

**COAL COMBUSTION RESIDUAL RULE
GROUNDWATER MONITORING SYSTEM CERTIFICATION**

**OAK GROVE STEAM ELECTRIC STATION
ASH LANDFILL 1
ROBERTSON COUNTY, TEXAS**

OCTOBER 16, 2017

Prepared For:

Luminant Generation Company, LLC
6555 Sierra Drive
Irving, TX 75039

Prepared By:

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Round Rock, Texas 78664
Texas Engineering Firm No. 4760

PROFESSIONAL CERTIFICATION

This document and all attachments were prepared by Pastor, Behling & Wheeler, LLC under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that the groundwater monitoring system installed at the referenced facility has been designed and constructed to meet the requirements of Section 257.91 of the CCR Rule.



A handwritten signature in black ink that reads "Patrick J. Behling".

Patrick J. Behling, P.E.
Principal Engineer
PASTOR, BEHLING & WHEELER, LLC

LUMINANT

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1.0 INTRODUCTION

Luminant Power (Luminant) operates the Oak Grove Steam Electric Station (OGSES) located approximately 10 miles north of Franklin, Robertson County, Texas (Figure 1). The OGSES consists of two 800-megawatt power generation units which burn lignite and coal. Coal Combustion Residuals (CCR) including fly ash, bottom ash, and gypsum are generated as part of OGSES unit operations. Currently, CCRs generated at the OGSES are managed by Luminant in surface impoundments located on the OGSES property or the Ash Landfill 1. Two CCR units have been identified within the OGSES operations, the FGD Pond Area and the Ash Landfill 1. This report discusses the Ash Landfill 1 (the Site), which is located approximately 3,500 feet southwest of the OGSES power plant. The Ash Landfill 1 meets the definition of a CCR landfill and is subject to groundwater monitoring system requirements of the CCR Rule.

The CCR Rule (40 CFR 257 Subpart D - *Standards for the Receipt of Coal Combustion Residuals in Landfills and Surface Impoundments*) has been promulgated by the EPA to regulate the management and disposal of CCRs as solid waste under Resource Conservation and Recovery Act (RCRA) Subtitle D. The final CCR Rule was published in the Federal Register on April 17, 2015. The effective date of the CCR Rule was October 19, 2015.

The CCR Rule establishes national minimum criteria for existing and new CCR landfills, existing and new CCR surface impoundments, and lateral expansions to landfills/impoundments. Pastor, Behling & Wheeler, LLC (PBW) was retained by Luminant to evaluate and certify that the groundwater monitoring system at the Site in accordance with Section 257.91 of the CCR Rule.

1.1 Description of Ash Landfill 1

Ash Landfill 1 is located approximately 3,500 feet southwest of the OGSES power plant (Figure 2). CCRs generated at the OGSES, including fly ash and bottom ash, are transported and managed/disposed of by Luminant in the Ash Landfill 1. Cell 1 of the Ash Landfill 1 was constructed in 2009 and the landfill was expanded in 2011. The existing liner system for the Ash Landfill 1 includes a 60-mil high density polyethylene (HDPE) geomembrane and a 3-foot thick compacted clay liner (Golder, 2015).

1.2 CCR Unit Groundwater Monitoring System Requirements

Section 257.91 of the CCR Rule indicates that existing CCR landfills and surface impoundments be provided with a groundwater monitoring system that consists of sufficient wells, installed at appropriate location and depths, to yield groundwater samples from the uppermost aquifer that meet the following criteria:

- Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit; and
- Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary to ensure detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

The specific configuration of the groundwater monitoring system must be determined based on site-specific technical information that must include aquifer thickness, groundwater flow rate, groundwater flow direction (including seasonal and temporal fluctuation in groundwater flow), saturated and unsaturated geologic units and fill materials that overlie the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thickness, stratigraphy, lithology, hydraulic conductivities, porosities, and effective porosities.

At a minimum, the monitoring system must consist of at least one upgradient and three downgradient monitoring wells, and any additional monitoring wells necessary to accurately represent the quality of the background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space above the sampling depth must be sealed to prevent contamination of samples and the groundwater. There must be documentation in the operating record of the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The qualified engineer must have access to and must review this documentation as part of the groundwater monitoring system certification.

2.0 GROUNDWATER MONITORING SYSTEM EVALUATION

2.1 Ash Landfill 1 Groundwater Monitoring System

The CCR groundwater monitoring well system at the Ash Landfill 1 consists of six monitoring wells (MW-02, MW-05, MW-07, MW-08R, MW-09, and AL-10) that are each screened in the uppermost aquifer at the Site. The locations of the CCR monitoring wells are shown on Figure 2. Well construction information and survey data for the CCR wells are summarized in Table 1, CCR monitoring well logs are presented in Appendix A, and photographs of the CCR wells are presented in Appendix B.

2.2 Local Geology and Hydrogeology

The Site is located in the outcrop area of the Eocene-aged Wilcox Group (Barnes, 1970). PBW reviewed historical soil boring logs, monitoring well completion documentation, and historical reports to describe the geologic and hydrogeologic conditions in the Ash Landfill 1. Geologic cross sections were constructed through the area using these data. The locations of the cross sections are presented on Figure 3 and the cross sections are presented on Figures 4 and 5.

Historical soil borings indicate the geology near the Ash Landfill 1 generally consists of relatively thick, interbedded sand and clay strata. The sand units in the Ash Landfill 1 Area are typically described as poorly sorted, silty to clayey sand with occasional zones of well sorted sand. The uppermost aquifer occurs under unconfined conditions within the shallow sand units at the Site.

2.3 Groundwater Potentiometric Surface Elevations

Eight background groundwater monitoring events were performed using the Ash Landfill 1 CCR monitoring well system from October 2015 to April 2017. Static water levels measured during the background monitoring period indicated water elevations ranging from 406.96 feet above mean sea level (amsl) to 419.20 feet amsl, and depths to water ranging from 26.79 feet bgs to 50.38 feet bgs (Table 2). Groundwater potentiometric surface maps based on data collected during the background monitoring period are presented in Appendix C.

Groundwater elevations were generally highest to the southwest of the Ash Landfill 1 and lowest to the east of the Ash Landfill 1, with an inferred groundwater flow direction to the east. Based on the inferred groundwater flow direction, the location of each CCR monitoring well relative to Ash Landfill 1 is as

follows:

Potential Upgradient Wells	Potential Downgradient Wells
MW-02	MW-05
AL-10	MW-07
	MW-08R
	MW-09

2.4 Uppermost Aquifer Hydraulic Conductivity Testing

PBW performed slug tests at monitoring wells MW-02, MW-05, and MW-09 on September 23, 2015 to evaluate groundwater linear flow velocities of the uppermost aquifer at the Site. Slug test data and time-head change plots used to calculate hydraulic conductivities and transmissivities of the uppermost aquifer are provided in Appendix D. A summary of these hydraulic properties is presented in Table 3. The average hydraulic conductivities for the wells ranged from 7.66×10^{-3} cm/sec (well MW-09) to 2.74×10^{-4} cm/sec (well MW-05), with a geometric mean for the test wells of 2.48×10^{-3} cm/sec.

2.5 Conclusions

The CCR groundwater monitoring well system at the Ash Landfill 1 complies with Section 257.91 of the CCR Rule. This conclusion is supported by the following as described in detail in previous sections of this report:

- Six monitoring wells are included in the CCR groundwater monitoring system – two upgradient monitoring wells and four downgradient monitoring wells.
- Each monitoring well is screened in the uppermost aquifer at the Site. Samples collected from upgradient monitoring wells will be representative of the quality of background groundwater that has not been affected by leakage from the landfill and samples collected from downgradient wells will ensure detection of groundwater contamination in the uppermost aquifer from the landfill.
- The monitoring wells are constructed with appropriate well casing to maintain the integrity of the monitoring well borehole and with slotted well screens to enable collection of groundwater samples. In addition, the annular space above the well screen is appropriately sealed to prevent contamination of groundwater samples from surface sources.
- Appropriate documentation exists concerning the design, installation, and development of the monitoring wells.

3.0 REFERENCES

Barnes, Virgil E., 1970. Geologic Atlas of Texas, Waco Sheet. Texas Bureau of Economic Geology.

Golder Associates (Golder), 2015. Coal Combustion Residuals Regulations and Their Effect on Existing Landfills and Surface Impoundments, Oak Grove Steam Electric Station. May 26.

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Tables

**TABLE 1
CCR WELL CONSTRUCTION SUMMARY
ASH LANDFILL 1
OAG GROVE STEAM ELECTRIC STATION**

Well ID	Date Installed	Northing	Easting	Ground Elevation (ft amsl)	TOC Elevation (ft amsl)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Screen Length (ft)	Total Design Depth (ft bgs)	Casing Diameter (in)
MW-04	11/17/86	568593	3200315	432.94	436.63	35	50	15	50	2
MW-05	09/05/08	569467	3201188	434.73	436.98	29	49	20	50	2
MW-07	09/06/08	570377	3200695	436.93	438.84	29	49	20	50	2
MW-08*	08/27/08	570980	3199824	440.64	443.38	31	51	20	52	2
MW-08R	11/09/16	570970	3199809	441.22	443.84	32.5	52.5	20	52.5	2
MW-09	12/29/11	570146	3198709	459.24	461.46	46	66	20	67	2
AL-10	9/22/15	568673	3197291	457.54	460.81	50.3	60.3	10	60.3	2

Notes:

1. Abbreviations: ft - feet; amsl - above mean sea level; bgs - below ground surface.
2. Coordinates in NAD 27 Texas State Plane Central 4208.
3. * - Well MW-08 was damaged by a haul truck in 2016 and was subsequently plugged and replaced by well MW-08R.

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TABLE 2
GROUNDWATER ELEVATION SUMMARY
ASH LANDFILL 1
OAK GROVE STEAM ELECTRIC STATION

Well ID	TOC Elevation (ft amsl)	Date	Depth to Water (ft btoc)	Water Elevation (ft amsl)
MW-02	463.65	11/03/15	47.61	416.04
		12/17/15	47.49	416.16
		02/10/16	45.93	417.72
		04/15/16	46.69	416.96
		06/14/16	44.84	418.81
		08/24/16	44.61	419.04
		10/04/16	45.24	418.41
		12/19/16	46.96	416.69
MW-05	436.98	11/03/15	29.94	407.04
		12/17/15	29.71	407.27
		02/10/16	28.93	408.05
		04/15/16	28.02	408.96
		06/14/16	27.57	409.41
		08/24/16	28.38	408.60
		10/04/16	27.94	409.04
		12/19/16	30.02	406.96
MW-07	438.84	11/03/15	28.54	410.30
		12/17/15	28.07	410.77
		02/09/16	27.71	411.13
		04/15/16	27.43	411.41
		06/14/16	27.11	411.73
		08/24/16	27.11	411.73
		10/04/16	27.62	411.22
		12/19/16	26.79	412.05
MW-08	443.38	11/03/15	32.77	410.61
		12/17/15	32.63	410.75
		02/09/16	32.47	410.91
		04/15/16	32.12	411.26
		06/14/16	29.96	413.42
		Destroyed		
MW-08R	443.84	12/19/16	33.97	409.87
		03/21/17	31.89	411.95
		04/20/17	31.80	412.04
MW-09	461.46	11/03/15	48.43	413.03
		12/17/15	48.71	412.75
		02/09/16	48.20	413.26
		04/15/16	47.69	413.77
		06/14/16	47.31	414.15
		08/24/16	47.56	413.90
		10/04/16	47.22	414.24
		12/19/16	50.38	411.08

TABLE 2
GROUNDWATER ELEVATION SUMMARY
ASH LANDFILL 1
OAK GROVE STEAM ELECTRIC STATION

Well ID	TOC Elevation (ft amsl)	Date	Depth to Water (ft btoc)	Water Elevation (ft amsl)
AL-10	460.81	11/03/15	43.19	417.62
		12/17/15	43.09	417.72
		02/10/16	42.51	418.30
		04/15/16	42.14	418.67
		06/14/16	41.61	419.20
		08/24/16	41.89	418.92
		10/04/16	41.92	418.89
		12/19/16	43.68	417.13

Notes:

1. Abbreviations: TOC - top of casing; ft - feet, amsl - above mean sea level.

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**TABLE 3
SUMMARY OF AQUIFER TEST RESULTS
ASH LANDFILL 1
OAK GROVE STEAM ELECTRIC STATION**

Well ID	Test Type	Aquifer Type	Analysis Method	Saturated Thickness (feet)	Results	
					T (cm ² /sec)	K (cm/sec)
Ash Landfill 1						
MW-02	Slug-Out ¹	Unconfined	Bouwer-Rice	19.74	4.36E+00	7.25E-03
MW-05	Slug-In	Unconfined	Bouwer-Rice	22.18	1.52E-01	2.25E-04
MW-05	Slug-Out	Unconfined	Bouwer-Rice	22.18	2.18E-01	3.22E-04
Mean					1.85E-01	2.74E-04
MW-09	Slug-Out ¹	Unconfined	Bouwer-Rice	19.79	4.62E+00	7.66E-03
Geometric mean for all tests					1.55E+00	2.48E-03

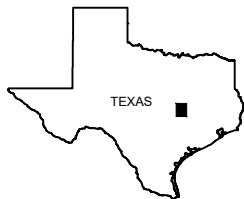
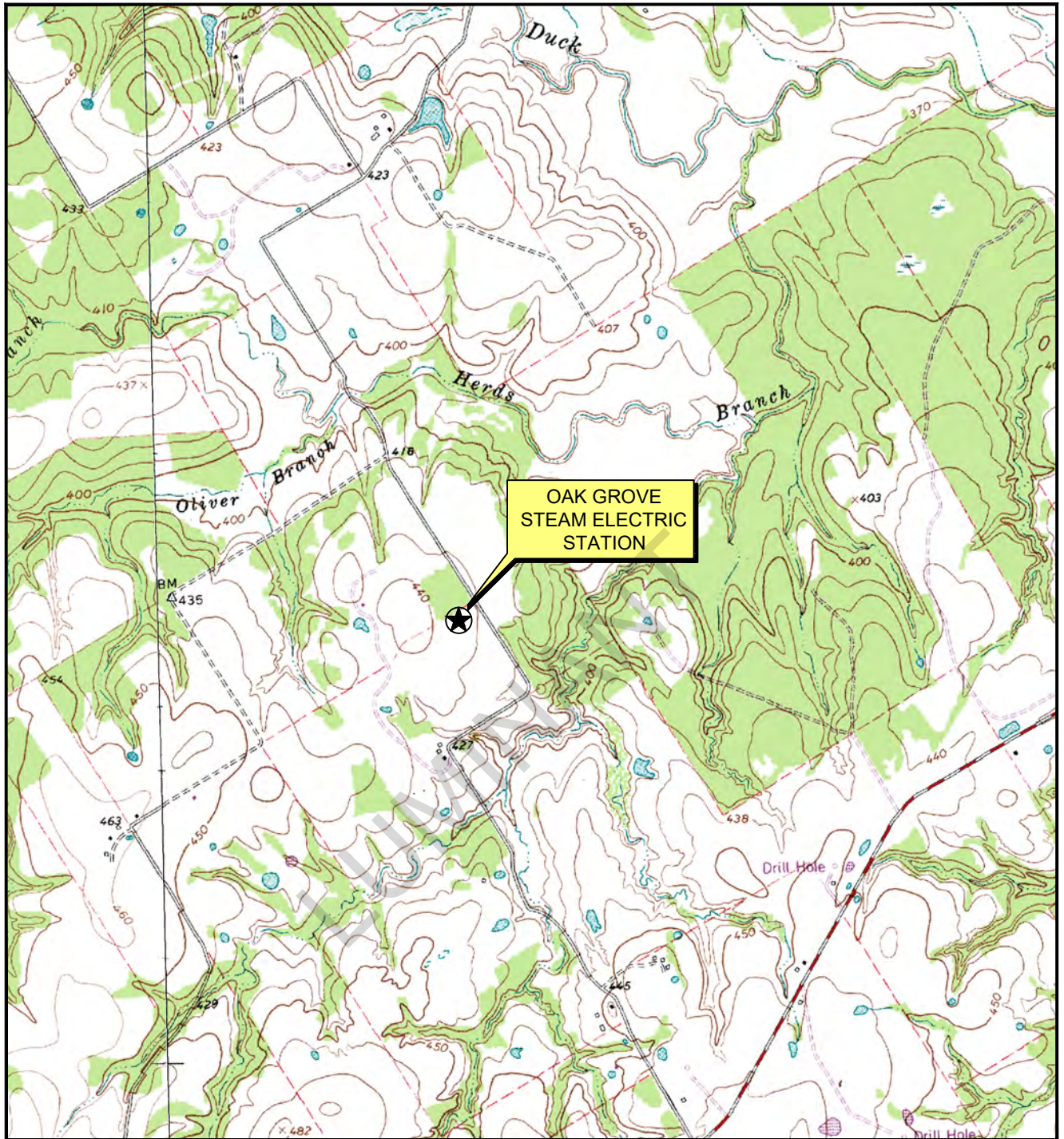
Notes:

¹ - A slug-in test was not performed because the static water level was below top of screen.

² - Although the static water level was above the top of the screen, data collected during the slug-in test was not adequate for analysis.

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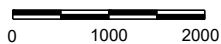
Figures



QUADRANGLE LOCATION



Scale in Feet



OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 1

ASH LANDFILL 1
SITE LOCATION MAP

PROJECT: 5164D

BY: AJD

REVISIONS

DATE: NOV, 2015

CHECKED: PJB

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

SOURCE:
Base map from www.tnris.gov, Bald Prairie, TX 7.5 min. USGS quadrangle dated 1965,
revised 1982.

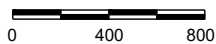


EXPLANATION

 CCR Monitoring Well



Scale in Feet



SOURCE:
Imagery from www.tnris.gov, Robertson Co., aerial photographs, 2012.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 2

ASH LANDFILL 1
DETAILED SITE PLAN

PROJECT: 5164D

BY: AJD

REVISIONS




DATE: SEPT., 2017

CHECKED: PJB

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

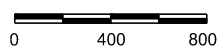


EXPLANATION

-  CCR Monitoring Well
-  Soil Boring Location
-  Geologic Cross Section Location Lines



Scale in Feet



SOURCE:
Imagery from www.tnris.gov, Robertson Co., aerial photographs, 2012.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 3

ASH LANDFILL 1
CROSS SECTION LOCATION MAP

PROJECT: 5164D

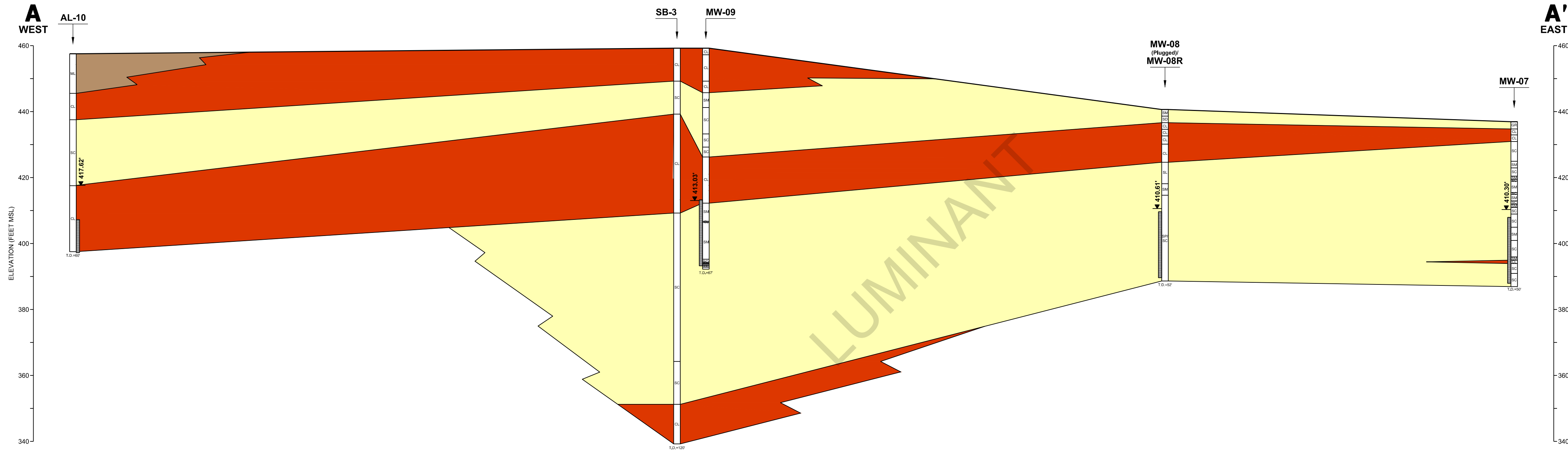
BY: AJD

REVISIONS

DATE: SEPT., 2017

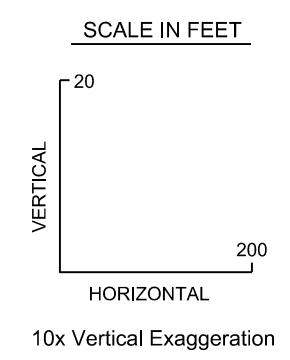
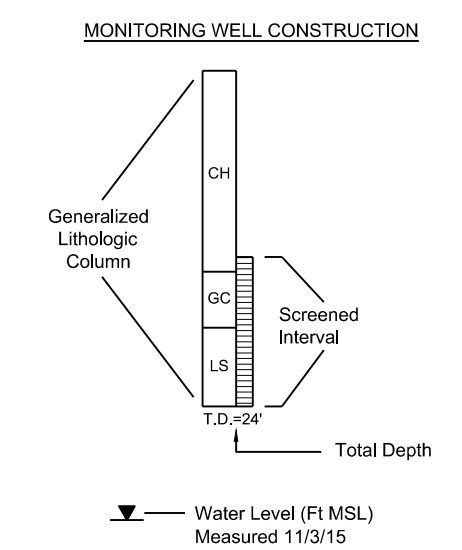
CHECKED: PJB

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EXPLANATION

[Yellow Box]	SAND
[Red Box]	CLAY
[Brown Box]	SILT

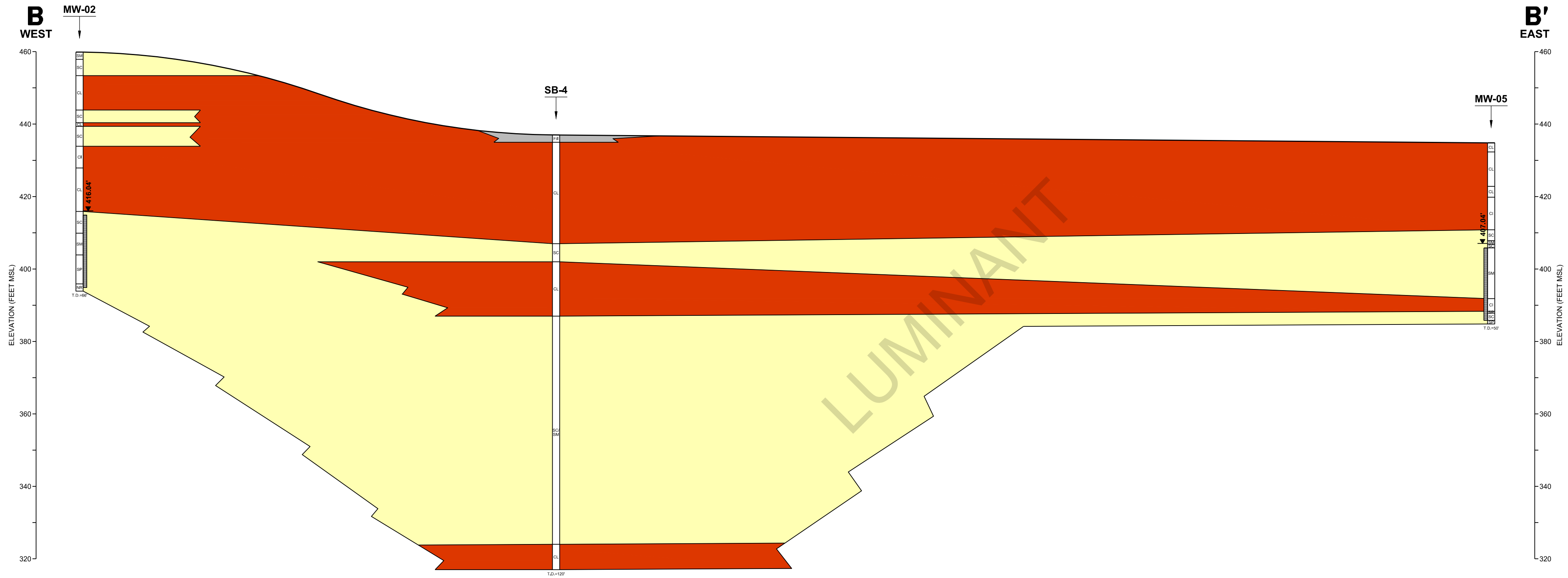


OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 4
ASH LANDFILL 1
GEOLOGIC CROSS SECTION A-A'
NORTHWEST SIDE OF LANDFILL

PROJECT: 5164D	BY: AJD	REVISIONS
DATE: OCT., 2017	CHECKED: PJB	

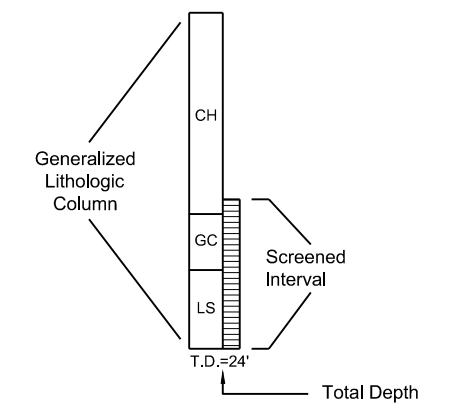
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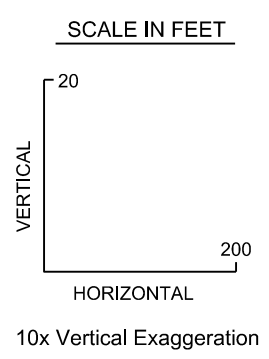
EXPLANATION

- SAND
- CLAY
- FILL

MONITORING WELL CONSTRUCTION



▼ Water Level (Ft MSL)
Measured 11/3/15



OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 5

ASH LANDFILL 1
GEOLOGIC CROSS SECTION B-B'
SOUTHEAST SIDE OF LANDFILL

PROJECT: 5164D	BY: AJD	REVISIONS
DATE: OCT., 2017	CHECKED: PJB	

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Appendix A

CCR Monitoring Well Logs

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Log of Boring: AL-10

Oak Grove Steam Electric Station Petteway, TX	Completion Date:	9/22/2015	Drilling Method:	Sonic
	Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
PBW Project No. 5164D	Driller:	Dwayne Whitehead	Total Depth (ft):	60
	Driller's License:	5814M	TOC Elevation (ft. AMSL):	460.81
	Logged By:	Sara Taube	Northing:	568673
	Sampling Method:	4"x10' Core barrel	Easting:	3197291

Depth (ft)	Well Materials	Recovery (ft/ft)	USCS	Lithologic Description
0				
5		1.3/10.0	ML	(0 - 12) Clayey SILT, tan/brown/ very dry, unconsolidated, fine to coarse subangular gravel, thin clay chips interspersed
10		2.1/5.0		
15		5.0/5.0	CL	(12 - 20) Sandy CLAY, tan/light gray, very dry, strong cementation, very hard, no plasticity, some silt present, very fine sand grains, heavily indurated, visible bands, sandier and less consolidated with depth, hardened clay nodules
20		2.4/5.0		
25		5.0/5.0	SC	(20 - 40) Clayey SAND, tan/light gray, slightly moist, moderately unconsolidated, very fine grain, some silt, trace red staining, medium to coarse nodules of very dry indurated sandy clay interbedded, trace black staining
30		9.6/10.0		
35		9.0/10.0	CL	(40 - 60) Silty CLAY, light gray, moist, slightly unconsolidated, some purple clay bands, silt decreasing with depth, wet below 50', trace orange staining
40		9.8/10.0		
45				
50				
55				
60				

PBW

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Notes:

1. This log should not be used separately from the report to which it is attached.

Well Materials

(+3.35 - 50.3) Casing, 2" Sch 40 FJT PVC
 (50.3 - 60.3) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials

(0-46') Grout
 (46'-48') Bentonite chips
 (48'-60') 20/40 sand

RECORD OF BOREHOLE MW-ALF-02

SHEET 1 OF 4
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 10-Sep-2008
BORING FINISHED: 10-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 2103.59
EASTING (ft): 1625.59
ELEVATION (ft): 459.89

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES		RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	NUMBER	TYPE		BLOWS/0.5 FT	UNDRAINED SHEAR STRENGTH Cu		
		Damp with shallow vegetation								
0		GROUND SURFACE								
		Loose, brown, silty SAND, some organics, damp		SB-1		2 4 5 N9	53			
2		Loose to compact, brown, clayey SAND, some organics, some roots, dry		SB-2		5 12 24 N10	47			
4		dense at 4'		SB-3		12 20 24 N44	53			
6		Hard, gray and yellow, mottled, silty CLAY, dry		SB-4		5 13 20 N33	73			
8		very stiff at 8'		SB-5		5 11 15 N26	73			
10		some iron oxide at 11'		SB-6		5 12 17 N29	87			
12		dark brown at 12.3'		SB-7		4 7 12 N19	87			
14		Hard, light grayish brown at 14'		SB-8		8 15 24 N39	87			
16		Hard, dark brown, CLAY, trace iron oxide, damp		SB-9		6 13 19 N32	100			
18				SB-10		6 14 40 N54	87			
20		Very dense, gray, clayey SAND, dry								
		--- CONTINUED NEXT PAGE ---								

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-02

SHEET 3 OF 4
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 10-Sep-2008
BORING FINISHED: 10-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 2103.59
EASTING (ft): 1625.59
ELEVATION (ft): 459.89

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %				ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS	
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20	40	60			80
-- CONTINUED FROM PREVIOUS PAGE --														
40				40.0										
					SB-21	15 25 38 N63	100							
42					SB-22	15 27 42 N69	93							
44		Very dense, gray, clayey SAND, damp		44.0	SB-23	16 27 50/1"	93							
46		moist at 46'			SB-24	22 46 50/3"	87							▼ 46' 09/10/2008
48		wet at 48'			SB-25	22 45 50/3"	93							
50		Very dense, gray, silty SAND, wet		50.0	SB-26	22 50/5"	67							
52					SB-27	23 46 50/2"	87							
54		some cemented clayey sand at 53'			SB-28	25 50/5"	67							
56		Very dense, gray, SAND, wet		56.0	SB-29	45 50/5"	80							
58					SB-30	45 50/5"	67							
60														
-- CONTINUED NEXT PAGE --														

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-02

SHEET 4 OF 4
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 10-Sep-2008
BORING FINISHED: 10-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 2103.59
EASTING (ft): 1625.59
ELEVATION (ft): 459.89

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20		
60		--- CONTINUED FROM PREVIOUS PAGE ---									
62				60.0	SB-31		87				
64				64.0	SB-32						
66		No recovery									
68		BORING TERMINATED AT 66'		66.0							
70											
72											
74											
76											
78											
80											

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-05

SHEET 1 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 05-Sep-2008
BORING FINISHED: 08-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 1758.08
EASTING (ft): 1973.71
ELEVATION (ft): 434.77

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES		RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER TYPE		BLOWS/0.5 FT	20 40 60 80			
		Dry with vegetation									
0		GROUND SURFACE		434.8							
		Soft to firm, dark brown, silty CLAY, with organics, dry		0.0							
2		Very stiff, light brown and yellow, mottled, CLAY, some organics, dry		2.5	SB-1	2 1 3 N4	87				
4		hard at 4'			SB-2	3 7 13 N20	67				
6		very stiff, light gray, with silt at 6'			SB-3	7 17 23 N40	67				
8		light grayish brown at 8'			SB-4	5 12 14 N26	53				
10		gray and dark brown, mottled, some iron oxide at 11'			SB-5	4 8 14 N22	87				
12		Hard, grayish brown and red, mottled, silty CLAY, dry		12.0	SB-6	5 12 16 N28	80				
14		Hard, grayish brown and red, mottled, silty CLAY, dry			SB-7	6 13 22 N35	80				
16		Hard, light gray, clayey SILT, dry		15.0	SB-8	8 29 32 N66	93				
18		reddish gray at 19'			SB-9	14 38 50/5"	87				
20		reddish gray at 19'			SB-10	20 35 46 N81	93				
-- CONTINUED NEXT PAGE --											

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-05

SHEET 2 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 05-Sep-2008
BORING FINISHED: 08-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 1758.08
EASTING (ft): 1973.71
ELEVATION (ft): 434.77

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20			
20		--- CONTINUED FROM PREVIOUS PAGE --- light grayish brown, damp at 20'										
22					SB-11	16 37 38 N75	100					
24			Very dense, yellowish gray, clayey SAND, damp	24.0	SB-12	6 17 25 N42	87					
26			grayish brown at 26'		SB-13	11 24 32 N56	100					
28			Very dense, yellowish gray, silty SAND, damp	27.0	SB-14	11 26 40 N66	87					
30			dense, seam of clayey SAND at 28'	28.0	SB-15	11 21 27 N48	87					
32			dense, light gray and brown, mottled, moist at 28.5'	29.0	SB-16	13 24 35 N59	100					
34			very dense, wet at 30'		SB-17	13 23 32 N55	93					
36			grayish brown, moist at 32'		SB-18	9 28 45 N73	100					
38			some iron oxide at 34'		SB-19	9 19 20 N39	100					
40			seam of brown at 34.5'		SB-20	9 17 22 N39	100					
			dense at 36'									
			--- CONTINUED NEXT PAGE ---									

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-05

SHEET 3 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 05-Sep-2008
BORING FINISHED: 08-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 1758.08
EASTING (ft): 1973.71
ELEVATION (ft): 434.77

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20			
40		--- CONTINUED FROM PREVIOUS PAGE --- very dense, yellowish brown, some clay at 40'		40.0	SB-21	11 21 32 N53	100					
42		dense at 42'										
43		Hard, dark grayish brown, clayey SILT, some iron oxide, damp		43.0	SB-22	12 22 40 N62	100					
44												
46		seam of yellowish SAND		46.5	SB-23	12 27 45 N72	100					
47		Very dense, gray and black, mottled, clayey SAND, some iron oxide, moist		47.0	SB-24	15 31 38 N69	100					
49		Very dense, gray, SAND, wet		49.0	SB-25	15 31 45 N76	100					
50		BORING TERMINATED AT 50'		50.0								
52												
54												
56												
58												
60												

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-06

SHEET 1 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 09-Sep-2008
BORING FINISHED: 09-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 2788.65
EASTING (ft): 2054.72
ELEVATION (ft): 436.52

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES		RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	NUMBER	TYPE		UNDRAINED SHEAR STRENGTH Cu	WATER CONTENT PERCENT PL		
	Damp						20 40 60 80			
0		GROUND SURFACE		436.5						
		Compact, light gray, SAND, with gravel		0.0	SB-1	8 5 6 6 N11				
2		Very stiff, reddish brown, CLAY, some sand, dry		2.2	SB-2	4 10 19 N29				
4		Hard, reddish brown, silty CLAY, some angular gravel, dry		4.0	SB-3	9 25 32 N57				
6		Very dense, yellowish light gray, clayey SAND, dry, some gravel, some organics, dry		6.0	SB-4	10 25 39 N64				
8					SB-5	20 50/5"				
10		dark red, some iron oxide at 9.5'			SB-6	15 35 50/5"				
12		Very dense, light yellowish brown, silty SAND, dry		12.0	SB-7	12 27 35 N62				
14		Very dense, light brown, clayey SAND, some iron oxide, dry		14.0	SB-8	18 29 47 N76				
16					SB-9	10 19 37 N56				
18		Very dense, gray, clayey SAND, some iron oxide, dry		17.5						
		Very dense, yellowish gray, silty SAND, dry		18.0	SB-10	12 33 50/5"				
20		-- CONTINUED NEXT PAGE --								

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-06

SHEET 2 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 09-Sep-2008
BORING FINISHED: 09-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 2788.65
EASTING (ft): 2054.72
ELEVATION (ft): 436.52

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES		RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		WATER CONTENT PERCENT	ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER TYPE		BLOWS/0.5 FT	20			
-- CONTINUED FROM PREVIOUS PAGE --											
20				20.0	SB-11	22 47 50/5"	80				
22		Very dense, clayey SAND, some iron oxide seam		21.5							
22		Very dense, yellowish gray, silty SAND, dry		22.0	SB-12	16 28 39 N67	87				
24		Very dense, yellowish brown, SAND, with clay seam		24.0	SB-13	13 31 40 N71	80				
26		Very dense, yellowish gray, silty SAND, damp		25.0	SB-14	3 13 13 N26	87				
26		Compact, yellowish gray, clayey SAND, damp		26.0	SB-15	12 22 50/5"	93				
28		Very dense, grayish brown, SAND, with clay, damp		28.0	SB-16	8 28 46 N74	93				
30		wet at 30'									▼ 30' 09/09/2008
32		Very dense, yellowish gray, silty SAND, wet		32.0	SB-17	25 43 48 N91	80				
34		some iron oxide at 35.5'			SB-18	8 31 27 N58	100				
36		Very dense, dark gray, clayey SAND, moist		36.0	SB-19	12 28 50/5"	100				
38		yellowish brown at 38.5'			SB-20	12 25 40 N65	93				
40		light gray at 39'									
40		dark gray, trace iron oxide at 39.5'									
-- CONTINUED NEXT PAGE --											

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-06

SHEET 3 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 09-Sep-2008
BORING FINISHED: 09-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 2788.65
EASTING (ft): 2054.72
ELEVATION (ft): 436.52

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20		
-- CONTINUED FROM PREVIOUS PAGE --											
40				40.0							
		Very dense, yellowish brown, silty SAND, damp		41.0	SB-21	11 26 42 N68	100				
42		Hard, brown, yellow, and gray, mottled, sandy CLAY, moist		42.0							
		Very dense, yellowish brown and gray, mottled, clayey SAND, moist dark brown at 43.5'		43.0	SB-22	15 34 42 N76	100				
44											
46		Very dense, gray and yellowish brown, mottled, SAND, moist		46.0	SB-24	22 40 50/5"	60				
48		gray and dark gray, mottled, some clay at 48'									
50		BORING TERMINATED AT 50'		50.0	SB-25	30 50/5"	67				
52											
54											
56											
58											
60											

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-07

SHEET 2 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 27-Aug-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY

NORTHING (ft): 3770.18
EASTING (ft): 1654.96
ELEVATION (ft): 440.00

BORING FINISHED: 28-Aug-2008

DRILLING OPERATOR: Lewis Environmental Drilling

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %				ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20	40	60		
20		--- CONTINUED FROM PREVIOUS PAGE --- Compact, occasional organic layers at 20'											
22		yellowish gray at 22'											
24		Dense, gray, silty SAND, damp											
24		very dense at 24'											
24.75		reddish brown seam at 24.75'											
26		Very dense, gray, SAND, damp											
27.5		reddish brown seam at 27.5'											
29		reddish yellow seam at 29'											
29.5		brownish gray seam at 29.5'											
30		moist at 30'											
36.3		dense, dark brown, with clay, some iron oxide, damp at 36.3'											
38		wet at 38'											
39		yellowish brown, damp at 39'											
40		--- CONTINUED NEXT PAGE ---											

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-07

SHEET 3 OF 3
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 27-Aug-2008
BORING FINISHED: 28-Aug-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 3770.18
EASTING (ft): 1654.96
ELEVATION (ft): 440.00

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.5 FT		20	40		
40		--- CONTINUED FROM PREVIOUS PAGE --- very dense, reddish brown, moist at 40'		40.0							
					SB-21	12 26 31 N57	87				
			gray, damp at 41'								
42			very dense, yellowish brown, moist at 42'								
			wet at 42.5'		SB-22	14 32 37 N69	100				
44											
			damp at 45'		SB-23	15 31 45 N76	67				
46			grayish brown, moist at 46'								
					SB-24	18 28 36 N64	100				
48			wet at 48'								
					SB-25	20 38 50/5"	93				
50											
					SB-26	24 50/5"	100				
52			BORING TERMINATED AT 52'	52.0							
54											
56											
58											
60											

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

Luminant

Log of Boring: MW-8R

Oak Grove Steam Electric Station Robertson County, TX	Completion Date:	11/9/2016	Drilling Method:	HSA
	Drilling Company:	Sunbelt Industrial Services	Borehole Diameter (in.):	8.25
PBW Project No. 5164D	Driller:	Juan R. Alcala	Total Depth (ft):	52.5
	Driller's License:	59430	TOC Elevation (ft. AMSL):	443.84
	Logged By:	Michelle Hermiston	Northing:	570970
	Sampling Method:	2.25" X 5' Split Spoon	Easting:	3199809

Depth (ft)	Well Materials	Recovery (ft/ft)	USCS	Lithologic Description
0		3.0/5.0	SM	(0 - 3) Silty SAND, dark brown, abundant roots, very fine grained sand, unconsolidated, damp, gradational basal contact
5		3.0/5.0		(3 - 10.5) Silty CLAY, mottled gray, orange, and red, firm, very firm from 4.0' to 5.0', pieces of lignite present throughout, moderate plasticity, damp, sharp basal contact
10		3.0/5.0		
15		4.0/5.0	CL	
20		4.0/5.0		(10.5 - 27.5) Sandy CLAY, laminated light gray and orange/brown, trace black laminations present, no to low plasticity, moderate plasticity at 17.5' to 27.5', higher sand content at 15.0' to 17.5', purplish gray clay lenses from 23.0' to 27.5', soft, firm to very firm from 17.5' to 27.5', damp, gradational basal contact
25		5.0/5.0		
30		5.0/5.0		
35		3.5/5.0	SM	(27.5 - 52.5) Silty SAND, light gray, laminated dark gray and orange (28.5'-31.0', 38.0'-42.0'), unconsolidated, trace clay present, 0.25" thick clay lenses at 31.5', 37.5', and 41.0', dark brown/red around clay lense at 37.5', trace black laminae at 38.0' to 40.0', moist, wet at 35.0', interbedded dark brownish red and light gray sand and clay at 42.0' to 45.5', orange/brown from 45.5' to 50.0', gray with some orange staining from 50.0' to 52.5'
40		4.0/5.0		
45		3.0/5.0		
50		2.5/2.5		

PBW

Pastor, Behling & Wheeler, LLC
 2201 Double Creek Dr., Suite 4004
 Round Rock, TX 78664
 Tel (512) 671-3434 Fax (512) 671-3446

Notes:

1. This log should not be used separately from the report to which it is attached.

Well Materials

(+2.5 - 32.5) Casing, 2" Sch 40 FJT PVC
 (32.5 - 52.5) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials

(0-30.5') Bentonite Grout
 (30.5'-52.5') 20/40 sand

RECORD OF BOREHOLE MW-ALF-08

SHEET 1 OF 4
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 29-Aug-2008
BORING FINISHED: 01-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 3681.62
EASTING (ft): 266.62
ELEVATION (ft): 458.55

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES		RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER TYPE		BLOWS/0.5 FT	UNDRAINED SHEAR STRENGTH Cu		
		Damp with shallow vegetation								
0		GROUND SURFACE		458.6						
		Stiff, dark brown, gray, and red, mottled, CLAY, with silt, some organics, damp		0.0						
					SB-1	3 3 3 3 N9	33			
2		Very stiff, reddish brown, silty CLAY, dry		2.0						
		red and light gray, mottled, some organics at 3'			SB-2	6 11 16 N27	67			
		light gray at 4'								
		yellow to orange, mottled, dry at 5'			SB-3	6 12 15 N27	67			
		hard at 6'								
		some organics at 7'			SB-4	8 17 19 N36	100			
		reddish gray at 7.5'								
		very stiff at 8'			SB-5	7 12 16 N23	93			
		light gray, damp at 9'								
10		Very stiff, gray, CLAY, damp		10.0						
					SB-6	3 8 11 N19	87			
		hard, yellowish gray at 12'								
					SB-7	5 9 22 N31	100			
		Dense, light gray, SAND, with silt, dry		13.5						
					SB-8	8 13 22 N35	100			
		seam of yellow clayey sand at 16'								
					SB-9	11 18 27 N45	100			
		Dense, light brown and yellow, mottled, clayey SAND, damp		18.0						
					SB-10	8 17 28 N45	100			
20		-- CONTINUED NEXT PAGE --								

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-08

SHEET 2 OF 4
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 29-Aug-2008
BORING FINISHED: 01-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 3681.62
EASTING (ft): 266.62
ELEVATION (ft): 458.55

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20		
20		--- CONTINUED FROM PREVIOUS PAGE ---									
		very dense, grayish brown, some silt at 20'		20.0							
					SB-11	13 26 39 N65	100				
22		dense at 22'									
					SB-12	14 20 28 N48	100				
24											
					SB-13	11 19 28 N47	100				
26		Very dense, grayish brown, SAND, with clay, damp		26.0							
					SB-14	14 28 42 N70	100				
28											
					SB-15	10 22 36 N58	87				
30		Very dense, yellowish brown, clayey SAND, damp		30.0							
					SB-16	12 26 41 N67	100				
32		compact, light gray, some silt at 32'									
					SB-17	8 12 15 N27	100				
34		Very stiff, light gray, silty CLAY, damp		33.0							
					SB-18	6 11 13 N24	100				
36		dark gray at 35.5' hard, grayish black, dry at 36'									
					SB-19	20 45 50/5"	100				
38		black at 37'									
					SB-20	15 45 50/5"	100				
40		--- CONTINUED NEXT PAGE ---									

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-08

SHEET 3 OF 4
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 29-Aug-2008
BORING FINISHED: 01-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 3681.62
EASTING (ft): 266.62
ELEVATION (ft): 458.55

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	NUMBER	TYPE	BLOWS/0.5 FT		20	40		
-- CONTINUED FROM PREVIOUS PAGE --											
40											
			40.0								
				SB-21	10 41 50/5"	100					
				SB-22	18 50/5"	87					
				SB-23	20 46 50/5"	100					
				SB-24	22 50/5"	87					
		Very dense, gray, silty SAND, moist	47.0								
				SB-25	25 50/5"	53					
				SB-26	30 50/5"	73					
				SB-27	23 50/5"	67					
		Hard, black, CLAY	52.5								
		Very dense, gray, silty SAND, moist	52.8								
				SB-28	18 50/5"	67					
				SB-29	27 50/5"	67					
				SB-30	27 50/5"	87					
-- CONTINUED NEXT PAGE --											

47' 08/29/2008

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

RECORD OF BOREHOLE MW-ALF-08

SHEET 4 OF 4
DATUM: LOCAL

PROJECT: OAK GROVE SES
LOCATION: FRANKLIN, TEXAS

BORING STARTED: 29-Aug-2008
BORING FINISHED: 01-Sep-2008

DRILLING EQUIPMENT: MOBILE B-57 BUGGY
DRILLING OPERATOR: Lewis Environmental Drilling

NORTHING (ft): 3681.62
EASTING (ft): 266.62
ELEVATION (ft): 458.55

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE		SAMPLES			RECOVERY%	ROCK QUALITY DESIGNATION (RQD) %		ADDITIONAL LAB. TESTING	INSTALLATION NOTES AND GROUNDWATER OBSERVATIONS
		DESCRIPTION	STRATA PLOT	ELEV. DEPTH (ft)	NUMBER	TYPE		BLOWS/0.5 FT	20		
60		--- CONTINUED FROM PREVIOUS PAGE --- Very dense, gray, silty SAND, moist									
62					SB-31		24 41 50/5"	100			
64					SB-32		23 50/5"	80			
64		Very dense, gray, SAND, layered with clay, moist		64.0							
66				64.9	SB-33		17 41 50/5"	87			
				65.2							
				65.4							
				65.7							
				66.0							
				66.4							
68		BORING TERMINATED AT 67'		67.0	SB-34		17 42 50/5"	100			

OAK GROVE - MW 94281GINT.GPJ GLDR HOU.GDT 10/31/08

DEPTH SCALE
1 inch to 2.5 feet



LOGGED: DH
CHECKED: BLT

LUMINANT

Appendix B

Photographs of CCR Monitoring Wells

**Appendix B – Photographs of CCR Monitoring Wells
Oak Grove Ash Landfill 1**



Photograph 1: AL-10



Photograph 2: MW-02

**Appendix B – Photographs of CCR Monitoring Wells
Oak Grove Ash Landfill 1**



Photograph 5: MW-05



Photograph 7: MW-07

**Appendix B – Photographs of CCR Monitoring Wells
Oak Grove Ash Landfill 1**



Photograph 8: MW-08



Photograph 9: MW-09


LUMINANT

Appendix C

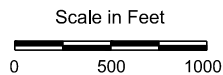
Potentiometric Surface Maps



EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 -** Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)

Note:
423.76*-measurement appears erroneous based on subsequent measurements. Result was not used to construct potentiometric surface contours.



SOURCE:
Imagery from www.tnris.gov, Robertson Co., aerial photographs, 2012.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 1


GROUNDWATER POTENTIOMETRIC SURFACE MAP
NOVEMBER 3, 2015

PROJECT: 5164D	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



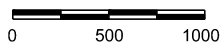
EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 —** Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)

Note:
423.89*-measurement appears erroneous based on subsequent measurements. Result was not used to construct potentiometric surface contours.



Scale in Feet



SOURCE:
Imagery from www.tnris.gov, Robertson Co., aerial photographs, 2012.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 2


**GROUNDWATER
POTENTIOMETRIC SURFACE MAP
DECEMBER 12, 2015**

PROJECT: 5164D	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

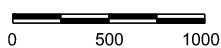


EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 —** Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)



Scale in Feet



SOURCE:
Imagery from www.tnris.gov, Robertson Co., aerial photographs, 2012.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 3

**GROUNDWATER
POTENTIOMETRIC SURFACE MAP
FEBRUARY 9-10, 2016**

PROJECT: 5164D

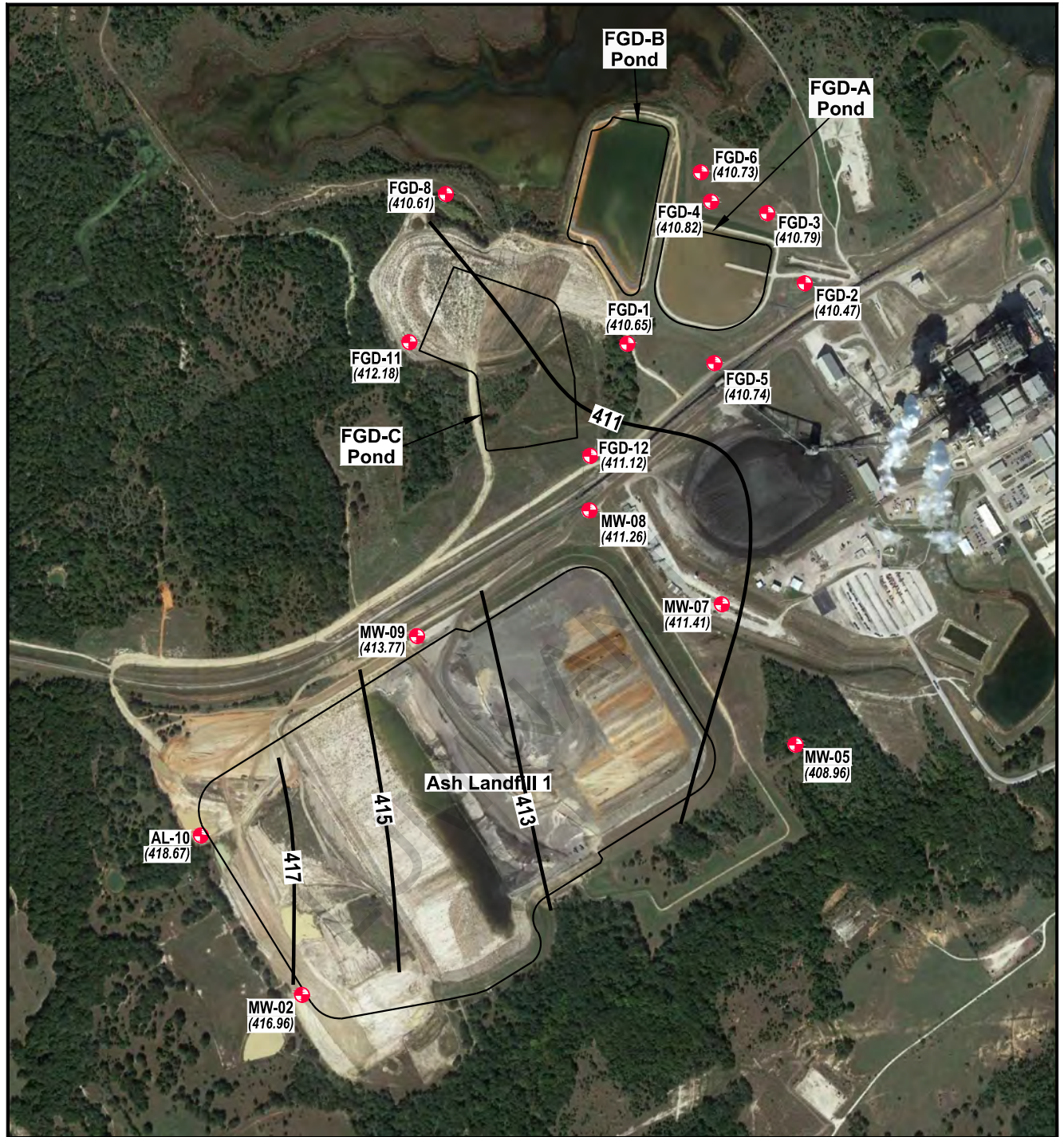
BY: AJD

REVISIONS


DATE: SEPT., 2017

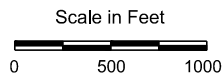
CHECKED: PJB

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 —** Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)



SOURCE:
Imagery from Google Earth dated 10/30/2014.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 4


**GROUNDWATER
POTENTIOMETRIC SURFACE MAP
APRIL 14-15, 2016**

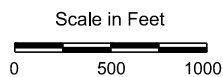
PROJECT: 5164D	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 —** Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)



SOURCE:
Imagery from Google Earth dated 10/30/2014.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 5

**GROUNDWATER
POTENTIOMETRIC SURFACE MAP
JUNE 16, 2016**

PROJECT: 5164D

BY: AJD

REVISIONS


DATE: SEPT., 2017

CHECKED: PJB

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

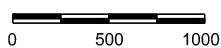


EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 —** Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)



Scale in Feet



SOURCE:
Imagery from Google Earth dated 10/30/2014.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 6

**GROUNDWATER
POTENTIOMETRIC SURFACE MAP
AUGUST 24, 2016**

PROJECT: 5164D

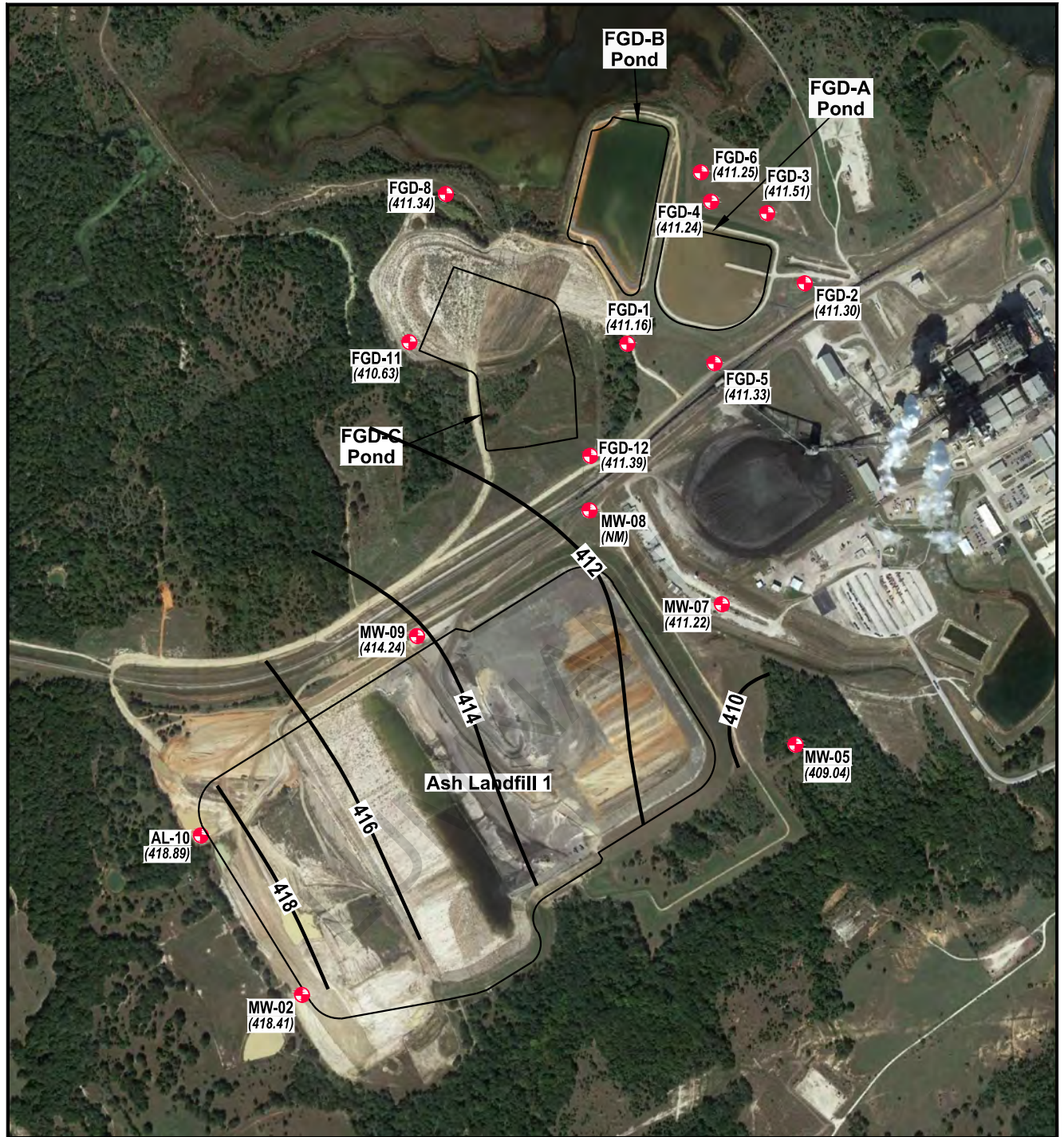
BY: AJD

REVISIONS


DATE: SEPT., 2017

CHECKED: PJB

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

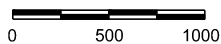


EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 —** Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)



Scale in Feet



SOURCE:
Imagery from Google Earth dated 10/30/2014.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 7


**GROUNDWATER
POTENTIOMETRIC SURFACE MAP
OCTOBER 4, 2016**

PROJECT: 5164D	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

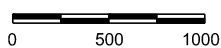


EXPLANATION

-  CCR Monitoring Well Location
- (410.06)** Groundwater Potentiometric Surface (ft. MSL)
- 400 —** Groundwater Potentiometric Surface Contour (C.I. = 5 ft.)



Scale in Feet



SOURCE:
Imagery from Google Earth dated 10/30/2014.

OAK GROVE STEAM ELECTRIC STATION
ROBERTSON COUNTY, TEXAS

Figure 8

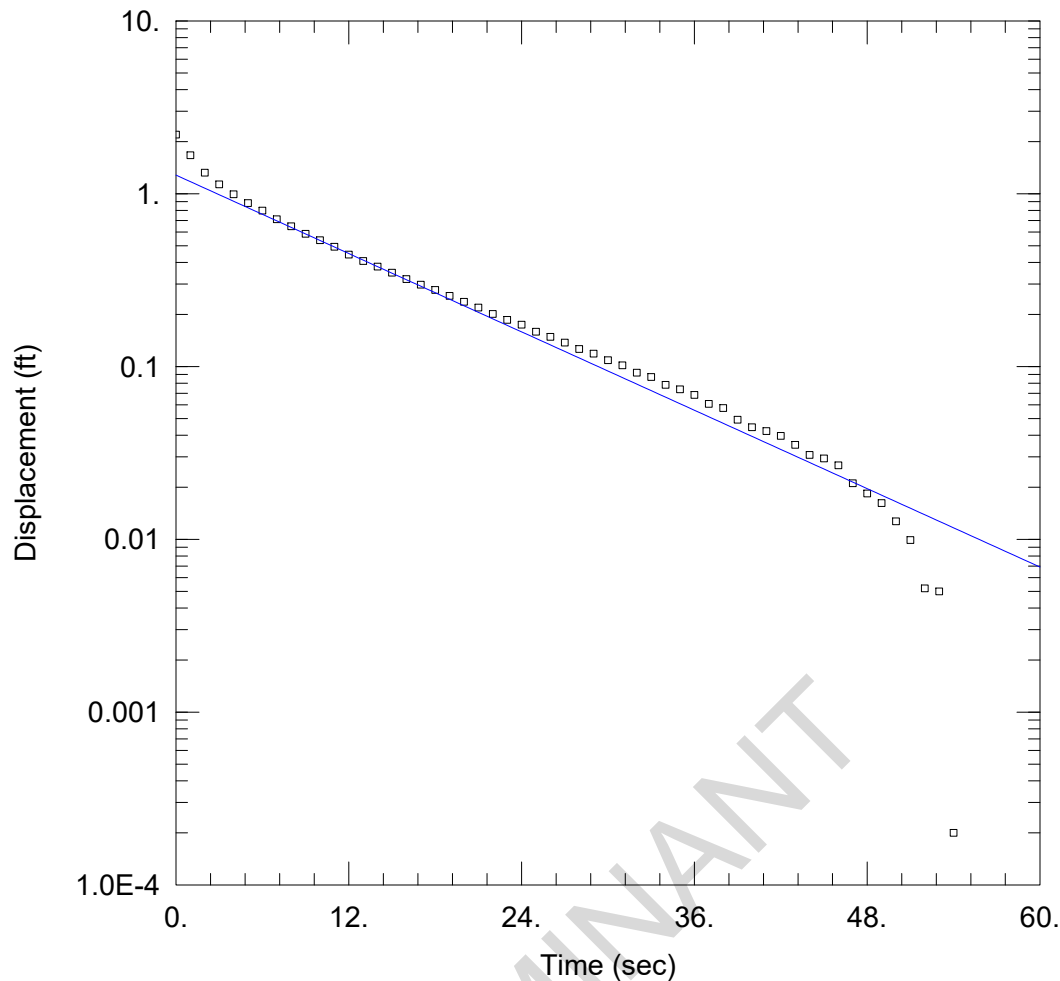
**GROUNDWATER
POTENTIOMETRIC SURFACE MAP
DECEMBER 19, 2016**

PROJECT: 5164D	BY: AJD	REVISIONS
DATE: SEPT., 2017	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

Appendix D
Aquifer Test Data

LUMINANT



WELL TEST ANALYSIS

Data Set: J:\...\MW-02 Slug OUT.aqt
 Date: 01/18/16

Time: 17:05:57

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: OGSES
 Test Well: MW-02
 Test Date: 9-23-15

AQUIFER DATA

Saturated Thickness: 19.74 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-02)

Initial Displacement: 2.2 ft
 Total Well Penetration Depth: 19.74 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 19.74 ft
 Screen Length: 19.74 ft
 Well Radius: 0.39 ft
 Gravel Pack Porosity: 0.2

SOLUTION

Aquifer Model: Unconfined
 K = 0.007252 cm/sec

Solution Method: Bower-Rice
 y0 = 1.281 ft

Data Set: J:\5164 - Luminant CCR Well Installation and GW Sampling\5164-D_Oak Grove\OGSES Slug Tests Sept 2015
 Date: 01/18/16
 Time: 17:06:12

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: OGSES
 Test Date: 9-23-15
 Test Well: MW-02

AQUIFER DATA

Saturated Thickness: 19.74 ft
 Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-02

X Location: 0. ft
 Y Location: 0. ft

Initial Displacement: 2.2 ft
 Static Water Column Height: 19.74 ft
 Casing Radius: 0.083 ft
 Well Radius: 0.39 ft
 Well Skin Radius: 0.39 ft
 Screen Length: 19.74 ft
 Total Well Penetration Depth: 19.74 ft
 Corrected Casing Radius (Bouwer-Rice Method): 0.1896 ft
 Gravel Pack Porosity: 0.2

No. of Observations: 55

Observation Data			
Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
0.	0.	28.	0.1264
1.	1.668	29.	0.1188
2.	1.325	30.	0.1088
3.	1.134	31.	0.1017
4.	0.9925	32.	0.0922
5.	0.8819	33.	0.0869
6.	0.7979	34.	0.0783
7.	0.7112	35.	0.0738
8.	0.648	36.	0.0685
9.	0.5866	37.	0.0608
10.	0.5383	38.	0.0575
11.	0.493	39.	0.0492
12.	0.4444	40.	0.0445
13.	0.4083	41.	0.0423
14.	0.3786	42.	0.0397
15.	0.3494	43.	0.0352
16.	0.3209	44.	0.0308
17.	0.2974	45.	0.0294
18.	0.2775	46.	0.0268
19.	0.2564	47.	0.0211
20.	0.2369	48.	0.0184
21.	0.2193	49.	0.0162
22.	0.2013	50.	0.0127
23.	0.1863	51.	0.0099
24.	0.1747	52.	0.0052
25.	0.1589	53.	0.005
26.	0.1485	54.	0.0002
27.	0.1375		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.004

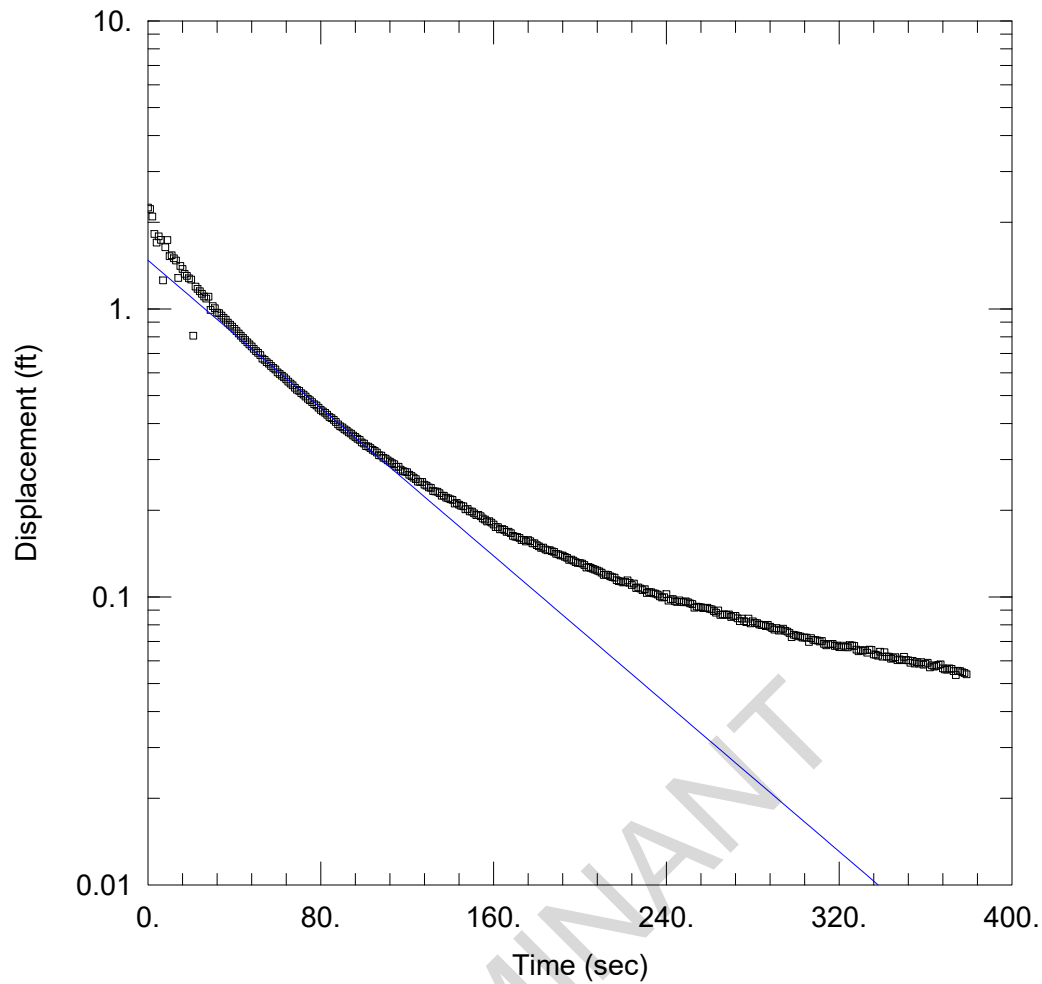
VISUAL ESTIMATION RESULTS

Estimated Parameters

<u>Parameter</u>	<u>Estimate</u>	
K	0.007252	cm/sec
y0	1.281	ft

$T = K \cdot b = 4.364 \text{ cm}^2/\text{sec}$

LUMINANT



WELL TEST ANALYSIS

Data Set: J:\...\MW-05 slug IN.aqt
 Date: 01/18/16

Time: 17:06:52

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: Oak Grove
 Test Well: MW-05
 Test Date: 9/23/15

AQUIFER DATA

Saturated Thickness: 22.18 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-05)

Initial Displacement: 2.25 ft
 Total Well Penetration Depth: 22.18 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.18 ft
 Screen Length: 21.3 ft
 Well Radius: 0.39 ft

SOLUTION

Aquifer Model: Unconfined
 K = 0.0002251 cm/sec

Solution Method: Bower-Rice
 y0 = 1.475 ft

Data Set: J:\5164 - Luminant CCR Well Installation and GW Sampling\5164-D_Oak Grove\OGSES Slug Tests Sept 2015
 Date: 01/19/16
 Time: 09:29:23

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: Oak Grove
 Test Date: 9/23/15
 Test Well: MW-05

AQUIFER DATA

Saturated Thickness: 22.18 ft
 Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-05

X Location: 0. ft
 Y Location: 0. ft

Initial Displacement: 2.25 ft
 Static Water Column Height: 22.18 ft
 Casing Radius: 0.083 ft
 Well Radius: 0.39 ft
 Well Skin Radius: 0.39 ft
 Screen Length: 21.3 ft
 Total Well Penetration Depth: 22.18 ft

No. of Observations: 380

Time (sec)	Observation Data		Displacement (ft)
	Displacement (ft)	Time (sec)	
0.	0.	190.	0.1407
1.	2.224	191.	0.1394
2.	2.095	192.	0.1392
3.	1.821	193.	0.1378
4.	1.699	194.	0.1367
5.	1.787	195.	0.1345
6.	1.737	196.	0.1348
7.	1.257	197.	0.1336
8.	1.637	198.	0.1321
9.	1.734	199.	0.1313
10.	1.524	200.	0.131
11.	1.535	201.	0.1306
12.	1.5	202.	0.129
13.	1.473	203.	0.1264
14.	1.28	204.	0.1271
15.	1.41	205.	0.1262
16.	1.375	206.	0.1251
17.	1.323	207.	0.1244
18.	1.303	208.	0.1234
19.	1.278	209.	0.1227
20.	1.264	210.	0.1214
21.	0.8071	211.	0.1192
22.	1.195	212.	0.1195
23.	1.174	213.	0.1193
24.	1.152	214.	0.1178
25.	1.128	215.	0.1171
26.	1.104	216.	0.1166
27.	1.085	217.	0.1143
28.	1.103	218.	0.1134
29.	0.9916	219.	0.1132

<u>Time (sec)</u>	<u>Displacement (ft)</u>	<u>Time (sec)</u>	<u>Displacement (ft)</u>
30.	1.023	220.	0.1123
31.	1.005	221.	0.1127
32.	0.9699	222.	0.1141
33.	0.9668	223.	0.112
34.	0.9486	224.	0.11
35.	0.9319	225.	0.1113
36.	0.9174	226.	0.1073
37.	0.8969	227.	0.1079
38.	0.8815	228.	0.1069
39.	0.8682	229.	0.1056
40.	0.8524	230.	0.1064
41.	0.8374	231.	0.1032
42.	0.8212	232.	0.104
43.	0.807	233.	0.1039
44.	0.7929	234.	0.1029
45.	0.7799	235.	0.1026
46.	0.7662	236.	0.1019
47.	0.7536	237.	0.1004
48.	0.7413	238.	0.0995
49.	0.7265	239.	0.0998
50.	0.7142	240.	0.1022
51.	0.7035	241.	0.0971
52.	0.6911	242.	0.098
53.	0.6721	243.	0.0983
54.	0.6655	244.	0.0965
55.	0.6534	245.	0.096
56.	0.6451	246.	0.0973
57.	0.6336	247.	0.0962
58.	0.624	248.	0.0958
59.	0.6159	249.	0.0965
60.	0.602	250.	0.0958
61.	0.5944	251.	0.0949
62.	0.5859	252.	0.0945
63.	0.5789	253.	0.0917
64.	0.5691	254.	0.0926
65.	0.559	255.	0.0923
66.	0.5506	256.	0.0921
67.	0.543	257.	0.0915
68.	0.5328	258.	0.0916
69.	0.5241	259.	0.0917
70.	0.5193	260.	0.0909
71.	0.51	261.	0.0906
72.	0.504	262.	0.0893
73.	0.4966	263.	0.0882
74.	0.4879	264.	0.0898
75.	0.4818	265.	0.0866
76.	0.4747	266.	0.0869
77.	0.4668	267.	0.0869
78.	0.4621	268.	0.0866
79.	0.4539	269.	0.0869
80.	0.4459	270.	0.0852
81.	0.4409	271.	0.0859
82.	0.4357	272.	0.0859
83.	0.429	273.	0.0843
84.	0.4213	274.	0.0824
85.	0.4175	275.	0.0841
86.	0.4117	276.	0.0824
87.	0.4049	277.	0.0818
88.	0.3975	278.	0.0841
89.	0.3912	279.	0.0809
90.	0.388	280.	0.0823
91.	0.3819	281.	0.0813
92.	0.3782	282.	0.0811
93.	0.3729	283.	0.0802
94.	0.3688	284.	0.0799
95.	0.3631	285.	0.0799

<u>Time (sec)</u>	<u>Displacement (ft)</u>	<u>Time (sec)</u>	<u>Displacement (ft)</u>
96.	0.3591	286.	0.0792
97.	0.3543	287.	0.08
98.	0.3512	288.	0.0788
99.	0.3438	289.	0.0779
100.	0.3406	290.	0.077
101.	0.3337	291.	0.078
102.	0.3328	292.	0.0764
103.	0.3287	293.	0.077
104.	0.3242	294.	0.0776
105.	0.3214	295.	0.0763
106.	0.3173	296.	0.0758
107.	0.3106	297.	0.0749
108.	0.3098	298.	0.0725
109.	0.3042	299.	0.0739
110.	0.3021	300.	0.0735
111.	0.2978	301.	0.0732
112.	0.2948	302.	0.0729
113.	0.2915	303.	0.0722
114.	0.289	304.	0.0723
115.	0.283	305.	0.0722
116.	0.2831	306.	0.0698
117.	0.2767	307.	0.0719
118.	0.2735	308.	0.0709
119.	0.272	309.	0.0708
120.	0.2712	310.	0.0706
121.	0.2655	311.	0.07
122.	0.2627	312.	0.0703
123.	0.2594	313.	0.0687
124.	0.2565	314.	0.0679
125.	0.2515	315.	0.0684
126.	0.2506	316.	0.0686
127.	0.2506	317.	0.0687
128.	0.2454	318.	0.0676
129.	0.2434	319.	0.0678
130.	0.2401	320.	0.067
131.	0.2391	321.	0.0669
132.	0.2331	322.	0.0677
133.	0.2324	323.	0.0671
134.	0.2318	324.	0.0668
135.	0.2292	325.	0.068
136.	0.2245	326.	0.0678
137.	0.2245	327.	0.0676
138.	0.2211	328.	0.0656
139.	0.2201	329.	0.0648
140.	0.2183	330.	0.0653
141.	0.2173	331.	0.0651
142.	0.211	332.	0.0653
143.	0.2119	333.	0.064
144.	0.209	334.	0.0656
145.	0.2073	335.	0.0654
146.	0.2063	336.	0.0631
147.	0.2015	337.	0.063
148.	0.2019	338.	0.0625
149.	0.1982	339.	0.0645
150.	0.1978	340.	0.062
151.	0.1951	341.	0.0643
152.	0.1925	342.	0.0621
153.	0.1926	343.	0.062
154.	0.1906	344.	0.061
155.	0.1874	345.	0.0613
156.	0.1855	346.	0.0618
157.	0.1829	347.	0.0603
158.	0.1833	348.	0.0607
159.	0.1811	349.	0.0603
160.	0.1784	350.	0.0619
161.	0.1748	351.	0.0604

<u>Time (sec)</u>	<u>Displacement (ft)</u>	<u>Time (sec)</u>	<u>Displacement (ft)</u>
162.	0.1747	352.	0.0602
163.	0.1717	353.	0.0591
164.	0.1721	354.	0.06
165.	0.1709	355.	0.0587
166.	0.1683	356.	0.0594
167.	0.1684	357.	0.0587
168.	0.1665	358.	0.0594
169.	0.1629	359.	0.0582
170.	0.1618	360.	0.0586
171.	0.1614	361.	0.0591
172.	0.1603	362.	0.0569
173.	0.1575	363.	0.0579
174.	0.1578	364.	0.0573
175.	0.1557	365.	0.0576
176.	0.1575	366.	0.0581
177.	0.1562	367.	0.0583
178.	0.1535	368.	0.0565
179.	0.1536	369.	0.056
180.	0.1512	370.	0.0559
181.	0.1499	371.	0.0565
182.	0.1481	372.	0.0563
183.	0.1484	373.	0.0553
184.	0.1461	374.	0.0535
185.	0.1451	375.	0.0554
186.	0.1453	376.	0.0553
187.	0.144	377.	0.0548
188.	0.1433	378.	0.0544
189.	0.1411	379.	0.0539

SOLUTION

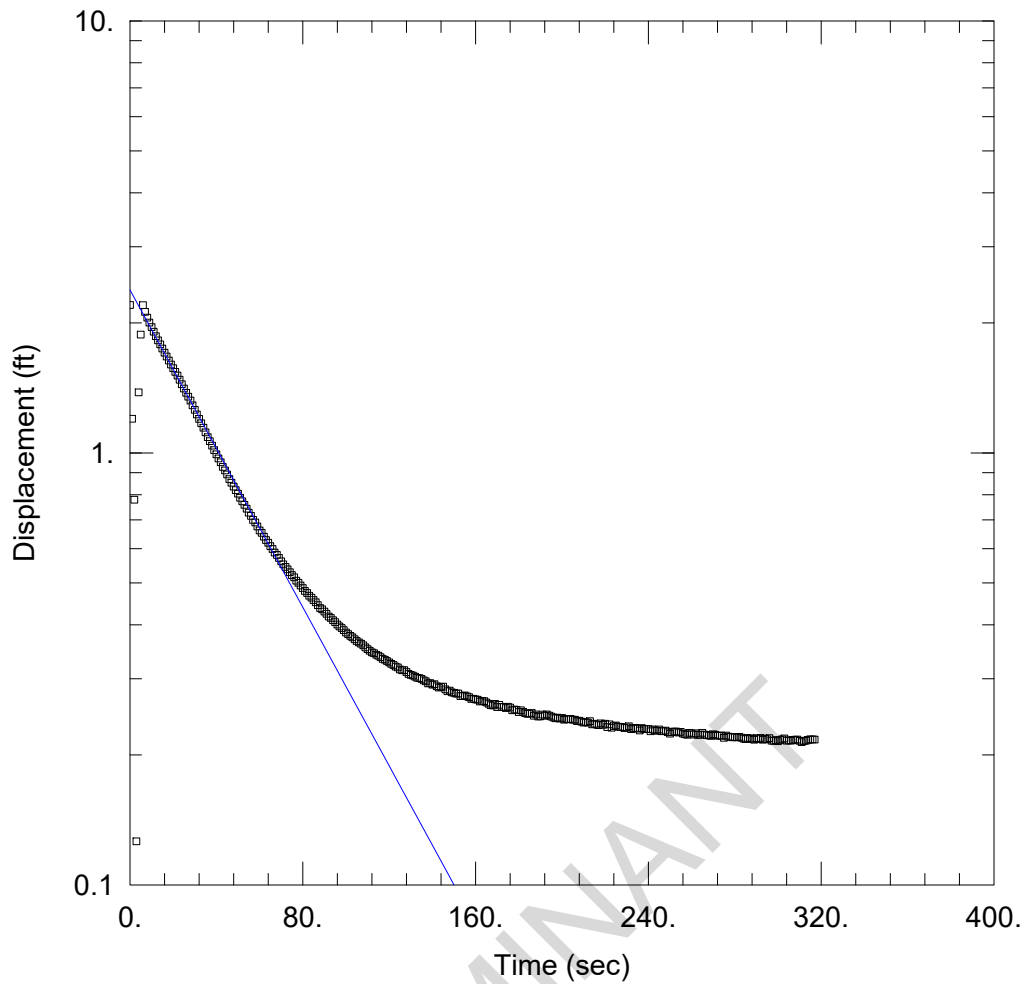
Slug Test
 Aquifer Model: Unconfined
 Solution Method: Bouwer-Rice
 ln(Re/rw): 0.

VISUAL ESTIMATION RESULTS

Estimated Parameters

<u>Parameter</u>	<u>Estimate</u>	
K	0.0002251	cm/sec
y0	1.475	ft

$T = K \cdot b = 0.1522 \text{ cm}^2/\text{sec}$



WELL TEST ANALYSIS

Data Set: J:\...\MW-05 SluG OUT.aqt
 Date: 01/19/16

Time: 09:30:32

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: OGSES
 Test Well: MW-05
 Test Date: 9-23-15

AQUIFER DATA

Saturated Thickness: 22.18 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-5)

Initial Displacement: 2.2 ft
 Total Well Penetration Depth: 22.18 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 22.18 ft
 Screen Length: 21.3 ft
 Well Radius: 0.39 ft

SOLUTION

Aquifer Model: Unconfined
 K = 0.0003221 cm/sec

Solution Method: Bower-Rice
 y0 = 2.384 ft

Data Set: J:\5164 - Luminant CCR Well Installation and GW Sampling\5164-D_Oak Grove\OGSES Slug Tests Sept 2015
 Date: 01/19/16
 Time: 09:30:55

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: OGSES
 Test Date: 9-23-15
 Test Well: MW-05

AQUIFER DATA

Saturated Thickness: 22.18 ft
 Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-5

X Location: 0. ft
 Y Location: 0. ft

Initial Displacement: 2.2 ft
 Static Water Column Height: 22.18 ft
 Casing Radius: 0.083 ft
 Well Radius: 0.39 ft
 Well Skin Radius: 0.39 ft
 Screen Length: 21.3 ft
 Total Well Penetration Depth: 22.18 ft

No. of Observations: 317

Time (sec)	Observation Data		Displacement (ft)
	Displacement (ft)	Time (sec)	
1.	1.2	160.	0.2689
2.	0.7792	161.	0.2684
3.	0.1262	162.	0.2658
4.	1.381	163.	0.2665
5.	1.878	164.	0.2662
6.	2.197	165.	0.2646
7.	2.121	166.	0.2626
8.	2.057	167.	0.2607
9.	2.002	168.	0.2602
10.	1.956	169.	0.2625
11.	1.907	170.	0.2581
12.	1.863	171.	0.2611
13.	1.822	172.	0.2583
14.	1.784	173.	0.2582
15.	1.744	174.	0.2568
16.	1.707	175.	0.2585
17.	1.672	176.	0.2573
18.	1.637	177.	0.2537
19.	1.602	178.	0.2548
20.	1.571	179.	0.254
21.	1.541	180.	0.2513
22.	1.51	181.	0.2536
23.	1.478	182.	0.2516
24.	1.443	183.	0.2498
25.	1.41	184.	0.2489
26.	1.378	185.	0.2492
27.	1.35	186.	0.2501
28.	1.322	187.	0.2464
29.	1.289	188.	0.2481
30.	1.259	189.	0.2454

<u>Time (sec)</u>	<u>Displacement (ft)</u>	<u>Time (sec)</u>	<u>Displacement (ft)</u>
31.	1.228	190.	0.2456
32.	1.199	191.	0.2479
33.	1.171	192.	0.2464
34.	1.143	193.	0.2482
35.	1.116	194.	0.2466
36.	1.087	195.	0.2453
37.	1.065	196.	0.2442
38.	1.04	197.	0.2431
39.	1.015	198.	0.2439
40.	0.9928	199.	0.2427
41.	0.9712	200.	0.2434
42.	0.9512	201.	0.2412
43.	0.9277	202.	0.2421
44.	0.9107	203.	0.2418
45.	0.8916	204.	0.2422
46.	0.8702	205.	0.2412
47.	0.8531	206.	0.2413
48.	0.8354	207.	0.2393
49.	0.8202	208.	0.2399
50.	0.8047	209.	0.2387
51.	0.7875	210.	0.2376
52.	0.7723	211.	0.2382
53.	0.7583	212.	0.2375
54.	0.7432	213.	0.2394
55.	0.7274	214.	0.2353
56.	0.715	215.	0.2361
57.	0.6999	216.	0.2351
58.	0.6904	217.	0.2343
59.	0.676	218.	0.2366
60.	0.6618	219.	0.2348
61.	0.6534	220.	0.2362
62.	0.6401	221.	0.232
63.	0.6285	222.	0.2354
64.	0.6196	223.	0.2312
65.	0.6084	224.	0.2332
66.	0.5991	225.	0.2339
67.	0.5882	226.	0.2323
68.	0.5807	227.	0.2321
69.	0.5714	228.	0.2318
70.	0.561	229.	0.2308
71.	0.552	230.	0.2316
72.	0.5446	231.	0.2329
73.	0.5377	232.	0.2293
74.	0.5295	233.	0.2306
75.	0.5214	234.	0.2309
76.	0.5152	235.	0.2299
77.	0.506	236.	0.2279
78.	0.5005	237.	0.2308
79.	0.4932	238.	0.2295
80.	0.4866	239.	0.2293
81.	0.4793	240.	0.2295
82.	0.4739	241.	0.2268
83.	0.4673	242.	0.2289
84.	0.4623	243.	0.228
85.	0.4565	244.	0.2274
86.	0.451	245.	0.2289
87.	0.4443	246.	0.2269
88.	0.4375	247.	0.2271
89.	0.4343	248.	0.2276
90.	0.4292	249.	0.2256
91.	0.4244	250.	0.2239
92.	0.418	251.	0.2257
93.	0.415	252.	0.2264
94.	0.4099	253.	0.2264
95.	0.4059	254.	0.2253
96.	0.4006	255.	0.2261

<u>Time (sec)</u>	<u>Displacement (ft)</u>	<u>Time (sec)</u>	<u>Displacement (ft)</u>
97.	0.3967	256.	0.2239
98.	0.3933	257.	0.2233
99.	0.3888	258.	0.2226
100.	0.3839	259.	0.2249
101.	0.3807	260.	0.2242
102.	0.3772	261.	0.2228
103.	0.3741	262.	0.2244
104.	0.3705	263.	0.2225
105.	0.367	264.	0.2229
106.	0.3643	265.	0.2249
107.	0.3616	266.	0.2228
108.	0.3587	267.	0.222
109.	0.3547	268.	0.2218
110.	0.3515	269.	0.2213
111.	0.3483	270.	0.2232
112.	0.3453	271.	0.2226
113.	0.3439	272.	0.2215
114.	0.3411	273.	0.2216
115.	0.3393	274.	0.2215
116.	0.3368	275.	0.219
117.	0.3335	276.	0.2216
118.	0.3321	277.	0.2204
119.	0.3298	278.	0.2202
120.	0.3274	279.	0.2197
121.	0.3249	280.	0.2198
122.	0.3229	281.	0.2196
123.	0.3202	282.	0.2202
124.	0.3188	283.	0.2193
125.	0.3152	284.	0.2182
126.	0.314	285.	0.2175
127.	0.3143	286.	0.2188
128.	0.3111	287.	0.2182
129.	0.3079	288.	0.2177
130.	0.3063	289.	0.2168
131.	0.3052	290.	0.2186
132.	0.3035	291.	0.2175
133.	0.3015	292.	0.2188
134.	0.301	293.	0.2168
135.	0.2998	294.	0.2178
136.	0.2975	295.	0.2174
137.	0.296	296.	0.2187
138.	0.2928	297.	0.2157
139.	0.2932	298.	0.2156
140.	0.2908	299.	0.2165
141.	0.2915	300.	0.2152
142.	0.2884	301.	0.2166
143.	0.2864	302.	0.2172
144.	0.2873	303.	0.2184
145.	0.2877	304.	0.2157
146.	0.2837	305.	0.216
147.	0.2808	306.	0.2157
148.	0.2817	307.	0.2165
149.	0.279	308.	0.2169
150.	0.2784	309.	0.217
151.	0.2772	310.	0.2155
152.	0.2775	311.	0.214
153.	0.2736	312.	0.2153
154.	0.2736	313.	0.2157
155.	0.2747	314.	0.2167
156.	0.2732	315.	0.2172
157.	0.2721	316.	0.2172
158.	0.2696	317.	0.2171
159.	0.2697		

SOLUTION

Slug Test
Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
ln(Re/rw): 3.091

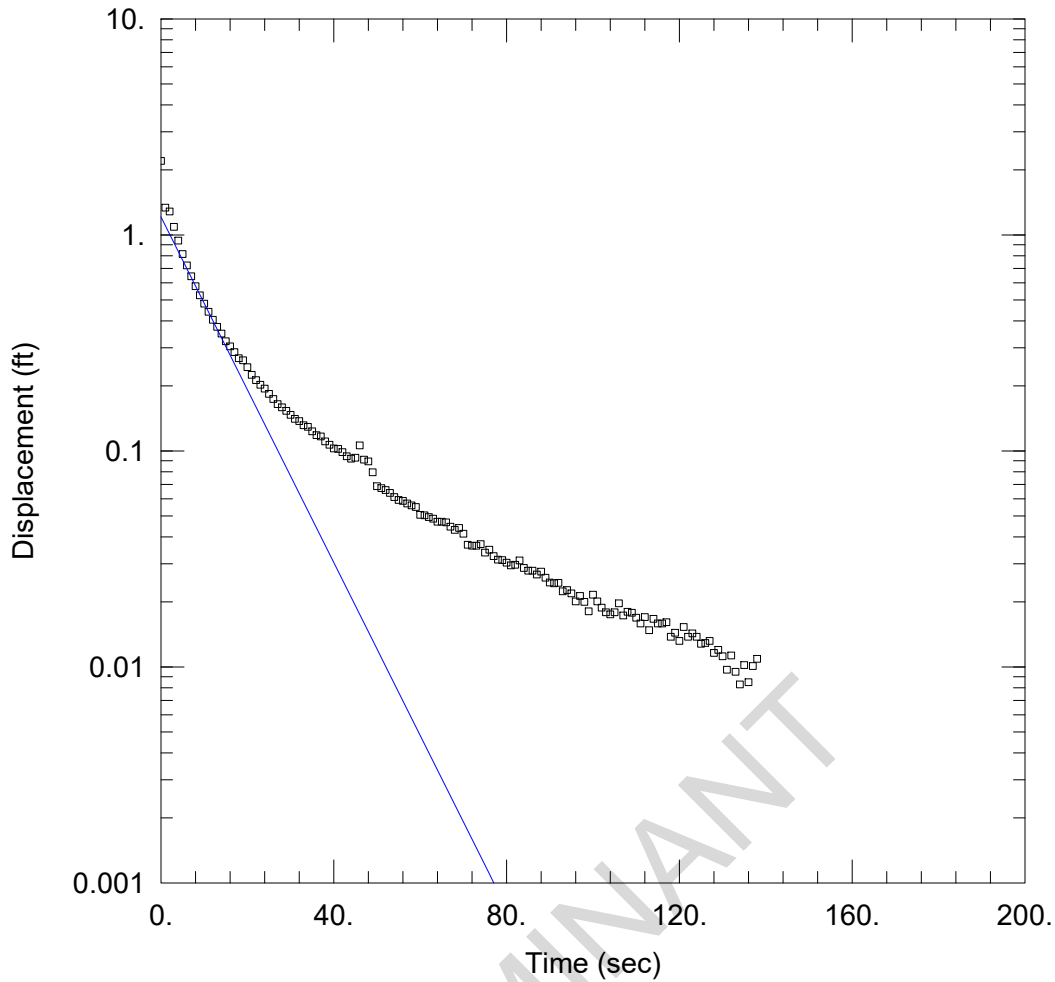
VISUAL ESTIMATION RESULTS

Estimated Parameters

<u>Parameter</u>	<u>Estimate</u>	
K	0.0003221	cm/sec
y0	2.384	ft

$T = K \cdot b = 0.2177 \text{ cm}^2/\text{sec}$

LUMINANT



WELL TEST ANALYSIS

Data Set: J:\...\MW-09 Slug OUT.aqt
 Date: 01/18/16

Time: 17:08:39

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: OGSES
 Test Well: MW-09
 Test Date: 9-23-15

AQUIFER DATA

Saturated Thickness: 19.79 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-9)

Initial Displacement: 2.2 ft
 Total Well Penetration Depth: 19.79 ft
 Casing Radius: 0.083 ft

Static Water Column Height: 19.79 ft
 Screen Length: 19.79 ft
 Well Radius: 0.39 ft
 Gravel Pack Porosity: 0.2

SOLUTION

Aquifer Model: Unconfined
 K = 0.007662 cm/sec

Solution Method: Bower-Rice
 y0 = 1.212 ft

Data Set: J:\5164 - Luminant CCR Well Installation and GW Sampling\5164-D_Oak Grove\OGSES Slug Tests Sept 2015
 Date: 01/18/16
 Time: 17:08:53

PROJECT INFORMATION

Company: PBW
 Client: Luminant
 Project: 5164-D
 Location: OGSES
 Test Date: 9-23-15
 Test Well: MW-09

AQUIFER DATA

Saturated Thickness: 19.79 ft
 Anisotropy Ratio (Kz/Kr): 1.

SLUG TEST WELL DATA

Test Well: MW-9

X Location: 0. ft
 Y Location: 0. ft

Initial Displacement: 2.2 ft
 Static Water Column Height: 19.79 ft
 Casing Radius: 0.083 ft
 Well Radius: 0.39 ft
 Well Skin Radius: 0.39 ft
 Screen Length: 19.79 ft
 Total Well Penetration Depth: 19.79 ft
 Corrected Casing Radius (Bouwer-Rice Method): 0.1896 ft
 Gravel Pack Porosity: 0.2

No. of Observations: 138

Observation Data			
<u>Time (sec)</u>	<u>Displacement (ft)</u>	<u>Time (sec)</u>	<u>Displacement (ft)</u>
1.	1.337	70.	0.0414
2.	1.285	71.	0.0368
3.	1.089	72.	0.0364
4.	0.941	73.	0.0364
5.	0.815	74.	0.037
6.	0.7223	75.	0.0338
7.	0.6433	76.	0.0349
8.	0.579	77.	0.0326
9.	0.5252	78.	0.0314
10.	0.481	79.	0.0312
11.	0.4407	80.	0.0304
12.	0.4044	81.	0.0295
13.	0.3751	82.	0.0297
14.	0.3497	83.	0.0311
15.	0.3219	84.	0.0287
16.	0.3047	85.	0.0279
17.	0.2865	86.	0.0279
18.	0.2688	87.	0.0268
19.	0.263	88.	0.0276
20.	0.2443	89.	0.0259
21.	0.2252	90.	0.0246
22.	0.2126	91.	0.0244
23.	0.2023	92.	0.0245
24.	0.1943	93.	0.0224
25.	0.1838	94.	0.0227
26.	0.1738	95.	0.0219
27.	0.1647	96.	0.0201
28.	0.1592	97.	0.0213

Time (sec)	Displacement (ft)	Time (sec)	Displacement (ft)
29.	0.1533	98.	0.02
30.	0.1468	99.	0.0181
31.	0.1407	100.	0.0216
32.	0.1375	101.	0.0201
33.	0.1315	102.	0.0188
34.	0.1292	103.	0.0179
35.	0.1232	104.	0.0175
36.	0.1183	105.	0.0179
37.	0.1166	106.	0.0197
38.	0.1106	107.	0.0173
39.	0.1068	108.	0.018
40.	0.1027	109.	0.0178
41.	0.1022	110.	0.0169
42.	0.0987	111.	0.0159
43.	0.0944	112.	0.017
44.	0.0921	113.	0.0148
45.	0.093	114.	0.0167
46.	0.106	115.	0.0159
47.	0.0911	116.	0.0159
48.	0.0894	117.	0.0161
49.	0.0796	118.	0.0138
50.	0.0687	119.	0.0144
51.	0.0673	120.	0.0132
52.	0.0659	121.	0.0153
53.	0.0639	122.	0.0138
54.	0.0611	123.	0.0143
55.	0.0593	124.	0.0138
56.	0.0587	125.	0.0128
57.	0.0571	126.	0.0129
58.	0.0559	127.	0.0132
59.	0.055	128.	0.0116
60.	0.0506	129.	0.012
61.	0.0503	130.	0.0112
62.	0.0494	131.	0.0097
63.	0.0486	132.	0.0113
64.	0.047	133.	0.0095
65.	0.047	134.	0.0083
66.	0.0467	135.	0.0102
67.	0.0446	136.	0.0085
68.	0.0431	137.	0.0101
69.	0.044	138.	0.0109

SOLUTION

Slug Test
 Aquifer Model: Unconfined
 Solution Method: Bouwer-Rice
 ln(Re/rw): 3.006

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.007662	cm/sec
y0	1.212	ft

$T = K \cdot b = 4.622 \text{ cm}^2/\text{sec}$