COAL COMBUSTION RESIDUAL RULE
GROUNDWATER MONITORING SYSTEM CERTIFICATION

BIG BROWN STEAM ELECTRIC STATION
BOTTOM ASH PONDS
FREESTONE COUNTY, TEXAS

OCTOBER 16, 2017

Prepared For:

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

Prepared By:

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October 16, 2017

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.

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

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1.0 INTRODUCTION

Luminant Generation Company, LLC (Luminant) operates the Big Brown Steam Electric Station (BBSES) located approximately 10 miles northeast of Fairfield, Freestone County, Texas (Figure 1). The BBSES consists of two coal/lignite-fired units with a combined operating capacity of approximately 1,150 megawatts that were put into operation in the early 1970s. Coal Combustion Residuals (CCRs) including fly ash and bed ash are generated as part of BBSES unit operation. The CCRs are transported off-site for beneficial use by third-parties or are managed/disposed of by Luminant at the BBSES. Two CCR units have been identified within the BBSES operations, the Bottom Ash Ponds and the Ash Disposal Area II. This report discusses the Bottom Ash Ponds (the Site), which include the North Bottom Ash Pond (NBAP) and the South Bottom Ash Pond (SBAP). The Bottom Ash Ponds meet the definition of a CCR surface impoundment and are 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 has been designed and constructed to meet the requirements in Section 257.91 of the CCR Rule.

1.1 Description of Bottom Ash Ponds

The NBAP and SBAP (collectively "Bottom Ash Ponds" or "BAPs") are located approximately 1,500 feet northwest of the BBSES power plant (Figure 2). Each impoundment is approximately 1,400 feet long by 250 feet wide and covers an area of approximately eight acres. The impoundments are constructed partially above and partially below grade and are surrounded by engineered earthen dikes that extend approximately 14 to 21 feet above grade (TUEC, 1998). The NBAP and SBAP were originally constructed in approximately the 1960s or early 1970s and were relined with a clay liner in 1989-1990

(TXU, 1991, TUEC, 1998). The clay liner is three feet thick and has a hydraulic conductivity less than 1 x 10^{-7} centimeters per second (cm/sec).

The Bottom Ash Ponds serve as settling basins to remove residual bottom ash and fines from a sump associated with the dewatering bins. The ponds also act as a surge basin for various water streams in the ash-water system. Decanted water at the opposite end of the pond from the slurry discharge pipeline is returned to the power plant where it is reused. When sufficient ash has accumulated in one pond, the ash slurry is diverted to the other pond. Ash in the inactive pond is then removed and taken to a nearby ash disposal area.

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 overly the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the upmost 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. Multi-unit groundwater monitoring systems

are allowed but must be equally as capable of detecting monitored constituents at the waste boundary of a CCR unit as individual groundwater monitoring wells.

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 Bottom Ash Ponds Groundwater Monitoring System

The CCR groundwater monitoring well system at the Bottom Ash Ponds consists of seven monitoring wells (BAP-57, BAP-58, BAP-59, BAP-60, BAP-61, BAP-62, and BAP-63) 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 Bottom Ash Ponds are located in the outcrop area of the Eocene-aged Wilcox Group (Barnes, 1970). PBW reviewed soil boring logs, monitoring well completion documentation, and historical reports to describe the geologic and hydrogeologic conditions in the Bottom Ash Pond area. Geologic cross sections were constructed using these data. The locations of the cross sections are shown on Figure 3 and the cross sections are shown on Figures 4, 5, and 6.

The geology of the Bottom Ash Pond area generally consists of an upper clay unit that extends from ground surface to about 10 to 30 feet below ground surface (bgs), an intermediate silty sand unit that is approximately 20-foot to 70-foot thick and contains minor occurrences of interbedded, well sorted, fine to medium-grained sand, and a lower clay unit. The uppermost aquifer at the Site occurs under unconfined conditions within the intermediate silty sand unit, and extends to the underlying confining clay unit.

2.3 Groundwater Potentiometric Surface

Eight background groundwater monitoring events were performed using the Bottom Ash Ponds CCR monitoring well system from October 2015 to December 2016. Static water levels measured during the background monitoring period indicated water elevations ranging from 307.38 feet above mean sea level (amsl) to 313.56 feet amsl, and depths to water ranging from 17.98 feet bgs to 37.54 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 near well BAP-57 of the Bottom Ash Ponds, with an inferred groundwater flow direction to the east, west, and south. Based on the inferred groundwater flow direction, the location of each CCR monitoring well relative to the Bottom Ash Ponds is as follows:

Upgradient Wells	Downgradient Wells
BAP-57	BAP-58
	BAP-59
	BAP-60
	BAP-61
	BAP-62
	BAP-63

2.4 Uppermost Aquifer Hydraulic Conductivity Testing

McCulley, Frick & Associates (MFA) performed slug tests in multiple wells screened in the uppermost sand unit in the Bottom Ash Pond Area in 1987 (MFA, 1987). Results of the slug tests indicate an average hydraulic conductivity for the uppermost sand of 6 $x10^{-3}$ cm/sec.

2.5 Conclusions

The CCR groundwater monitoring well system at the Bottom Ash Ponds 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:

- Seven monitoring wells are included in the CCR groundwater monitoring system – one upgradient monitoring well and six 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 CCR unit and samples collected from downgradient wells will ensure detection of groundwater contamination in the uppermost aquifer from the CCR unit.
- 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.

McCulley, Frick & Associates (MFA), 1987. Groundwater Investigation Operating Bottom Ash Pond Area, Big Brown Steam Electric Station, Freestone County, Texas. July 17.

Texas Utilities Electric Company (TUEC), 1998. Application for Permit to Receive and Process Non-Hazardous Solid Waste, Big Brown Steam Electric Station, Freestone County, Texas. February.

TXU Electric Company (TXU), 1991. As-Built Engineering Drawings 119-1134-301-01, 119-1134-301-02, and 119-1134-301-03, Big Brown Steam Electric Station – Bottom Ash Ponds, February 8.

Tables

TABLE 1
WELL CONSTRUCTION SUMMARY
BOTTOM ASH PONDS
BIG BROWN STEAM ELECTRIC STATION

Well ID	Date Installed	Northing	Easting	Cooncrete Pad 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)
BAP-57	9/11/2015	10651746	3622487	332.28	335.75	34.0	44.0	10.0	44.0	2
BAP-58	9/11/2015	10652234	3623191	326.54	330.12	31.0	41.0	10.0	41.0	2
BAP-59	9/11/2015	10651971	3623549	332.83	336.14	35.0	45.0	10.0	45.0	2
BAP-60	8/31/2015	10651500	3623383	333.79	337.56	36.0	46.0	10.0	46.0	2
BAP-61	9/1/2015	10650992	3622607	333.95	337.63	34.5	44.5	10.0	44.5	2
BAP-62	9/1/2015	10651096	3622077	343.88	347.59	31.0	41.0	10.0	41.0	2
BAP-63	9/10/2015	10651348	3621886	342.57	345.57	35.5	45.5	10.0	45.5	2

Notes:
1. Abbreviations: ft - feet; TOC - top of casing; amsl - above mean sea level; bgs - below ground surface; in - inches.

TABLE 2
GROUNDWATER ELEVATION SUMMARY
BOTTOM ASH PONDS
BIG BROWN STEAM ELECTRIC STATION

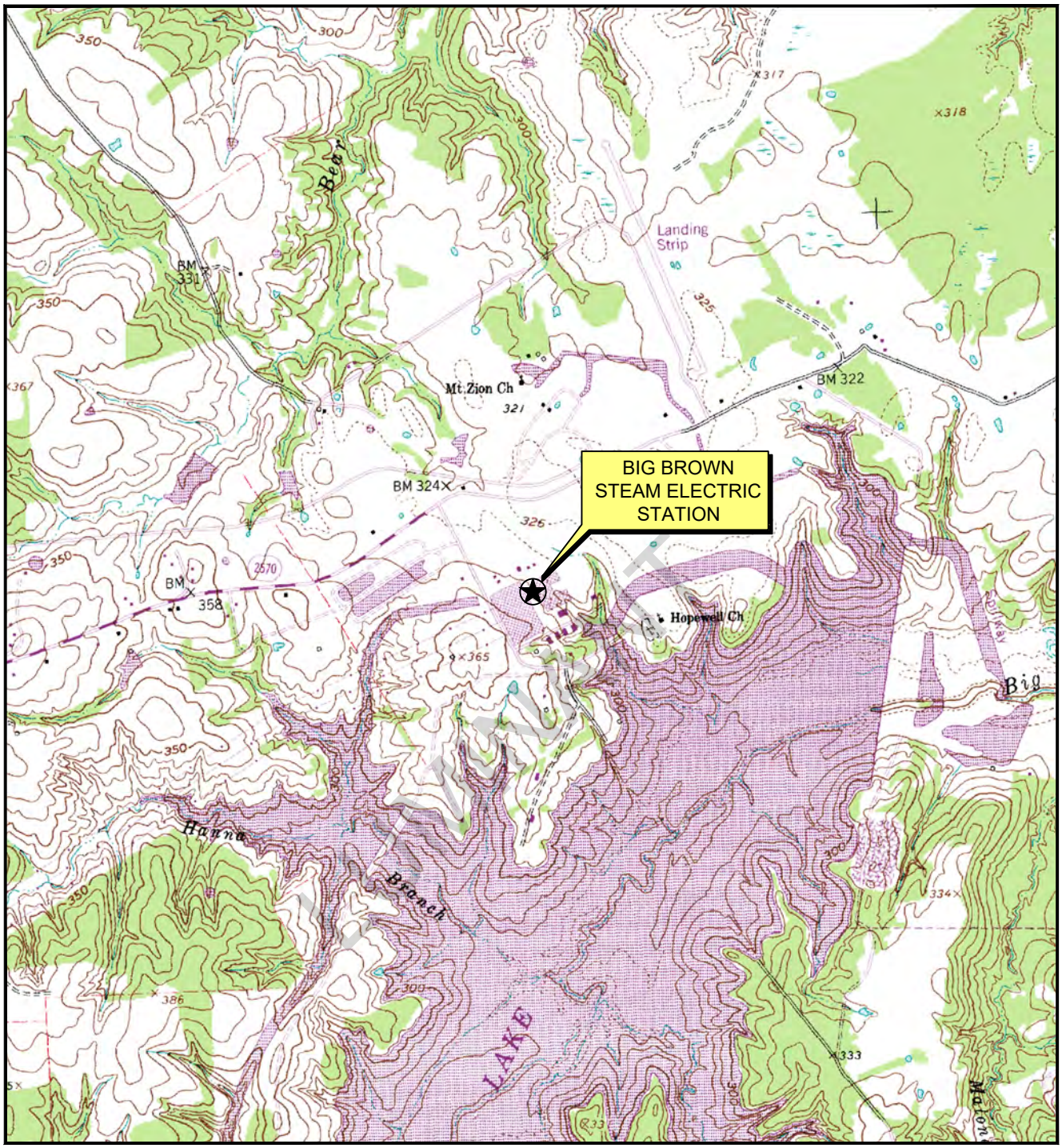
Well ID	TOC Elevation (ft amsl)	Date	Depth to Water (ft btoc)	Water Elevation (ft amsl)
BAP-57	335.745	10/27/15	24.81	310.94
		12/15/15	22.74	313.01
		02/29/16	22.82	312.93
		04/13/16	22.54	313.21
		06/09/16	24.29	311.46
		09/01/16	22.19	313.56
		10/06/16	22.94	312.81
		12/14/16	25.76	309.99
BAP-58	330.119	10/27/15	20.76	309.36
		12/15/15	19.26	310.86
		02/29/16	22.74	307.38
		04/13/16	18.19	311.93
		06/09/16	17.98	312.14
		09/01/16	18.03	312.09
		10/06/16	18.71	311.41
		12/14/16	22.38	307.74
BAP-59	336.14	10/27/15	26.18	309.96
		12/15/15	24.34	311.80
		02/29/16	24.67	311.47
		04/13/16	24.59	311.55
		06/09/16	22.74	313.40
		09/01/16	23.98	312.16
		10/06/16	24.49	311.65
		12/14/16	27.61	308.53
BAP-60	337.556	10/27/15	27.18	310.38
		12/15/15	26.02	311.54
		02/29/16	26.44	311.12
		04/13/16	26.36	311.20
		06/09/16	24.93	312.63
		09/01/16	25.56	312.00
		10/06/16	26.02	311.54
		12/14/16	29.17	308.39
BAP-61	337.632	10/27/15	27.21	310.42
		12/15/15	26.24	311.39
		02/29/16	27.34	310.29
		04/13/16	27.22	310.41
		06/09/16	25.57	312.06
		09/01/16	26.34	311.29
		10/06/16	26.51	311.12
		12/14/16	29.21	308.42

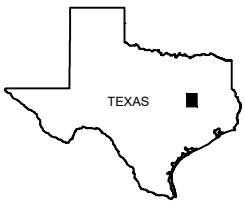
TABLE 2
GROUNDWATER ELEVATION SUMMARY
BOTTOM ASH PONDS
BIG BROWN STEAM ELECTRIC STATION

Well ID	TOC Elevation (ft amsl)	Date	Depth to Water (ft btoc)	Water Elevation (ft amsl)
BAP-62	347.592	10/27/15	37.14	310.45
		12/15/15	36.09	311.50
		02/29/16	36.04	311.55
		04/13/16	35.86	311.73
		06/09/16	35.11	312.48
		09/01/16	35.31	312.28
		10/06/16	35.33	312.26
		12/14/16	37.54	310.05
BAP-63	345.571	10/27/15	36.03	309.54
		12/15/15	35.11	310.46
		02/29/16	34.54	311.03
		04/13/16	34.48	311.09
		06/09/16	33.78	311.79
		09/01/16	33.57	312.00
		10/06/16	33.69	311.88
		12/14/16	35.84	309.73

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

Figures





QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

SOURCE:
Base map from www.tnris.gov, Young, TX 7.5 min. USGS quadrangle dated 1961, revised 1982.

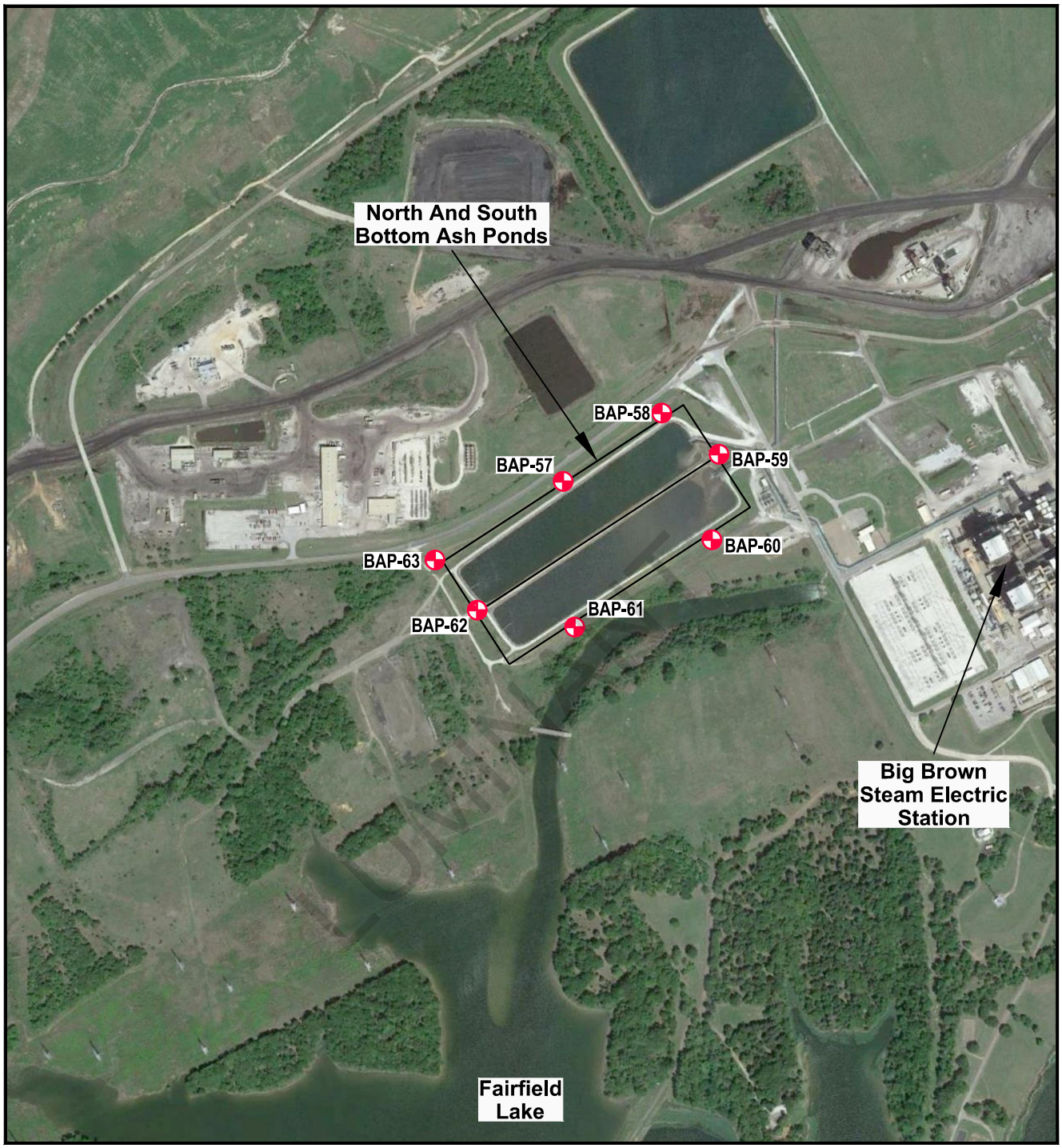
BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 1

BOTTOM ASH PONDS SITE LOCATION MAP

PROJECT: 5123A	BY: AJD	REVISIONS
DATE: JUNE, 2015	CHECKED: PJB	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

CCR Monitoring Well Location

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/30/2017.

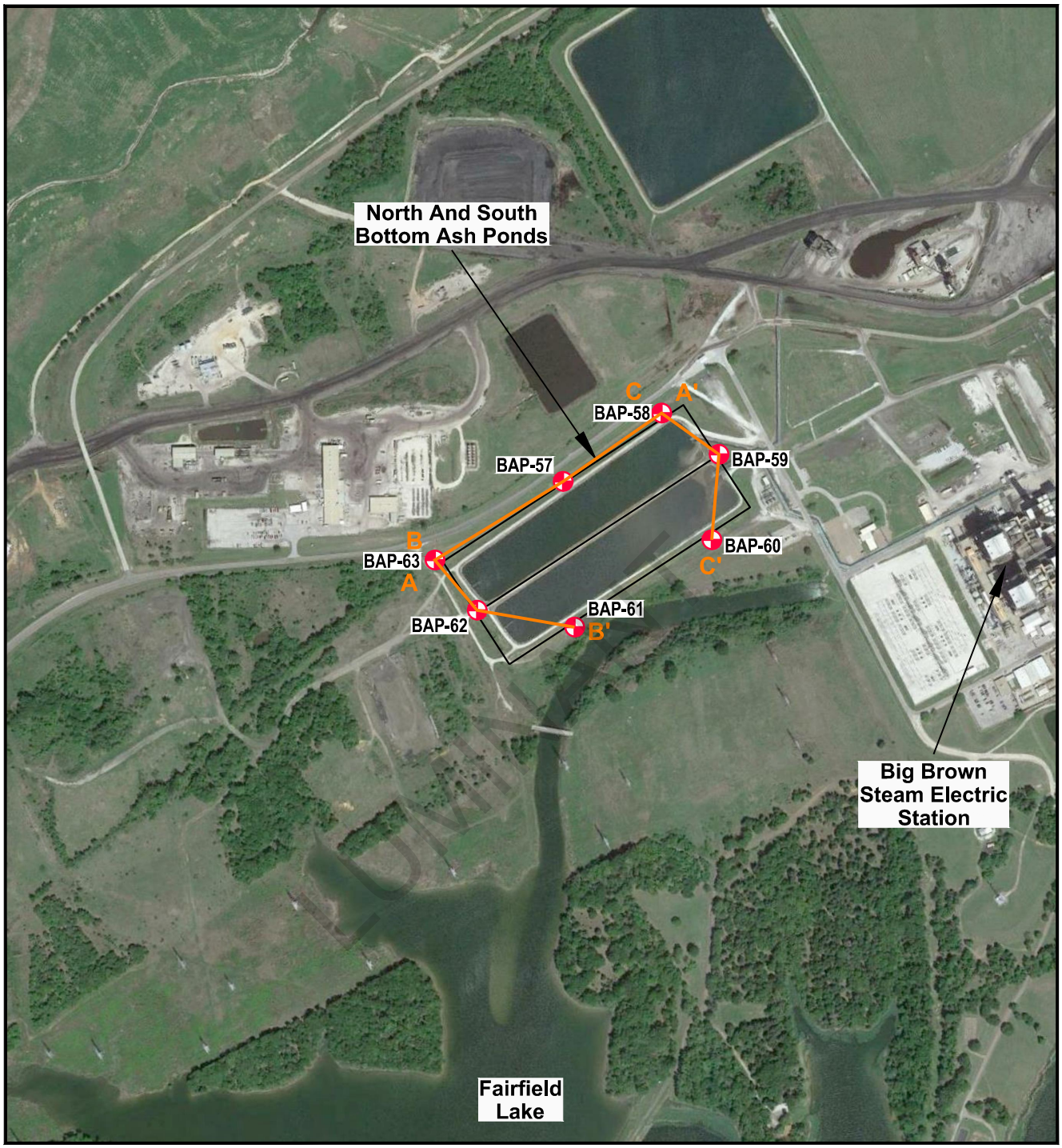
BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 2

BOTTOM ASH PONDS DETAILED SITE PLAN

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

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- CCR Monitoring Well Location
- A A' Geologic Cross Section Location Lines

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/30/2017.

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 3

BOTTOM ASH PONDS CROSS SECTION LOCATION MAP

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

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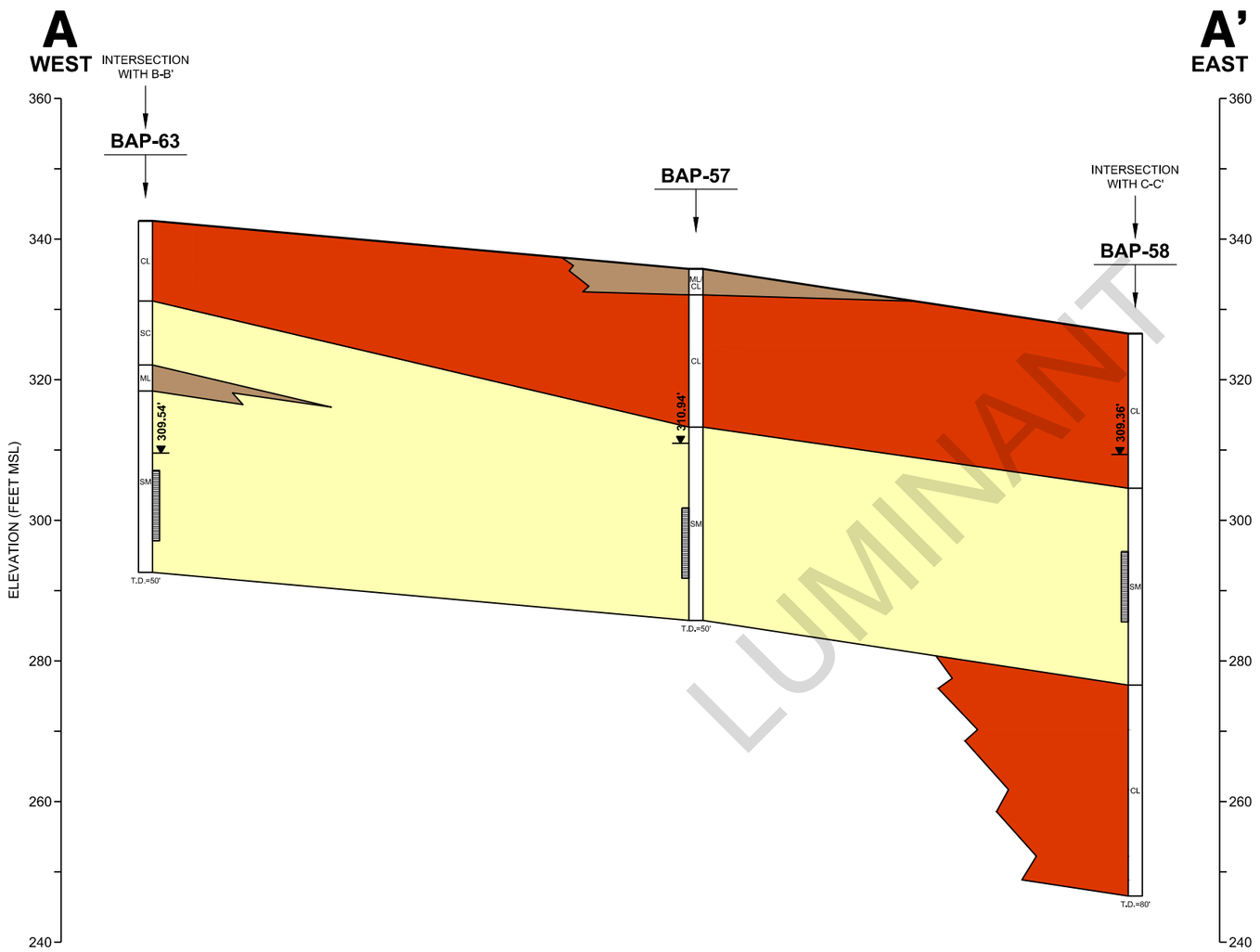
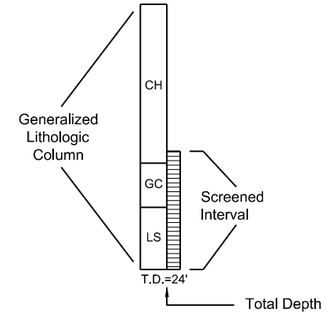


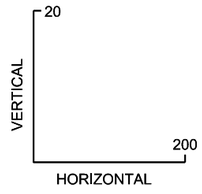
EXPLANATION

- SAND
- CLAY
- SILT

MONITORING WELL CONSTRUCTION



SCALE IN FEET



10x Vertical Exaggeration

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 4

BOTTOM ASH PONDS GEOLOGIC CROSS SECTION A-A'

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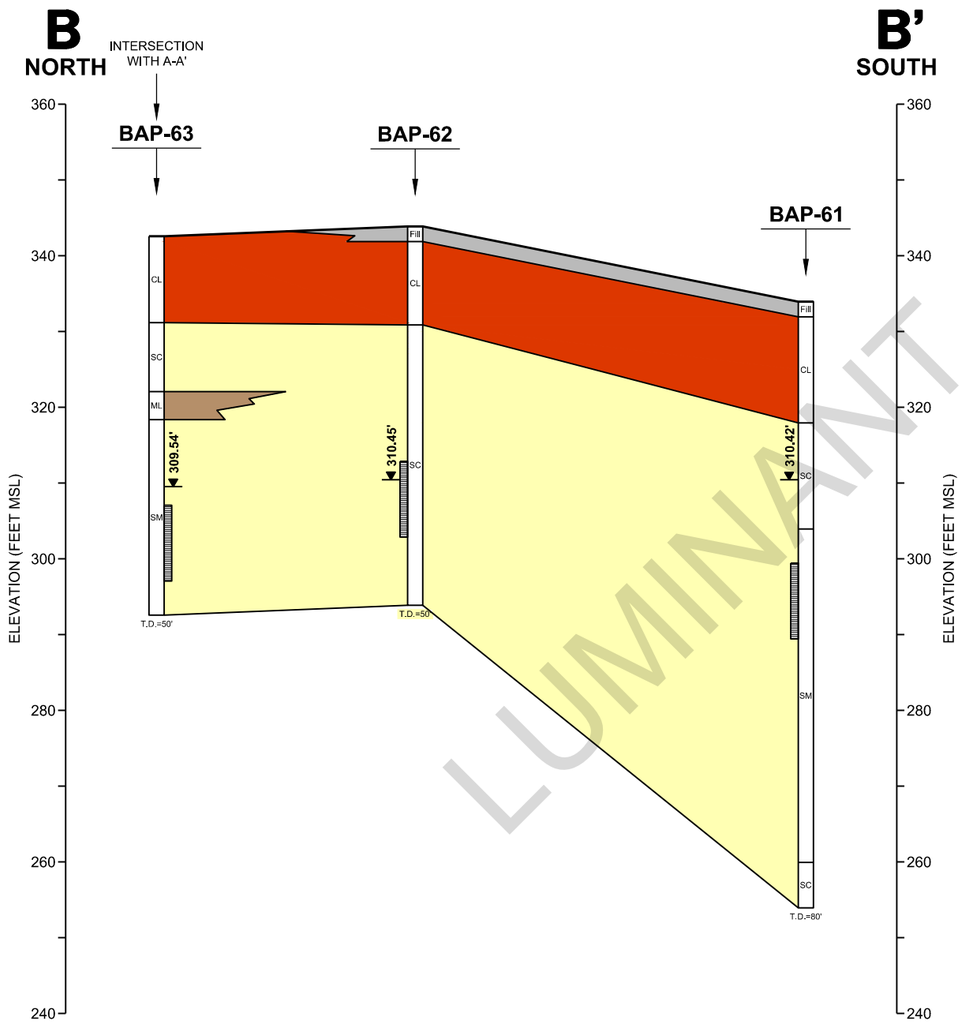
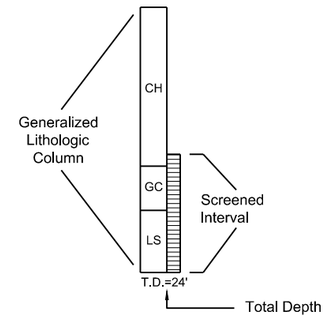


EXPLANATION

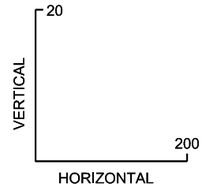
- SAND
- CLAY
- SILT
- FILL

MONITORING WELL CONSTRUCTION



Water Level (Ft MSL) Measured 10/27/15

SCALE IN FEET



10x Vertical Exaggeration

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 5

BOTTOM ASH PONDS
GEOLOGIC CROSS SECTION B-B'

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DATE: OCT., 2017	CHECKED: PJB	

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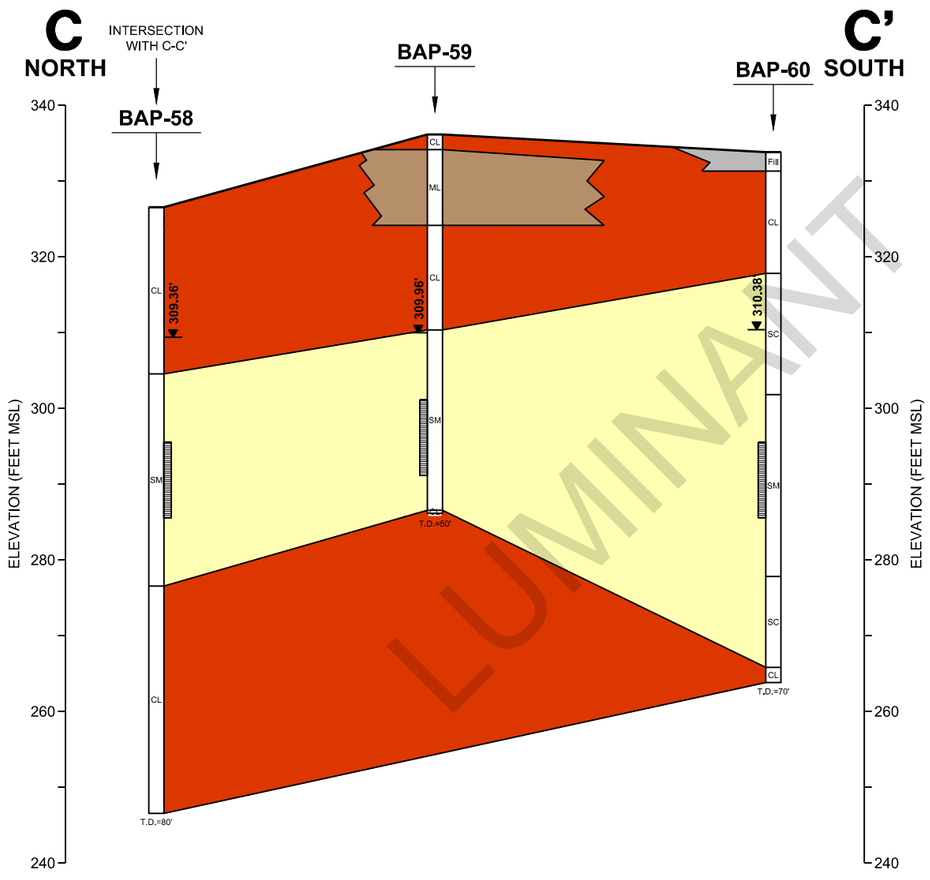
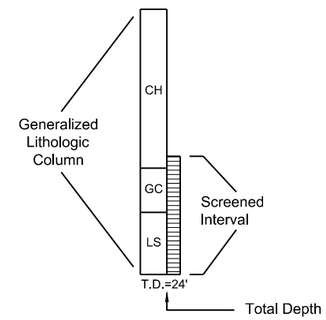


EXPLANATION

- SAND
- CLAY
- SILT
- FILL

MONITORING WELL CONSTRUCTION



Water Level (Ft MSL)
Measured 10/27/15

SCALE IN FEET

VERTICAL 20

HORIZONTAL 200

10x Vertical Exaggeration

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 6

BOTTOM ASH PONDS
GEOLOGIC CROSS SECTION C-C'

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

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

Appendix A

CCR Monitoring Well Logs

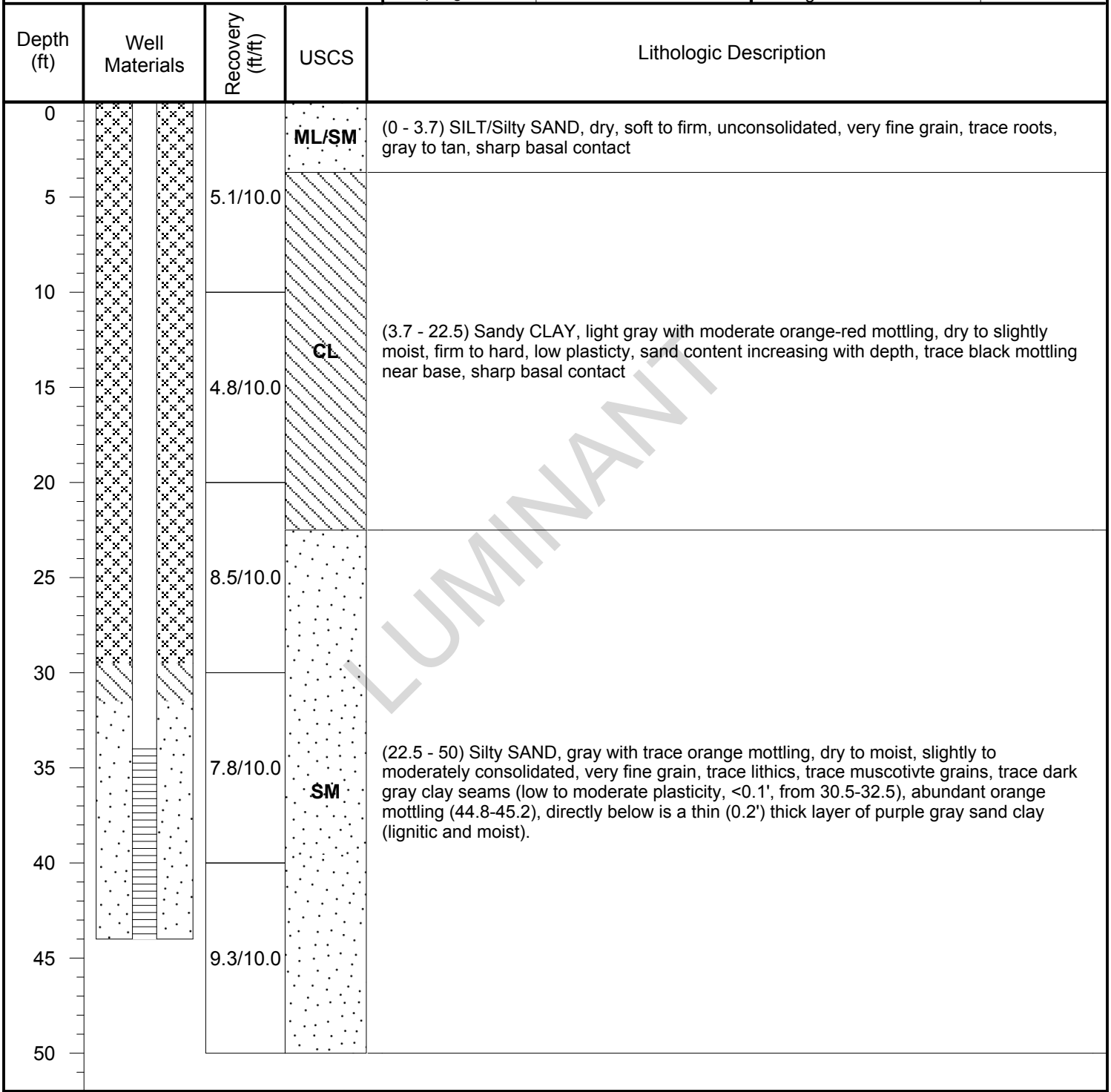
Luminant

Log of Boring: BAP-57

Big Brown Steam Electric Station
Fairfield, TX

PBW Project No. 5164A

Completion Date:	9/11/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Dwayne Whitehead	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	335.745
Logged By:	Nolan Townsend	Northing:	10651745.62
Sampling Method:	4"x10' Core barrel	Easting:	3622487.039



PBW

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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
(+3.50 - 34) Casing, 2" Sch 40 FJT PVC
(34 - 44) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-30') Grout
(30'-32') Bentonite pellets
(32'-44') 20/40 sand

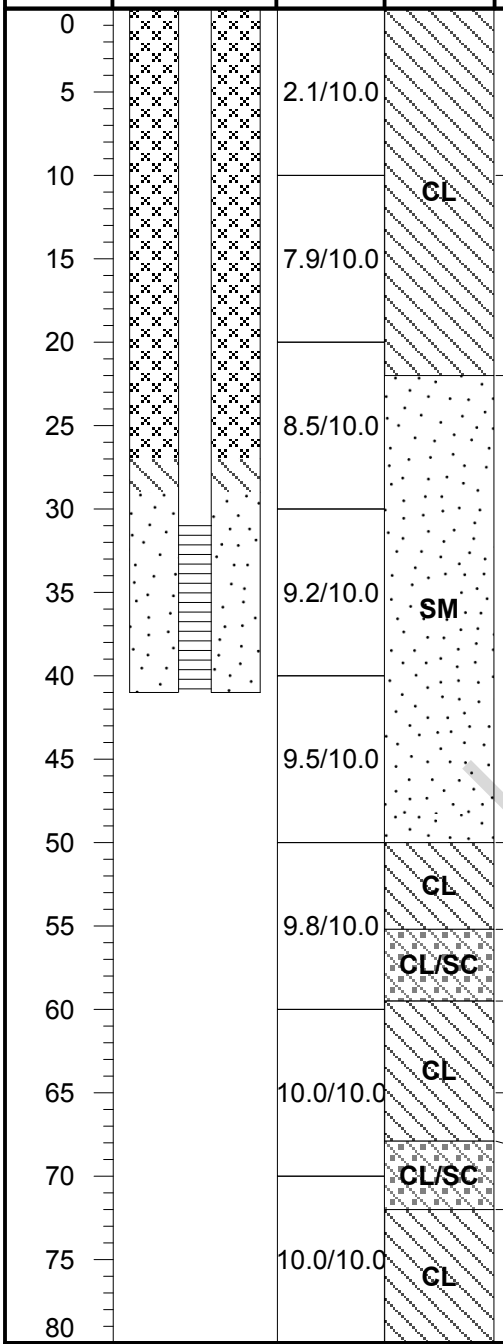
Luminant

Log of Boring: BAP-58

Big Brown Steam Electric Station
Fairfield, TX

PBW Project No. 5164A

Completion Date:	9/11/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Dwayne Whitehead	Total Depth (ft):	41
Driller's License:	5814M	TOC Elevation (ft. AMSL):	330.119
Logged By:	Nolan Townsend	Northing:	10652233.972
Sampling Method:	4"x10' Core barrel	Easting:	3623191.276



Lithologic Description
(0 - 10) Silty/sandy CLAY, gray to reddish orange, dry, frim to hard, low plasticity, fine to coarse gravel, sharp basal contact
(10 - 22) Sandy CLAY, gray with moderate orange/black mottling, dry to moist, firm, low plasticity, very fine grain sand, more sandy with depth and moisture increases with depth, sharp basal contact
(22 - 50) Silty SAND, gray, moist to wet (wet 25-46), slightly to moderately unconsolidated, very fine grain, moderate to abundant orange mottling, 43.5-43.7 and 47.3-47.8 thin band of purple-gray clay with sand, trace mica and lithic fragments, sharp basal contact
(50 - 55.2) Sandy CLAY, gray to dark gray-purple, dry, firm to very hard, low plasticity, sandy interbeds, trace to moderate orange mottling bands, sharp basal contact
(55.2 - 59.5) CLAY-sandy CLAY, dry, hard to very hard, low plasticity, trace sandy lenses, dark gray to purple gray, lignitic
(59.5 - 65) Sandy CLAY, light gray to dark gray-purple with thin dark gray bands, dry, hard to very hard, low plasticity, orange mottling in sandy bands, very fine grain sand interbeds
(65 - 67.9) CLAY, gray to dark gray, dry to slightly moist, hard to very hard low to moderate plasticity, trace sand, trace orange mottling, sharp basal contact
(67.9 - 72) CLAY/sandy CLAY, dry to slightly moist, firm to hard, low to moderate plasticity, clay has thin silty sand interbeds (light gray), sharp basal contact
(72 - 80) CLAY, gray to dark gray, dry, hard to very hard, low to moderate plasticity, trace sand content

PBW

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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
(+3.73 - 31) Casing, 2" Sch 40 FJT PVC
(31 - 41) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-27') Grout
(27'-29') Bentonite pellets
(29'-41') 20/40 sand

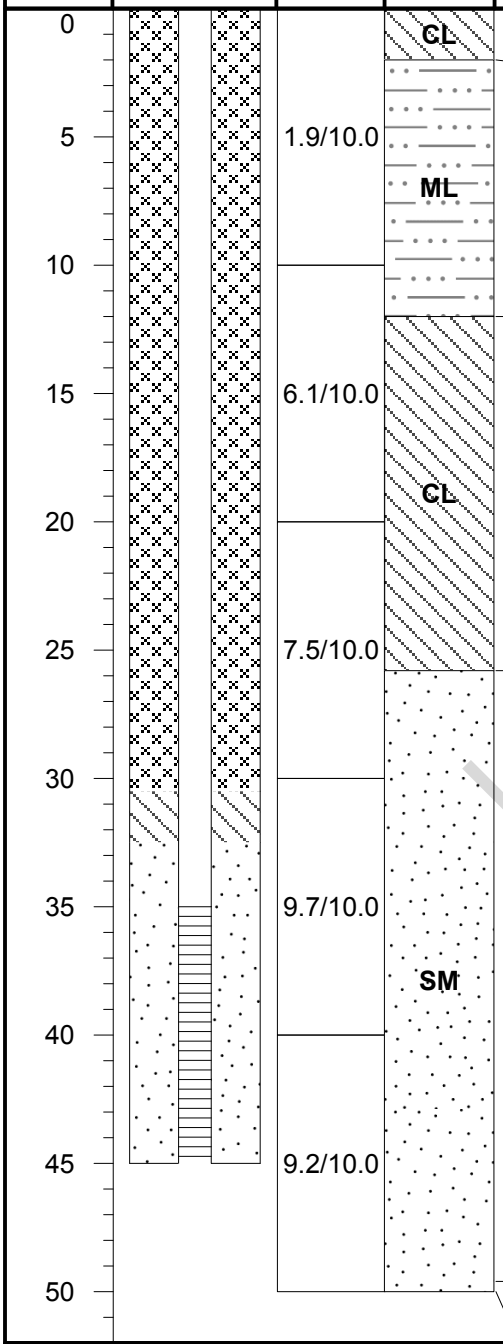
Luminant

Log of Boring: BAP-59

Big Brown Steam Electric Station
Fairfield, TX

PBW Project No. 5164A

Completion Date:	9/11/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Dwayne Whitehead	Total Depth (ft):	80
Driller's License:	5814M	TOC Elevation (ft. AMSL):	336.14
Logged By:	Nolan Townsend	Northing:	10651971.306
Sampling Method:	4"x10' Core barrel	Easting:	3623548.812



USCS	Lithologic Description
CL	(0 - 2) FILL - silty, sandy clay, tan to brown, dry, firm to hard, low plasticity, fine to coarse gravel, very fine sand
ML	(2 - 12) Sandy SILT, gray, dry, slightly unconsolidated; fine to coarse gravely, very fine sand; trace clay, sharp basal contact
CL	(12 - 25.8) Sandy, silty CLAY, gray with red/orange mottling, dry, firm to hard, low plasticity
SM	(25.8 - 49.6) Silty SAND, gray with moderate-abundant reddish orange mottling, dry to moist (moist to wet 33'-36'), slightly to moderately unconsolidated, 31.8' base of oxidized zone, very fine sand, 40-42 gray to dark gray clay seams/lenses, becomes brown/orangish brown 47-49.6, sharp basal contact
	(49.6 - 50) Silty, clayey SAND, purple-gray to reddish brown, dry, slightly unconsolidated, thin clay lenses, thin ligntic seams

PBW

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Notes:
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Well Materials
(+3.68 - 35) Casing, 2" Sch 40 FJT PVC
(35 - 45) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-30') Grout
(30'-32') Bentonite pellets
(32'-45) 20/40 sand

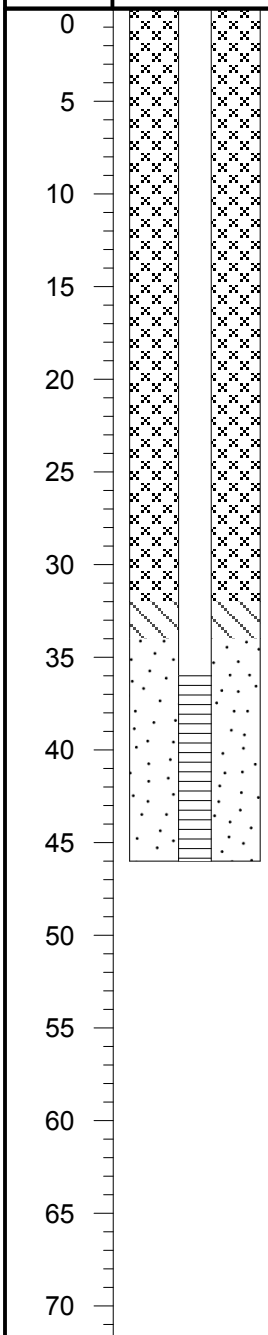
Luminant

Log of Boring: BAP-60

Big Brown Steam Electric Station
Fairfield, TX

PBW Project No. 5164A

Completion Date:	8/31/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Dwayne Whitehead	Total Depth (ft):	70
Driller's License:	5814M	TOC Elevation (ft. AMSL):	337.556
Logged By:	Sara Taube	Northing:	10651500.276
Sampling Method:	4"x10' Core barrel	Easting:	3623382.967



Depth (ft)	Recovery (ft/ft)	USCS	Lithologic Description
0		ML	(0 - 2.5) FILL - sandy silt, brown, dry, unconsolidated, fine to medium gravel, some small clayey nodules
5	5.2/10.0	CL	(2.5 - 16) Silty CLAY, light reddish brown to dark gray, moist, firm, low to medium plasticity, gradational basal contact
10			
15	6.0/10.0		(16 - 20) Silty, sandy CLAY, light gray with orange-dark red mottling, slightly moist, firm to hard, low plasticity, very fine grain sand
20	3.0/10.0	SC	(20 - 32) Clayey SAND, light gray to red/brown, slightly moist, moderately consolidated, gray clay lenses, very fine to fine grain sand, light gray sandy layer 20'-20.5', gradationally becomes clayier with depth
25			
30	9.5/10.0	SM	(32 - 56) Silty SAND, light gray with red nodules, moist to wet, unconsolidated to slightly consolidated, very fine grain, some clay present, thin orange tinged bands intermittently, reddish brown 47'-49', gradational change to reddish brown and clayey and light gray below 55', gradational basal contact
35			
40			
45	8.5/10.0		
50			
55	9.0/10.0	SC	(56 - 68) Clayey SAND with silt, reddish brown, moist, unconsolidated, very fine to fine grained, very thin clear laminated beds of alternating sand (gray) and clay (reddish brown), sharp basal contact
60			
65	8.75/10.0		
70		CL	(68 - 70) Sandy CLAY, purple and gray banded, moist, slightly firm, low to no plasticity, possibly thin bands of lignit, very high sand content

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Notes:
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Well Materials
(+3.77 - 36) Casing, 2" Sch 40 FJT PVC
(36 - 46) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-32') Grout
(32'-34') Bentonite pellets
(34'-46.5') 20/40 sand

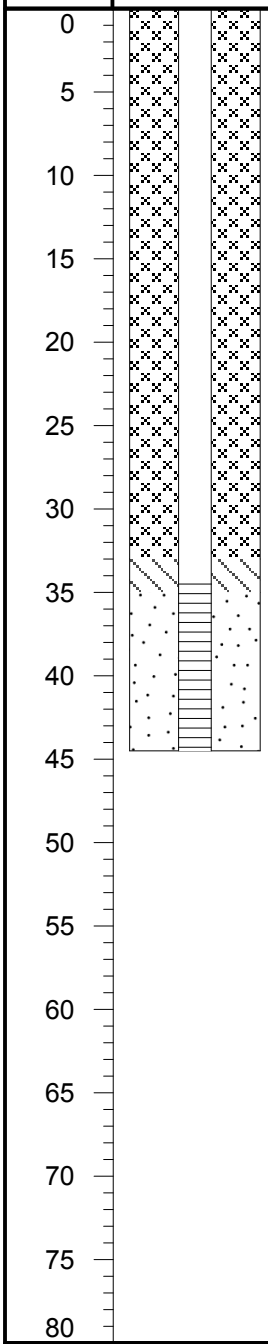
Luminant

Log of Boring: BAP-61

Big Brown Steam Electric Station
Fairfield, TX

PBW Project No. 5164A

Completion Date:	9/1/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Dwayne Whitehead	Total Depth (ft):	80
Driller's License:	5814M	TOC Elevation (ft. AMSL):	337.632
Logged By:	Sara Taube	Northing:	10650991.773
Sampling Method:	4"x10' Core barrel	Easting:	3622606.935



Lithologic Description
(0 - 2) FILL - clayey, sandy silt, dark brown, dry, soft, fine to medium gravel, sharp basal contact
(2 - 16) Silty, sand CLAY, light gray with red/orange mottling, slightly moist, firm, low plasticity
(16 - 30) Clayey SAND, gray to brown with reddish brown mottling/thing layers of interbedded gray sand and orangey clay, slightly moist, weak to no cementation, slightly firm, no plasticity
(30 - 74) Silty SAND, gray, moist to wet, unconsolidated, some orangey clay lenses, sandier and less consolidated with depth, black mineral streaks 34.5'-38', medium carbonate gravel at 39.5, rusty orange streak around 56, purple/gray with black streaks 67-67.5, still sandy but harder
(74 - 80) Clayey SAND, gray and purple with black mottling, moist, slightly consolidated, abundant mica

PBW

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Notes:
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Well Materials
(+3.79 - 34.5) Casing, 2" Sch 40 FJT PVC
(34.5 - 44.5) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-33') Grout
(33'-35') Bentonite pellets
(35'-44.5') 20/40 sand

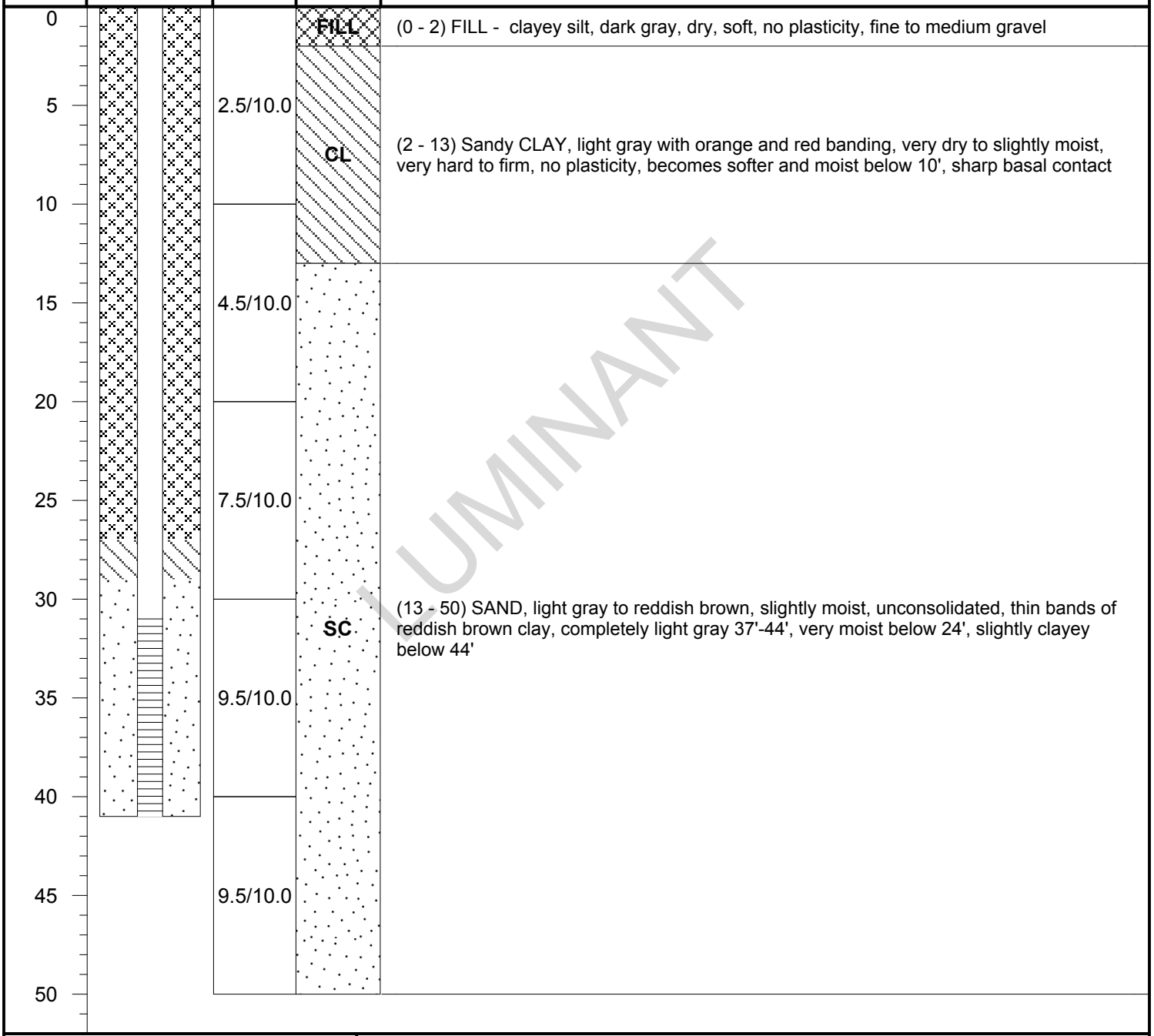
Luminant

Log of Boring: BAP-62

Big Brown Steam Electric Station
Fairfield, TX

PBW Project No. 5164A

Completion Date:	9/1/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Dwayne Whitehead	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	347.592
Logged By:	Sara Taube	Northing:	10651095.763
Sampling Method:	4"x10' Core barrel	Easting:	3622077.112



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

Well Materials
(+3.60 - 31) Casing, 2" Sch 40 FJT PVC
(31 - 41) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-27') Grout
(27'-29') Bentonite pellets
(29'-41) 20/40 sand

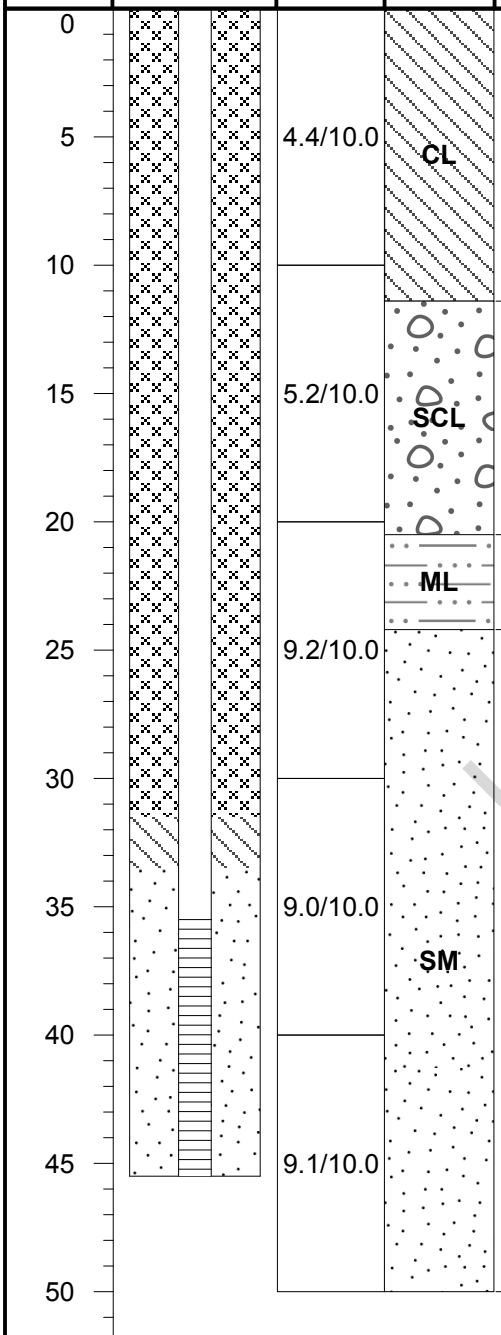
Luminant

Log of Boring: BAP-63

Big Brown Steam Electric Station
Fairfield, TX

PBW Project No. 5164A

Completion Date:	9/10/2015	Drilling Method:	Sonic
Drilling Company:	Walker-Hill Environmental	Borehole Diameter (in.):	6.5
Driller:	Dwayne Whitehead	Total Depth (ft):	50
Driller's License:	5814M	TOC Elevation (ft. AMSL):	345.571
Logged By:	Nolan Townsend	Northing:	10651347.93
Sampling Method:	4"x10' Core barrel	Easting:	3621885.716



Lithologic Description

(0 - 11.4) Sandy, silty CLAY, gray with orange/red mottling, dry to moist, firm to hard, low plasticity, very fine sand, sand content increasing with depth, trace black streaks, gradational basal contact

(11.4 - 20.5) Clayey SAND, brownish yellow to gray, dry, slightly unconsolidated, low plasticity, very fine sand, orange/red mottling, base of oxidized zone, sharp basal contact

(20.5 - 24.2) Sandy SILT, gray to tan, dry, very slightly unconsolidated, very fine sand, powdery, trace to moderate fine to coarse white gravel, sharp basal contact

(24.2 - 50) Silty SAND, light browish yellow to gray, dry to sligtly moist (moist to wet 31'-50', wet 36'-44'), trace mica grains, lithic framents in sand, very fine sand, trace to moderate orange mottling, gray from 28.4 to 50, trace clay, moderate to poor sorting

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Notes:
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Well Materials
(+3.45 - 35.5) Casing, 2" Sch 40 FJT PVC
(35.5 - 45.5) Screen, 2" Sch 40 FJT PVC, 0.010" slot

Annular Materials
(0'-31.5') Grout
(31.5'-33.5') Bentonite pellets
(33.5'-45.5) 20/40 sand

Appendix B

Photographs of CCR Groundwater Monitoring Wells

Appendix B – Photographs of New CCR Groundwater Monitoring Wells
Bottom Ash Ponds - BBSES

Photograph 1: BAP-57

Photograph 2: BAP-58 prior to installation of bollards.

Appendix B – Photographs of New CCR Groundwater Monitoring Wells
Bottom Ash Ponds - BBSES

Photograph 3: BAP-59

Photograph 4: BAP-60 prior to installation of bollards.

Appendix B – Photographs of New CCR Groundwater Monitoring Wells
Bottom Ash Ponds - BBSES

Photograph 5: BAP-61 prior to installation of bollards.

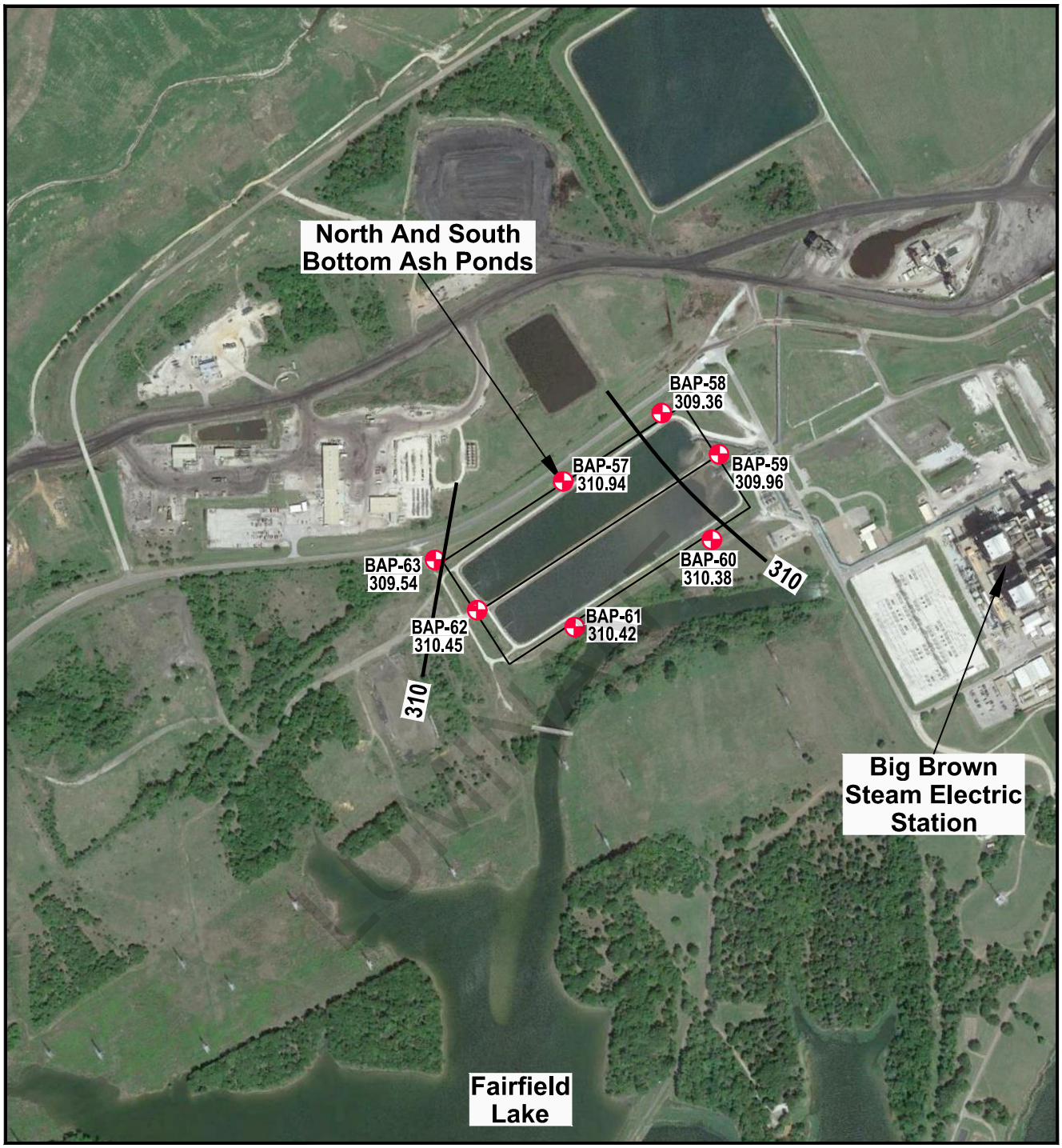
Photograph 6: BAP-62 prior to installation of bollards.

Appendix B – Photographs of New CCR Groundwater Monitoring Wells
Bottom Ash Ponds - BBSES

Photograph 7: BAP-63 prior to installation of bollards.

Appendix C

Groundwater Potentiometric Surface Maps



EXPLANATION

- CCR Monitoring Well Location
- (294.01) Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/20/2017.

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 1

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A OCTOBER 27, 2015

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

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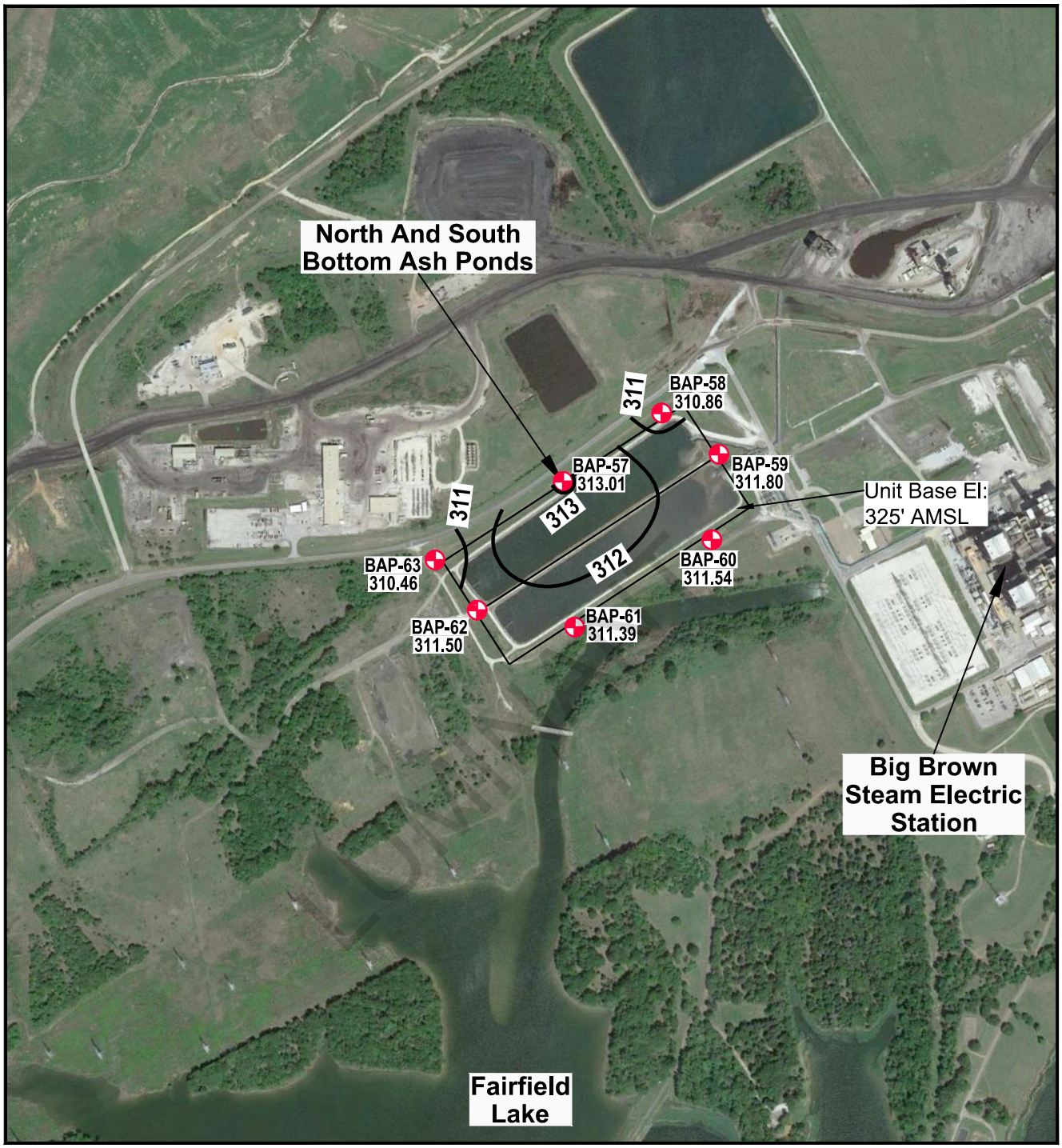

EXPLANATION

- CCR Monitoring Well Location
- (294.01) Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/20/2017.

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 2

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A DECEMBER 15, 2015

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

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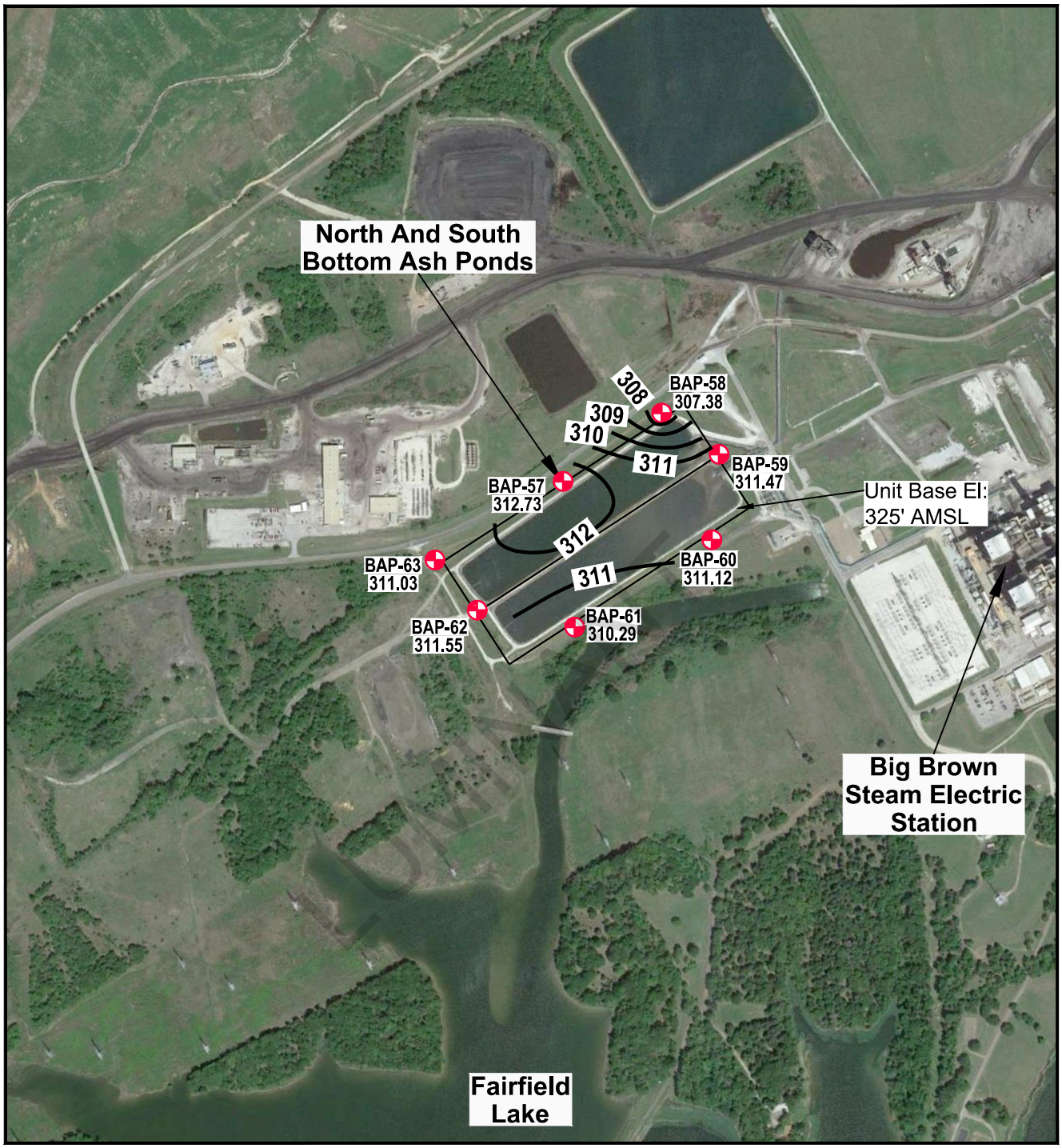

EXPLANATION

- CCR Monitoring Well Location
- (294.01) Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/20/2017.

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 3

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A FEBRUARY 29, 2016

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

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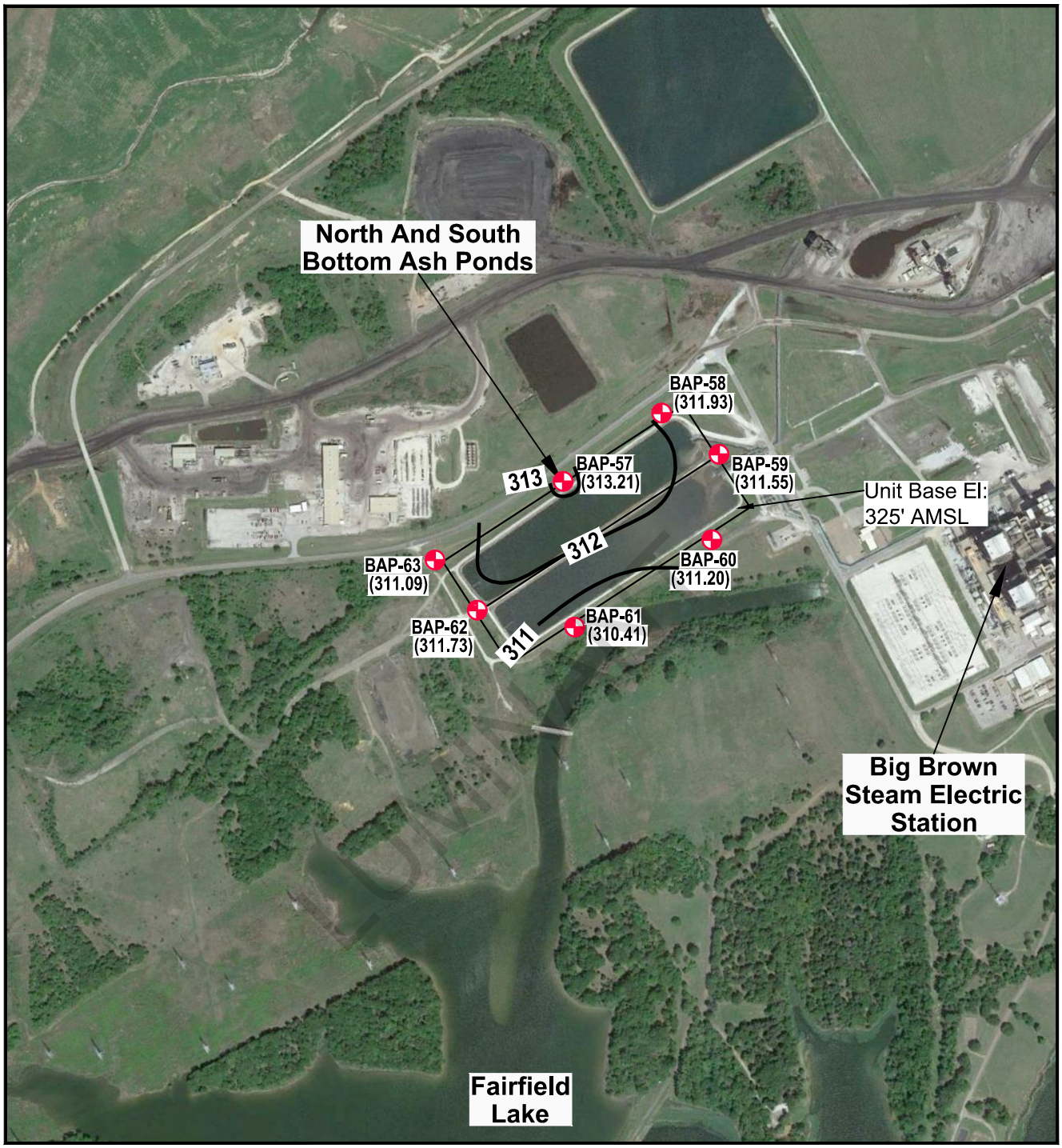

EXPLANATION

- CCR Monitoring Well Location
- *(294.01)* Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/20/2017.

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 4

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A APRIL 13, 2016

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

PASTOR, BEHLING & WHEELER, LLC
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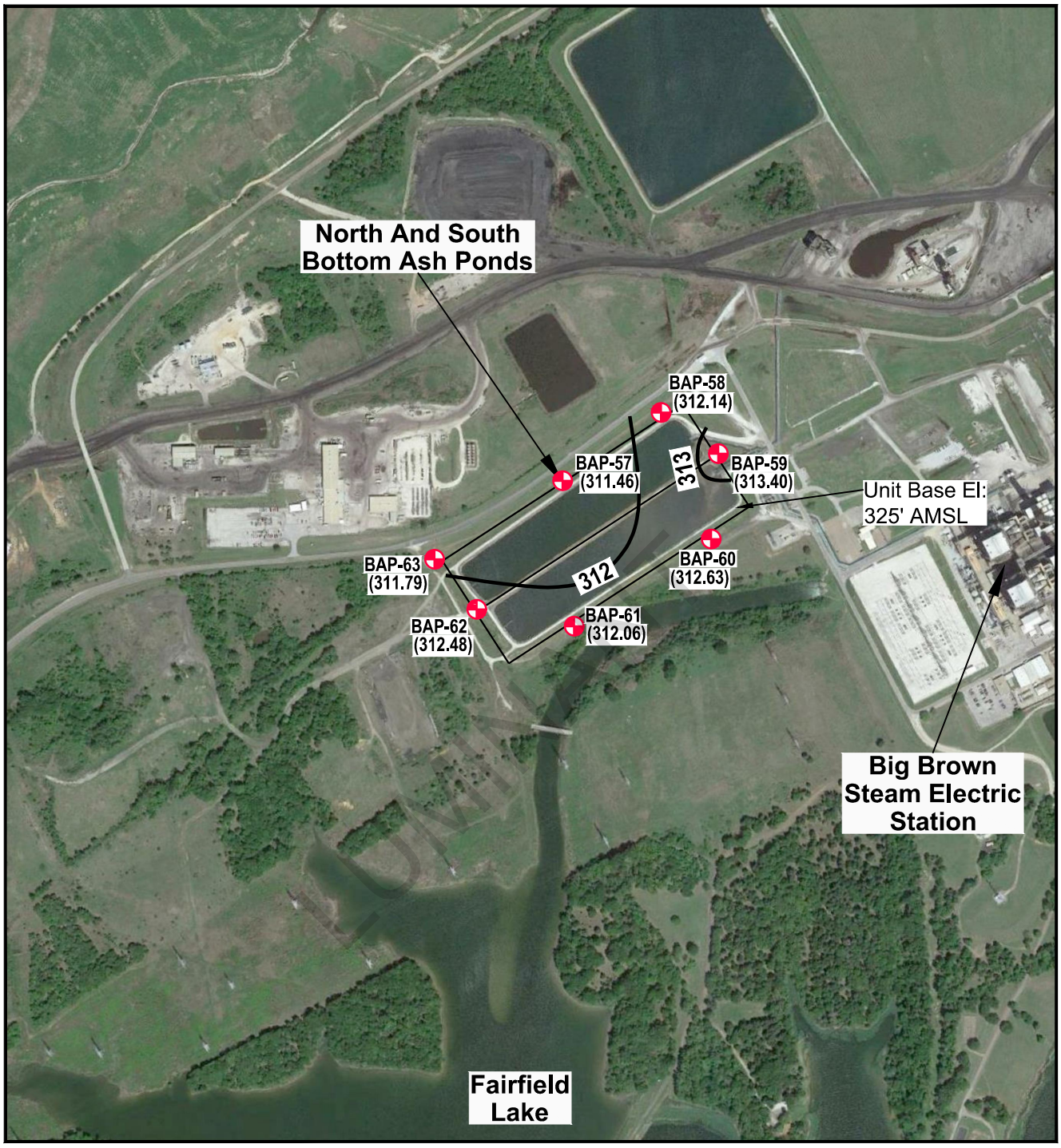

EXPLANATION

- CCR Monitoring Well Location
- (294.01) Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/30/2017.

BIG BROWN STEAM ELECTRIC STATION

FAIRFIELD, TEXAS

Figure 5

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A JUNE 9, 2016

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

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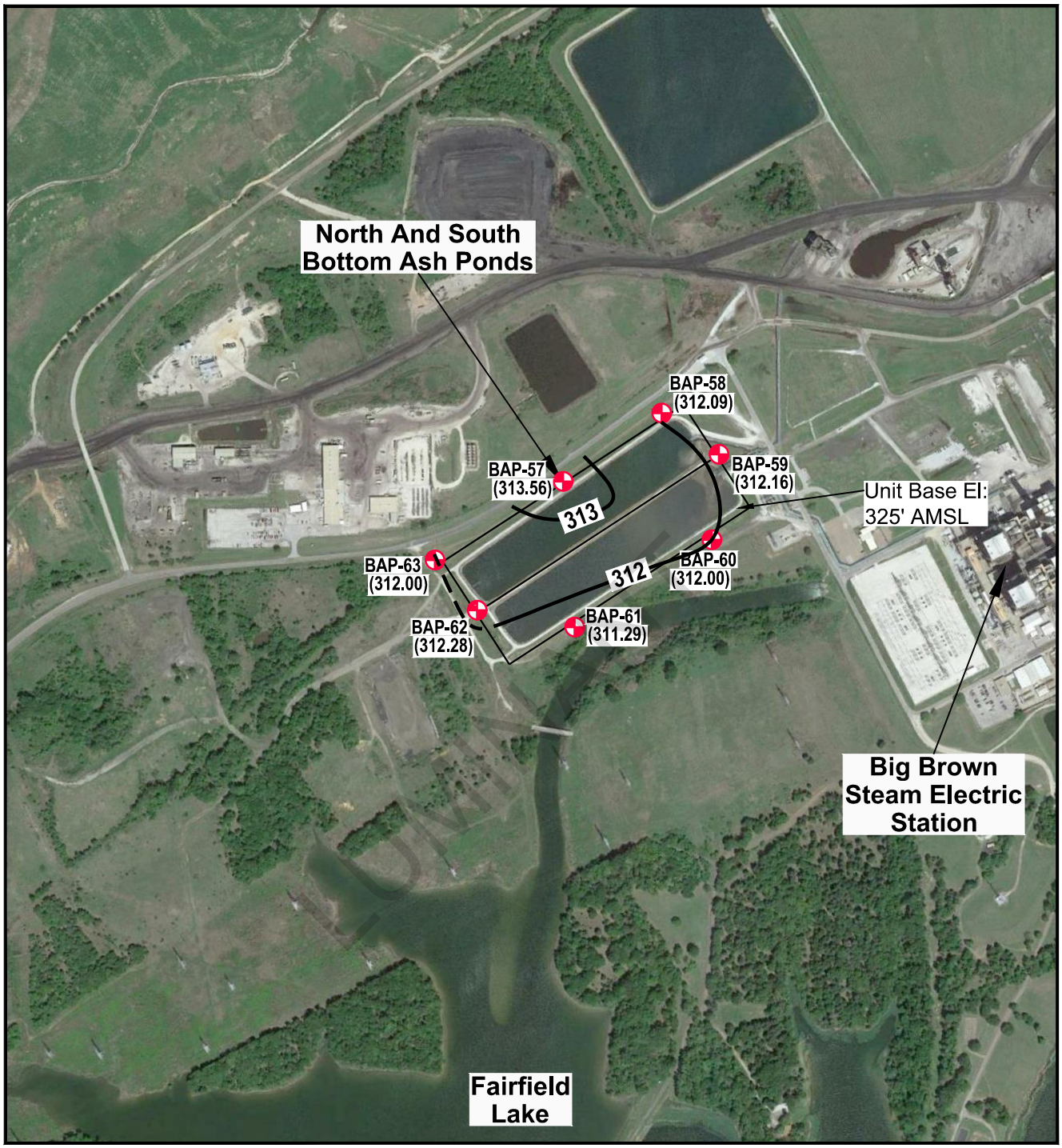

EXPLANATION

- CCR Monitoring Well Location
- *(294.01)* Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/30/2017.

BIG BROWN STEAM ELECTRIC STATION

FAIRFIELD, TEXAS

Figure 6

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A SEPTEMBER 1, 2016

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

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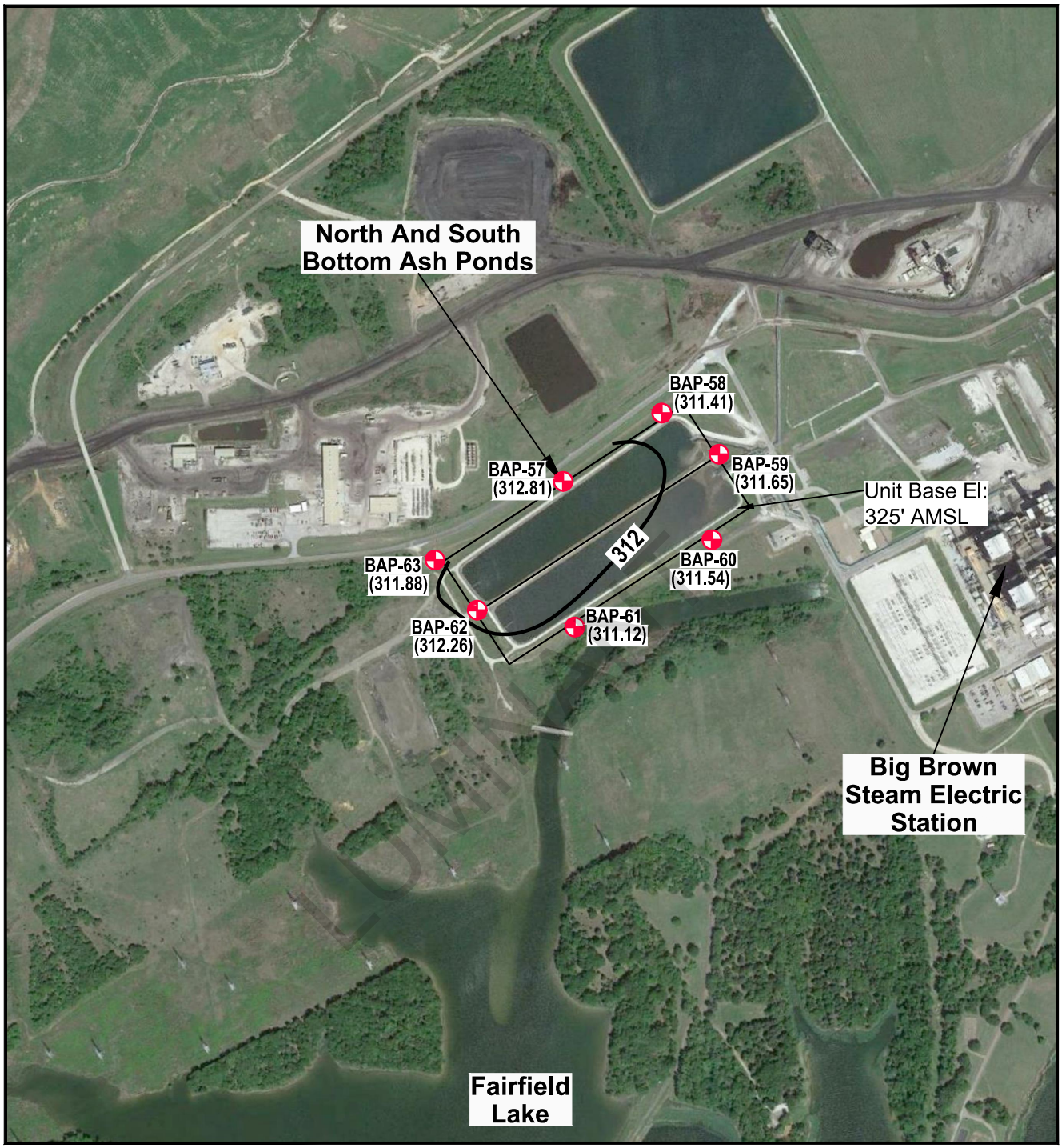

EXPLANATION

- CCR Monitoring Well Location
- *(294.01)* Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/30/2017.

BIG BROWN STEAM ELECTRIC STATION
FAIRFIELD, TEXAS

Figure 7

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A OCTOBER 6, 2016

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

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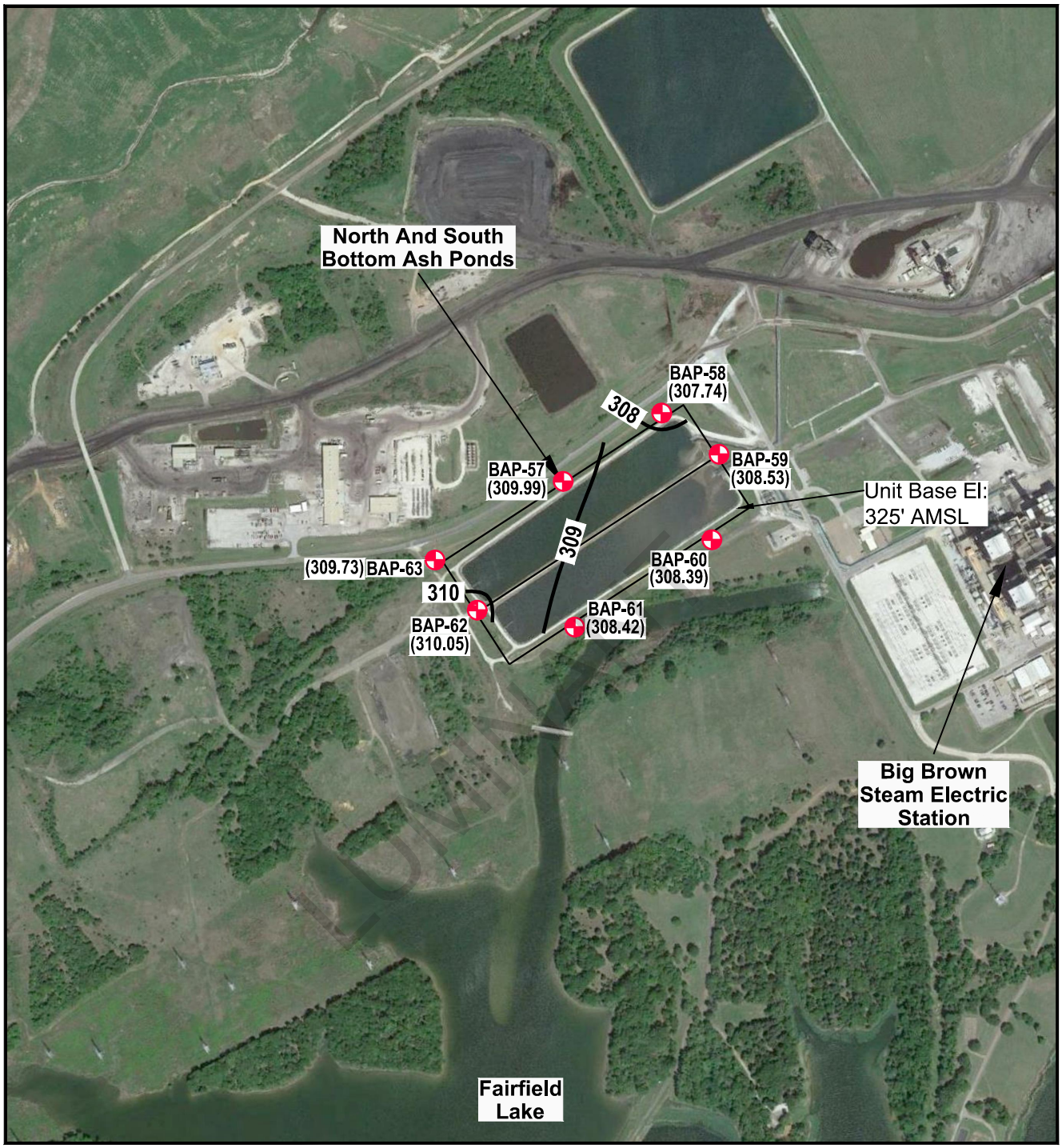

EXPLANATION

- CCR Monitoring Well Location
- *(294.01)* Groundwater Potentiometric Surface (ft. MSL)
- 300 Groundwater Potentiometric Surface Contour (C.I. = 2 ft.) (Dashed where inferred)

N

Scale in Feet

0 400 800

SOURCE:
Imagery from Google Earth dated 3/20/2017.

BIG BROWN STEAM ELECTRIC STATION

FAIRFIELD, TEXAS

Figure 8

BOTTOM ASH PONDS GROUNDWATER POTENTIOMETRIC SURFACE MAP ZONE A DECEMBER 14, 2016

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

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