2017 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT COAL COMBUSTION RESIDUALS (CCR) RULE

MARION POWER PLANT WILLIAMSON COUNTY, ILLINOIS

Prepared for:

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1.0 INTRODUCTION

At the request of Southern Illinois Power Cooperative (SIPC), AECOM Technical Services, Inc. (AECOM) prepared this 2017 Annual Groundwater Monitoring and Corrective Action Report for the SIPC Marion Power Plant (Marion Plant), located near in Marion, Illinois in accordance with the United States Environmental Protection Agency (USEPA) Final Rule 40 Code of Federal Regulations (CFR), Part 257.90. Sub-Part (e) (Rule). The Rule was established to regulate the disposal of Coal Combustion Residuals (CCR) produced by electricity generating facilities (USEPA, 2015).

This report summarizes all activities related to the CCR Rule groundwater monitoring program at the Marion Plant through 2017. The following sections present a site background summary, a discussion of field activities performed, a summary of laboratory results, statistical evaluation findings, and conclusions regarding groundwater conditions in the aquifer system subject to monitoring under the CCR Rule.

1.1 Site Background

The Marion Plant is situated on the northwestern shoreline of the Lake of Egypt, south of the town of Marion, Illinois. SIPC developed the 2300 acre lake for cooling water by damming the south fork of the Saline River. The Marion Plant is a coal-fired power plant and has been in operation since 1963. A general location map of the site is provided as **Figure 1**.

There is one settling pond on-site that has been identified as a potential surface impoundment subject to the CCR Rule. CCRs managed in the pond are generated from the, precipitator, boiler, scrubber and air heater washes during plant outages.

The impoundment is approximately 1.1 acres in size and approximately 8-feet deep.

2.0 2016 – 2017 ACTIVITIES SUMMARY

The following subsections describe the activities that were performed in 2017 for the Marion Plant related to the CCR Groundwater Monitoring Network.

2.1 Certified Monitoring Well System

Five monitoring wells were installed between February 7, 2017 and February 8, 2017 by Holcomb Engineering. AECOM was present onsite during well installation activities. A complete report of the well installation and details about the monitoring network are available in the Draft Monitoring Well Installation Report, *Coal Combustion Residuals Rule, Marion Power Station, Williamson County, Illinois* dated September 28, 2017.

Monitoring well locations are shown on **Figure 2**. Each well was installed into the upper portion of the uppermost aquifer underlying the site. At the Marion Plant, the uppermost aquifer is a shallow, hydraulically “perched” zone comprised of fill and residuum (silts and clays) from the weathering of bedrock, and is not considered a useable water source. Bedrock in the vicinity of the site consists of interbedded sandstone and shale, with minor amounts of limestone. This uppermost aquifer is marginal at best because of its shallow depth and contact with fill material. It was selected for monitoring because the geologic setting and local well records suggest there is no deeper usable aquifer below the site. **Table 1** contains information regarding well locations and construction details. Well lithologic and construction logs are included as **Appendix A**.

The CCR monitoring network at the Marion Plant was reviewed and certified by a Professional Engineer as required by 40 Code of Federal Regulations (CFR) § 257.91(e)(1). A copy of the Groundwater Monitoring System Certification document will be made available on the public website for CCR Activities maintained by SIPC.

2.2 Baseline Groundwater Sampling

Eight Baseline groundwater sampling events were conducted at the Marion Plant between March 2017 and October 2017. The following table summarizes the dates of each of the sampling events for the baseline period and the wells included in the events.

Event Type	Sampling Event	Dates	Wells Sampled
Baseline Groundwater Sampling	1	March 24, 2017	EBG, EP-1, EP-2, EP-3, and EP-4
	2	April 24, 2017	
	3	May 25, 2017	
	4	June 22, 2017	
	5	June 29, 2017	
	6	July 24, 2017	
	7	August 3, 2017	
	8	August 31, 2017	

Monitoring wells were sampled by evacuating the wells and allowing groundwater recharge before sample collection. All wells were sampled for Appendix III and Appendix IV parameters in accordance with 40 CFR § 257.93. Results from the eight baseline events are summarized in **Table 2**.

2.4 Statistical Method Certification

As required by 40 CFR § 257.93(f)(6) a statistical program for evaluating statistically significant increases (SSI) over baseline levels is currently under development. The Statistical Methods Certification document details the selected method and will be made available on the public website for CCR Activities maintained by SIPC.

3.0 DATA EVALUATION

The following sections present details about the monitoring system, groundwater flow, groundwater sampling results, and statistical evaluation for the Marion Plant well network and datasets.

3.1 Monitoring Well System

The CCR monitoring well system at the Marion Plant contains one background monitoring well and four downgradient monitoring wells. Their locations are shown in **Figure 2**. Construction details for these monitoring wells are available in **Table 1**.

3.2 Groundwater Flow

Monitoring wells were gauged prior to collecting a sample at each well. A potentiometric surface map was created to confirm groundwater flow direction. A summary of groundwater measured elevations is included in **Table 3** and groundwater flow maps for each event are included in **Appendix B**.

Generally, groundwater flow in the vicinity of Emery Pond is to the northeast. In the fifth through eighth sampling events groundwater flow shifted to the more easterly flow path.

Groundwater flow rate (i.e., velocity) estimates were calculated using the groundwater flow maps, estimated hydraulic conductivity and porosity values from nearby monitoring wells. Estimated groundwater velocities range from 0.0014 to 0.003 feet per day. These upper and lower range values are based on estimated hydraulic characteristics from a nearby monitoring well, which is located to the

southwest of the Emery Pond Impoundment. **Table 4** contains groundwater flow rate calculations for each of the baseline sampling events.

3.3 Sampling Results

During 2017 a total of eight Baseline Monitoring events were completed. Discussion of the results from these sampling activities is presented in the following subsections.

3.3.1 Baseline Sampling

During the Baseline Sampling period, all wells were sampled for Appendix III and Appendix IV parameter lists. Constituents from both parameter lists were detected in all of the monitoring wells in all groundwater sampling events conducted. Analytical results from the Baseline Sampling are displayed in **Table 2**.

3.4 Statistical Evaluation

The first Detection Monitoring event for the Emery Pond was not complete as of the time of this annual report preparation. In the interim, a statistical evaluation using the Baseline dataset was conducted to identify any SSIs for the Appendix III parameters. The eighth baseline event data were compared to the previous seven events, which were considered the "baseline" data. Statistical methods were chosen in accordance with 40 CFR § 257.93(f)(1). Monitoring wells were evaluated using an interwell approach with monitoring well EBG used for background comparison. The well is located roughly upgradient of the Emery Pond surface impoundment. Rationale behind why each method was selected is outlined in *Statistical Methods Certification Document.* This document is under final development as of the preparation of this annual report. A copy of this document will be made available on the public website for CCR Activities maintained by SIPC.

Constituents with SSIs identified through the eight Baseline Monitoring events include:

- Boron, calcium, pH, sulfate and total dissolved solids (TDS) in EP-1
- Boron, calcium, sulfate and TDS in EP-2
- Calcium, chloride, sulfate, and TDS in EP-3
- Boron, calcium, chloride, sulfate, and TDS in EP-4

All SSIs are highlighted in **Table 2**.

3.5 Discussion and Conclusions

SIPC is preparing to conduct Detection Monitoring sampling in early 2018 for the Appendix III constituents at the monitoring wells listed in Section 2.2 above. Upon receipt of results from the confirmation sampling, SIPC will repeat the statistical evaluation tasks to determine if Assessment Monitoring is required.

4.0 GENERAL INFORMATION

The following sections summarize any problems encountered in the CCR program through 2017, any resolutions to those problems if needed and upcoming actions planned for 2018.

4.1 Problems Encountered and Resolutions

No problems were encountered during the 2017 reporting period.

4.2 Actions Planned for 2018

SIPC plans on performing semiannual Detection Monitoring sampling for Appendix III parameters at all monitoring wells prior to April 2018. Upon receiving the results of the detection monitoring event, an addition statistical evaluation will be completed. Based on the analytical results and updated statistical evaluation, the need for alternate source demonstration activities or corrective action evaluation will be evaluated. Any notifications required by 40 CRF § 257.94(e)(3) will be transmitted accordingly.

5.0 REFERENCES

AECOM, October 2017. *Coal Combustion Residuals Rule Groundwater Monitoring System Certification*, Marion Power Plant, TBD.

AECOM, October 2017. *Coal Combustion Residuals Rule Statistical Methods Certification*, Marion Power Plant, TBD.

AECOM, September 2017. *Draft Monitoring Well Installation Report Coal Combustion Residuals (CCR) Rule,* Marion Power Plant, September 28, 2017.

United States Environmental Protection Agency, 2015. Part 257.90, Sub-Part (e) Coal Combustion Residuals Rule.

Tables

TABLE 1
SOUTHERN ILLINOIS POWER COOPERATIVE
MARION POWER PLANT
EMERY POND IMPOUNDMENT
MONITORING WELL CONSTRUCTION SUMMARY

Well ID	Easting [1]	Northing [1]	Well Installation Date	TOC Elevation (ft MSL) [1]	Ground Surface Elevation (ft MSL) [1]	Stickup Height	Total Depth (ft bgs)	Total Depth (ft BTOC)	Bottom Elevation (ft MSL)	Screen Length (feet)	Top of Screen (ft bgs)	Top of Screen (feet BTOC)	Bottom of Screen (ft bgs)	Bottom of Screen (ft BTOC)	Top of Screen Elevation (ft MSL)	Bottom of Screen Elevation (ft MSL)	Well Casing Material	Well Screen Material and Slot Size	Groundwater Flow Location	Program Use
EP-1	804661.174	347042.306	2/7/2017	519.72	517.07	2.65	31.00	33.65	486.07	10	21	23.65	31	33.65	496.07	486.07	2-inch Schedule 40 PVC	2-inch Schedule 40 PVC and 0.01-inch slot	Downgradient	Detection
EP-2	804799.408	347113.029	2/7/2017	513.79	511.15	2.64	15.00	17.64	496.15	10	5	7.64	15	17.64	506.15	496.15			Downgradient	
EP-3	804814.534	347245.080	2/7/2017	518.95	516.24	2.71	26.50	29.21	489.74	10	16.5	19.21	26.5	29.21	499.74	489.74			Downgradient	
EP-4	804687.527	3472883297	2/8/2017	519.74	517.07	2.67	18.50	21.17	498.57	10	8.5	11.17	18.5	21.17	508.57	498.57			Downgradient	
EBG	804168.155	346358.140	2/8/2017	524.87	521.74	3.13	25.00	28.13	496.74	10	15	18.13	25	28.13	506.74	496.74			Background/Upgradient	

TOC - Top of Casing
ft MSL - feet above Mean Sea Level
ft BTOC - feet below top of casing
ft bgs - feet below ground surface
PVC - Polyvinyl Chloride
[1] - Easting/Northing and Elevation data provided by SIPC using the SIPC Control Network Horizontal and Vertical Datum as established by Clarida & Ziegler Engineering Co.

Table 2
Southern Illinois Power Cooperative
Marion Power Plant
Analytical Data

			Appendix III Constituents													
Analtyte Name			Boron		Calcium		Chloride		Fluoride		pH		Sulfate		TDS	
units			mg/L		mg/L		mg/L		mg/L		S.U.		mg/L		mg/L	
Downgradient Wells	EP-01	3/23/17	0.1300		220.0		54.0		0.5	U	6.94		820		2000	
		4/24/17	0.2100		280.0		54.0		0.5	U	6.89		910		2300	H1
		5/25/17	0.2800		310.0		48.0		0.5	U	6.55		850		2300	
		6/22/17	0.2600		310.0		50.0		0.5	U	6.52		850		2300	
		6/29/17	0.3200		310.0		50.0		0.5	U	6.64		440		2200	
		7/24/17	0.2100		270.0		51.0		0.5	U	6.57		540		2200	
		8/1/17	0.2300		250.0		48.0		0.5	U	6.82		520		2100	
		8/31/17	0.1700		240.0		48.0		0.5	U	6.79		440		2100	
	EP-02	3/23/17	0.2200		190.0		42.0		0.5	U	6.18		860		1800	
		4/24/17	0.1900		170.0		39.0		0.5	U	6.39		660		1800	H1
		5/25/17	0.2000		200.0		36.0		0.5	U	6.31		780		1900	
		6/22/17	0.2300		200.0		37.0		0.5	U	6.10		780		1800	
		6/29/17	0.2900		470.0		36.0		0.5	U	5.75		470		1900	
		7/24/17	0.2600		200.0		36.0		0.5	U	5.86		430		1800	
		8/1/17	0.3100		190.0		36.0		0.5	U	5.88		770		1800	
		8/31/17	0.2300		180.0		36.0		0.5	U	6.33		340		1800	
	EP-03	3/23/17	0.1100		34.0		100.0		0.5	U	5.99		120.0		680	
		4/24/17	0.0890		29.0		120.0		0.5	U	5.96		180.0		820	H1
		5/25/17	0.0810		45.0		140.0		0.5	U	6.03		190		1400	
		6/22/17	0.0570		93.0		220.0		0.5	U	6.08		300		560	
		6/29/17	0.0850		30.0		66.0		0.5	U	6.01		73		570	
		7/24/17	0.0830		32.0		110.0		0.5	U	5.96		130		720	
		8/1/17	0.0900		34.0		120.0		0.5	U	6.02		140		630	
		8/31/17	0.0900		33.0		110.0		0.5	U	6.13		110		1000	
	EP-04	3/23/17	15.0	D	190.0		460.0		0.5	U	5.51		620		2300	
		4/24/17	23.0	D	170.0		290.0		0.5	U	5.88		530		2300	H1
		5/25/17	14.0	D	170.0		380.0		0.5	U	5.77		660		2400	
		6/22/17	11.0	D	150.0		430.0		0.5	U	5.80		730		2000	
		6/29/17	13.0	D	190.0		250.0		0.5	U	5.81		410		2100	
		7/24/17	11.0	D	160.0		180.0		0.5	U	5.80		290		2300	
		8/1/17	14.0	D	150.0		210.0		0.5	U	5.80		330		2200	
		8/31/17	11.0	D	150.0		210.0		0.5	U	5.85		340		2300	
Upgradient Wells	EBG	3/23/17	0.1200		23.0		55.0		0.5	U	6.50		64		480	
		4/24/17	0.0790		10.0		11.0		0.5	U	6.80		54		400	H1
		5/25/17	0.1000		30.0		84.0		0.5	U	6.41		42		440	
		6/22/17	0.0710		23.0		68.0		0.5	U	6.45		57		470	
		6/29/17	0.0730		32.0		79.0		0.5	U	6.53		50		280	
		7/24/17	0.0790		37.0		27.0	M2	0.64	M1	6.59		61	M2	420	
		8/1/17	0.0740		35.0	M3	86.0		0.5	U	6.66		45		380	
		8/31/17	0.0560		35.0		82.0		0.5	U	6.26		44		470	
Upper Limit			0.1210		46.3		118.1		0.640		6.85		68.6		550	

		Appendix IV Constituents																	
Well	Date	Antimony		Arsenic		Barium		Beryllium		Cadmium		Chromium		Cobalt		Fluoride		Lead	
units		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
EP-01	3/23/17	0.00043	J	0.0050	U	0.0450		0.0002	U	0.0050	U	0.005	U	0.0017	J	0.5	U	0.0050	U
	4/24/17	0.0002	U	0.0050	U	0.0400		0.0002	U	0.0060		0.005	U	0.0008	j	0.5	U	0.0050	U
	5/25/17	0.005	U	0.0050	U	0.0410		0.0050	U	0.0100	U	0.010	U	0.0050	U	0.5	U	0.0100	U
	6/22/17	0.00057	J	0.0050	U	0.0320		0.0002	U	0.0100	U	0.010	U	0.0008	J	0.5	U	0.0100	U
	6/29/17	0.0010	J	0.0050	U	0.0330		0.0002	U	0.0100	U	0.010	U	0.0006	J	0.5	U	0.0100	U
	7/24/17	0.0050	U	0.0050	U	0.0290		0.0050	U	0.0100	U	0.010	U	0.0050	U	0.5	U	0.0100	U
	8/1/17	0.0002	U	0.0050	U	0.0280		0.0002	U	0.0100	U	0.010	U	0.0007	J	0.5	U	0.0100	U
	8/31/17	0.0050	u	0.0050	U	0.0260		0.0050	U	0.0100	U	0.010	U	0.0050	U	0.5	U	0.0100	U
EP-02	3/23/17	0.00029	J	0.0050	U	0.0390		0.0002	U	0.0050	U	0.0050	U	0.0520		0.5	U	0.0050	U
	4/24/17	0.0002	U	0.0050	U	0.0350		0.0002	U	0.0050	U	0.005	U	0.0290		0.5	U	0.0050	U
	5/25/17	0.0050	U	0.0050	U	0.0380		0.0050	U	0.0100	U	0.010	U	0.0230		0.5	U	0.0100	U
	6/22/17	0.0004	J	0.0050	U	0.0300		0.0002	U	0.0100	U	0.010	U	0.0160		0.5	U	0.0100	U
	6/29/17	0.0007	J	0.0050	U	0.0290		0.0002	U	0.0100	U	0.010	U	0.0087		0.5	U	0.0100	U
	7/24/17	0.0050	U	0.0050	U	0.0250		0.0050	U	0.0100	U	0.010	U	0.0050	U	0.5	U	0.0100	U
	8/1/17	0.0002	U	0.0050	U	0.0250		0.0002	U	0.0100	U	0.010	U	0.0009	J	0.5	U	0.0100	U
	8/31/17	0.0050	U	0.0050	U	0.0250		0.0050	U	0.0100	U	0.010	U	0.0050	U	0.5	U	0.0100	U
EP-03	3/23/17	0.00022	J	0.0050	U	0.0720		0.0002	U	0.0050	U	0.005	U	0.1100		0.5	U	0.0050	U
	4/24/17	0.0002	U	0.0088		0.0590		0.0002	U	0.0050	U	0.005	U	0.1200		0.5	U	0.0056	U
	5/25/17	0.0050	U	0.0076		0.0590		0.0050	U	0.0100	U	0.010	U	0.0910		0.5	U	0.0100	U
	6/22/17	0.0003	J	0.0061		0.0610		0.0002	U	0.0100	U	0.010	U	0.0370		0.5	U	0.0100	U
	6/29/17	0.0009	J	0.0050	U	0.0650		0.0002	U	0.0100	U	0.010	U	0.1100		0.5	U	0.0100	U
	7/24/17	0.0050	U	0.0093		0.0640		0.0050	U	0.0100	U	0.010	U	0.1200		0.5	U	0.0100	U
	8/1/17	0.0002	U	0.0062		0.0570		0.0002	U	0.0100	U	0.010	U	0.1000		0.5	U	0.0100	U
	8/31/17	0.0050	U	0.0069		0.0580		0.0050	U	0.0100	U	0.010	U	0.1100		0.5	U	0.0100	U
EP-04	3/23/17	0.00028	J	0.0350		0.0350		0.0002	U	0.0050	U	0.005	U	0.3900		0.5	U	0.0090	
	4/24/17	0.0002	U	0.0390		0.0260		0.0002	U	0.0052		0.0050	U	0.4100		0.5	U	0.0130	
	5/25/17	0.0050	U	0.0370		0.0280		0.0050	U	0.0100	U	0.010	U	0.4100		0.5	U	0.0110	
	6/22/17	0.0003	J	0.0530		0.0290		0.0002	U	0.0100	U	0.010	U	0.4400		0.5	U	0.0170	
	6/29/17	0.0005	J	0.0440		0.0370		0.0002	U	0.0100	U	0.010	U	0.3400		0.5	U	0.0100	U
	7/24/17	0.0050	U	0.0440		0.0260		0.0050	U	0.0100	U	0.010	U	0.4100		0.5	U	0.0110	
	8/1/17	0.0002	U	0.0350		0.0310		0.0002	U	0.0100	U	0.010	U	0.4200		0.5	U	0.0120	
	8/31/17	0.0050	U	0.0490		0.0230		0.0050	U	0.0100	U	0.010	U	0.3800		0.5	U	0.0120	
EBG	3/23/17	0.00057	J	0.0050	U	0.1300		0.00033	J	0.0050	U	0.006	U	0.0080		0.5	U	0.0050	U
	4/24/17	0.00085	J	0.0050	U	0.0290		0.0002	U	0.0050	U	0.005	U	0.0002	J	0.5	U	0.0050	U
	5/25/17	0.0050	U	0.0050	U	0.1700		0.0050	U	0.0100	U	0.010	U	0.0140		0.5	U	0.0100	U
	6/22/17	0.00069	J	0.0050	U	0.0490		0.0002	U	0.0100	U	0.010	U	0.0002	J	0.5	U	0.0100	U
	6/29/17	0.0014	J	0.0050	U	0.0860		0.0002	U	0.0100	U	0.010	U	0.0014	J	0.5	U	0.0100	U
	7/24/17	0.0050	U	0.0050	U	0.1900		0.0050	U	0.0100	U	0.010	U	0.0093		0.64	M1	0.0100	U
	8/1/17	0.00022	J	0.0050	U	0.1800		0.0002	U	0.0100	U	0.010	U	0.0038	J	0.5	U	0.0100	U
	8/31/17	0.0050	U	0.0050	U	0.1600		0.0050	U	0.0100	U	0.010	U	0.0073		0.5	U	0.0100	U
Upper Limit		Statistical Evaluation is Not Applicable																	

		Appendix IV Constituents															
Well	Date	Lithium		Mercury		Molybdenum		Selenium		Thallium		Radium 226*		Radium 228*		Radium	
units		mg/L		mg/L		mg/L		mg/L		mg/L		pCi/L		pCi/L		pCi/L	
EP-01	3/23/17	0.0240	J	0.00020	U	0.00280	J	0.0012	J	0.02500	U	0.6030		0.0552		0.658	
	4/24/17	0.0280	J	0.00020	U	0.00160	J	0.0014	J	0.02500	U	NA		NA		NA	
	5/25/17	0.1000	U	0.00020	U	0.00500	U	0.0050	U	NA		NA		NA		NA	
	6/22/17	0.0320	J	0.00020	U	0.00077	J	0.0050	J	NA		0.313		0.496		0.809	
	6/29/17	0.0290	J	0.00020	U	0.00180	J	0.0025	J	NA		0.1390	U	0.0387	U	0.178	U
	7/24/17	0.1000	U	0.00020	U	0.00500	U	0.0050	U	NA		0.1600		-0.27		-0.110	
	8/1/17	0.0240	J	0.00020	U	0.00190	J	0.0011	J	NA		0.3800		1.04		1.420	
	8/31/17	0.1000	U	0.00020	U	0.00500	U	0.0050	U	NA		0.2400		1.15		1.390	
EP-02	3/23/17	0.0180	J	0.00020	U	0.00150	J	0.0038	J	0.02500	U	0.1870	U	0.8530		1.040	U
	4/24/17	0.0150	J	0.00020	U	0.00170	J	0.0027	J	0.02500	U	NA		NA		NA	
	5/25/17	0.1000	U	0.00020	U	0.00500	U	0.0050	U	0.05000	U	NA		NA		NA	
	6/22/17	0.0200	JU	0.00020	U	0.00030	J	0.0074		0.05000	U	0.1970		-0.127	U	0.070	U
	6/29/17	0.0250	J	0.00020	U	0.00055	J	0.0061		0.05000	U	1.9000		0.458	U	2.358	U
	7/24/17	0.1000	U	0.00020	U	0.00500	U	0.0054		0.05000	U	0.0800		0.4		0.480	
	8/1/17	0.0210	J	0.00020	U	0.00082	J	0.0046	J	0.05000	U	0.1400		1.35		1.490	
	8/31/17	0.1000	U	0.00020	U	0.00500	U	0.0050	U	0.05000	U	0.0800		0.64		0.720	
EP-03	3/23/17	0.0030	U	0.00020	U	0.00037	J	0.0130		0.02500	U	1.6400		0.4380	U	2.078	U
	4/24/17	0.0095	J	0.00020	U	0.00045	J	0.0110		0.02500	U	NA		NA		NA	
	5/25/17	0.1000	U	0.00020	U	0.00500	U	0.0160		0.05000	U	NA		NA		NA	
	6/22/17	0.1200		0.00020	U	0.00020	U	0.0280		0.05000	U	0.3550		0.420		0.775	U
	6/29/17	0.0120	J	0.00020	U	0.00020	U	0.0130		0.05000	U	0.3170		0.397	U	0.714	U
	7/24/17	0.1000	U	0.00020	U	0.00500	U	0.0160		0.05000	U	0.1900		0.770		0.960	
	8/1/17	0.0280	j	0.00020	U	0.00047	J	0.0120		0.05000	U	0.4600		2.420		2.880	
	8/31/17	0.1000	U	0.00020	U	0.00500	U	0.0220		0.05000	U	0.4100		0.770		1.180	
EP-04	3/23/17	0.0044	J	0.00020	U	0.00092	J	0.1300		0.02500	U	1.100		0.442	U	1.542	U
	4/24/17	0.0062	J	0.00020	U	0.00110	J	0.1200		0.06500		NA		NA		NA	
	5/25/17	0.1000	U	0.00020	U	0.00500	U	0.1300		0.09200		NA		NA		NA	
	6/22/17	0.0047	J	0.00020	U	0.00020	U	0.2000		0.09400		0.180		0.897		1.077	
	6/29/17	0.0063	J	0.00020	U	0.00058	J	0.1300		0.05800		0.219	U	0.490	U	0.709	U
	7/24/17	0.1000	U	0.00020	U	0.00500	U	0.1300		0.30000		0.300		0.440		0.740	
	8/1/17	0.0053	J	0.00020	U	0.00100	J	0.1100		0.07500		0.150		0.960		1.110	
	8/31/17	0.1000	U	0.00020	U	0.00500	U	0.1600		0.07500		0.330		2.140		2.470	
EBG	3/23/17	0.0046	J	0.00020	U	0.0034	J	0.0019	J	0.02500	U	0.878		1.060		1.938	
	4/24/17	0.0074	J	0.00020	U	0.00430	J	0.0005	U	0.02500	U	NA		NA		NA	
	5/25/17	0.1000	U	0.00020	U	0.00500	U	0.0050	U	0.05000	U	NA		NA		NA	
	6/22/17	0.0280	J	0.00020	U	0.00170	J	0.0036	J	0.05000	U	0.262	U	0.0695	U	0.332	U
	6/29/17	0.0590	J	0.00020	U	0.00160	J	0.0019	J	0.05000	U	0.245	U	0.371	U	0.616	U
	7/24/17	0.1000	U	0.00020	U	0.00500	U	0.0050	U	0.05000	U	0.430		0.980		1.410	
	8/1/17	0.0820	J	0.00020	U	0.00240	J	0.0028	J	0.05000	U	0.280		1.240		1.520	
	8/31/17	0.1000	U	0.00020	U	0.00500	U	0.0070		0.05000	U	0.770		2.220		2.990	
Upper Limit		Statistical Evaluation is Not Applicable															

Statistically significant increase (SSI) over baseline sampling using well specific and parameter specific statistical limits.
TDS = Total Dissolved Solids
NA = Not Analyzed
mg/L = milligrams per liter
S.U. = Standard Units
pCi/L = picoCurie/liter
D = Dilution
J = The analyte was positively identified, but the quanitation was below the RL
U = Analyte analyzed for but not detected
* = "U" flag for radionuclides is not detected above the minimum detectable concentration which differs from similar flag for aqueous results.
M1 = Matrix Spike recovery outside Control Limits due to sample matrix interference; biased high.
M2 = Matrix Spike recovery outside Control Limits due to sample matrix interference; biased low
M3 = Analyte in the parent sample for the Matrix Spike was >4x the concentration of the spike solution which renders the spike amount insignificant. Matrix spike recoveries do not impact the quality of the parent sample data for this analyte.
H1 = Sample received outside of holding time for these analyses

TABLE 3
SOUTHERN ILLINOIS POWER COOPERATIVE
MARION POWER PLANT
MONITORING WELL GROUNDWATER ELEVATIONS

		Event 1		Event 2		Event 3		Event 4	
	Date	3/24/2017		4/24/2017		5/25/2017		6/22/2017	
Well	TOC Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)
EGB	524.87	5.20	519.67	7.90	516.97	8.00	516.87	8.00	516.87
EP-1	519.72	7.30	512.42	5.80	513.92	7.00	512.72	8.00	511.72
EP-2	513.79	4.90	508.89	3.90	509.89	4.50	509.29	5.10	508.69
EP-3	518.95	12.40	506.55	13.10	505.85	13.30	505.65	13.00	505.95
EP-4	519.74	10.00	509.74	10.00	509.74	10.20	509.54	9.90	509.84

TOC = Top of casing
DTW = Depth to water

TABLE 3
SOUTHERN ILLINOIS POWER COOPERATIVE
MARION POWER PLANT
MONITORING WELL GROUNDWATER ELEVATIONS

		Event 5		Event 6		Event 7		Event 8	
	Date	6/29/2017		7/24/2017		8/3/2017		8/31/2017	
Well	TOC Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)	DTW (feet)	Groundwater Elevation (feet, msl)
EGB	524.87	13.00	511.87	8.00	516.87	9.60	515.27	8.90	515.97
EP-1	519.72	8.20	511.52	9.00	510.72	10.30	509.42	10.90	508.82
EP-2	513.79	5.00	508.79	6.00	507.79	6.40	507.39	6.80	506.99
EP-3	518.95	13.30	505.65	11.50	507.45	12.70	506.25	11.50	507.45
EP-4	519.74	7.20	512.54	10.00	509.74	9.50	510.24	9.90	509.84

TOC = Top of casing
DTW = Depth to water

Table 4
Southern Illinois Power Cooperative
Marion Power Plant
Groundwater Flow Rates

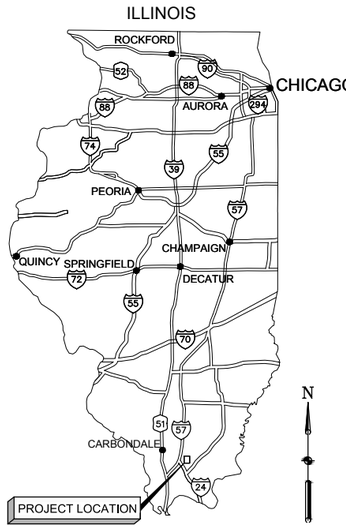
	Event	Groundwater Flow Direction	Hydraulic Conductivity (cm/sec)	Gradient (dh/dl)	DTW (upgradient)	DTW (downgradient)	Difference b/w head (ft)	Effective Porosity	Length (ft)	Max velocity (cm/sec)	Max velocity (ft/day)
Flow Path from EP-1 to EP-2	1	Northeast	1.60E-05	0.024	512.42	508.89	3.53	40%	150	**9.41E-07**	**2.67E-03**
	2			0.027	513.92	509.89	4.03			**1.07E-06**	**3.05E-03**
	3			0.023	512.72	509.29	3.43			**9.15E-07**	**2.59E-03**
	4			0.020	511.72	508.69	3.03			**8.08E-07**	**2.29E-03**
	5	East		0.018	511.52	508.79	2.73			**7.28E-07**	**2.06E-03**
	6			0.020	510.72	507.79	2.93			**7.81E-07**	**2.21E-03**
	7			0.014	509.42	507.39	2.03			**5.41E-07**	**1.53E-03**
	8			0.012	508.82	506.99	1.83			**4.88E-07**	**1.38E-03**

cm/sec = Centimeters per second

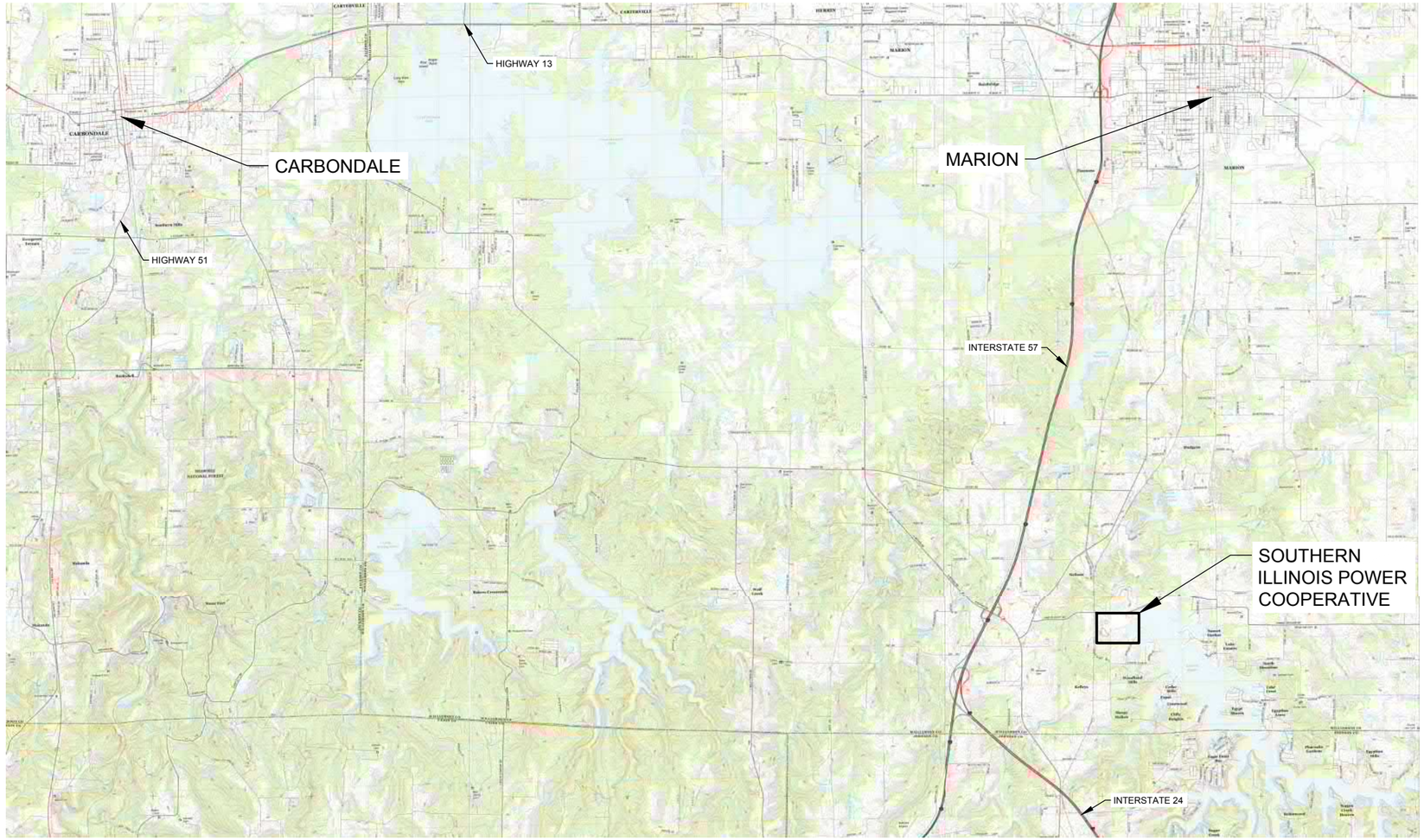
References:
Holcomb Foundation Engineering Co., February 2017. *Southern Illinois Power Cooperative Slug Tests* . Marion Power Plant, February 10, 2017.
Fetter, C.W., 2001. Applied Hydrogeology: Fourth Edition, Prentice-Hall, Inc.

	Porosity (%)
[a] Silt	35 - 50%
[b] Clay	33 - 60%

Figures



STATE MAP
NOT TO SCALE



USGS QUADRANGLE MAPS

CARBONDALE, ILLINOIS
CRAB ORCHARD LAKE, ILLINOIS
GOREVILLE, ILLINOIS
LICK CREEK, ILLINOIS
MAKANDA, ILLINOIS
MARION, ILLINOIS

N

0 5000 10000 15000
SCALE IN FEET

AECOM
1001 Highlands Plaza
Drive West, Suite 300
St. Louis, Mo. 63110-1337
314 429-0100 (phone)
314 429-0462 (fax)

SOUTHERN ILLINOIS POWER COOPERATIVE
11543 Lake of Egypt Road
Marion, Illinois 62959
(618) 964-1867

MARION POWER PLANT
MARION, ILLINOIS

GROUNDWATER MONITORING WELLS

PRELIMINARY NOT FOR CONSTRUCTION

ISSUED FOR BIDDING ____ DATE

ISSUED FOR CONSTRUCTION ____ DATE

REVISIONS

NO.	DESCRIPTION	DATE
△		
△		
△		
△		
△		

AECOM PROJECT NO:	60535846
DRAWN BY:	MJC
DESIGNED BY:	MJC
CHECKED BY:	SB
DATE CREATED:	09/29/2017
PLOT DATE:	10/2/2017
SCALE:	1" = 5000'
ACAD VER:	2017

SHEET TITLE

GENERAL LOCATION MAP

FIGURE 1

LEGEND

EP–1 GROUNDWATER MONITORING WELL

N

0 100 200 300

SCALE IN FEET

AECOM
1001 Highlands Plaza
Drive West, Suite 300
St. Louis, Mo. 63110-1337
314 429-0100 (phone)
314 429-0462 (fax)

SOUTHERN ILLINOIS POWER COOPERATIVE
11543 Lake of Egypt Road
Marion, Illinois 62959
(618) 964-1867

MARION POWER PLANT
MARION, ILLINOIS

GROUNDWATER MONITORING WELLS

PRELIMINARY NOT FOR CONSTRUCTION

ISSUED FOR BIDDING DATE

ISSUED FOR CONSTRUCTION DATE

REVISIONS

NO.	DESCRIPTION	DATE
1		
2		
3		
4		
5		

AECOM PROJECT NO:	60535846
DRAWN BY:	MJC
DESIGNED BY:	MJC
CHECKED BY:	SB
DATE CREATED:	09/29/2017
PLOT DATE:	10/2/2017
SCALE:	1" = 100'
ACAD VER:	2017

SHEET TITLE

WELL LOCATION MAP

FIGURE 2

Appendix A

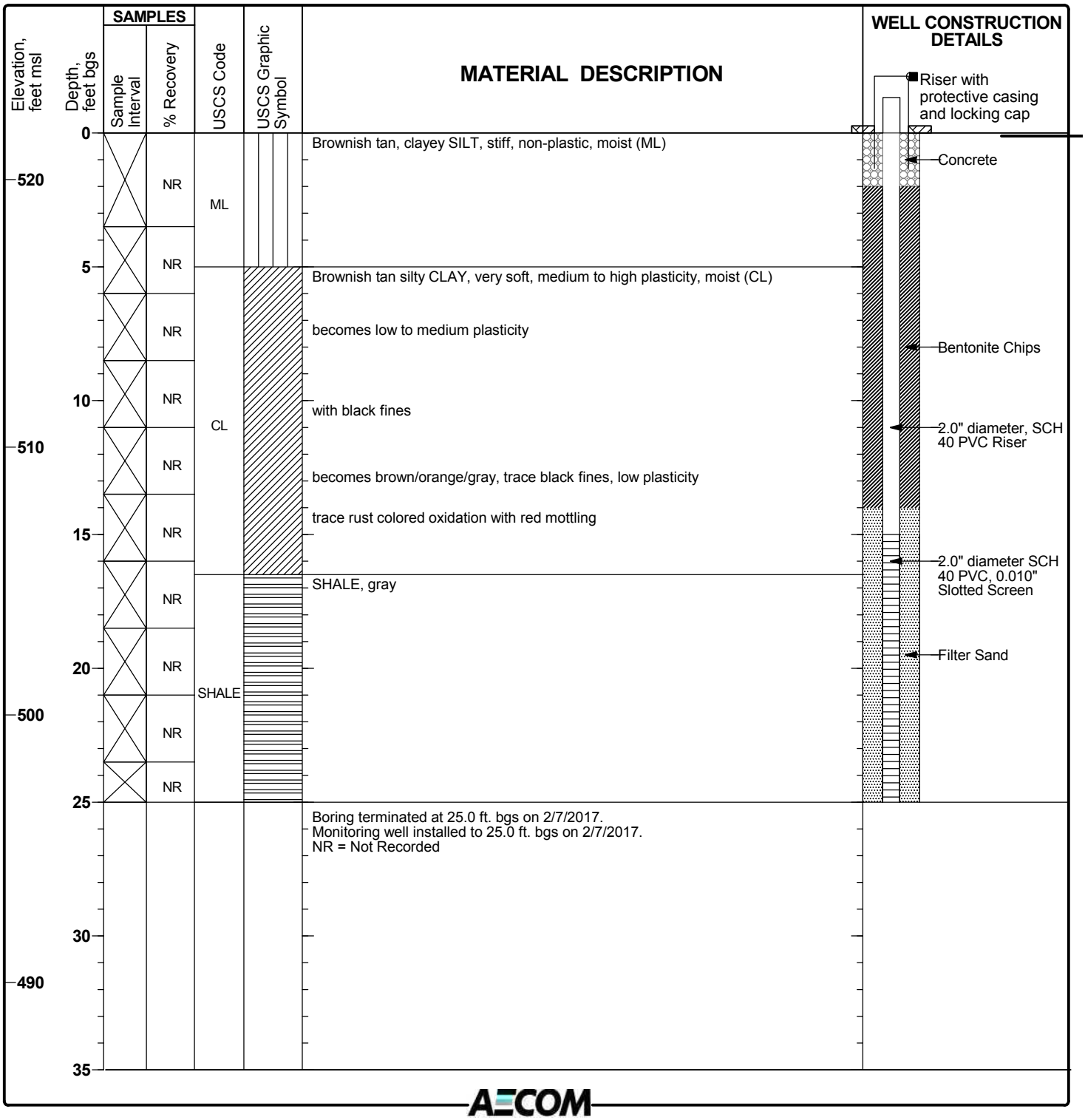
Monitoring Well Construction Logs

Client: Southern Illinois Power Cooperative
Project Name: SIPC Marion CCR
Project Location: SIPC Marion
Project Number: 60535846

Log of EBG

Sheet 1 of 1

Date(s) Drilled and Installed	**2/8/2017**	Logged By	**Suzanne Dale**	Reviewed By	
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**Holcomb Engineering**	Total Depth of Borehole	**25.0 feet, bgs**
Sampling Method	**Split Spoon**	Water Level TOIC	**Not measured**	TOC Elevation Ground Surface	**524.87 ft, msl** **521.74 ft, msl**
Size and Type of Well Casing	**2-Inch Schedule 40 PVC**	Screen Perforation	**0.010 - inch**	Northing (Plant) Easting (Plant)	**346358.14 ft** **804168.155 ft**
Seal or Backfill	**Bentonite Chips**				



SIPC MARION SIPC MARION.GPJ 10/9/17

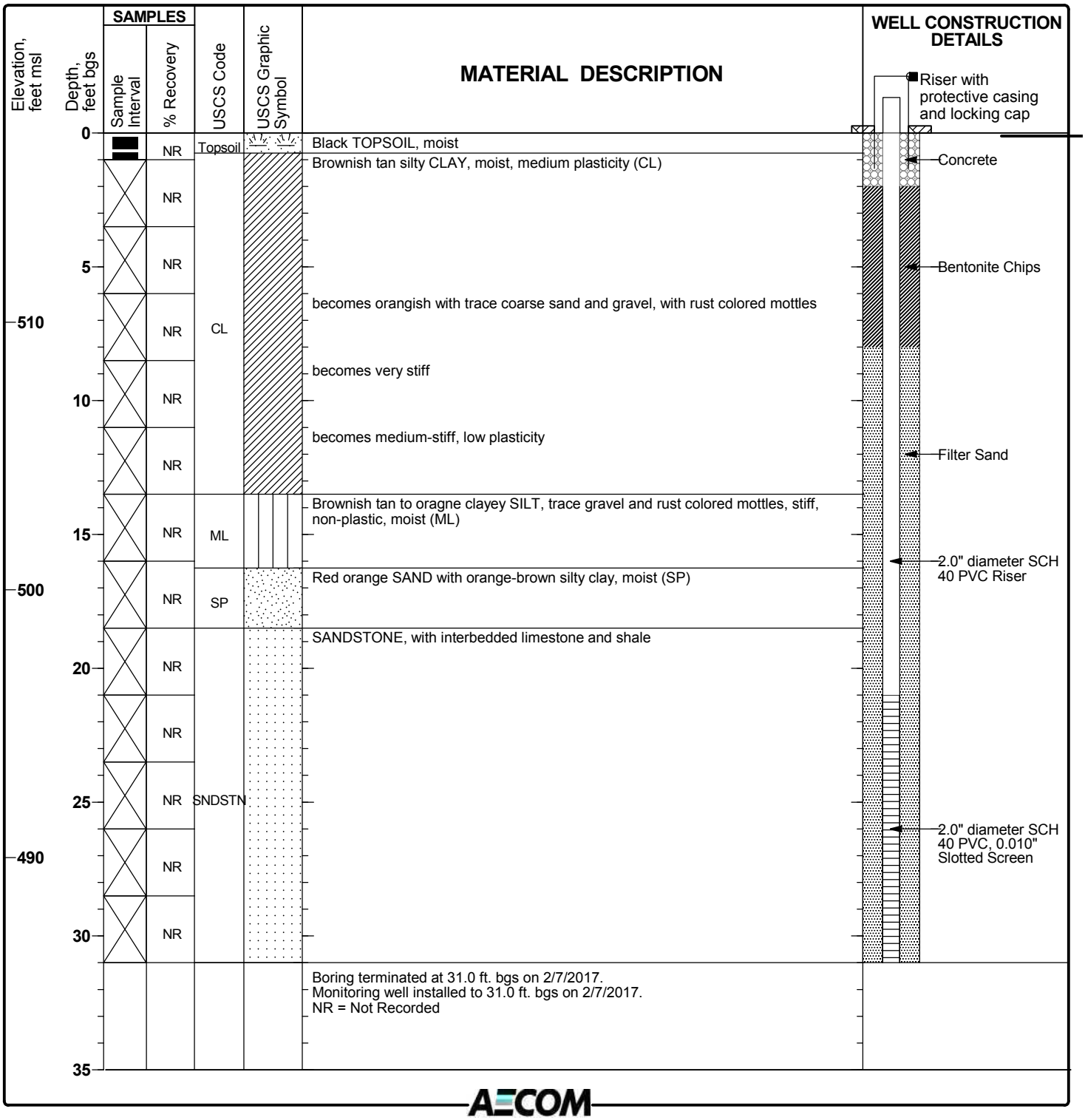
AECOM

Client: Southern Illinois Power Cooperative
Project Name: SIPC Marion CCR
Project Location: SIPC Marion
Project Number: 60535846

Log of EP-1

Sheet 1 of 1

Date(s) Drilled and Installed	**2/7/2017**	Logged By	**Suzanne Dale**	Reviewed By	
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**Holcomb Engineering**	Total Depth of Borehole	**31.0 feet, bgs**
Sampling Method	**Split Spoon**	Water Level TOIC	**Not measured**	TOC Elevation Ground Surface	**519.72 ft, msl** **517.07 ft, msl**
Size and Type of Well Casing	**2-Inch Schedule 40 PVC**	Screen Perforation	**0.010 - inch**	Northing (Plant) Easting (Plant)	**347042.306 ft** **804661.174 ft**
Seal or Backfill	**Bentonite Chips**				



SIPC MARION SIPC MARION.GPJ 10/9/17

AECOM

Client: Southern Illinois Power Cooperative
Project Name: SIPC Marion CCR
Project Location: SIPC Marion
Project Number: 60535846

Log of EP-2

Sheet 1 of 1

Date(s) Drilled and Installed	**2/7/2017**	Logged By	**Suzanne Dale**	Reviewed By	
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**Holcomb Engineering**	Total Depth of Borehole	**15.0 feet, bgs**
Sampling Method	**Split Spoon**	Water Level TOIC	**Not measured**	TOC Elevation Ground Surface	**513.79 ft, msl** **511.15 ft, msl**
Size and Type of Well Casing	**2-Inch Schedule 40 PVC**	Screen Perforation	**0.010 - inch**	Northing (Plant) Easting (Plant)	**347113.029 ft** **804799.408 ft**
Seal or Backfill	**Bentonite Chips**				

Elevation, feet msl	Depth, feet bgs	SAMPLES: Sample Interval	SAMPLES: % Recovery	USCS Code	USCS Graphic Symbol	MATERIAL DESCRIPTION
510	0		NR	Fill		Asphalt and GRAVEL (FILL)
			NR	CL		Brown to tan silty CLAY, medium stiff, moist (CL)
			NR	CL		brown to tan silty CLAY, soft to medium, medium to high plasticity, moist (CL)
	5		NR			medium plasticity, with rust color oxidation, trace sand and gravel
			NR			
	10		NR			
500			NR	ML		Tan clayey SILT, stiff, low plasticity, moist (ML)
	15		NR	SNDSTN		SANDSTONE
490	20					Boring terminated at 15.0 ft. bgs on 2/7/2017. Monitoring well installed to 15.0 ft. bgs on 2/7/2017. NR = Not Recorded
	25					
480	30					
	35					

WELL CONSTRUCTION DETAILS

- Riser with protective casing and locking cap
- Concrete
- Bentonite Chips
- 2.0" diameter SCH 40 PVC Riser
- Filter Sand
- 2.0" diameter SCH 40 PVC, 0.010" Slotted Screen

SIPC MARION SIPC MARION.GPJ 10/9/17

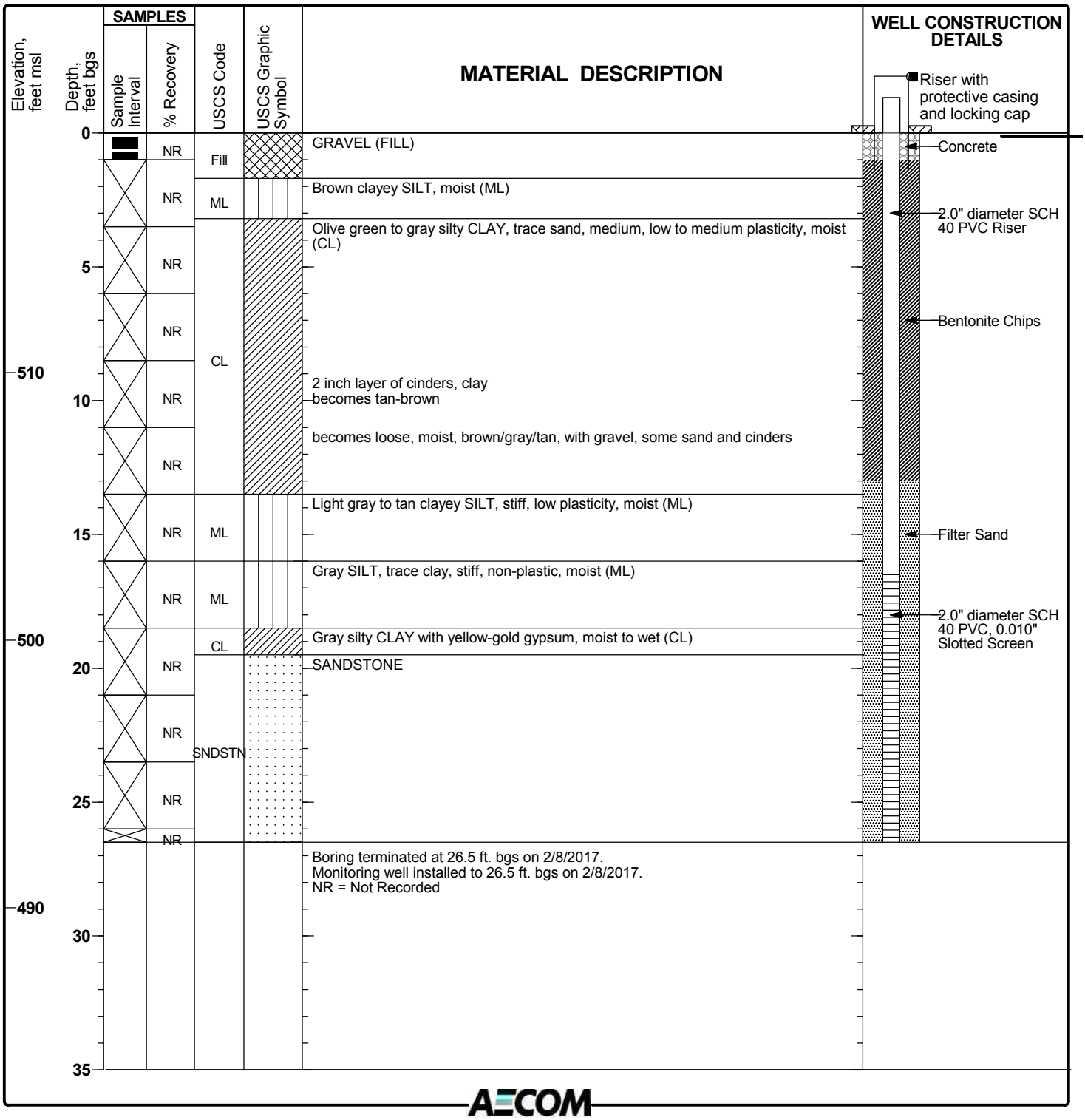
AECOM

Client: Southern Illinois Power Cooperative
Project Name: SIPC Marion CCR
Project Location: SIPC Marion
Project Number: 60535846

Log of EP-3

Sheet 1 of 1

Date(s) Drilled and Installed	**2/8/2017**	Logged By	**Suzanne Dale**	Reviewed By	
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**Holcomb Engineering**	Total Depth of Borehole	**26.5 feet, bgs**
Sampling Method	**Split Spoon**	Water Level TOIC	**Not measured**	TOC Elevation Ground Surface	**518.95 ft, msl** **518.95 ft, msl**
Size and Type of Well Casing	**2-Inch Schedule 40 PVC**	Screen Perforation	**0.010 - inch**	Northing (Plant) Easting (Plant)	**347245.08 ft** **804814.534 ft**
Seal or Backfill	**Bentonite Chips**				



SIPC MARION SIPC MARION.GPJ 10/9/17

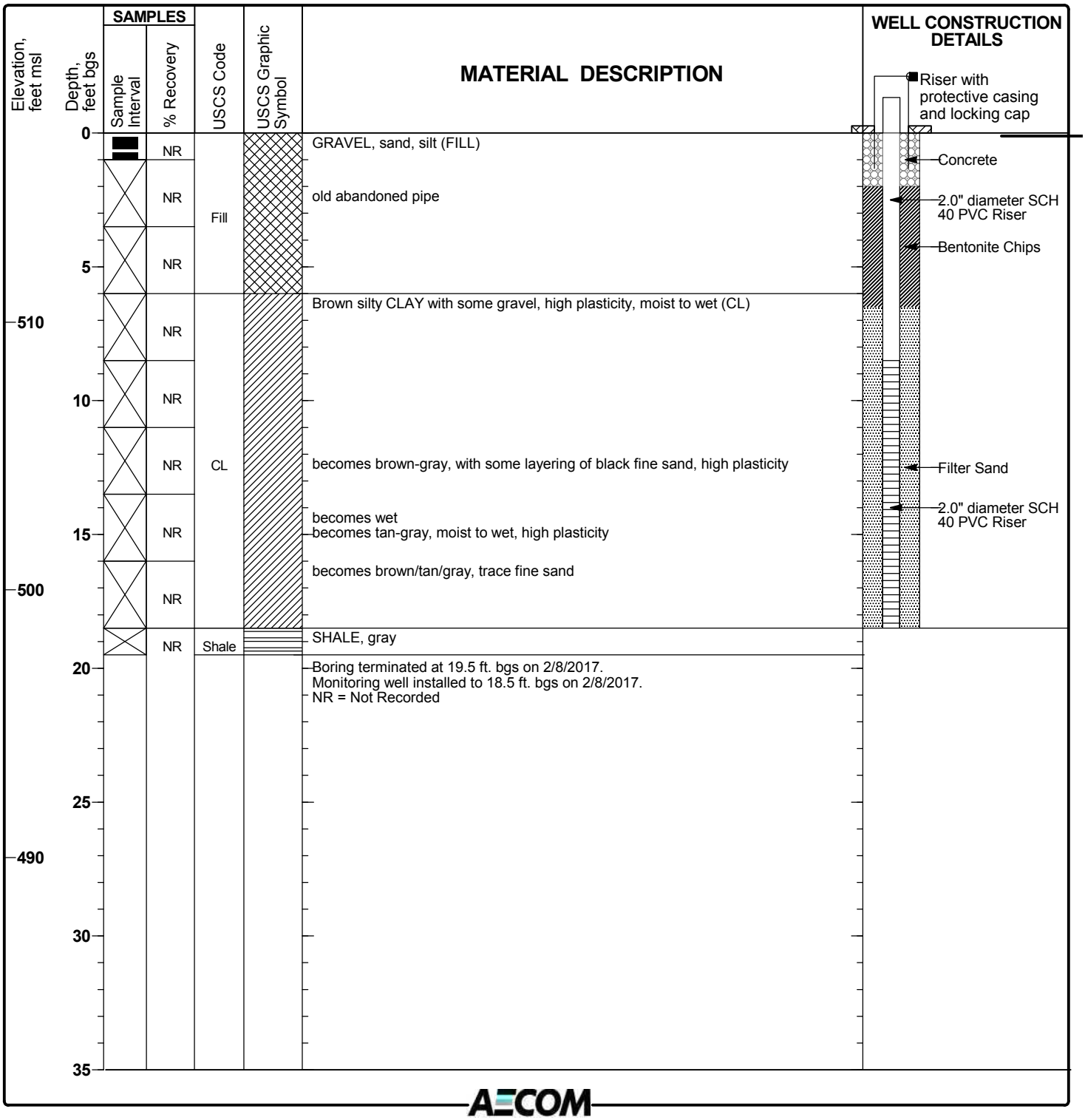
AECOM

Client: Southern Illinois Power Cooperative
Project Name: SIPC Marion CCR
Project Location: SIPC Marion
Project Number: 60535846

Log of EP-4

Sheet 1 of 1

Date(s) Drilled and Installed	**2/8/2017**	Logged By	**Suzanne Dale**	Reviewed By	
Drilling Method	**Hollow Stem Auger**	Drilling Contractor	**Holcomb Engineering**	Total Depth of Borehole	**18.5 feet, bgs**
Sampling Method	**Split Spoon**	Water Level TOIC	**Not measured**	TOC Elevation Ground Surface	**519.74 ft, msl** **517.07 ft, msl**
Size and Type of Well Casing	**2-Inch Schedule 40 PVC**	Screen Perforation	**0.010 - inch**	Northing (Plant) Easting (Plant)	**347288.297 ft** **804687.527 ft**
Seal or Backfill	**Bentonite Chips**				



SIPC MARION SIPC MARION.GPJ 10/9/17

AECOM

Appendix B

Groundwater Flow Maps

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Legend

- Groundwater Monitoring Well
- ;
- Solid
- Inferred Direction of Groundwater Flow

0 200 400
Feet

N

MARION POWER PLANT

APPENDIX B
EVENT 1
EMORY POND POTENTIOMETRIC SURFACE MAP MARCH 24, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	

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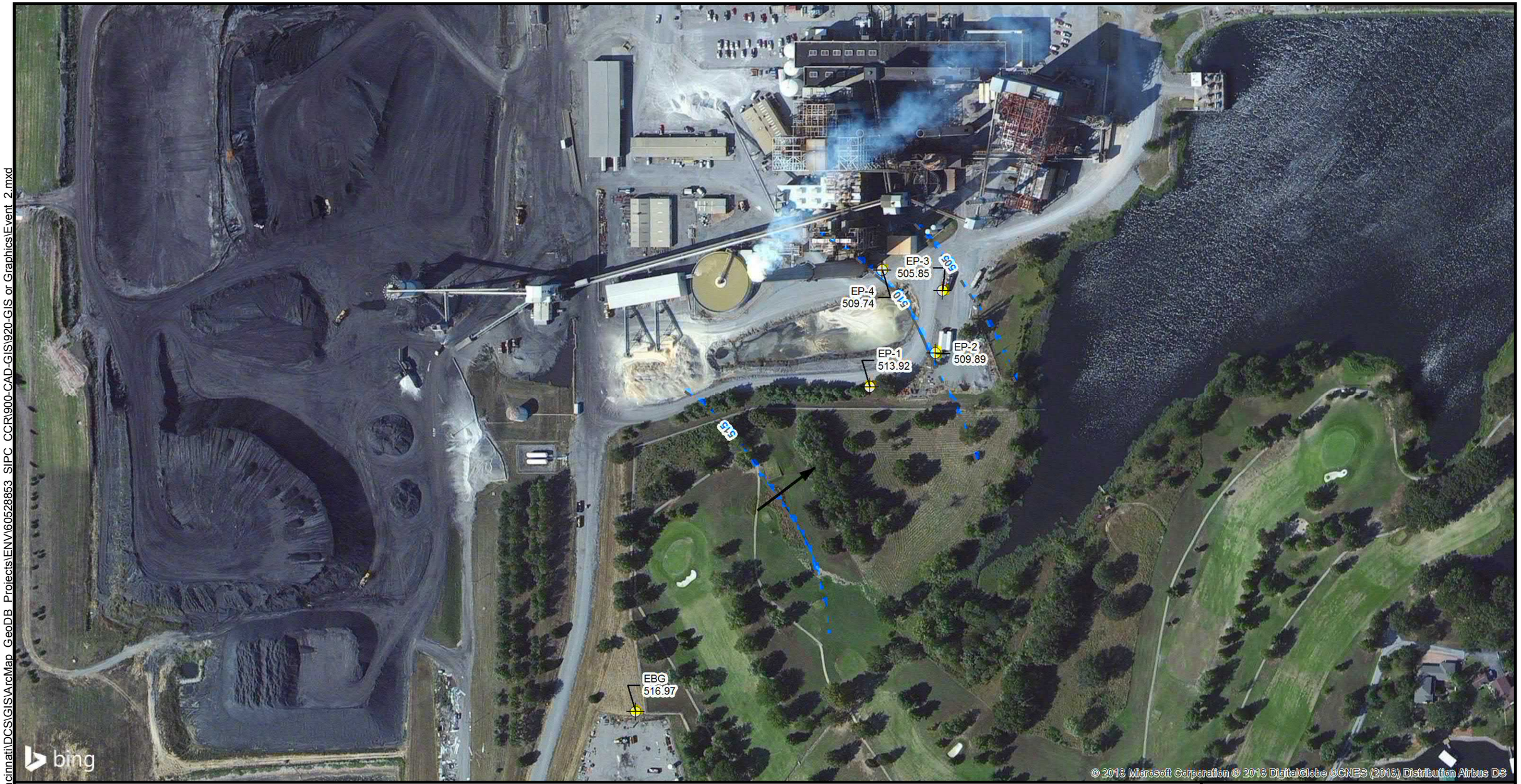


Legend

- Groundwater Monitoring Well
- Groundwater Contour (ft,msl)
- Inferred Groundwater Contour (ft,msl)
- Inferred Direction of Groundwater Flow

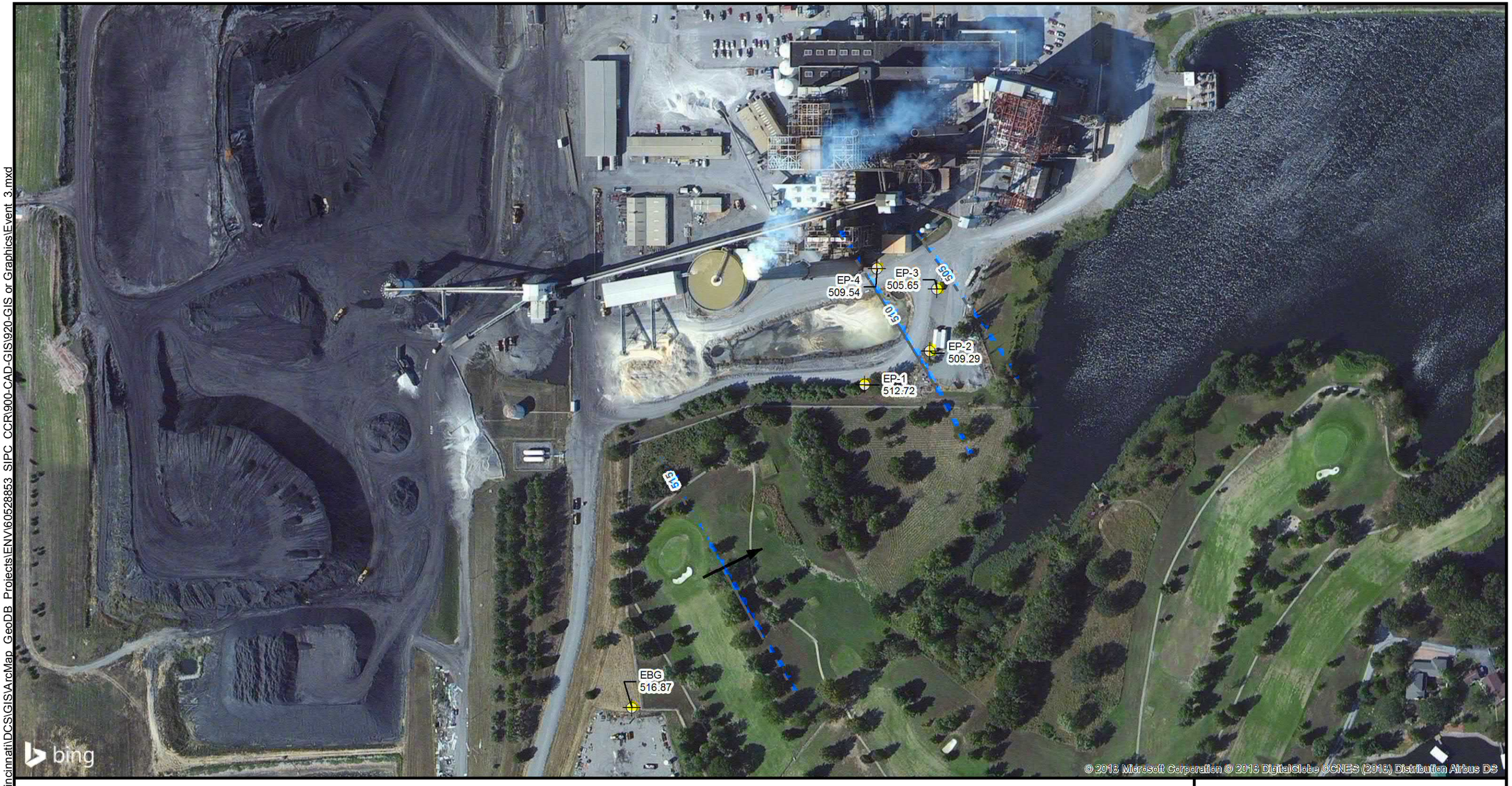
0 200 400
Feet

N

MARION POWER PLANT

APPENDIX B
EVENT 2
EMORY POND POTENTIOMETRIC SURFACE MAP APRIL 24, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	



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Legend

- Groundwater Monitoring Well
- Groundwater Contour (ft,msl)
- Inferred Groundwater Contour (ft,msl)
- Inferred Direction of Groundwater Flow

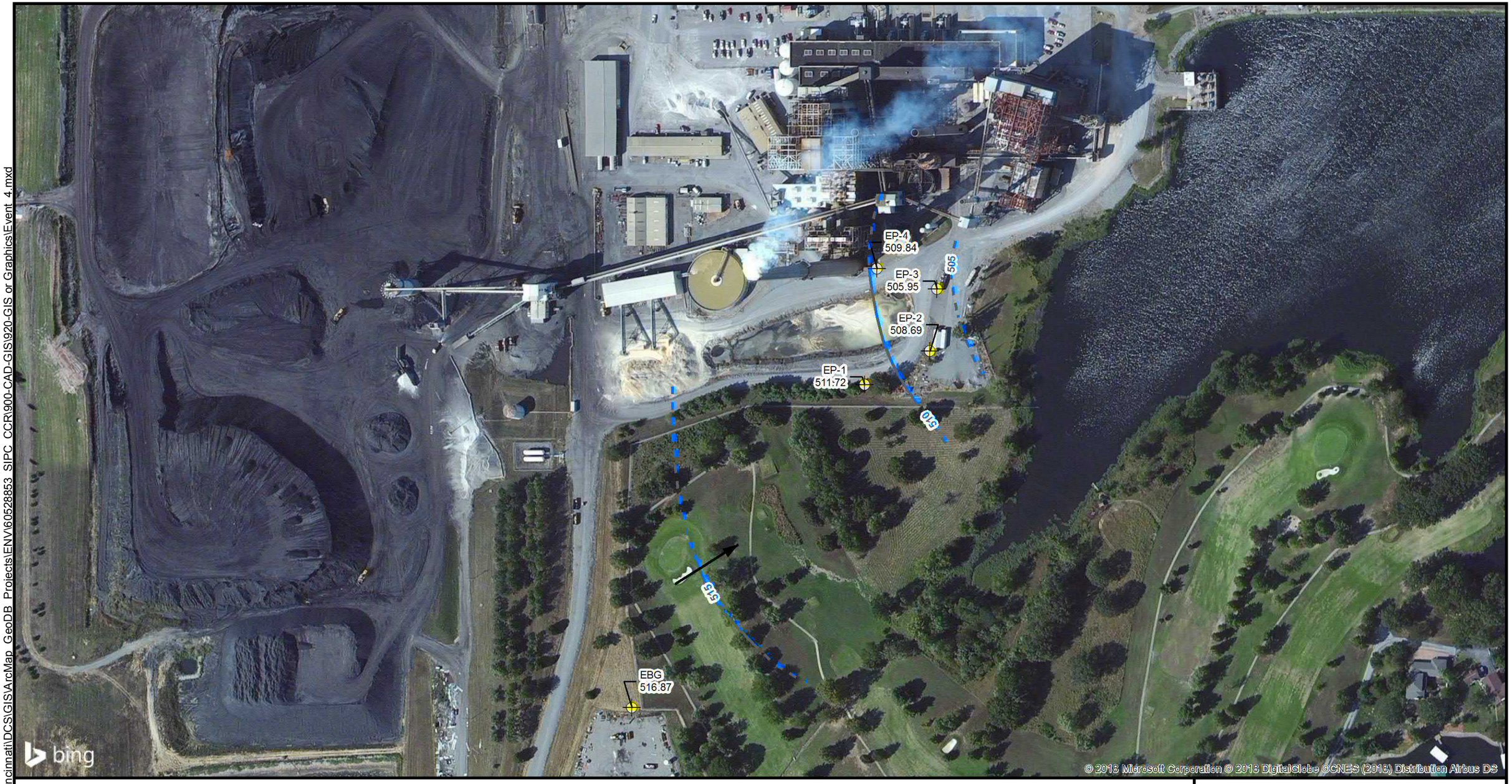
0 200 400
Feet

N

MARION POWER PLANT

APPENDIX B
EVENT 3
EMORY POND POTENTIOMETRIC SURFACE MAP MAY 25, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	



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Legend

- Groundwater Monitoring Well
- Groundwater Contour (ft,msl)
- Inferred Groundwater Contour (ft,msl)
- Inferred Direction of Groundwater Flow

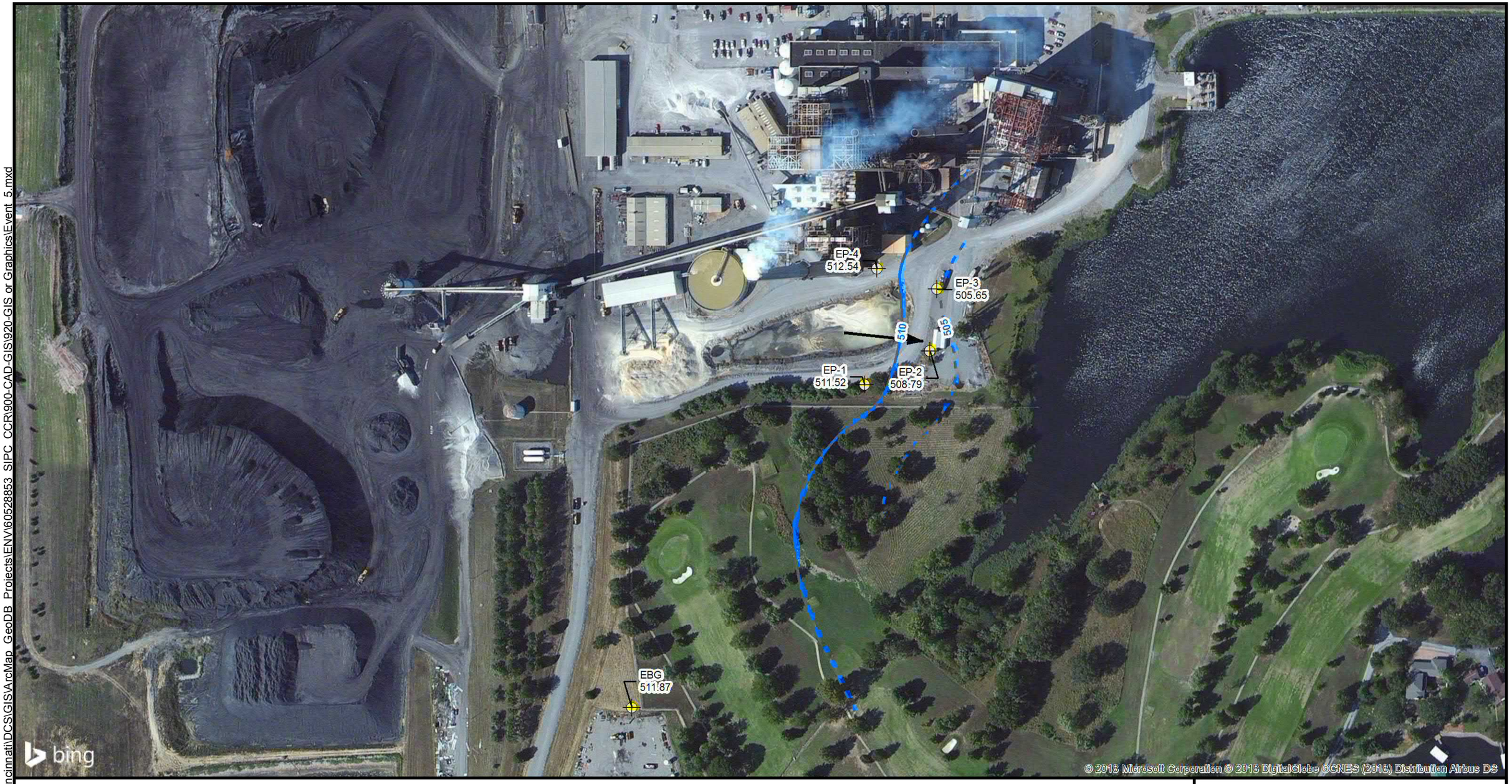
0 200 400
Feet

N

MARION POWER PLANT

APPENDIX B
EVENT 4
EMORY POND POTENTIOMETRIC SURFACE MAP JUNE 22, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	



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Legend

- Groundwater Monitoring Well
- Groundwater Contour (ft,msl)
- Inferred Groundwater Contour (ft,msl)
- Inferred Direction of Groundwater Flow

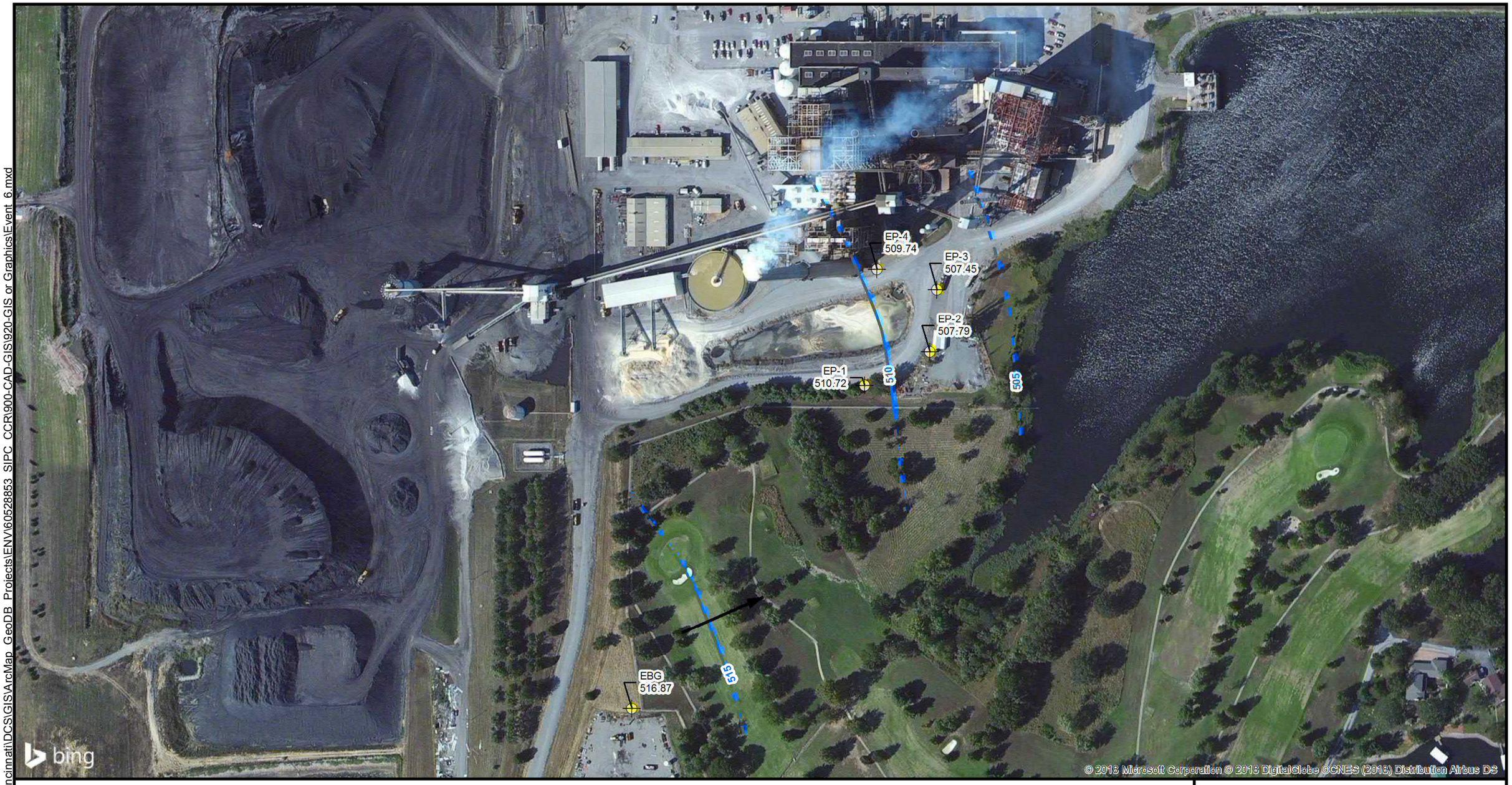
0 200 400
Feet

N

MARION POWER PLANT

APPENDIX B
EVENT 5
EMORY POND POTENTIOMETRIC SURFACE MAP JUNE 29, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	



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Legend

- Groundwater Monitoring Well
- Groundwater Contour (ft,msl)
- Inferred Groundwater Contour (ft,msl)
- Inferred Direction of Groundwater Flow

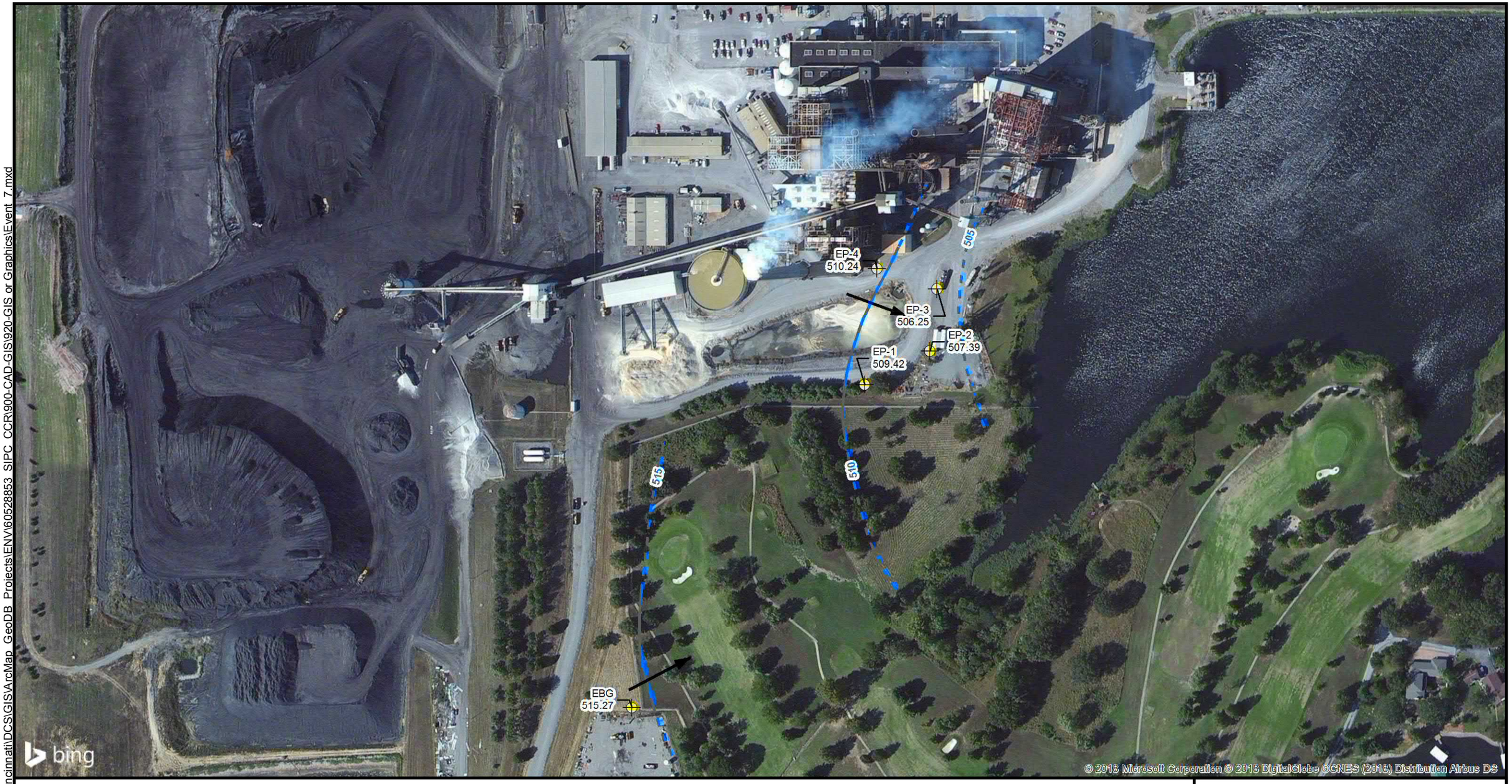
0 200 400
Feet

N

MARION POWER PLANT

APPENDIX B
EVENT 6
EMORY POND POTENTIOMETRIC SURFACE MAP JULY 24, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	



Legend

- Groundwater Monitoring Well
- Groundwater Contour (ft,msl)
- Inferred Groundwater Contour (ft,msl)
- Inferred Direction of Groundwater Flow

0 200 400
Feet

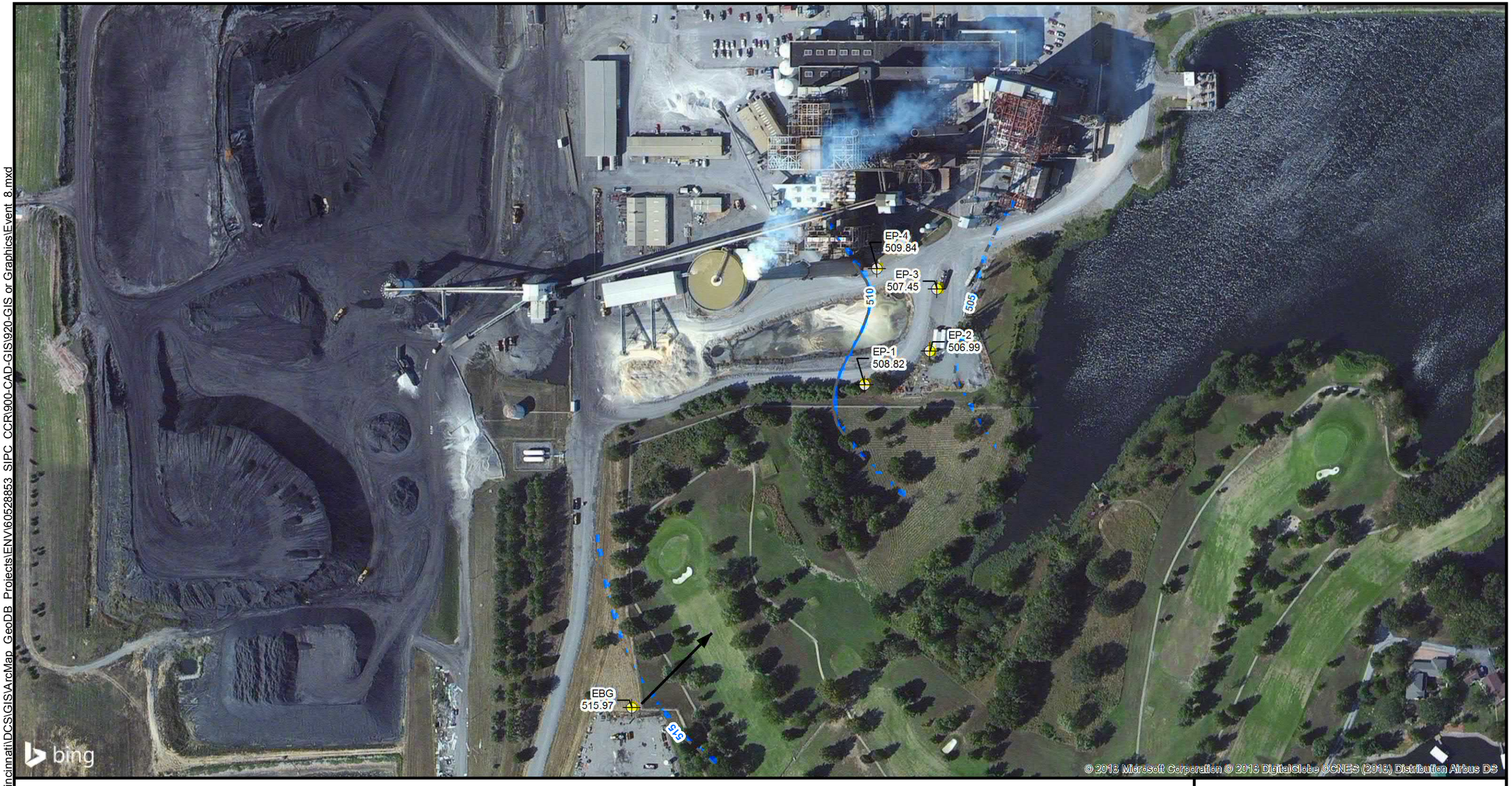
N

MARION POWER PLANT

APPENDIX B
EVENT 7
EMORY POND POTENTIOMETRIC
SURFACE MAP AUGUST 3, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	

Document Path: G:\Cincinnati\DCS\GIS\ArcMap_GeoDB_Projects\ENV\60528853_SIPC_CCR\900-CAD-GIS\920-GIS or Graphics\Event_7.mxd



Legend

- Groundwater Monitoring Well
- Groundwater Contour (ft,msl)
- Inferred Groundwater Contour (ft,msl)
- Inferred Direction of Groundwater Flow

0 200 400
Feet

N

MARION POWER PLANT

APPENDIX B
EVENT 8
EMORY POND POTENTIOMETRIC SURFACE MAP AUGUST 31, 2017

DATE: 1/22/2018	1 inch = 200 feet
CREATED BY: TA	CHECKED BY: DPC
JOB NO. 60535846	

Document Path: G:\Cincinnati\DCS\GIS\ArcMap_GeoDB_Projects\ENV\60528853_SIPC_CCR\900-CAD-GIS\920-GIS or Graphics\Event_8.mxd