blue-gray & yellow-brown seams; quartz seams grades out	PP>4.5 tsf
														62		428			
														64		426			
														66		424			
SPT	17	14	16	20	36	1.5								68		422			
														70		420			
														72		418			
														74		416			Bottom of boring at 73.0'. Water level not recorded. Boring backfilled w/ bentonite chips.
														76		414			
														78		412			
														80		410			
														82		408			
														84		406			
														86		404			
														88		402			

BLACK & VEATCH

BORING LOG

BORING NO. BV-105

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3690.0' E 10524.0'	464.0 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Side hill, tall weeds	Plant	8/1/07	8/1/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	2	2	3	5	0.8								0		464		CLAY: brown; firm; moist; high plasticity (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. @2' PP=2.0 tsf @3.5' PP=2.0 tsf @6' PP=2.8 tsf
TW	2	2.0	-	-	-	1.5								2		462		grading stiff	
SPT	3	3	3	4	7	1.5								4		460		grading firm	
TW	4	2.0	-	-	-	1.7								6		458		grading yellow-brown & gray seams; very stiff	
TW	5	2.0	-	-	-	2.0								8		456			
														10		454			
														12		452		grading fissile	PP>4.5 tsf
														14		450			
														16		448			
SPT	6	6	8	10	18	1.5								18		446			PP>4.5 tsf
														20		444			
														22		442			
TW	7	2.0	-	-	-	1.8								24		440		grading w/occasional cemented quartz seams	PP>4.5 tsf
														26		438			
SPT	8	12	15	24	39	1.5								28		436		grading blue-gray; hard; gray seams grades out	PP>4.5 tsf

BLACK & VEATCH

BORING LOG

BORING NO. BV-105

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3690.0' E 10524.0'	464.0 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Side hill, tall weeds	Plant	8/1/07	8/1/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	9	0.6	-	-	-	0.6								30		434			
														32		432			
																		33.0	TW refusal
														34		430		CLAYSHALE; gray; hard; moist; high plasticity; fissile	
														36		428			
SPT	10	21	32	42	74	1.5								38		426		grading w/frequent cemetations	
														40		424			
														42		422			
TW	11	0.9	-	-	-	0.9													Thick walled tube driven 100 blows
														44		420			
														46		418			
SPT	12	32	42	46	88	1.5								48		416			
														50		414			Bottom of boring at 49.5'. Water level not recorded. Boring backfilled w/ bentonite chips.
														52		412			
														54		410			
														56		408			
														58		406			

BLACK & VEATCH

BORING LOG

BORING NO. BV-106

SHEET 1 OF 2

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2448.0' E 9621.0'		44.2 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Valley, tall weeds	Plant	8/3/07	8/3/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	2	2	2	4	1.0								0		440		CLAY; brown; soft; moist; high plasticity; w/trace coarse sand & 1" gravel (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. @4' PP=2.2 tsf Gravel in SPT3
														2		438		grading stiff	
TW	2	2.0	-	-	-	1.1								4		436			
SPT	3	2	5	5	10	0.1								6		434		grading dark gray; w/some gravel	
TW	4	2.0	-	-	-	2.0								8		432		grading very stiff	Gravel in SPT5
SPT	5	4	6	10	16	0.1								10		430			
														12		428			
																			PP>4.5 tsf
TW	6	2.0	-	-	-	1.8								14		426			
														16		424			
SPT	7	14	26	33	59	1.5								18		422		grading hard; w/frequent light gray partings; occasional cemented clay seams; gravel grades out	
														20		420			
														22		418			
TW	8	0.8	-	-	-	0.8								23.0				CLAYSHALE; gray; hard; moist; high plasticity; fissile	
														24		416			
														26		414			
SPT	9	20	25	32	57	1.5								28		412			

BLACK & VEATCH

BORING LOG

BORING NO. BV-106

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2448.0' E 9621.0'		44.2 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Valley, tall weeds	Plant	8/3/07	8/3/07

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING									
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	10	1.0	-	-	-	1.0								30		410			Thick walled tube pushed 8", then driven 2".
														32		408			
														34		406			
														36		404			
SPT	11	26	35	43	78	1.5								38		402			
														40		400			
														42		398			Thick walled tube pushed 4", then driven 10".
TW	12	1.2	-	-	-	1.2								44		396			Bottom of boring at 44.2' Water level not recorded. Boring backfilled w/ bentonite chips.
														46		394			
														48		392			
														50		390			
														52		388			
														54		386			
														56		384			
														58		382			

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BORING LOG

BORING NO. BV-107

SHEET 1 OF 1

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 3101.0' E 10663.0'		29.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Natural drainage path, brush cover	Plant	08/09/2007	08/09/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
														0		450		CLAY; brown; moist; high plasticity; w/some gravel; trace sand (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer.
														2		448			
														4		446			
TW	1	2.0	-	-	-	1.2								6		444		grading very stiff	PP=2.5 tsf
														8		442			
														10		440			
														12		438			
SPT	2	4	6	7	13	1.5								14		436		grading mottled yellow-brown-gray; stiff	
														16		434			
TW	3	1.2	-	-	-	1.2								18		432		grading dark gray; moist; slightly fissile; w/some cemented clay seams & gravel	TW refusal @ 19.2'
														20		430			
														22		428		23.0	
SPT	4	16	20	28	48	1.5								24		426		CLAYSHALE; gray; hard; moist; high plasticity; fissile; w/some gravel	Harder drilling
														26		424			Bottom of boring at 29.5'. Water level not recorded. Piezometer installed on 08/ 09/07.
														28		422			
SPT	5	19	25	36	61	1.5													

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BORING LOG

BORING NO. BV-108

SHEET 1 OF 2

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2345.0' E 10497.0'	443.7 ft (MSL)	39.0 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Hill; weeds	Plant	08/02/2007	08/02/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	3	3	3	6	1.2								0				CLAY; brown; firm; moist; high plasticity; w/some sand & 1" gravel (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. TW-2 disturbed @2' PP=3.2 tsf @4' PP=3.2 tsf TW4 PP=4.0 tsf
														2		442			
TW	2	2.0	-	-	-	2.0												grading yellow-brown	
														4		440			
SPT	3	3	6	7	13	1.5												grading stiff	
														6		438			
TW	4	2.0	-	-	-	2.0										436			
														8					
SPT	5	7	9	10	19	1.5										434		grading very stiff; w/some quartz sand	
														10					
														12		432			
TW	6	2.0	-	-	-	2.0										430		grading mottled dark gray	PP>4.5 tsf
														14					
														16		428			
																426			
														18				18.0	PP>4.5 tsf
SPT	7	16	26	38	64	1.5										424		CLAYSHALE; gray; hard; moist; high plasticity; fissile; w/occasional cementation @ 19.5' grading dark gray	
														20					
														22		422			
TW	8	0.7	-	-	-	0.7										420			PP>4.5 tsf
														24					
														26		418			
																416			
														28					
SPT	9	20	33	46	79	1.5										414			PP>4.5 tsf

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BORING LOG

BORING NO. BV-108

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2345.0' E 10497.0'	443.7 ft (MSL)	39.0 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Hill; weeds	Plant	08/02/2007	08/02/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	10	0.8	-	-	-	0.8								30					
														32		412			
														34		410			
														36		408			
														38		406			
TW	11	1.0	-	-	-	1.0								40		404			Bottom of boring @ 39.0'. Water level not recorded. Boring backfilled w/ bentonite chips.
														42		402			
														44		400			
														46		398			
														48		396			
														50		394			
														52		392			
														54		390			
														56		388			
														58		386			
																384			

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BORING LOG

BORING NO. BV-109

SHEET 1 OF 2

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2339.0' E 10190.0'	441.6 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Valley; tall weeds	Plant	08/02/2007	08/02/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	3	2	2	4	1.1								0				CLAY; brown; soft; moist; high plasticity (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer.
																440			
														2				grading yellow-brown	
TW	2	2.0	-	-	-	1.0										438			
														4				grading stiff	
SPT	3	3	6	6	12	1.4										436			
														6					PP=2.0 tsf
TW	4	2.0	-	-	-	2.0										434			
														8				grading very stiff	
SPT	5	8	12	15	27	1.5										432			
														10					
																430			
														12					
TW	6	1.0	-	-	-	1.0										428		grading dark gray	
														14					
																426			
														16					
																424			
														18				18.0	
SPT	7	17	27	37	64	1.5										422		CLAYSHALE; gray; hard; moist; high plasticity; fissile; w/frequent cemented clay seams	
														20					
																420			
														22					
TW	8	0.5	-	-	-	0.5										418			
														24					
																416			
														26					
																414			
														28					
SPT	9	21	32	41	73	1.5										412			

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BORING LOG

BORING NO. BV-109

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2339.0' E 10190.0'	441.6 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Valley; tall weeds	Plant	08/02/2007	08/02/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	10	0.5	-	-	-	0.5								30					
														32		410			
																408			Tube end crushed.
														34					
																406			
														36					
																404			
SPT	11	22	32	41	73	1.5								38					
																402			
														40					
																400			
TW	12	0.5	-	-	-	0.5								42					
																398			
														44					
																396			
														46					
																394			
SPT	13	27	39	46	85	1.5								48					
																392			
														50					Bottom of boring @ 49.5'. Water level not recorded. Boring backfilled w/ bentonite chips.
																390			
														52					
																388			
														54					
																386			
														56					
																384			
														58					
																382			

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BORING LOG

BORING NO. BV-110

SHEET 1 OF 2

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2551.0' E 10393.0'	439.6 ft (MSL)	39.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Valley/tall weeds	Plant	8/3/07	8/4/07

LOGGED BY	CHECKED BY	APPROVED BY
DE Campbell	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	WOH	2	2	4	1.2								0				CLAY: brown; soft; moist; high plasticity; w/trace subrounded red fine gravel (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer. @2' PP=1.5 tsf
														2		438			
TW	2	2.0	-	-	-	1.1										436			
														4				grading stiff	
SPT	3	3	4	7	11	1.0										434			
														6				grading yellow-brown; firm	
SPT	4	3	3	3	6	1.3										432			
														8					
TW	5	2.0	-	-	-	2.0										430			
														10				@ 10.0' grading mottled gray	PP=2.25 tsf
																428			
														12					
SPT	6	3	5	8	13	1.3										426		grading w/trace cementation; gravel grades out	
														14					
																424			
														16					
																422			
TW	7	1.2	-	-	-	1.2								18				grading gray	
																420			
														20					
																418			
														22					
																416		grading hard; w/occasional cemented clay seams	
SPT	8	18	26	36	62	1.5								24					
																414			
														26					
																412			
														28					
																410			

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BORING LOG

BORING NO. BV-110

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2551.0' E 10393.0'	439.6 ft (MSL)	39.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
Valley/tall weeds	Plant	8/3/07	8/4/07

LOGGED BY	CHECKED BY	APPROVED BY
DE Campbell	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	9	0.8	-	-	-	0.8								30					
														32		408			
														33.0					Tube end crushed.
														34		406		CLAYSHALE: gray; hard; moist; high plasticity; fissile; w/trace cementation	
														36		404			
														38		402			
SPT	10	22	34	43	76	1.5								40		400			Bottom of boring @ 39.5'. Water level not recorded. Boring backfilled w/ bentonite chips.
														42		398			
														44		396			
														46		394			
														48		392			
														50		390			
														52		388			
														54		386			
														56		384			
														58		382			
																380			

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BORING LOG

BORING NO. BV-111

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2739.0' E 10465.0'	446.0 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
tall weeds in valley, heavy rain	Plant	08/02/2007	08/02/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING										
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
SPT	1	2	2	3	5	1.2								0		446		CLAY; brown; firm; moist; high plasticity (6" Topsoil)	Boring advanced w/rotary wash using 3-7/8" step bit & bentonite mud as drilling fluid. SPT performed w/ autohammer.
TW	2	2.0	-	-	-	1.5								2		444			
SPT	3	2	4	5	9	1.4								4		442		grading stiff	
TW	4	2.0	-	-	-	1.8								6		440		grading yellow; w/trace sand	@6' PP=1.5 tsf
SPT	5	2	4	7	11	1.5								8		438		@ 9.0' grading yellow-brown	@8' PP=3.5 tsf
														10		436			
														12		434			
TW	6	2.0	-	-	-	2.0								14		432			PP>4.5 tsf
														16		430			
SPT	7	10	15	19	34	1.5								18		428		grading hard; w/some sand @ 18.5' grading w/1" gravel	PP>4.5 tsf
														20		426		@ 19.5' grading gray-brown	
														22		424			
TW	8	0.8	-	-	-	0.8								24		422		grading w/occasiional quartz seams	
														26		420			
SPT	9	20	27	38	65	1.5								28		418		28.0 CLAYSHALE; gray; hard; moist; high plasticity; fissile; w/trace cementation	

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BORING LOG

BORING NO. BV-111

CLIENT	PROJECT	PROJECT NO.
Sandy Creek Energy Associates	Sandy Creek Energy Station	149060

PROJECT LOCATION	COORDINATES	GROUND ELEVATION (DATUM)	TOTAL DEPTH
Reisel, Texas	N 2739.0' E 10465.0'	446.0 ft (MSL)	49.5 (feet)

SURFACE CONDITIONS	COORDINATE SYSTEM	DATE START	DATE FINISHED
tall weeds in valley, heavy rain	Plant	08/02/2007	08/02/2007

LOGGED BY	CHECKED BY	APPROVED BY
JJ Deeken	V Bhadriraju	BL Christensen

SOIL SAMPLING							ROCK CORING									
SAMPLE TYPE	SAMPLE NUMBER	SET 6 INCHES	2ND 6 INCHES	3RD 6 INCHES	N VALUE	SAMPLE RECOVERY	CORE SIZE	RUN NUMBER	RUN LENGTH	RUN RECOVERY	RQD RECOVERY	PERCENT RECOVERY	RQD	DEPTH (FEET)	SAMPLE TYPE	ELEVATION (FEET)	GRAPHIC LOG	CLASSIFICATION OF MATERIALS	REMARKS
TW	10	0.7	-	-	-	0.7								30		416			
														32		414			
																			Thick walled tube driven.
														34		412			
														36		410			
														38		408		grading dry to moist	
SPT	11	23	44	41	85	1.5													
														40		406			
														42		404			
																			Thick walled tube driven.
TW	12	1.0	-	-	-	1.0								44		402			
														46		400			
														48		398			
SPT	13	30	40	47	87	1.5													
														50		396			Bottom of boring @ 49.5'. Water level not recorded. Boring backfilled w/ bentonite chips.
														52		394			
														54		392			
														56		390			
														58		388			

APPENDIX D

Slope Stability Analysis

Environmental Consultants
and Contractors

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SCS ENGINEERS

September 27, 2018
File No. 16215106.00

TECHNICAL MEMORANDUM

ANALYSIS BY: Keith Gilkey
Deb Nelson

REVIEWED BY: Phil Gearing
Dave Hendron

SUBJECT: Slope Stability Review and Analyses
Unstable Areas Compliance Demonstration Report
Cells 1 and 2 (Stages 1 and 2)
Sandy Creek Solid Waste Disposal Facility
Sandy Creek Energy Station

BACKGROUND & PURPOSE

The original slope stability analyses conducted by Black & Veatch (B&V) in 2009 investigated the 4H:1V slopes of the disposal facility (dry ash landfill) through four filling stages (Stages 1 through 4) of the design storage area lifetime. The purpose of the SCS Engineers (SCS) slope stability analysis is to review the previous analyses conducted by B&V for Cells 1 and 2 (Stages 1 and 2). The slope stability analysis review is part of the Unstable Areas Compliance Demonstration to meet 40 CFR 257. 64. The analyses cross section locations are shown in **Attachment D2**. Cells 1 and 2 are the existing coal combustion residual (CCR) landfill. Future CCR units beyond Cells 1 and 2 are not addressed and are not discussed further herein.

CONCLUSION

SCS reviewed the 2009 slope stability analyses for Cells 1 and 2 (Stages 1 and 2) of the waste disposal facility. We concur that the slope geometry; material properties for the drainage/ protective layer, byproduct (waste), and clayshale; and the piezometric surface used for undrained clay shear strength analyses are appropriate. Based on our review of the clay shear strength (both drained and undrained) test results, SCS determined that a lower undrained clay shear strength than the values used in 2009 should be used for the slope stability analyses. SCS also determined that slope stability analyses using the drained clay shear strength should be performed in addition to the undrained clay shear strength analyses for comparison with the stability analyses made using undrained shear strength values. The soil shear strength evaluation is discussed in more detail below. When the safety factors are compared, analyses made using either shear strength should compare well with each other.

Based on the slope stability analysis results in **Attachments D1** and **D4**, SCS calculated slope stability safety factors in the range of 1.54 to 1.84 for Cells 1 and 2 that meet the recommended minimum safety factor of 1.5. The 1.5 minimum slope stability safety factor is based on industry practice for solid waste landfills.

SOIL SHEAR STRENGTH EVALUATION

The soil properties from field and laboratory testing of the site prior to landfill construction are contained in the 2010 Geotechnical Design Report by B&V and the 2009 Engineering Report by B&V. The site soils are highly plastic, stiff, fissured clays overlying a hard clayshale formed by weathering of the underlying shale bedrock. The properties of the stiff, fissured clay soils that SCS summarized from information in the aforementioned Reports are given in **Attachment D3**. The 2009 slope stability analysis performed by B&V is based on their interpretation of the undrained shear strength for the stiff, fissured clay soils that significantly increases with depth below the landfill. The test results summarized and plotted in **Attachment D3** do not support an increasing undrained shear strength of the stiff, fissured clays with depth. The data show that the minimum shear strength for these clay strata is about 2,000 psf. Therefore, SCS used a value of 2,000 psf in the slope stability analyses performed for this review.

The slope stability analyses shown in **Attachments D1** and **D4** were performed by SCS for both undrained and drained clay shear strengths. Based on the test results summarized in **Attachment D3**, SCS used an undrained shear strength of 2,000 psf for the stiff, fissured clay layers and a drained shear strength of 20 degrees for the clay layers. The drained shear strength of 20 degrees is consistent with drained shear strength testing conducted by B&V and with recommendations from Stark and Hussain (2012) for clays with liquid limits and clay fraction contents similar to those shown by testing of the Sandy Creek site stiff, fissured clays in **Appendix D3**.

PORE WATER PRESSURE EVALUATION

The 2009 slope stability analyses by B&V assumed a piezometric surface that is 10 feet above the landfill liner to account for pore water pressure within the waste and soils. SCS also used a piezometric surface that is 10 feet above the landfill liner for the stability analyses using undrained clay shear strength. SCS assumed that this piezometric surface is “perched” above the normal groundwater piezometric surface in the clay soils underlying the landfill.

With respect to the normal groundwater piezometric surface, SCS used two piezometric surfaces for the stability analyses using the drained clay shear strength of 20 degrees mentioned previously. The lower piezometric surface corresponds to groundwater levels approximately 10 feet below ground surface (bgs) (near elevation 460 feet above mean sea level (amsl)) and approximately 20 feet bgs (near elevation 450 feet amsl). The lower piezometric surfaces were selected based on the groundwater levels in the 2018 Semiannual Groundwater Monitoring Report.

SLOPE STABILITY ANALYSIS RESULTS

The calculated safety factors for the Stage 1 and Stage 2 waste slopes are shown in the summary table in **Attachment D1**. The slopes were analyzed using the Spencer method for circular failure that is consistent with the 2009 slope stability analyses performed by B&V.

B&V recommended a minimum safety factor of 1.5 for the waste slopes, and SCS is in agreement with the recommended 1.5 minimum safety factor. The stability analysis results by SCS in **Attachments D1**and **D4** indicate that the Cell 1 and Cell 2 (Stage 1 and Stage 2) waste slopes have calculated safety factors in the range of 1.54 to 1.84. The safety factors calculated with undrained clay shear strength are in reasonably good agreement with the safety factors calculated with drained clay shear strength and both result in a minimum factor of safety greater than 1.5. The Cell 1 and Cell 2 waste slope stability safety factors meet the recommendation of a safety factor of 1.5 or greater.

REFERENCES

1. Black & Veatch Corp., Sandy Creek Energy Station, Byproduct Storage Area – Slope Stability, 2009.
2. Black & Veatch Corp., Sandy Creek Energy Station, Engineering Report – Revision 1, 2010, Sandy Creek Services LLC.
3. Black & Veatch Corp., Sandy Creek Energy Station, Geotechnical Design Report – Revision 0, 2009, Sandy Creek Services LLC.
4. SCS Engineers, 2018, June 2018 Semiannual Groundwater Monitoring Report Submittal, Sandy Creek Energy Station, McLennan County, Texas.
5. Stark, Timothy D. and Manzoor Hussain, 2012, Empirical Correlations – Drained Shear Strength for Slope Stability Analyses, Journal of Geotechnical and Geoenvironmental Engineering, American Society of Civil Engineers.
6. Geo-Slope International, Ltd., GeoStudio 2016, Version 8.16.2.14053, Slope/W slope stability software.

MATERIAL PROPERTIES

- Material properties utilized for the undrained clay shear strength slope stability analyses are as shown in the table below, based on the values used for the 2009 stability analyses by B&V and an undrained shear strength (cohesion) of 2,000 psf determined by SCS.

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Drainage / Protective Layer	120	32	0
Byproduct	103	27	0
Compacted Clay Layer	120	0	2,000
Yellow Brown Clay (A)	125	0	2,000

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Yellow Brown Clay (B)	125	0	2,000
Yellow Brown Clay (C)	125	0	2,000
ClayShale	130	0	7,000

- Material properties utilized for the drained clay shear strength slope stability analyses are as shown in the table below, based on the values used for the 2009 stability analyses by B&V and a drained clay shear strength (friction angle) of 20 degrees determined by SCS.

Material	Unit Weight (pcf)	Friction Angle (degrees)	Cohesion (psf)
Drainage / Protective Layer	120	32	0
Byproduct	103	27	0
Compacted Clay Layer	120	20	0
Yellow Brown Clay (A)	125	20	0
Yellow Brown Clay (B)	125	20	0
Yellow Brown Clay (C)	125	20	0
ClayShale	130	0	7,000

Attachments: Calculations organized as follows:

D1 - Factor of Safety Summary Table
D2 – Cross Section Locations
D3 – Clay Test Result Summary Tables and Shear Strength Plots
D4 – Slope/W Outputs

BSS/DLN/jsn/DMH/MRH

Slope Stability Analyses
Factors of Safety Results Summary
Sandy Creek Energy Station - Unstable Areas Compliance Demonstration Report

Byproduct Storage Area Stage 1 Slope		
Soil Properties and Pore Pressures	**SCS Calculated Safety Factor**	**Recommended Min. Safety Factor**
Underdrained Clay Shear Strength of 2,000 psf, Piezometric Surface 10 feet above Liner	1.631	1.5
Drained Clay Shear Strength of 20°, Upper Piezometric Surface 10 feet above Liner, Lower Piezometric Surface at El. 460	1.543	1.5
Drained Clay Shear Strength of 20°, Upper Piezometric Surface 10 feet above Liner, Lower Piezometric Surface at El. 450	1.543	1.5

Byproduct Storage Area Stage 2 Slope		
Soil Properties and Pore Pressures	**SCS Calculated Safety Factor**	**Recommended Min. Safety Factor**
Underdrained Clay Shear Strength of 2,000 psf, Piezometric Surface 10 feet above Liner	1.575	1.5
Drained Clay Shear Strength of 20°, Upper Piezometric Surface 10 feet above Liner, Lower Piezometric Surface at El. 460	1.838	1.5
Drained Clay Shear Strength of 20°, Upper Piezometric Surface 10 feet above Liner, Lower Piezometric Surface at El. 450	1.840	1.5

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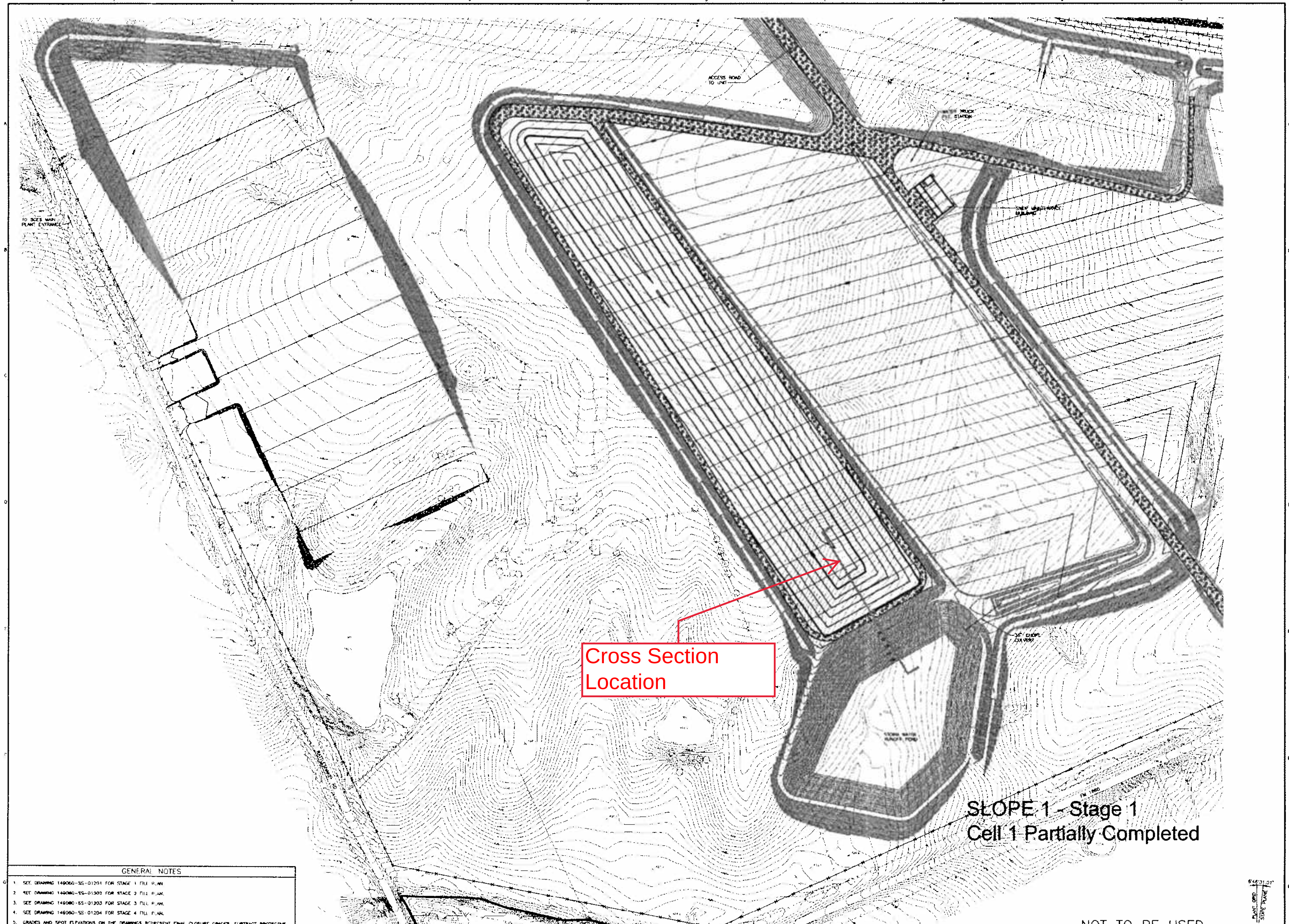
Last Revision by: KRG, 9/25/18
Checked by: DLN, 9/25/18



GENERAL NOTES

1. SEE DRAWING 149060-SS-01201 FOR STAGE 1 FILL PLAN.
2. SEE DRAWING 149060-SS-01202 FOR STAGE 2 FILL PLAN.
3. SEE DRAWING 149060-SS-01203 FOR STAGE 3 FILL PLAN.
4. SEE DRAWING 149060-SS-01204 FOR STAGE 4 FILL PLAN.
5. GRADES AND SPOT ELEVATIONS ON THE DRAWINGS REPRESENT FINAL CLOSURE GRADES. SUBTRACT PROTECTIVE LAYER THICKNESS AND CLAY CAP THICKNESS TO OBTAIN MAXIMUM FILL VOLUME GRADES.
6. UPON REACHING FINAL CLOSURE GRADE OF A CELL, THE AREA SHALL BE CAPPED WITH 3 FT OF CLAY PER THE SWDF ENGINEERING REPORT.
7. CAPPED AREAS SHALL RECEIVE A PROTECTIVE COVER AND BE VEGETATED PER THE SWDF ENGINEERING REPORT.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE
0	30/JUN/09	INITIAL ISSUE

1" = 80'

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF TEXAS
SIGNED
DATE REG NO.

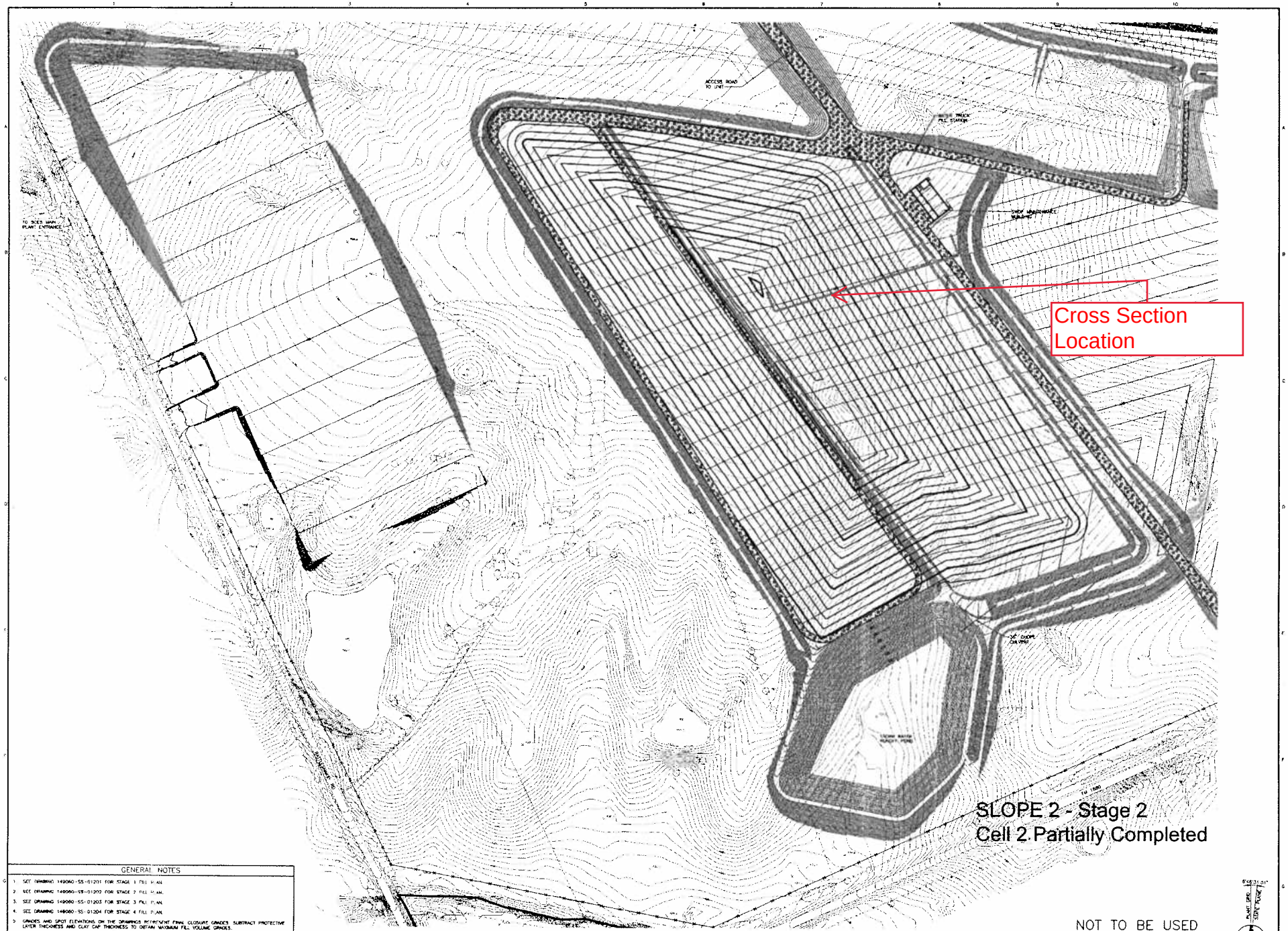
BLACK & VEATCH CORPORATION — SCPP

ENGINEER JOB — DRAWN SAC — CHECKED — DATE 30/JUN/09

SANDY CREEK ENERGY STATION
UNIT 1

SOLID WASTE DISPOSAL FACILITY
FILL PLAN - STAGE 1

PROJECT DRAWING NUMBER: 149060-SS-01201
REV: 0



GENERAL NOTES

1. SEE DRAWING 149060-SS-01201 FOR STAGE 1 FILL PLAN.
2. SEE DRAWING 149060-SS-01202 FOR STAGE 2 FILL PLAN.
3. SEE DRAWING 149060-SS-01203 FOR STAGE 3 FILL PLAN.
4. SEE DRAWING 149060-SS-01204 FOR STAGE 4 FILL PLAN.
5. GRADES AND SPOT ELEVATIONS ON THE DRAWINGS REPRESENT FINAL CLOSURE GRADES. SUBTRACT PROTECTIVE LAYER THICKNESS AND CLAY CAP THICKNESS TO OBTAIN MAXIMUM FILL VOLUME GRADES.
6. UPON REACHING FINAL CLOSURE GRADE OF A CELL, THE AREA SHALL BE CAPPED WITH 3 FT OF CLAY PER THE SWDF ENGINEERING REPORT.
7. CAPPED AREAS SHALL RECEIVE A PROTECTIVE COVER AND BE VEGETATED PER THE SWDF ENGINEERING REPORT.

NOT TO BE USED FOR CONSTRUCTION

THE DISTRIBUTION AND USE OF THE NATIVE FILE FORMAT OF THIS DRAWING OUTSIDE OF BLACK & VEATCH IS UNCONTROLLED AND SHALL BE USED FOR REFERENCE PURPOSES ONLY.

NO	DATE	REVISIONS AND RECORD OF ISSUE
0	30/JUN/09	INITIAL ISSUE

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY US OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF TEXAS

STATE OF TEXAS — REG. NO. _____ — DATE _____

BLACK & VEATCH CORPORATION — SCPP

DESIGNED	JCR	DRAWN	TMC
CHECKED	JBW	DATE	26/JUN/09

SANDY CREEK ENERGY STATION
UNIT 1

SOLID WASTE DISPOSAL FACILITY
FILL PLAN – STAGE 2

PROJECT 149060-SS-01202 — REV 0

DRAWING NUMBER

DATE

AREA

80' 40' 0 80' 160'
1"=80'

PLANT GRID NORTH
STATE PLANE GRID NORTH

Laboratory Soil Test Results
Sandy Creek Energy Station

Boring No.	Sample No.	Depth (feet)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	P200 Content (%)	% Clay
BV-1	3	5-6.5	25	74	23	51		
BV-1	5	12-13.5	20	66	27	39		
BV-1	7	22-23.5	23	68	26	42		
BV-2	2	6-7.5	25	74	29	45		
BV-2	6	22-23.5	23					
BV-2	10	42.43.5	18					
BV-2	12	52-53.5	17					
BV-3	3	4-4.5	21	73	28	45		
BV-3	6	15-16.5	21					
BV-3	11	25-26.5	25	71	27	44		
BV-3	15	40-	22					
BV-4	3	7-8.5	27					
BV-4	7	27-28.5	22	69	27	42		
BV-4	11	46-47.5	19					
BV-6	4	13-14.5	26	66	25	41		
BV-6	6	23-24.5	25	66	27	39		
BV-6	10	43-44.5	23	70	30	40		
BV-7	3	6-7.5	26	72	27	45		
BV-7	7	23-24.5	26	71	30	41		
BV-7	9	33-34.5	28					
BV-7	11	43-44.5	23	68	27	41		
BV-8	5	12-15	23	71	31	40		
BV-8	7	20-21.5	26	72	28	44		
BV-8	11	30-35	21					
BV-8	14	40-41.5	23					
BV-8	18	60-61.5	18	66	27	39	98	58
BV-9	2	6-7.5	19	60	20	40		
BV-9	10	35-40	23	65	23	42		
BV-9	13	45-50	21	68	25	43		
BV-10	4	9-10.5	24	75	28	47		
BV-10	8	20-21.5	28					
BV-10	12	35-40	Sample Not Received by the Lab					
BV-10	14	48-49.5	23	78	25	53		
BV-11	4	13-14.5	26	81	23	58		
BV-11	8	32-33.5	24	78	23	55		
BV-11	14	65-66.5	19	69	21	48		
BV-12	4	6-7.5	26	78	23	55		
BV-12	9	39-40.5	24					
BV-13	4	8-9.5	23	80	21	59		
BV-13	8	20-21.5	25	72	23	49		
BV-13	12	30-31.5	24					
BV-13	15	45-46.5	19	75	25	50		
BV-14	2	8-9.5	22	73	21	52		
BV-14	8	37-38.5	22	77	23	54		
BV-14	11	53-54.5	19					
BV-15A	5	8-9.5	28					
BV-15A	7	18-19.5	27	57	23	34	98	50
BV-15A	13	48-49.5	26	70	28	42		
BV-15A	17	78-79.5	20	68	21	47	92	47
BV-16	3	12-13.5	24	73	22	51		
BV-16	5	22-23.5	26					
BV-16	7	32-33.5	26	78	25	53		
BV-16	9	42-43.5	26	72	27	45		
BV-17A	13	48-49.5	22					
BV-17A	15	68-69.5	19					
BV-18	3	12-13.5	23	72	21	51		

Laboratory Soil Test Results
Sandy Creek Energy Station

Boring No.	Sample No.	Depth (feet)	Moisture Content (%)	Liquid Limit	Plastic Limit	Plasticity Index	P200 Content (%)	% Clay
BV-18	10	48-49.5	25	66	26	41		
BV-19	9	25-26.5	23	77	22	55		
BV-19	29	48-49.5	Sample Not Received by the Lab					
BV-20	6	18-19.5	25	67	23	44		
BV-20	8	28-29.5	28					
BV-20	10	38-39.5	29	69	25	44		
BV-20	14	58-59.5	20	66	26	40	99	48
BV-21	3	4-5.5	18	52	17	35		
BV-21	6	10-11.5	25					
BV-21	11	33-34.5	26	77	27	50		
BV-21	13	43-44.5	25					
BV-24	3	6-7.5	23	61	23	38	98	58
BV-24	5	17-18.5	26	68	22	46		
BV-24	7	26-27.5	16	60	24	36		
BV-26	3	5-6.5	24	69	27	42		
BV-26	6	15-16.5	25					
BV-26	9	25-26.5	25	66	25	41		
BV-26	12	35-36.5	19					
BV-31	5	19-20.5	2	66	25	37		
BV-31	7	27-28.5	25	69	24	45		
BV-31	10	50-51.5	18	56	22	34		
BV-34	4	6-7.5	25	72	27	45		
BV-34	9	39-40.5	24					
BV-34	11	59-60.5	21	57	23	34		
BV-35	3	6-7.5	25	67	27	40		
BV-35	6	17-18.5	26					
BV-35	8	27-28.5	25	68	29	39		
BV-35	10	37-38.5	19					
BV-35	11	45-46.5	20	62	28	34		
BV-35		59-60.5					92	42
BV-36	4	6-7.5	22	70	26	44		
BV-36	7	15-16.5	24					
BV-36	12	30-31.5	24	67	24	43		
BV-36	15	45-46.5	22	66	27	39	92	43
BV-36	16	50-51.5	20					
Minimum:			2	52	17	34	92	42
Maximum:			29	81	31	59	99	58
Average:			23	69	25	44	96	49

Created by: LMH Date: 9/11/2018
Last revision by: LMH Date: 9/11/2018
Checked by: DLN Date: 9/24/2018

I:\16215106\[Moisture Content_Atterberg Limits.xlsx]Moisture and Atterberg

Soil Shear Strength Test Results
Sandy Creek Energy Station

							Unconsolidated Undrained Compression		CU Bar *
Boring No.	Depth (ft)		Moisture Content (%)	Dry Density (pcf)	Vane Shear TV (tsf)	Unconfined Compression (ksf)	Confining Pressure (lb/in^2)	Shear Strength (ksf)	Drained Friction Angle (degrees)
BV-1	8	8			2.25				
BV-1	19	19			2.25				
BV-2	8-9	8	11.9	110.1		3.87			
BV-2	18	18			2.5				
BV-2	18-19.8	18	22.8	101.1			14	2.89	
BV-2	18-19.8	18	22.4	103.7			7	3.78	
BV-2	38-38.5	38	15.6	97.6		3.08			
BV-3	8	8			2				
BV-3	8-9	8-9	26.8	99.9			3	4.61	
BV-3	8-9	8-9	23.7	99.8			7	4.05	
BV-3	20-21	20	27.6	96.8		3.29			
BV-3	45-46.1	45	20.8	103.9		4.39			
BV-4	3-5	3	35.4	88.4			7	1.71	
BV-4	3-5	3	28.9	91.2			4	1.26	
BV-6	18-20	18	27.9	97.3			31	3.94	
BV-6	18-20	18	25.2	99.3			21	3.87	
BV-6	18-20	18	44.9	82.9			10	2.57	
BV-6	73-73.5	73	7.1	107.5		0.62			
BV-7	8-9	8	33.6	86		1.73			
BV-7	28-29	28	25.9	98.9			14	3.54	
BV-7	48-49	48	20.1	106.4		3.58			
BV-9	40-41.5	40	23.7	101			56	5.06	
BV-9	40-41.5	40	27.2	92.6			14	4.28	
BV-10	6-7	6	22.5	102.3					
BV-10	11	11			2				
BV-10	15	15			1.5				
BV-10	19	19			2				
BV-11	8-10	8	36.2	90.6	2.25				
BV-11	18-20	18	25.7	99.8			31	3.66	
BV-11	18-20	18	26.3	97.7			21	3.11	
BV-11	18-20	18	27.7	96.9			10	3.37	
BV-11	83	83		137.6		23.93			
BV-12	10-12	10	24.7	101.7			28	5.04	
BV-12	10-12	10	32.9	93.8			14	3.28	
BV-12	10-12	10	25.8	100.1			7	2.38	
BV-12	19-21	19	3.7	119.3		3.29			
BV-13	6-7.5	6	5.7	116.4		7.92			
BV-13	15-16	15	14.5	101.8		2			
BV-13	25-26	25	26.3	98.5			31	3.2	
BV-13	25-26	25	30.5	96.5			11	3.75	
BV-13	40-40.7	40	18.8	96.6		6.36			
BV-14	13-15	13	24.9	100.1		2.54			
BV-14	17	17			1.5				
BV-14	25	25			1.5				
BV-14	23-25	23	28.1	97.2			10	2.16	
BV-14	23-25	23	26.2	100			21	3.23	
BV-14	23-25	23	25.9	99.6			31	3.06	
BV-15A	13-15	13	22.3	104.4		3.25			

Soil Shear Strength Test Results
Sandy Creek Energy Station

							Unconsolidated Undrained Compression		CU Bar *
Boring No.	Depth (ft)		Moisture Content (%)	Dry Density (pcf)	Vane Shear TV (tsf)	Unconfined Compression (ksf)	Confining Pressure (lb/in^2)	Shear Strength (ksf)	Drained Friction Angle (degrees)
BV-15A	33-34.7	33	43.5	75.9			56	0.33	
BV-15A	33-34.7	33	24.2	103.3			24	6.73	
BV-15A	33-34.7	33	25.4	99.9			14	5.01	
BV-15A	43-44.6	43	23.4	101.4		3.52			
BV-15A	58-58.6	58	48.1	73.6		0.14			
BV-16	11	11			2.5				
BV-16	20	20			2				
BV-16	28	28			2				
BV-16	18-20	18	20.7	103.5			28	4.07	
BV-16	18-20	18	25.8	99.1			14	2.82	
BV-16	18-20	18	25.6	100.1			7	2	
BV-17	13-15	13	25.6	100.6			28	3.97	
BV-17	13-15	13	25.2	98			7	2.32	
BV-17	23-25	23	22.3	102.6		3.84			
BV-17	43-44.8	43	24.7	100.9		5.48			
BV-17A	6-8	6	23.5	101.6					
BV-18	8				2.5				
BV-18	18	18			2.5				
BV-18	18-20	18	25.5	99.8			28	3.88	
BV-18	18-20	18	24	101.8			14	3.54	
BV-18	18-20	18	27.6	96.6			7	2.1	
BV-19	10-12	10	24.2	100.9			14	3.05	
BV-19	10-12	10	23.9	99.6			4	2.47	
BV-19	19-21	19	22.3	103.8		2.92			
BV-19	20	20			2.25				
BV-19	24	24			2.25				
BV-19	26	26			2.125				
BV-20	13-15	13	29.1	91.9			28	2.97	
BV-20	13-15	13	26.4	97.7			7	2.84	
BV-20	43-35	43	25.8	96.4					
BV-20	68-68.8	68	20.6	105.2		7.43			
BV-20	78-78.5	78	31.8	96.2		0.97			
BV-21	18-19.8	18	23.4	105.6			28	7.33	
BV-21	18-19.8	18	23.8	105.5			14	7.62	
BV-21	18-19.8	18	24	99.3			7	1.95	
BV-22	6	6			2.25				
BV-24	16	16			1.25				
BV-34	14-16	14	24.4	99.2		3.37			
BV-34	49-49.9	49	23.3	104.9		3.48			
BV-35	9	9			2				
BV-27, 28, 32, & 33			18.1	104.0					20.6
BV-36	25-26.2	25	23.4	108.2			35	4.82	
BV-36	25-26.2	25	16.4	116.4			17	5.13	
BV-36	40-41.4	40	25.7	102.0			42	5.41	
BV-36	40-41.4	40	24	101.9			28	3.81	
BV-37 & 39			18.8	104.4					23.1
BV-103			17.7	103.0					24.6
BV-104			17.4	102.0					16.0

Soil Shear Strength Test Results
Sandy Creek Energy Station

							Unconsolidated Undrained Compression		CU Bar *
Boring No.	**Depth (ft)**		**Moisture Content (%)**	**Dry Density (pcf)**	**Vane Shear TV (tsf)**	**Unconfined Compression (ksf)**	**Confining Pressure (lb/in^2)**	**Shear Strength (ksf)**	**Drained Friction Angle (degrees)**
BV-105			17.7	103.0					30.8
BV-108	38-38.8	38	19.3	108.2			28	9.15	
TP-3			17.2	102.2					20.5
Minimum:			3.7	73.6	1.3	0.14		0.33	16.0
Maximum:			48.1	137.6	2.5	23.93		9.15	30.8
Average:			24.3	100.4	2.1	4.39		3.72	22.6

Note: * CU Bar tests were performed on remolded samples.

Created by:	KRG	Date:	9/12/2018
Last revision by:	KRG	Date:	9/24/2018
Checked by:	DLN	Date:	9/24/2018

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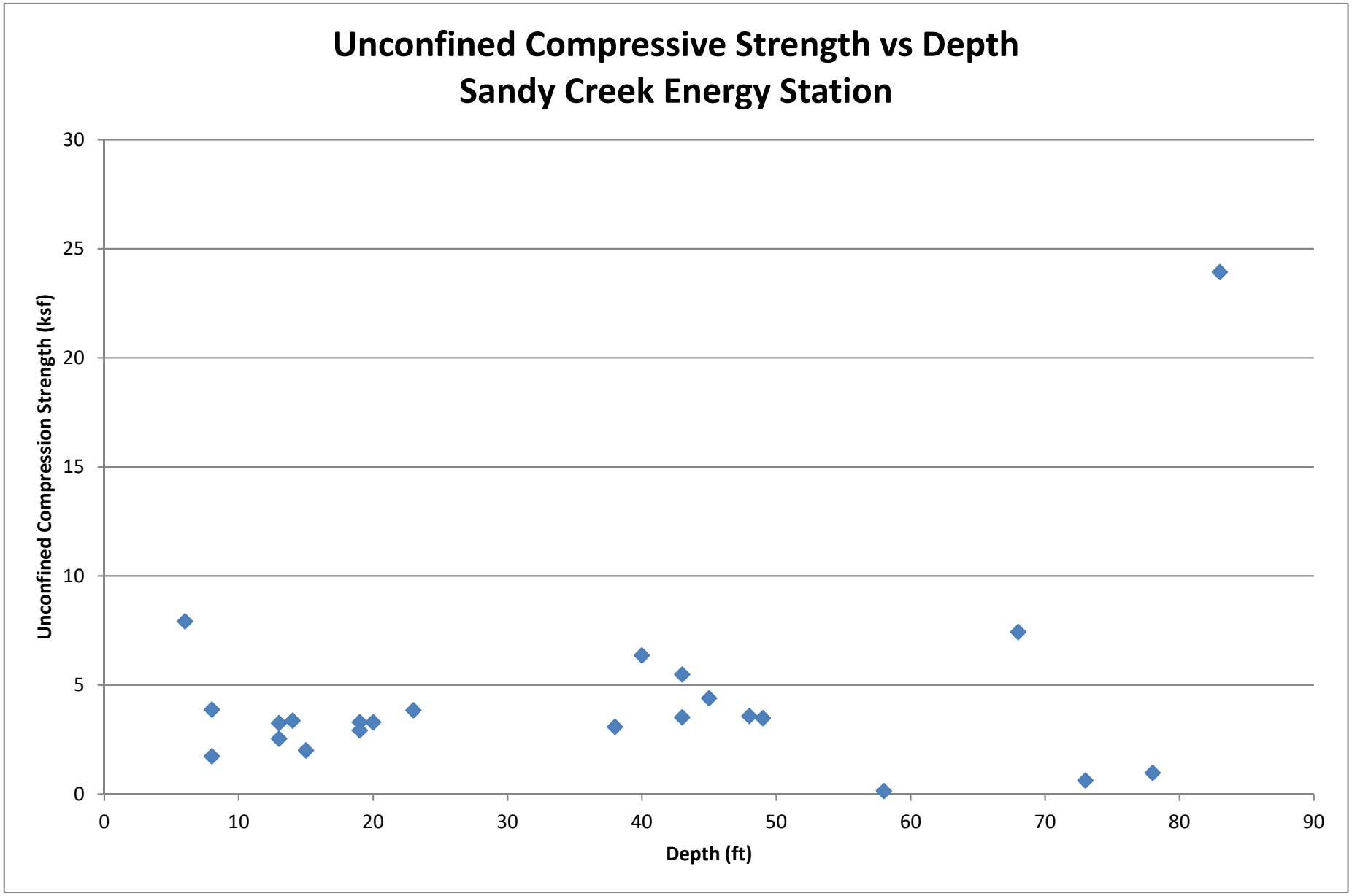
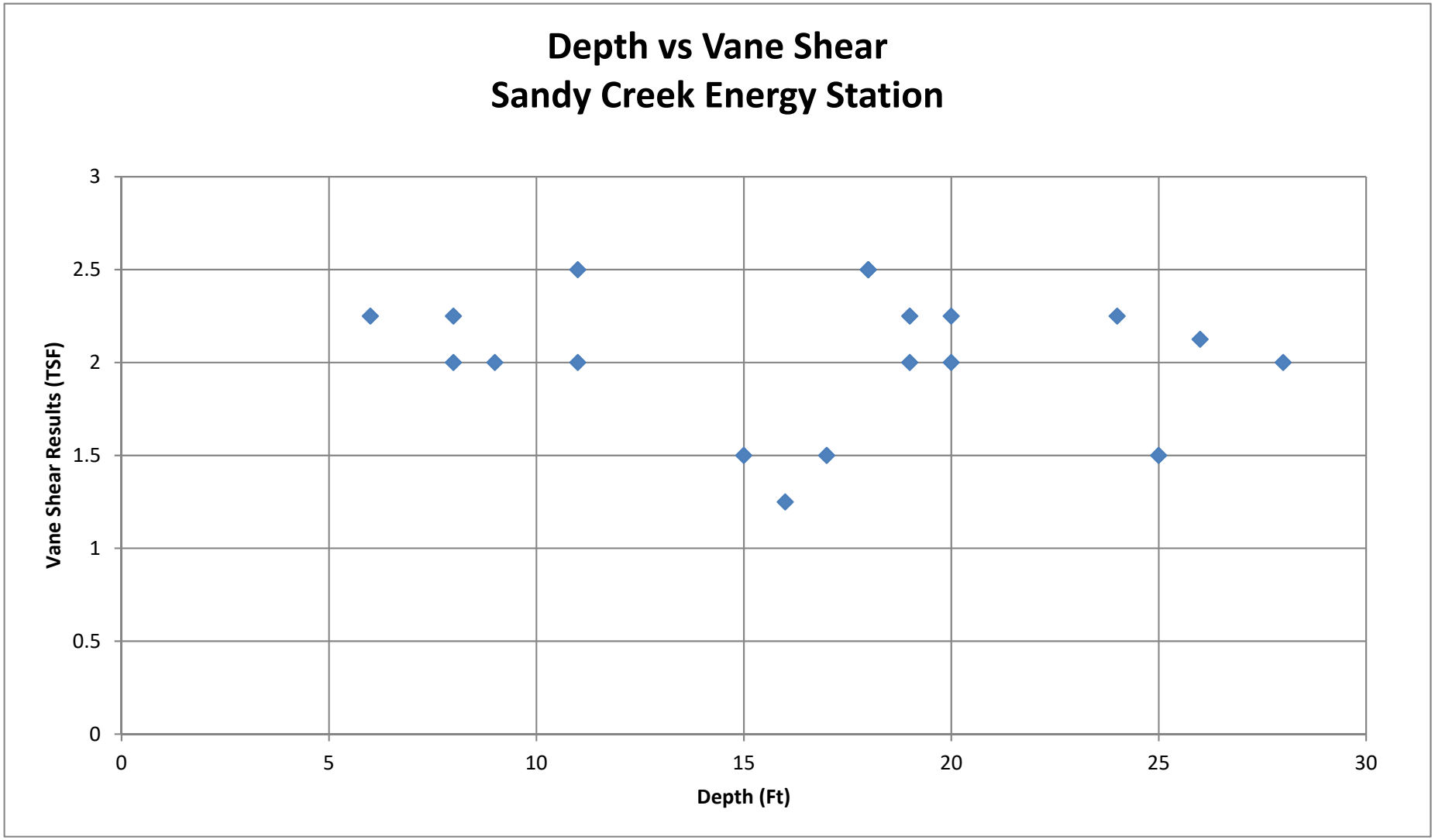
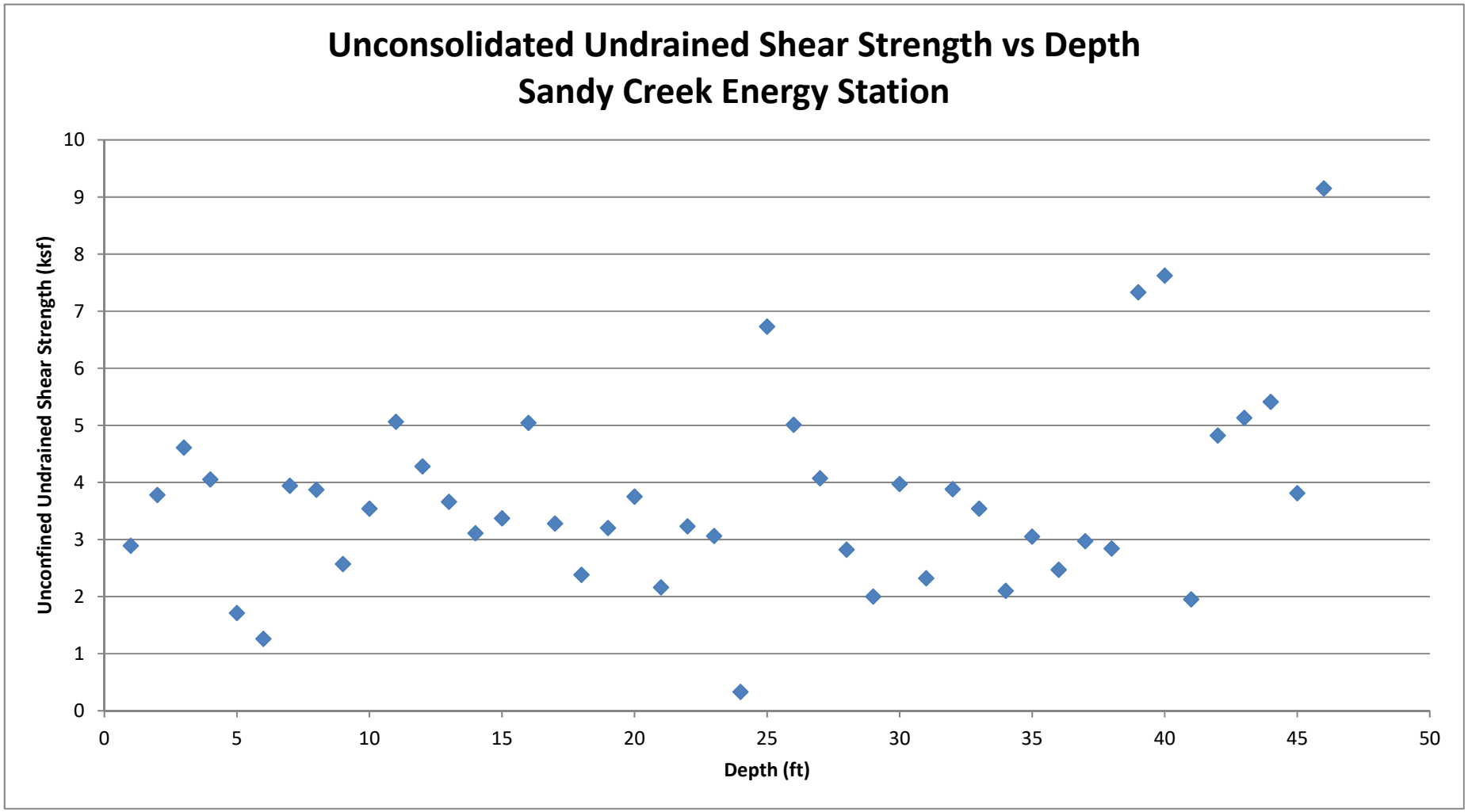
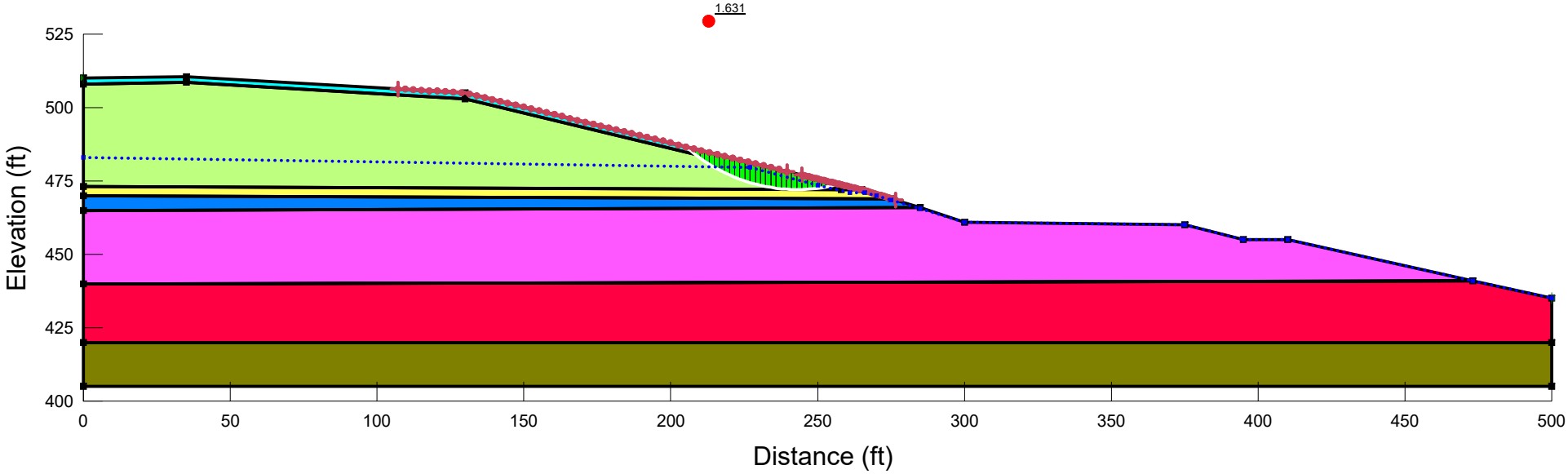

Unconfined Compressive Strength vs Depth
Sandy Creek Energy Station
Unconfined Compression Strength (ksf)
30
25
20
15
10
5
0
0
10
20
30
40
50
60
70
80
90
Depth (ft)


Depth vs Vane Shear
Sandy Creek Energy Station
Vane Shear Results (TSF)
3
2.5
2
1.5
1
0.5
0
0
5
10
15
20
25
30
Depth (Ft)


Unconsolidated Undrained Shear Strength vs Depth
Sandy Creek Energy Station
Unconfined Undrained Shear Strength (ksf)
Depth (ft)
0
1
2
3
4
5
6
7
8
9
10
0
5
10
15
20
25
30
35
40
45
50

F of S: 1.631
Slope 1 - Stage 1_Check_clay_2000.gsz

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Include Ru in PWP
	Byproduct	Mohr-Coulomb	103	0	27	1	No
	ClayShale	Mohr-Coulomb	130	7,000	0	1	No
	Compacted Clay Layer	Mohr-Coulomb	120	2,000	0	1	No
	Drainage / Protective Layer	Mohr-Coulomb	120	0	32	1	No
	Yellow Brown Clay (A)	Mohr-Coulomb	125	2,000	0	1	No
	Yellow Brown Clay (B)	Mohr-Coulomb	125	2,000	0	1	No
	Yellow Brown Clay (C)	Mohr-Coulomb	125	2,000	0	1	No



2_Sandy Creek Stage 1 - SCS Version (Drained strength)

File Information

File Version: 8.16
Created By: Gilkey, Keith
Last Edited By: Gearing, Phillip
Revision Number: 93
Date: 9/25/2018
Time: 11:13:17 AM
Tool Version: 8.16.5.15361
File Name: Slope 1 - Stage 1_Check_clay_2000.gsz
Directory: I:\16215106\Calculations\Stability\
Last Solved Date: 9/25/2018
Last Solved Time: 11:13:42 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

2_Sandy Creek Stage 1 - SCS Version (Drained strength)

Description: Sandy Creek Energy Station Stage 1
Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: Piezometric Line with Ru
    Apply Phreatic Correction: No
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1
Resisting Side Maximum Convex Angle: 1 °
Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Drainage / Protective Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Byproduct

Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion': 0 psf
Phi': 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Compacted Clay Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure

Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (A)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (B)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (C)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

ClayShale

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 7,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (107, 506.33158) ft

Left-Zone Right Coordinate: (239.5, 478.23333) ft
Left-Zone Increment: 50
Right Projection: Range
Right-Zone Left Coordinate: (244.54545, 477) ft
Right-Zone Right Coordinate: (276.5, 468.55) ft
Right-Zone Increment: 50
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 510) ft
Right Coordinate: (500, 435) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	483
Coordinate 2	227	479.5
Coordinate 3	250	473.5
Coordinate 4	261	471
Coordinate 5	266	471
Coordinate 6	270	470
Coordinate 7	275	468.5
Coordinate 8	285	465.5
Coordinate 9	300	461
Coordinate 10	375	460
Coordinate 11	395	455
Coordinate 12	410	455
Coordinate 13	473	441
Coordinate 14	500	435

Points

	X (ft)	Y (ft)
Point 1	0	405
Point 2	500	405

Point 3	500	420
Point 4	0	420
Point 5	0	440
Point 6	500	435
Point 7	410	455
Point 8	395	455
Point 9	375	460
Point 10	300	461
Point 11	285	466
Point 12	0	465
Point 13	473	441
Point 14	0	470
Point 15	275	469
Point 16	265	472
Point 17	0	473
Point 18	130	505
Point 19	35	510.5
Point 20	0	510
Point 21	0	508
Point 22	35	508.5
Point 23	130	503
Point 24	258	472

Regions

	Material	Points	Area (ft²)
Region 1	ClayShale	4,1,2,3	7,500
Region 2	Yellow Brown Clay (C)	5,13,6,3,4	10,183
Region 3	Yellow Brown Clay (B)	5,12,11,10,9,8,7,13	10,000
Region 4	Yellow Brown Clay (A)	12,14,15,11	1,120
Region 5	Compacted Clay Layer	14,17,24,16,15	801.5
Region 6	Byproduct	23,24,17,21,22	6,330
Region 7	Drainage / Protective Layer	21,20,19,18,16,24,23,22	503.5

Current Slip Surface

Slip Surface: 20,981

F of S: 1.631
Volume: 244.36361 ft³
Weight: 26,641.502 lbs
Resisting Moment: 544,211.46 lbs-ft
Activating Moment: 333,589.07 lbs-ft
Resisting Force: 9,050.3296 lbs
Activating Force: 5,548.3571 lbs
F of S Rank (Analysis): 1 of 28,611 slip surfaces
F of S Rank (Query): 1 of 28,611 slip surfaces
Exit: (257.39245, 473.85962) ft
Entry: (205.21131, 486.61501) ft
Radius: 56.834455 ft
Center: (243.19532, 528.89231) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	205.98115	485.94789	-382.12591	40.234034	25.141015	0
Slice 2	207.52084	484.65987	-303.23482	119.74642	74.82587	0
Slice 3	209.09801	483.43343	-228.22206	197.31491	100.53697	0
Slice 4	210.71265	482.26546	-156.89429	262.95991	133.98477	0
Slice 5	212.3273	481.18072	-90.760275	324.18542	165.18072	0
Slice 6	213.94194	480.17365	-29.472317	380.99018	194.12419	0
Slice 7	215.62431	479.20335	29.455934	438.00674	208.16704	0
Slice 8	217.37442	478.27145	85.922251	493.84288	207.84594	0
Slice 9	219.12452	477.41592	137.6237	543.03541	206.56758	0
Slice 10	220.87463	476.63299	184.7947	585.73558	204.28958	0
Slice 11	222.62474	475.91944	227.63646	622.06371	200.97072	0

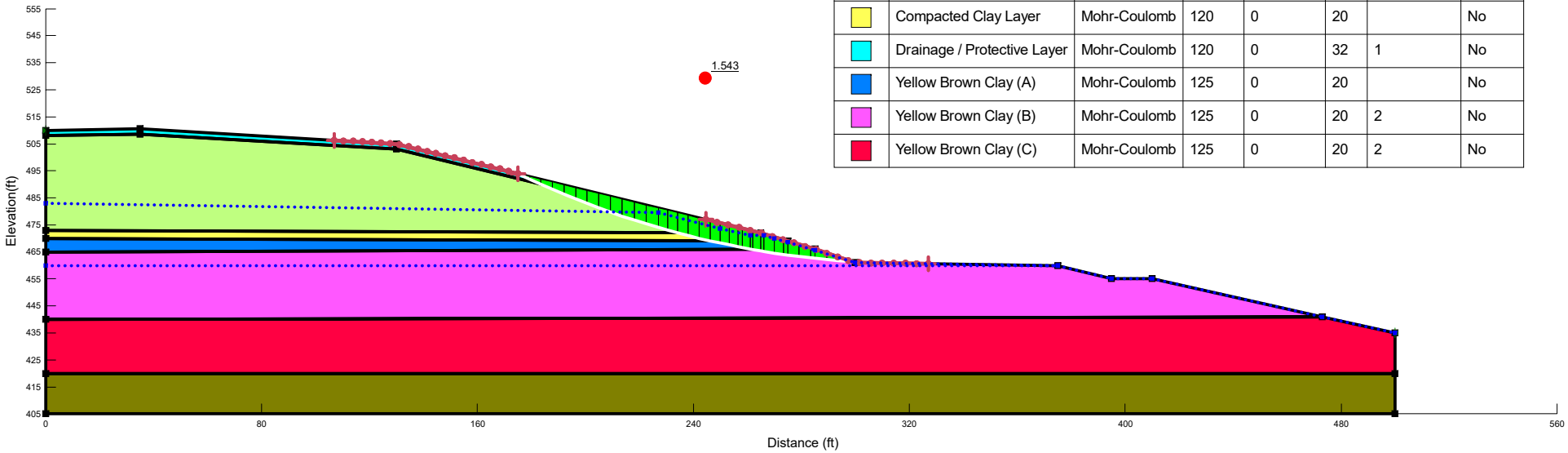
Slice 12	224.37484	475.27249	266.32206	652.11186	196.56972	0
Slice 13	226.12495	474.68977	301.00053	675.94592	191.04422	0
Slice 14	227.88462	474.16669	318.39864	693.36172	191.05323	0
Slice 15	229.65385	473.70215	318.58596	704.70333	196.73662	0
Slice 16	231.42308	473.29778	315.01855	710.28103	201.39629	0
Slice 17	233.19231	472.95228	307.77794	710.07464	204.9804	0
Slice 18	234.96154	472.66455	296.93191	704.04285	207.43338	0
Slice 19	236.73077	472.43372	282.53564	692.12258	208.69497	0
Slice 20	238.5	472.25909	264.63258	674.22791	208.69924	0
Slice 21	240.26923	472.14014	243.25514	650.24852	207.37348	0
Slice 22	242.03846	472.07652	218.42517	620.04772	204.63691	0
Slice 23	243.80769	472.06804	190.15426	583.4598	200.39918	0
Slice 24	245.57692	472.11468	158.44397	540.28681	194.55864	0
Slice 25	247.34615	472.21657	123.2858	490.29436	187.0002	0
Slice 26	249.11538	472.37402	84.661072	433.20653	177.59278	0
Slice 27	250.69268	472.55887	48.903053	376.19541	166.76379	0
Slice 28	252.07805	472.76067	16.663505	320.54558	154.83566	0
Slice 29	253.24039	472.95463	-11.923558	268.58118	136.84895	0
Slice 30	254.63066	473.22809	-48.704125	195.1389	121.93632	0

Slice 31	256.47185	473.63842	-100.42	68.361094	42.716752	0

F of S: 1.543

Slope 1 - Stage 1_Check-20_deg-2 water surfaces_El_460.gsz

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Include Ru in PWP
	Byproduct	Mohr-Coulomb	103	0	27	1	No
	ClayShale	Mohr-Coulomb	130	7,000	0	2	No
	Compacted Clay Layer	Mohr-Coulomb	120	0	20		No
	Drainage / Protective Layer	Mohr-Coulomb	120	0	32	1	No
	Yellow Brown Clay (A)	Mohr-Coulomb	125	0	20		No
	Yellow Brown Clay (B)	Mohr-Coulomb	125	0	20	2	No
	Yellow Brown Clay (C)	Mohr-Coulomb	125	0	20	2	No



2_Sandy Creek Stage 1 - SCS Version (Drained strength)

File Information

File Version: 8.16
Created By: Gilkey, Keith
Last Edited By: Gilkey, Keith
Revision Number: 91
Date: 9/13/2018
Time: 11:59:17 AM
Tool Version: 8.16.5.15361
File Name: Slope 1 - Stage 1_Check-20_deg-2 water surfaces_El_460.gsz
Directory: I:\16215106\Calculations\Stability\
Last Solved Date: 9/13/2018
Last Solved Time: 11:59:32 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

2_Sandy Creek Stage 1 - SCS Version (Drained strength)

Description: Sandy Creek Energy Station Stage 1
Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: Piezometric Line with Ru
    Apply Phreatic Correction: No
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1
Resisting Side Maximum Convex Angle: 1 °
Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Drainage / Protective Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Byproduct

Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion': 0 psf
Phi': 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Compacted Clay Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure

Include Ru in PWP: No

Yellow Brown Clay (A)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Include Ru in PWP: No

Yellow Brown Clay (B)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Yellow Brown Clay (C)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

ClayShale

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 7,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (107, 506.33158) ft
Left-Zone Right Coordinate: (175, 494) ft
Left-Zone Increment: 20

Right Projection: Range
Right-Zone Left Coordinate: (244.54545, 477) ft
Right-Zone Right Coordinate: (327, 460.64) ft
Right-Zone Increment: 20
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 510) ft
Right Coordinate: (500, 435) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	483
Coordinate 2	227	479.5
Coordinate 3	250	473.5
Coordinate 4	261	471
Coordinate 5	266	471
Coordinate 6	270	470
Coordinate 7	275	468.5
Coordinate 8	285	465.5
Coordinate 9	300	461
Coordinate 10	375	460
Coordinate 11	395	455
Coordinate 12	410	455
Coordinate 13	473	441
Coordinate 14	500	435

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	460
Coordinate 2	375	460

Points

	X (ft)	Y (ft)
Point 1	0	405
Point 2	500	405
Point 3	500	420
Point 4	0	420
Point 5	0	440
Point 6	500	435
Point 7	410	455
Point 8	395	455
Point 9	375	460
Point 10	300	461
Point 11	285	466
Point 12	0	465
Point 13	473	441
Point 14	0	470
Point 15	275	469
Point 16	265	472
Point 17	0	473
Point 18	130	505
Point 19	35	510.5
Point 20	0	510
Point 21	0	508
Point 22	35	508.5
Point 23	130	503
Point 24	258	472

Regions

	Material	Points	Area (ft²)
Region 1	ClayShale	4,1,2,3	7,500
Region 2	Yellow Brown Clay (C)	5,13,6,3,4	10,183
Region 3	Yellow Brown Clay (B)	5,12,11,10,9,8,7,13	10,000
Region 4	Yellow Brown Clay (A)	12,14,15,11	1,120
Region 5	Compacted Clay Layer	14,17,24,16,15	801.5
Region 6	Byproduct	23,24,17,21,22	6,330

Region 7	Drainage / Protective Layer	21,20,19,18,16,24,23,22	503.5

Current Slip Surface

Slip Surface: 4,820
F of S: 1.543
Volume: 633.44821 ft³
Weight: 72,487.878 lbs
Resisting Moment: 9,069,422.2 lbs-ft
Activating Moment: 5,878,938.1 lbs-ft
Resisting Force: 26,093.759 lbs
Activating Force: 16,913.961 lbs
F of S Rank (Analysis): 1 of 4,851 slip surfaces
F of S Rank (Query): 1 of 4,851 slip surfaces
Exit: (298.60431, 461.46523) ft
Entry: (175, 494) ft
Radius: 335.08867 ft
Center: (320.53232, 795.83566) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	177.13017	492.99133	-793.87826	48.466849	30.285449	0
Slice 2	181.39051	491.01031	-674.36151	143.09609	89.41636	0
Slice 3	185.66265	489.09616	-559.02941	229.19781	116.78212	0
Slice 4	189.94657	487.24795	-447.82262	301.91657	153.83417	0
Slice 5	194.23048	485.46988	-340.99218	369.5047	188.27205	0
Slice 6	198.5144	483.76073	-238.46327	431.92014	220.07431	0
Slice 7	202.79832	482.1194	-140.16559	489.11916	249.21866	0
Slice 8	207.08224	480.54481	-46.033013	541.05613	275.68187	0
Slice 9	211.44618	479.00903	45.601017	589.83979	277.3035	0

Slice 10	215.89013	477.51356	134.64313	634.56951	254.72521	0
Slice 11	220.33408	476.08683	219.39494	672.59414	230.91653	0
Slice 12	224.77803	474.72795	299.91364	703.90672	205.84476	0
Slice 13	228.76865	473.56176	341.75585	726.22555	195.8971	0
Slice 14	232.30594	472.57545	345.72075	741.09088	201.45114	0
Slice 15	236.08863	471.56825	0	759.96367	276.60415	0
Slice 16	240.1167	470.54587	0	784.11844	285.39577	0
Slice 17	244.14478	469.57643	0	802.49511	292.08433	0
Slice 18	248.07941	468.67954	0	816.88176	297.32065	0
Slice 19	251.64393	467.90886	0	827.02866	301.01381	0
Slice 20	254.93178	467.23532	0	831.96062	302.8089	0
Slice 21	257.28785	466.77027	0	833.38462	303.3272	0
Slice 22	259.5	466.35554	0	826.1704	300.70144	0
Slice 23	261.44316	465.99829	0	816.46728	297.16979	0
Slice 24	263.44316	465.64972	-352.54266	804.08251	292.6621	0
Slice 25	265.5	465.2973	-330.55142	787.2649	286.54099	0
Slice 26	268	464.89658	-305.54644	750.90436	273.30684	0
Slice 27	271.65644	464.33488	-270.49655	694.22402	252.67688	0
Slice 28	274.15644	463.97278	-247.90119	652.39661	237.45295	0

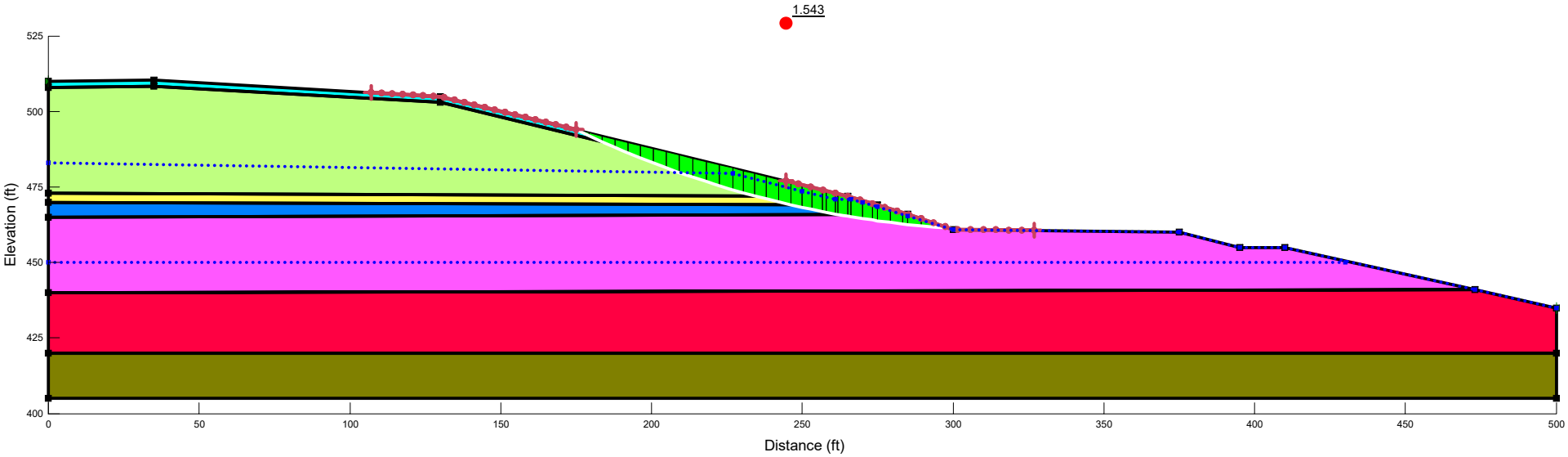
Slice 29	277.08815	463.58186	-223.50776	595.6793	216.80953	0
Slice 30	281.26445	463.06241	-191.09447	507.56869	184.7399	0
Slice 31	284.1763	462.72611	-170.10902	442.2426	160.96314	0
Slice 32	287.23427	462.41308	-150.57595	358.57205	130.50955	0
Slice 33	291.7028	461.997	-124.61279	224.60517	81.749598	0
Slice 34	296.17133	461.64119	-102.41013	81.169804	29.543393	0
Slice 35	298.50495	461.47178	-91.838849	3.4082442	1.2404994	0

F of S: 1.543

Slope 1 - Stage 1_Check-20_deg-2 water surfaces_El_450.gsz

File Version: 8.16

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line	Include Ru in PWP
	Byproduct	Mohr-Coulomb	103	0	27	1	No
	ClayShale	Mohr-Coulomb	130	7,000	0	2	No
	Compacted Clay Layer	Mohr-Coulomb	120	0	20		No
	Drainage / Protective Layer	Mohr-Coulomb	120	0	32	1	No
	Yellow Brown Clay (A)	Mohr-Coulomb	125	0	20		No
	Yellow Brown Clay (B)	Mohr-Coulomb	125	0	20	2	No
	Yellow Brown Clay (C)	Mohr-Coulomb	125	0	20	2	No



2_Sandy Creek Stage 1 - SCS Version (Drained strength)

File Information

File Version: 8.16
Created By: Gilkey, Keith
Last Edited By: Gilkey, Keith
Revision Number: 89
Date: 9/13/2018
Time: 9:49:15 AM
Tool Version: 8.16.5.15361
File Name: Slope 1 - Stage 1_Check-20_deg-2 water surfaces_El_450.gsz
Directory: I:\16215106\Calculations\Stability\
Last Solved Date: 9/13/2018
Last Solved Time: 9:50:30 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

2_Sandy Creek Stage 1 - SCS Version (Drained strength)

Description: Sandy Creek Energy Station Stage 1
Kind: SLOPE/W
Method: Spencer
Settings
    PWP Conditions Source: Piezometric Line with Ru
    Apply Phreatic Correction: No
Slip Surface
    Direction of movement: Left to Right
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit

Critical slip surfaces saved: 1
Resisting Side Maximum Convex Angle: 1 °
Driving Side Maximum Convex Angle: 5 °
Optimize Critical Slip Surface Location: No
Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Drainage / Protective Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Byproduct

Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion': 0 psf
Phi': 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Compacted Clay Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure

Include Ru in PWP: No

Yellow Brown Clay (A)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Include Ru in PWP: No

Yellow Brown Clay (B)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Yellow Brown Clay (C)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

ClayShale

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 7,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (107, 506.33158) ft
Left-Zone Right Coordinate: (175, 494) ft
Left-Zone Increment: 20

Right Projection: Range
Right-Zone Left Coordinate: (244.54545, 477) ft
Right-Zone Right Coordinate: (327, 460.64) ft
Right-Zone Increment: 20
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 510) ft
Right Coordinate: (500, 435) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	483
Coordinate 2	227	479.5
Coordinate 3	250	473.5
Coordinate 4	261	471
Coordinate 5	266	471
Coordinate 6	270	470
Coordinate 7	275	468.5
Coordinate 8	285	465.5
Coordinate 9	300	461
Coordinate 10	375	460
Coordinate 11	395	455
Coordinate 12	410	455
Coordinate 13	473	441
Coordinate 14	500	435

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	450
Coordinate 2	430	450

Points

	X (ft)	Y (ft)
Point 1	0	405
Point 2	500	405
Point 3	500	420
Point 4	0	420
Point 5	0	440
Point 6	500	435
Point 7	410	455
Point 8	395	455
Point 9	375	460
Point 10	300	461
Point 11	285	466
Point 12	0	465
Point 13	473	441
Point 14	0	470
Point 15	275	469
Point 16	265	472
Point 17	0	473
Point 18	130	505
Point 19	35	510.5
Point 20	0	510
Point 21	0	508
Point 22	35	508.5
Point 23	130	503
Point 24	258	472

Regions

	Material	Points	Area (ft²)
Region 1	ClayShale	4,1,2,3	7,500
Region 2	Yellow Brown Clay (C)	5,13,6,3,4	10,183
Region 3	Yellow Brown Clay (B)	5,12,11,10,9,8,7,13	10,000
Region 4	Yellow Brown Clay (A)	12,14,15,11	1,120
Region 5	Compacted Clay Layer	14,17,24,16,15	801.5
Region 6	Byproduct	23,24,17,21,22	6,330

Region 7	Drainage / Protective Layer	21,20,19,18,16,24,23,22	503.5

Current Slip Surface

Slip Surface: 4,820
F of S: 1.543
Volume: 633.44821 ft³
Weight: 72,487.878 lbs
Resisting Moment: 9,069,422.2 lbs-ft
Activating Moment: 5,878,938.1 lbs-ft
Resisting Force: 26,093.759 lbs
Activating Force: 16,913.961 lbs
F of S Rank (Analysis): 1 of 4,851 slip surfaces
F of S Rank (Query): 1 of 4,851 slip surfaces
Exit: (298.60431, 461.46523) ft
Entry: (175, 494) ft
Radius: 335.08867 ft
Center: (320.53232, 795.83566) ft

Slip Slices

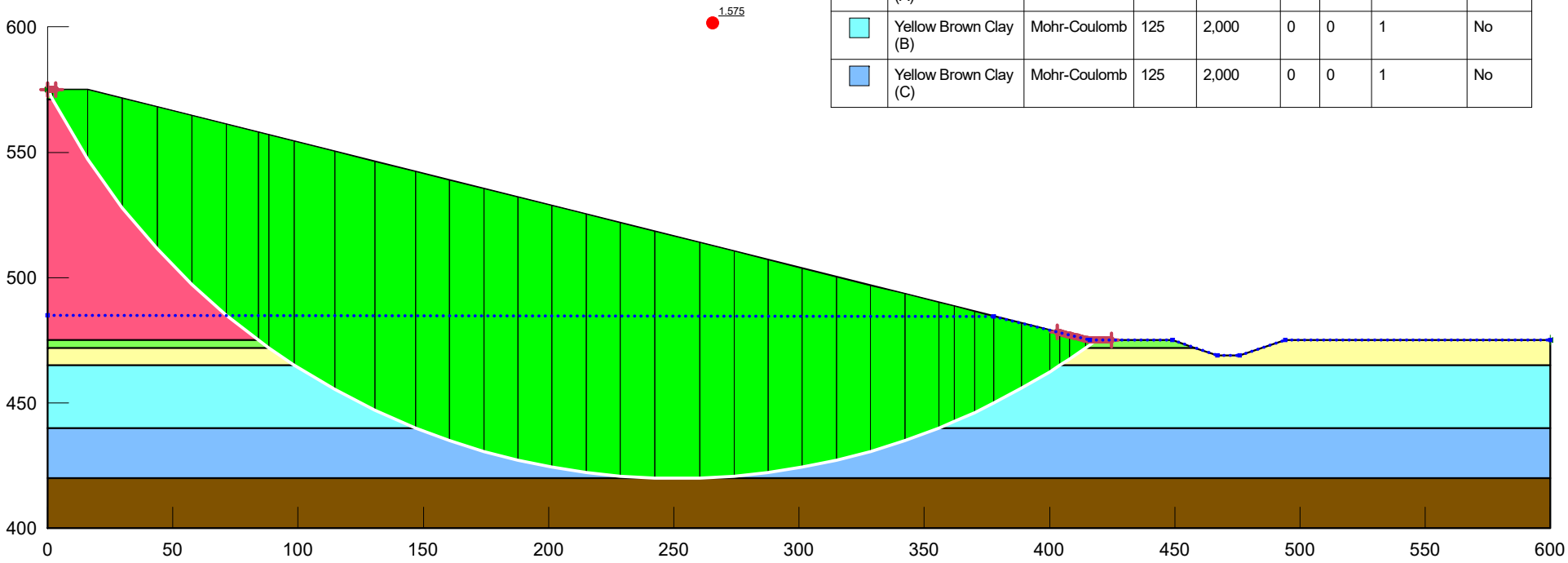
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	177.13017	492.99133	-793.87826	48.466849	30.285449	0
Slice 2	181.39051	491.01031	-674.36151	143.09609	89.41636	0
Slice 3	185.66265	489.09616	-559.02941	229.19781	116.78212	0
Slice 4	189.94657	487.24795	-447.82262	301.91657	153.83417	0
Slice 5	194.23048	485.46988	-340.99218	369.5047	188.27205	0
Slice 6	198.5144	483.76073	-238.46327	431.92014	220.07431	0
Slice 7	202.79832	482.1194	-140.16559	489.11916	249.21866	0
Slice 8	207.08224	480.54481	-46.033013	541.05613	275.68187	0
Slice 9	211.44618	479.00903	45.601017	589.83979	277.3035	0

Slice 10	215.89013	477.51356	134.64313	634.56951	254.72521	0
Slice 11	220.33408	476.08683	219.39494	672.59414	230.91653	0
Slice 12	224.77803	474.72795	299.91364	703.90672	205.84476	0
Slice 13	228.76865	473.56176	341.75585	726.22555	195.8971	0
Slice 14	232.30594	472.57545	345.72075	741.09088	201.45114	0
Slice 15	236.08863	471.56825	0	759.96367	276.60415	0
Slice 16	240.1167	470.54587	0	784.11844	285.39577	0
Slice 17	244.14478	469.57643	0	802.49511	292.08433	0
Slice 18	248.07941	468.67954	0	816.88176	297.32065	0
Slice 19	251.64393	467.90886	0	827.02866	301.01381	0
Slice 20	254.93178	467.23532	0	831.96062	302.8089	0
Slice 21	257.28785	466.77027	0	833.38462	303.3272	0
Slice 22	259.5	466.35554	0	826.1704	300.70144	0
Slice 23	261.44316	465.99829	0	816.46728	297.16979	0
Slice 24	263.44316	465.64972	-976.54266	804.08251	292.6621	0
Slice 25	265.5	465.2973	-954.55142	787.2649	286.54099	0
Slice 26	268	464.89658	-929.54644	750.90436	273.30684	0
Slice 27	271.65644	464.33488	-894.49655	694.22402	252.67688	0
Slice 28	274.15644	463.97278	-871.90119	652.39661	237.45295	0

Slice 29	277.08815	463.58186	-847.50776	595.6793	216.80953	0
Slice 30	281.26445	463.06241	-815.09447	507.56869	184.7399	0
Slice 31	284.1763	462.72611	-794.10902	442.2426	160.96314	0
Slice 32	287.23427	462.41308	-774.57595	358.57205	130.50955	0
Slice 33	291.7028	461.997	-748.61279	224.60517	81.749598	0
Slice 34	296.17133	461.64119	-726.41013	81.169804	29.543393	0
Slice 35	298.50495	461.47178	-715.83885	3.4082442	1.2404994	0

File Name: Stage 2-2000.gsz
F of S: 1.575

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)	Piezometric Line	Include Ru in PWP
	By Product	Mohr-Coulomb	103	0	27	0	1	No
	Clayshale	Mohr-Coulomb	130	7,000	0	0	1	No
	Compacted Clay	Mohr-Coulomb	120	2,000	0	0	1	No
	Drainage / Protective Layer	Mohr-Coulomb	120	0	32	0	1	No
	Yellow Brown Clay (A)	Mohr-Coulomb	125	2,000	0	0	1	No
	Yellow Brown Clay (B)	Mohr-Coulomb	125	2,000	0	0	1	No
	Yellow Brown Clay (C)	Mohr-Coulomb	125	2,000	0	0	1	No



Stage 2

File Information

File Version: 8.16
Created By: Gilkey, Keith
Last Edited By: Gearing, Phillip
Revision Number: 26
Date: 9/25/2018
Time: 11:53:44 AM
Tool Version: 8.16.5.15361
File Name: Stage 2-2000.gsz
Directory: I:\16215106\Calculations\Stability\
Last Solved Date: 9/25/2018
Last Solved Time: 11:54:06 AM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Stage 2

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: Piezometric Line with Ru
- Apply Phreatic Correction: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Compacted Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Drainage / Protective Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

By Product

Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion': 0 psf
Phi': 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (A)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (B)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (C)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 2,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Clayshale

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 7,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, 575) ft
Left-Zone Right Coordinate: (3.11517, 575) ft
Left-Zone Increment: 50
Right Projection: Range

Right-Zone Left Coordinate: (402.96485, 478.25879) ft
Right-Zone Right Coordinate: (424.77607, 475) ft
Right-Zone Increment: 50
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 575) ft
Right Coordinate: (600, 475) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	485
Coordinate 2	377.8	484.5
Coordinate 3	416	475
Coordinate 4	449	475
Coordinate 5	467	469
Coordinate 6	476	469
Coordinate 7	494	475
Coordinate 8	600	475

Points

	X (ft)	Y (ft)
Point 1	0	400
Point 2	600	400
Point 3	0	420
Point 4	600	420
Point 5	0	440
Point 6	600	440
Point 7	0	465
Point 8	600	465
Point 9	0	472
Point 10	467	469

Point 11	476	469
Point 12	449	475
Point 13	600	475
Point 14	0	475
Point 15	416	475
Point 16	0	571
Point 17	16	571
Point 18	400	475
Point 19	0	573
Point 20	16	573
Point 21	408	475
Point 22	0	575
Point 23	16	575
Point 24	494	475
Point 25	458	472

Regions

	Material	Points	Area (ft²)
Region 1	Clayshale	1,3,4,2	12,000
Region 2	Yellow Brown Clay (C)	5,6,4,3	12,000
Region 3	Yellow Brown Clay (B)	7,8,6,5	15,000
Region 4	Yellow Brown Clay (A)	7,9,25,10,11,24,13,8	4,477.5
Region 5	Compacted Clay	9,14,18,21,15,12,25	1,360.5
Region 6	By Product	14,16,17,18	19,968
Region 7	Compacted Clay	16,19,20,21,18,17	808
Region 8	Drainage / Protective Layer	19,22,23,15,21,20	824

Current Slip Surface

Slip Surface: 403
F of S: 1.575
Volume: 30,587.114 ft³
Weight: 3,449,035.3 lbs
Resisting Moment: 2.6630332e+008 lbs-ft
Activating Moment: 1.6901128e+008 lbs-ft
Resisting Force: 828,248.56 lbs
Activating Force: 525,888.74 lbs
F of S Rank (Analysis): 1 of 28,611 slip surfaces

F of S Rank (Query): 1 of 5 slip surfaces
Exit: (418.5566, 475) ft
Entry: (0, 575) ft
Radius: 281.13949 ft
Center: (251.3262, 700.99426) ft

Slip Slices

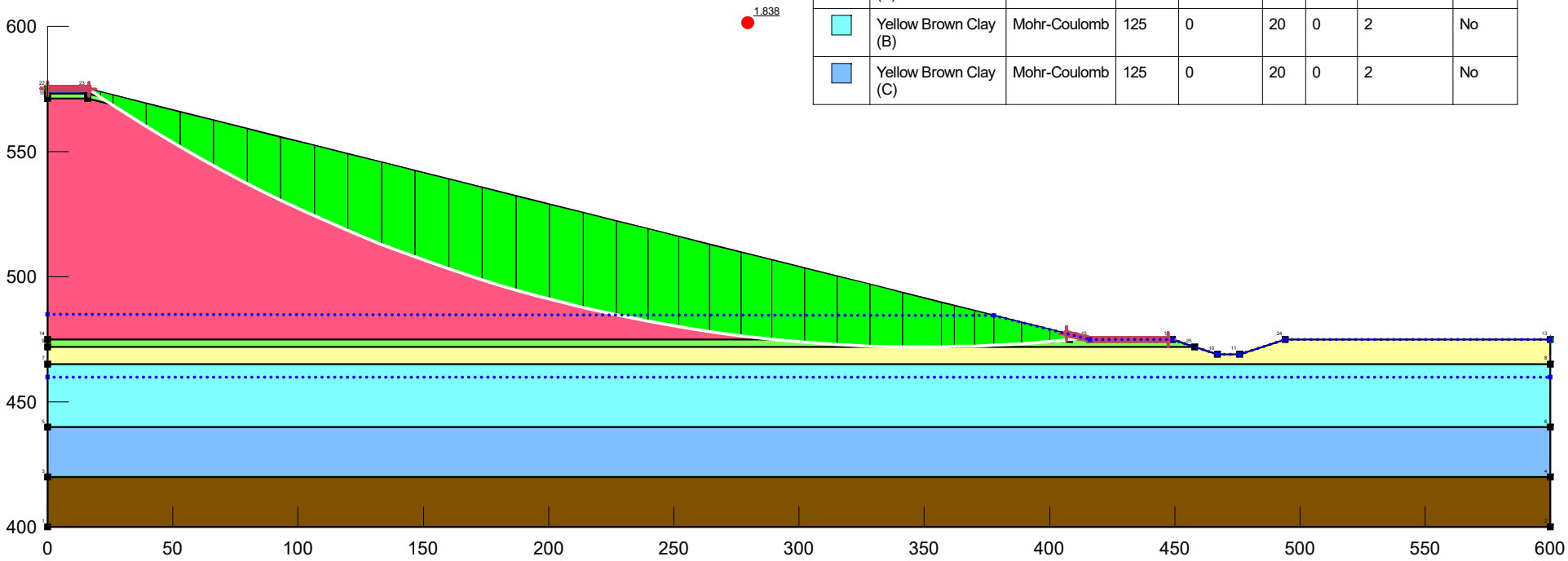
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	0.50631657	574	-5,553.6418	59.836602	37.390059	0
Slice 2	1.5290291	572	-5,428.9263	-1,508.4309	-0	2,000
Slice 3	9.0227126	559.08648	-4,623.7415	977.15061	497.8831	0
Slice 4	22.934874	537.48619	-3,277.0324	2,341.7584	1,193.1855	0
Slice 5	36.804623	519.59814	-2,161.9635	3,484.6582	1,775.522	0
Slice 6	50.674372	504.32168	-1,209.8574	4,520.384	2,303.2507	0
Slice 7	64.544121	491.07595	-384.46926	5,457.0962	2,780.5294	0
Slice 8	77.787398	479.9527	308.52754	6,317.0334	3,061.4867	0
Slice 9	86.161873	473.5	710.48446	7,256.7665	0	2,000
Slice 10	93.379885	468.5	1,021.8884	7,748.2842	0	2,000
Slice 11	106.57996	460.16285	1,541.0365	8,566.1847	0	2,000
Slice 12	122.67624	451.18103	2,100.1726	9,425.144	0	2,000
Slice 13	138.77252	443.51818	2,577.0051	10,127.412	0	2,000
Slice 14	153.63996	437.47212	2,953.0515	10,652.055	0	2,000
Slice 15	167.27856	432.80713	3,243.0205	11,026.169	0	2,000

Slice 16	180.91715	428.90538	3,485.3638	11,306.618	0	2,000
Slice 17	194.55575	425.7343	3,682.1128	11,496.61	0	2,000
Slice 18	208.19435	423.2688	3,834.8335	11,598.508	0	2,000
Slice 19	221.83295	421.49016	3,944.694	11,613.925	0	2,000
Slice 20	235.47155	420.3853	4,012.5115	11,543.795	0	2,000
Slice 21	251.3262	420	4,035.2446	11,347.273	0	2,000
Slice 22	267.18085	420.3853	4,009.8928	11,050.501	0	2,000
Slice 23	280.81945	421.49016	3,939.8227	10,694.413	0	2,000
Slice 24	294.45805	423.2688	3,827.7095	10,249.325	0	2,000
Slice 25	308.09665	425.7343	3,672.7362	9,712.5337	0	2,000
Slice 26	321.73525	428.90538	3,473.7346	9,080.4412	0	2,000
Slice 27	335.37384	432.80713	3,229.1386	8,348.3879	0	2,000
Slice 28	349.01244	437.47212	2,936.9169	7,510.4201	0	2,000
Slice 29	358.87383	441.25963	2,699.7622	6,845.1777	0	2,000
Slice 30	365.9372	444.31482	2,508.535	6,320.8836	0	2,000
Slice 31	373.87924	448.00971	2,277.318	5,693.5843	0	2,000
Slice 32	383.35	452.86203	1,888.0829	4,880.9356	0	2,000
Slice 33	394.45	459.09882	1,326.6535	3,845.8717	0	2,000
Slice 34	402.06029	463.69131	921.98313	3,077.1138	0	2,000

Slice 35	406.06029	466.27874	698.45444	2,633.4203	0	2,000
Slice 36	411.21223	469.77874	400.10497	2,036.0896	0	2,000
Slice 37	415.21223	472.56519	164.15731	1,563.1885	0	2,000
Slice 38	417.2783	474.06519	58.332401	1,359.1607	0	2,000

File Name: Stage 2-20 deg_2 water surfaces El 460.gsz
F of S: 1.838

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)	Piezometric Line	Include Ru in PWP
	By Product	Mohr-Coulomb	103	0	27	0	1	No
	Clayshale	Mohr-Coulomb	130	7,000	0	0	2	No
	Compacted Clay	Mohr-Coulomb	120	0	20	0	1	No
	Drainage / Protective Layer	Mohr-Coulomb	120	0	32	0	1	No
	Yellow Brown Clay (A)	Mohr-Coulomb	125	0	20	0		No
	Yellow Brown Clay (B)	Mohr-Coulomb	125	0	20	0	2	No
	Yellow Brown Clay (C)	Mohr-Coulomb	125	0	20	0	2	No



Stage 2

File Information

File Version: 8.16
Created By: Gilkey, Keith
Last Edited By: Gilkey, Keith
Revision Number: 19
Date: 9/25/2018
Time: 2:14:45 PM
Tool Version: 8.16.5.15361
File Name: Stage 2-20 deg_2 water surfaces El 460.gsz
Directory: I:\16215106\Calculations\Stability\
Last Solved Date: 9/25/2018
Last Solved Time: 2:15:36 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Stage 2

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: Piezometric Line with Ru
- Apply Phreatic Correction: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Compacted Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Drainage / Protective Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

By Product

Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion': 0 psf
Phi': 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (A)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Include Ru in PWP: No

Yellow Brown Clay (B)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Yellow Brown Clay (C)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Clayshale

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 7,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, 575) ft
Left-Zone Right Coordinate: (16.48981, 574.87755) ft
Left-Zone Increment: 50
Right Projection: Range
Right-Zone Left Coordinate: (406.7319, 477.31702) ft

Right-Zone Right Coordinate: (447.35723, 475) ft
Right-Zone Increment: 50
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 575) ft
Right Coordinate: (600, 475) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	485
Coordinate 2	377.8	484.5
Coordinate 3	416	475
Coordinate 4	449	475
Coordinate 5	467	469
Coordinate 6	476	469
Coordinate 7	494	475
Coordinate 8	600	475

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	460
Coordinate 2	600	460

Points

	X (ft)	Y (ft)
Point 1	0	400
Point 2	600	400
Point 3	0	420
Point 4	600	420

Point 5	0	440
Point 6	600	440
Point 7	0	465
Point 8	600	465
Point 9	0	472
Point 10	467	469
Point 11	476	469
Point 12	449	475
Point 13	600	475
Point 14	0	475
Point 15	416	475
Point 16	0	571
Point 17	16	571
Point 18	400	475
Point 19	0	573
Point 20	16	573
Point 21	408	475
Point 22	0	575
Point 23	16	575
Point 24	494	475
Point 25	458	472

Regions

	Material	Points	Area (ft²)
Region 1	Clayshale	1,3,4,2	12,000
Region 2	Yellow Brown Clay (C)	5,6,4,3	12,000
Region 3	Yellow Brown Clay (B)	7,8,6,5	15,000
Region 4	Yellow Brown Clay (A)	7,9,25,10,11,24,13,8	4,477.5
Region 5	Compacted Clay	9,14,18,21,15,12,25	1,360.5
Region 6	By Product	14,16,17,18	19,968
Region 7	Compacted Clay	16,19,20,21,18,17	808
Region 8	Drainage / Protective Layer	19,22,23,15,21,20	824

Current Slip Surface

Slip Surface: 28,152

F of S: 1.838
Volume: 10,097.481 ft³
Weight: 1,070,412.7 lbs
Resisting Moment: 2.6920364e+008 lbs-ft
Activating Moment: 1.4644683e+008 lbs-ft
Resisting Force: 436,759.14 lbs
Activating Force: 237,562.5 lbs
F of S Rank (Analysis): 1 of 28,611 slip surfaces
F of S Rank (Query): 1 of 28,611 slip surfaces
Exit: (413.87594, 475.53102) ft
Entry: (16.489809, 574.87755) ft
Radius: 588.63612 ft
Center: (349.02785, 1,060.5842) ft

Slip Slices

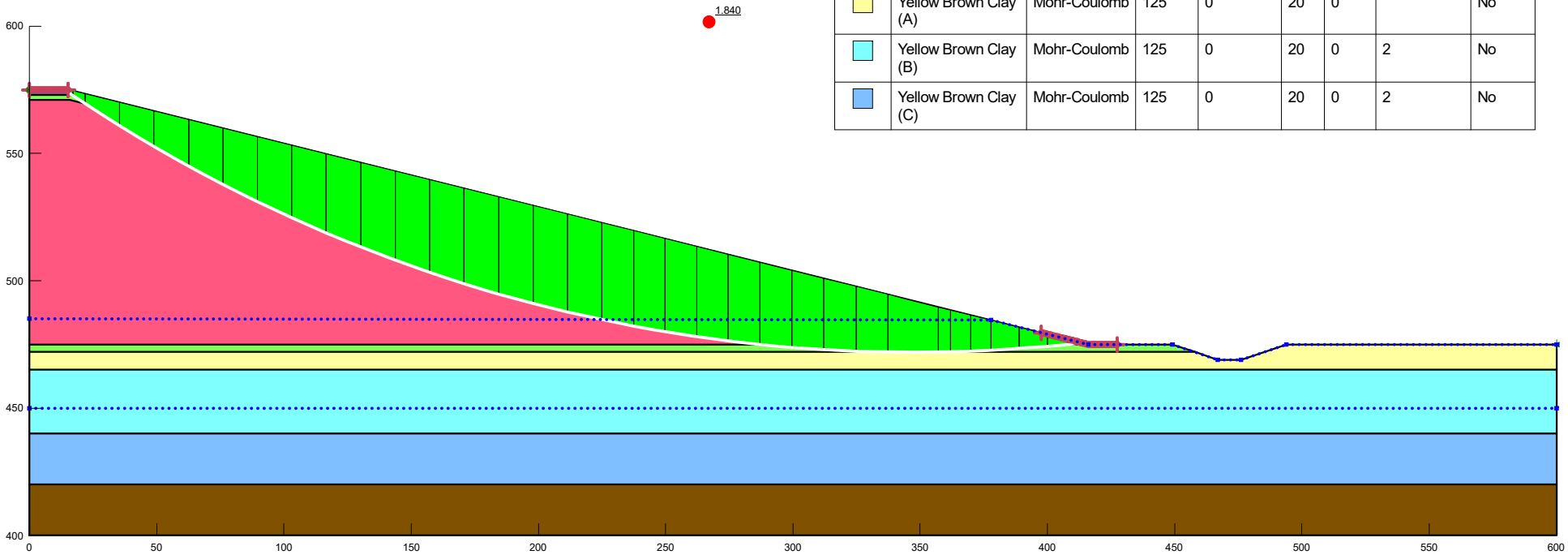
	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	18.828321	573.29292	-5,511.0331	90.860967	56.776233	0
Slice 2	23.585105	570.10372	-5,312.4201	286.65003	104.33208	0
Slice 3	32.708958	564.22583	-4,946.3929	587.16822	299.17715	0
Slice 4	46.120119	555.92764	-4,429.6935	1,003.1773	511.14436	0
Slice 5	59.53128	548.11476	-3,943.2775	1,391.1897	708.84656	0
Slice 6	72.94244	540.76529	-3,485.7779	1,750.9942	892.1761	0
Slice 7	86.353601	533.8598	-3,055.9829	2,082.3748	1,061.023	0
Slice 8	99.764762	527.38103	-2,652.815	2,385.1034	1,215.2709	0
Slice 9	113.17592	521.31358	-2,275.3136	2,658.9333	1,354.7942	0
Slice 10	126.58708	515.6437	-1,922.6207	2,903.5937	1,479.4549	0
Slice 11	139.99824	510.35909	-1,593.9687	3,118.785	1,589.1003	0

Slice 12	153.40941	505.44874	-1,288.6705	3,304.1743	1,683.5609	0
Slice 13	166.82057	500.90279	-1,006.1109	3,459.3907	1,762.6476	0
Slice 14	180.23173	496.71243	-745.73953	3,584.0218	1,826.1503	0
Slice 15	193.64289	492.86976	-507.06483	3,677.6087	1,873.8353	0
Slice 16	207.05405	489.36778	-289.6486	3,739.642	1,905.4428	0
Slice 17	220.46521	486.20024	-93.101766	3,769.5567	1,920.6851	0
Slice 18	233.37014	483.45699	77.011592	3,766.6237	1,879.9513	0
Slice 19	245.76884	481.10993	222.44379	3,731.4219	1,787.9136	0
Slice 20	258.16753	479.03666	350.79176	3,665.7543	1,689.0577	0
Slice 21	270.56623	477.23426	462.23776	3,569.2477	1,583.1006	0
Slice 22	282.96493	475.70022	556.93811	3,441.4672	1,469.741	0
Slice 23	295.6698	474.40782	636.53466	3,249.9327	951.19909	0
Slice 24	308.68086	473.36865	700.3043	3,064.1677	860.37592	0
Slice 25	321.69191	472.6192	745.99524	2,838.6267	761.65557	0
Slice 26	334.70297	472.15837	773.67661	2,572.4766	654.70965	0
Slice 27	349.02785	472	782.3761	2,229.3941	526.6715	0
Slice 28	359.38155	472.04458	778.73896	1,956.4625	428.65629	0
Slice 29	365.9372	472.20474	768.20407	1,764.7506	362.71328	0
Slice 30	373.87924	472.48598	749.99835	1,518.7651	279.80821	0

Slice 31	383.35	472.97584	632.98089	1,207.7242	209.18947	0
Slice 32	394.45	473.72958	413.69403	820.20039	147.95622	0
Slice 33	404	474.53435	215.27633	443.37488	83.021084	0
Slice 34	408.44571	474.95478	120.05176	248.18237	46.635727	0
Slice 35	411.37981	475.26508	55.156629	118.17758	39.379862	0
Slice 36	413.87207	475.53059	-0.086741895	0.19888453	0.12427685	0

File Name: Stage 2-20 deg_2 water surfaces El 450.gsz
F of S: 1.840

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Phi-B (°)	Piezometric Line	Include Ru in PWP
	By Product	Mohr-Coulomb	103	0	27	0	1	No
	Clayshale	Mohr-Coulomb	130	7,000	0	0	2	No
	Compacted Clay	Mohr-Coulomb	120	0	20	0	1	No
	Drainage / Protective Layer	Mohr-Coulomb	120	0	32	0	1	No
	Yellow Brown Clay (A)	Mohr-Coulomb	125	0	20	0		No
	Yellow Brown Clay (B)	Mohr-Coulomb	125	0	20	0	2	No
	Yellow Brown Clay (C)	Mohr-Coulomb	125	0	20	0	2	No



Stage 2

File Information

File Version: 8.16
Created By: Gilkey, Keith
Last Edited By: Gearing, Phillip
Revision Number: 20
Date: 9/24/2018
Time: 5:53:33 PM
Tool Version: 8.16.5.15361
File Name: Stage 2-20 deg_2 water surfaces El 450.gsz
Directory: I:\16215106\Calculations\Stability\
Last Solved Date: 9/24/2018
Last Solved Time: 5:54:06 PM

Project Settings

Length(L) Units: Feet
Time(t) Units: Seconds
Force(F) Units: Pounds
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D
Element Thickness: 1

Analysis Settings

Stage 2

Kind: SLOPE/W
Method: Spencer
Settings
- PWP Conditions Source: Piezometric Line with Ru
- Apply Phreatic Correction: No

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Resisting Side Maximum Convex Angle: 1 °
- Driving Side Maximum Convex Angle: 5 °
- Optimize Critical Slip Surface Location: No

Tension Crack
Tension Crack Option: (none)
F of S Distribution
F of S Calculation Option: Constant
Advanced
Number of Slices: 30
F of S Tolerance: 0.001
Minimum Slip Surface Depth: 0.1 ft
Search Method: Root Finder
Tolerable difference between starting and converged F of S: 3
Maximum iterations to calculate converged lambda: 20
Max Absolute Lambda: 2

Materials

Compacted Clay

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Drainage / Protective Layer

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

By Product

Model: Mohr-Coulomb
Unit Weight: 103 pcf
Cohesion': 0 psf
Phi': 27 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1
Include Ru in PWP: No

Yellow Brown Clay (A)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Include Ru in PWP: No

Yellow Brown Clay (B)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Yellow Brown Clay (C)

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 0 psf
Phi': 20 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Clayshale

Model: Mohr-Coulomb
Unit Weight: 130 pcf
Cohesion': 7,000 psf
Phi': 0 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 2
Include Ru in PWP: No

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (0, 575) ft
Left-Zone Right Coordinate: (15.24856, 575) ft
Left-Zone Increment: 50
Right Projection: Range
Right-Zone Left Coordinate: (397.55248, 479.61188) ft

Right-Zone Right Coordinate: (427.35586, 475) ft
Right-Zone Increment: 50
Radius Increments: 10

Slip Surface Limits

Left Coordinate: (0, 575) ft
Right Coordinate: (600, 475) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	485
Coordinate 2	377.8	484.5
Coordinate 3	416	475
Coordinate 4	449	475
Coordinate 5	467	469
Coordinate 6	476	469
Coordinate 7	494	475
Coordinate 8	600	475

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
Coordinate 1	0	450
Coordinate 2	600	450

Points

	X (ft)	Y (ft)
Point 1	0	400
Point 2	600	400
Point 3	0	420
Point 4	600	420

Point 5	0	440
Point 6	600	440
Point 7	0	465
Point 8	600	465
Point 9	0	472
Point 10	467	469
Point 11	476	469
Point 12	449	475
Point 13	600	475
Point 14	0	475
Point 15	416	475
Point 16	0	571
Point 17	16	571
Point 18	400	475
Point 19	0	573
Point 20	16	573
Point 21	408	475
Point 22	0	575
Point 23	16	575
Point 24	494	475
Point 25	458	472

Regions

	Material	Points	Area (ft²)
Region 1	Clayshale	1,3,4,2	12,000
Region 2	Yellow Brown Clay (C)	5,6,4,3	12,000
Region 3	Yellow Brown Clay (B)	7,8,6,5	15,000
Region 4	Yellow Brown Clay (A)	7,9,25,10,11,24,13,8	4,477.5
Region 5	Compacted Clay	9,14,18,21,15,12,25	1,360.5
Region 6	By Product	14,16,17,18	19,968
Region 7	Compacted Clay	16,19,20,21,18,17	808
Region 8	Drainage / Protective Layer	19,22,23,15,21,20	824

Current Slip Surface

Slip Surface: 25,545

F of S: 1.840
Volume: 10,337.538 ft³
Weight: 1,095,453.6 lbs
Resisting Moment: 2.7676765e+008 lbs-ft
Activating Moment: 1.5043275e+008 lbs-ft
Resisting Force: 447,075.32 lbs
Activating Force: 242,964.35 lbs
F of S Rank (Analysis): 1 of 28,611 slip surfaces
F of S Rank (Query): 1 of 28,611 slip surfaces
Exit: (413.46321, 475.6342) ft
Entry: (13.723704, 575) ft
Radius: 591.15831 ft
Center: (347.26728, 1,063.0746) ft

Slip Slices

	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
Slice 1	14.861852	574.22609	-5,568.9351	70.255813	43.900704	0
Slice 2	16.531973	573.09309	-5,498.3743	161.40415	100.85651	0
Slice 3	19.465813	571.13355	-5,376.3409	286.40752	104.24381	0
Slice 4	28.638175	565.20011	-5,006.8517	590.10527	300.67365	0
Slice 5	42.179168	556.78724	-4,483.0071	1,012.626	515.95872	0
Slice 6	55.720161	548.86858	-3,990.0008	1,406.7162	716.75769	0
Slice 7	69.261154	541.42159	-3,526.4268	1,772.163	902.96214	0
Slice 8	82.802146	534.42631	-3,091.04	2,108.7492	1,074.4614	0
Slice 9	96.343139	527.86502	-2,682.7338	2,416.2453	1,231.1385	0
Slice 10	109.88413	521.72193	-2,300.5228	2,694.4028	1,372.8668	0
Slice 11	123.42512	515.98292	-1,943.5271	2,942.9489	1,499.5073	0

Slice 12	136.96612	510.6354	-1,610.9601	3,161.581	1,610.906	0
Slice 13	150.50711	505.66809	-1,302.1184	3,349.9627	1,706.8912	0
Slice 14	164.0481	501.07091	-1,016.3722	3,507.7187	1,787.2719	0
Slice 15	177.5891	496.83482	-753.15871	3,634.4309	1,851.835	0
Slice 16	191.13009	492.95178	-511.97526	3,729.6339	1,900.3434	0
Slice 17	204.67108	489.41461	-292.37422	3,792.8104	1,932.5334	0
Slice 18	218.21207	486.21695	-93.958312	3,823.3863	1,948.1126	0
Slice 19	231.18079	483.46085	76.951161	3,820.7915	1,907.5819	0
Slice 20	243.57723	481.1151	222.30261	3,785.9272	1,815.7574	0
Slice 21	255.97366	479.04185	350.64915	3,720.7458	1,717.15	0
Slice 22	268.3701	477.23823	462.17141	3,624.8791	1,611.4801	0
Slice 23	280.76654	475.70175	557.02445	3,497.8984	1,498.4502	0
Slice 24	293.25918	474.4225	635.81798	3,309.7198	973.22065	0
Slice 25	305.84801	473.40286	698.40343	3,132.3124	885.87041	0
Slice 26	318.43685	472.65338	744.13171	2,917.8916	791.1839	0
Slice 27	331.02568	472.17301	773.06701	2,665.719	688.86898	0
Slice 28	347.26728	472	782.5215	2,277.0729	543.97221	0
Slice 29	359.56519	472.04891	778.4537	1,953.3074	427.61177	0
Slice 30	365.9372	472.22489	766.94635	1,764.1348	362.94689	0

Slice 31	373.87924	472.52864	747.33656	1,514.9754	279.39768	0
Slice 32	383.35	473.04473	628.68222	1,200.2233	208.02393	0
Slice 33	394.45	473.82854	407.51905	808.40919	145.91208	0
Slice 34	403.93732	474.65214	208.89891	430.70387	80.730402	0
Slice 35	410.66433	475.33225	62.068179	133.07964	44.372885	0
Slice 36	413.45862	475.63368	-0.10359649	0.23776018	0.14856905	0

APPENDIX E

Seepage Potential and Karst Condition Assessment

Seepage Potential and Karst Condition Assessment

The disposal facility is designed and constructed to include storm water run-on and run-off management and leachate control systems. The storm water management system consists of drainage ditches, diversion berms, culverts, drop inlets, storm water pipes, and a storm water run-off pond to convey and contain storm water away from the disposal facility. The leachate control system consists of a series of 4-inch diameter perforated pipes spaced approximately 50 feet apart that drain in the direction of the storm water runoff pond to limit leachate head buildup within the waste over the liner. The landfill liner elevation is above the groundwater elevation. There are no concerns that storm water, leachate, or groundwater movement will impact the stability of the landfill.

As noted in **Appendix A**, karst features were not observed in the borings within and adjacent to the disposal facility. Regionally, the site geology is not known for karst features. The site soils are clays overlying clayshale weathered from shale bedrock that are not subject to karst conditions.

References

Black & Veatch Corp., 2009, Geotechnical Design Report, Sandy Creek Energy Station, Riesel, Texas, Sandy Creek Power Partners.

Black & Veatch Corp., 2010, Engineering Report, Solid Waste Disposal Facility, Sandy Creek Energy Station, Sandy Creek Services, LLC.

SCS Engineers, 2018, June 2018 Semiannual Groundwater Monitoring Report Submittal, Sandy Creek Energy Station, McLennan County, Texas.

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