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water resources / environmental consultants

GROUNDWATER MONITORING NETWORK EVALUATION PLUM POINT ENERGY STATION COAL COMBUSTION RESIDUAL LANDFILL

PREPARED IN COMPLIANCE WITH THE EPA FINAL RULE FOR THE DISPOSAL OF COAL COMBUSTION RESIDUALS TITLE 40 CODE OF FEDERAL REGULATIONS PART 257

OCTOBER 9, 2017

GROUNDWATER MONITORING NETWORK EVALUATION
PLUM POINT ENTERGY STATION
COAL COMBUSTION RESIDUAL LANDFILL

PREPARED IN COMPLIANCE WITH THE
EPA FINAL RULE FOR THE DISPOSAL OF COAL COMBUSTION RESIDUALS
TITLE 40 CODE OF FEDERAL REGULATIONS PART 257

Prepared for

Plum Point Services Company, LLC
Plum Point Energy Station
2732 South County Road 623
Osceola, AR 72370

Prepared by

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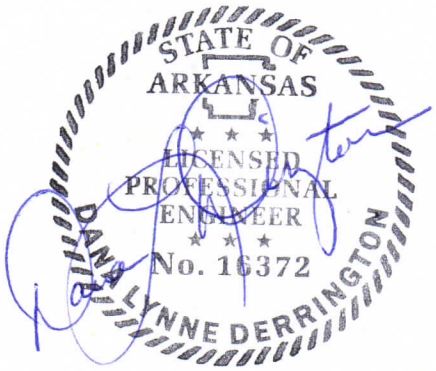
FTN No. R14590-1621-001

October 9, 2017

PROFESSIONAL ENGINEER'S CERTIFICATION

With this certification, I certify that I am a qualified professional engineer as defined in §257.53 of Title 40 Code of Federal Regulations Part 257, that I have reviewed the available documents discussed in this report, and that the groundwater monitoring network described herein meets the requirements of §257.91 of 40 CFR Part 257.



Dana L. Derrington, Arkansas PE #16372

10-09-2017
Date

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1.0 INTRODUCTION

Plum Point Services Company, LLC (PPSC) operates a landfill for the disposal of coal combustion residuals (CCRs) the Plum Point Energy Station in Mississippi County, Arkansas. The plant and landfill are located approximately 2 miles south of the city of Osceola, as shown on Figure 1.1. The landfill is permitted by the Arkansas Department of Environmental Quality (ADEQ) under Permit No. 0303-S3N-R1 and became active during March 2010. Groundwater detection monitoring was initiated at the landfill in November 2007, in accordance with Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 22 requirements.

The landfill's groundwater monitoring system was recently expanded to conform to the groundwater monitoring requirements of the Environmental Protection Agency (EPA) final rule for the disposal of coal combustion residuals (hereafter referred to as the CCR Rule) promulgated at Title 40 Code of Federal Regulations (40 CFR) Part 257 and published on April 17, 2015. Facilities regulated under this new rule are required by §257.91(f) to obtain a certification from a qualified professional engineer that the groundwater monitoring system meets the requirements of §257.91. This report has been prepared by FTN Associates, Ltd. (FTN), on behalf of PPSC to document an assessment of the landfill's groundwater monitoring network to ensure it meets the requirements of §257.91.

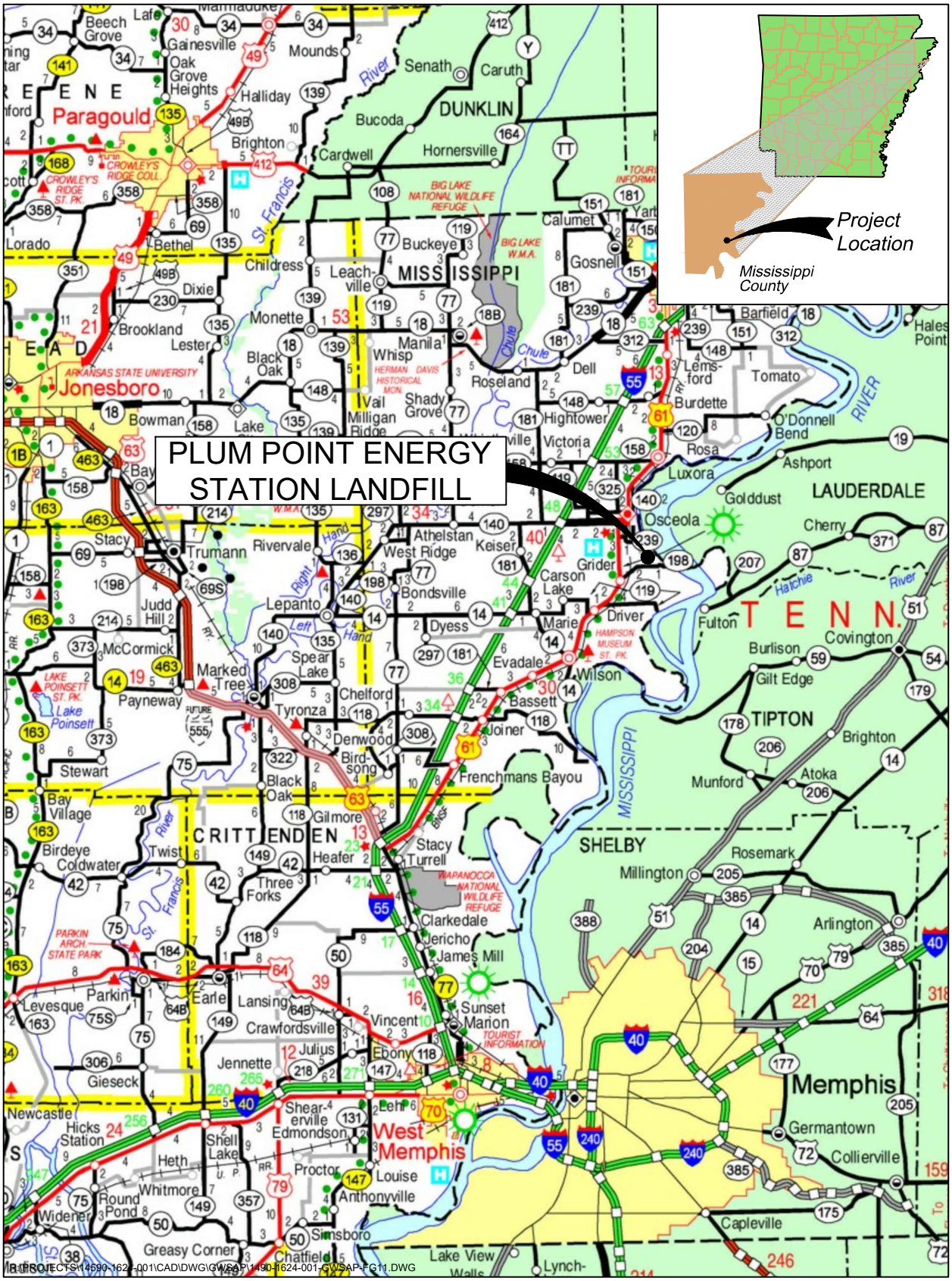

Figure 1.1. Location map.

2.0 BACKGROUND

This section includes a brief description of the location and operation of the plant and landfill, a summary of relevant previous investigations at the landfill, and a description of the existing monitoring well network maintained under the CCR Rule.

2.1 Location Description

The landfill area encompasses approximately 245 acres located approximately 1 mile west of the Mississippi River and 2 miles south of Osceola, Arkansas. The landfill is bordered by Arkansas Highway 239 to the east, Arkansas Highway 198 to the south, and the BNSF rail line to the west. Beyond these features and immediately north of the landfill are agricultural fields, and topography is relatively flat. A vicinity map of the Plum Point Energy Station and landfill is provided as Figure 2.1.

2.2 Operational History

The plant has been in operation since 2010 and generates electricity through the combustion of coal. Approximately 500,000 tons of CCR material is produced and deposited in the landfill each year. The landfill currently has two open disposal cells, Cells 1 and 3, which are shown on Figure 2.2. The combined area of the two CCR disposal cells is approximately 30 acres.

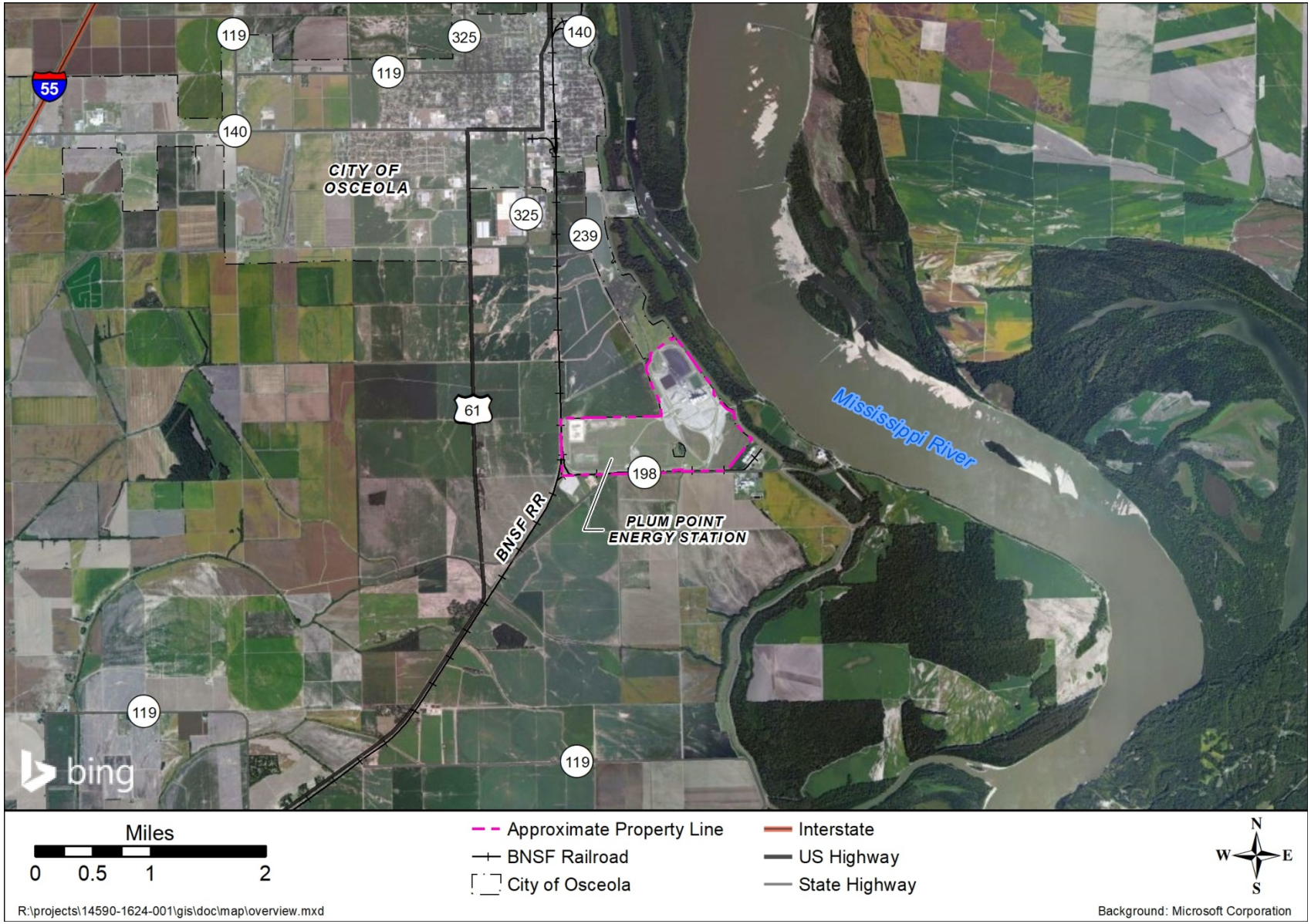

Figure 2.1. Vicinity map.

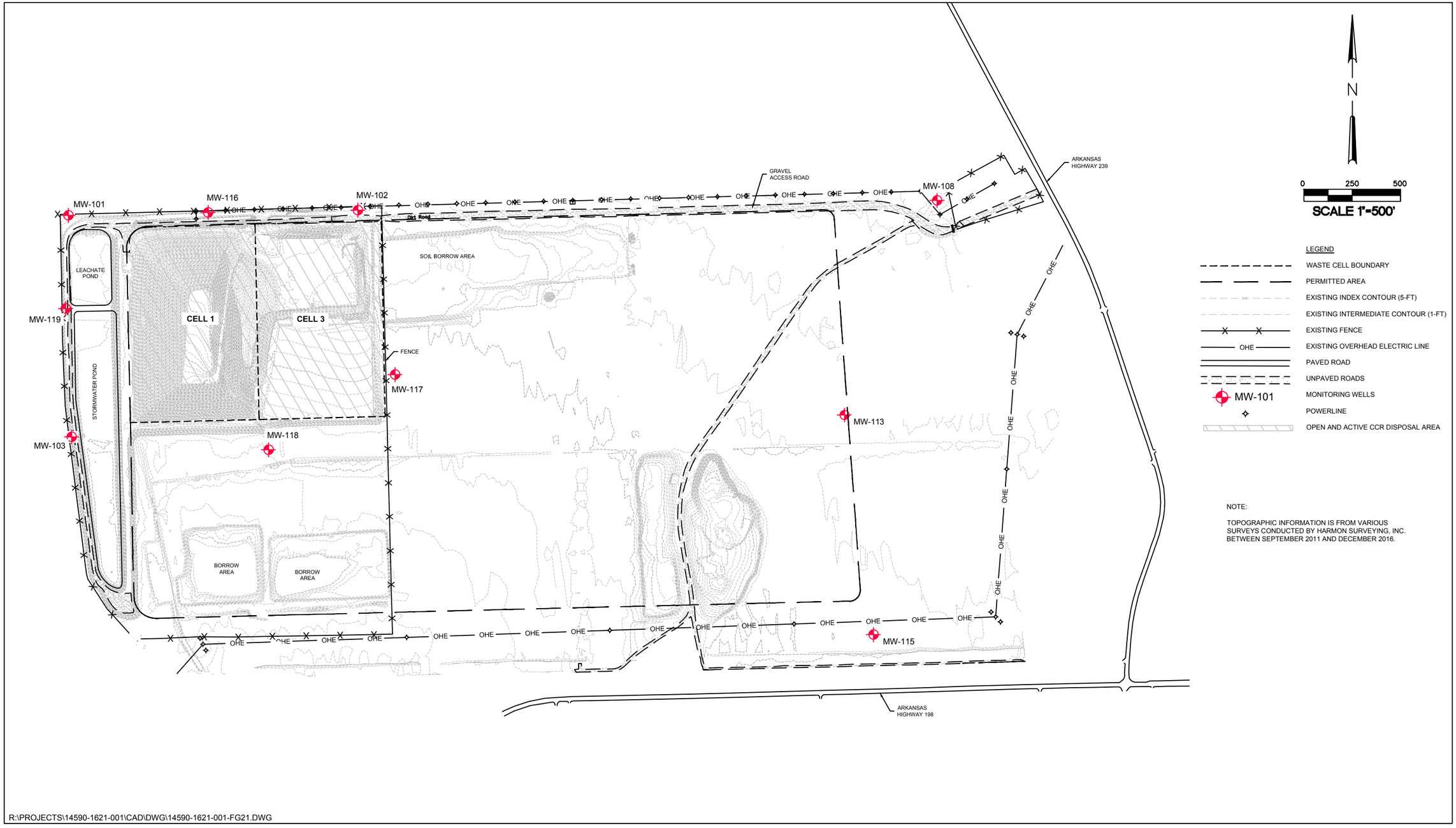

Figure 2.2. Landfill site map.

2.3 Previous Investigations

A detailed site investigation was performed in 2001 as part of the permit application for the landfill. The findings from the investigation were submitted to ADEQ by Genesis Environmental Consulting, Inc. (GEC), in a geotechnical and hydrogeological investigation (GHI) report (GEC 2001). The report generally included a review of the regional geological and hydrogeological setting of the landfill, a description of surface and subsurface exploration activities at the landfill site, a characterization of onsite lithology and hydrogeological conditions, and results for geotechnical testing of onsite soils. The GHI report was reviewed as part of this evaluation.

In addition to the GHI report, four monitoring well installation reports submitted to ADEQ were reviewed and include a November 2007 report prepared by Edwards Engineering, PA; a May 2009 report prepared by Civil Engineering Associates, LLC; and two reports prepared by FTN during October 2015 and December 2016.

Other minor studies have been performed as part of landfill design submittals to ADEQ, but are beyond the scope of this review.

2.4 Groundwater Monitoring Well Network

The groundwater monitoring network for the CCR Rule includes the 10 monitoring wells shown on Figure 2.2. The wells are constructed of 2-inch, Schedule 40 polyvinyl chloride (PVC) pipe, with 10-ft slotted well screens. A summary of well construction details is included in Table 2.1. Available boring logs and well construction diagrams are included in Appendix A.

Table 2.1. Summary of monitoring well construction data.

Well Number	Well Installation Date	Ground Surface Elevation (ft NAVD)[a]	Top of Casing (TOC) Elevation[b] (ft NAVD)	Total Depth (ft below TOC)	Screen Interval (ft NAVD)[a]
MW-101	4/9/2001	239.4	242.75	33.6	219.2-209.2
MW-102	4/9/2001	240.5	243.99	30.2	223.8-213.8
MW-103	9/26/2007	240.5	243.25	32.8	220.5-210.5
MW-108	4/11/2001	241.8	245.11	32.4	222.7-212.7
MW-113	4/07/2009	241.5	244.63	35.9	223.7-208.7
MW-115	9/25/2007	240.4	243.55	33.0	220.6-210.7
MW-116	6/23/2015	239.3	243.97	31.9	222.5-212.5
MW-117	6/24/2015	239.4	242.53	34.2	218.5-208.5
MW-118	6/24/2015	238.0	241.23	31.4	220.2-210.2
MW-119	10/6/2016	243.6	246.53	35.4	221.5-211.5

Notes:
a. North American Vertical Datum of 1988.
b. The elevation datum for the TOC elevation also corresponds to the measuring point (MP) elevation.

3.0 HYDROGEOLOGICAL SETTING

3.1 Regional Hydrogeological Setting

The landfill is located in the Mississippi Alluvial Plain physiographic region, as shown by Figure 3.1. The region was formed by the deposits of the Mississippi River and its tributaries and is generally flat-lying (Cushing, Boswell, and Hosman 1964). The Mississippi River Valley alluvial aquifer (hereafter referred to as the alluvial aquifer) underlies the Mississippi Alluvial Plain in eastern Arkansas and is the uppermost aquifer in the region.

The alluvial aquifer is comprised of unconsolidated Quaternary alluvial and terrace deposits of sands and gravels that grade upward to clays and silts that form a semi-confining to confining layer over much of the aquifer. Regionally, the alluvium reaches depths of 100 ft to 200 ft below ground surface (bgs) (Ryling 1960; Cushing, Boswell, and Hosman 1964). Published documents indicate that the alluvial aquifer commonly yields 2,000 gallons per minute (gpm) (Kresse et al. 2014).

The regional direction of flow in the alluvial aquifer is to the southwest, across Mississippi County, as shown by Figure 3.2 (Schrader 2015). Natural recharge to the alluvial aquifer in Mississippi County occurs primarily from influent seepage from the Mississippi River or from infiltration of rainfall in the northwestern corner of the county, where the confining unit is thin or absent (Ryling 1960; Cushing, Boswell, and Hosman 1964; Peterson, Broom, and Bush 1985).

Beneath the alluvial aquifer is the Tertiary-aged Jackson-Claiborne clay, which acts as a confining unit below the aquifer. The Jackson group contains dense marine clays and shale with occasional lenses of fine-grained sand (Peterson, Broom, and Bush 1985). The upper unit of the Claiborne is characterized by silty clay interbedded with thin and discontinuous beds of sand (Broom and Lyford 1981).

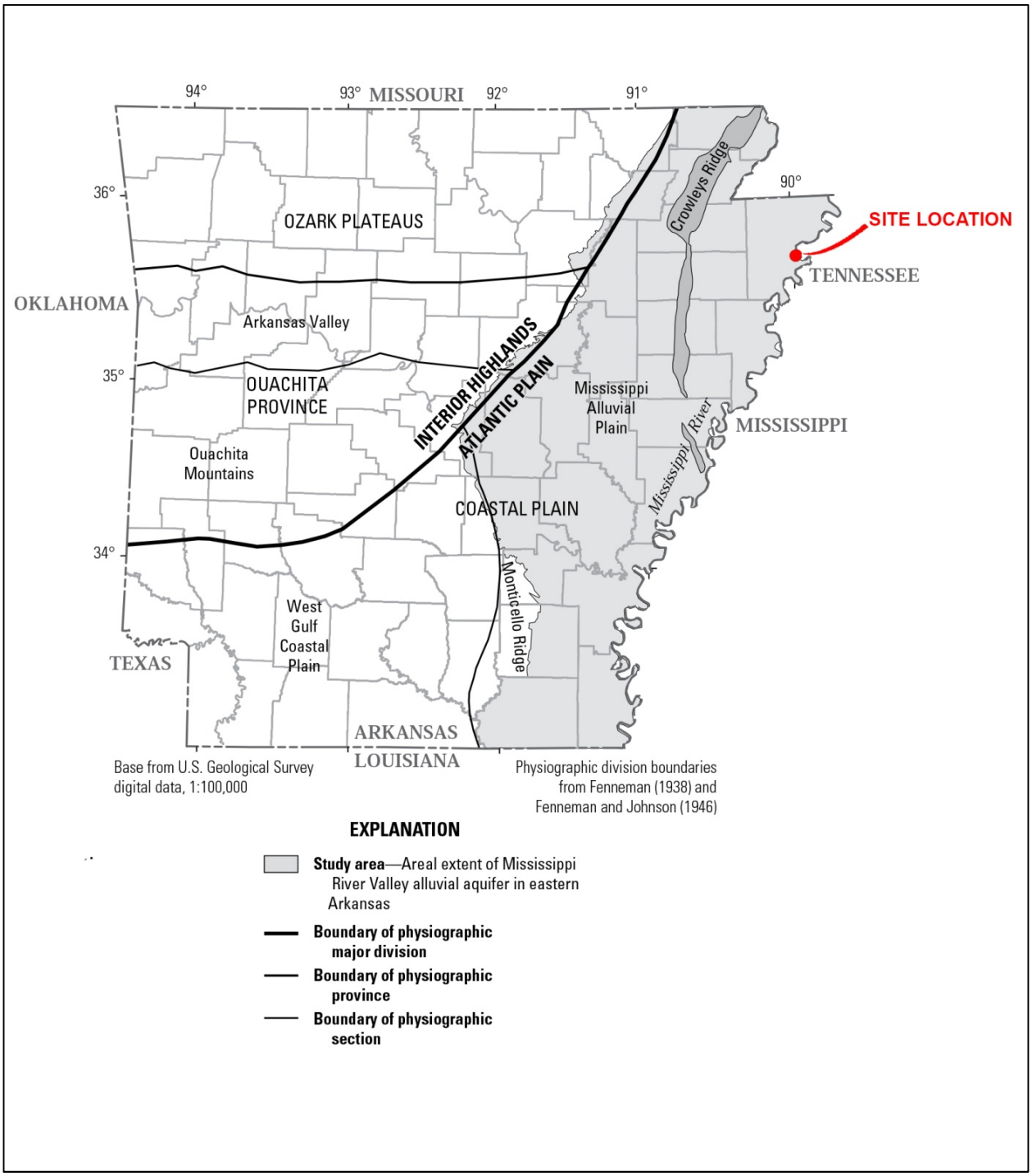

Figure 3.1. Physiographic regions (adapted from Schrader 2015).

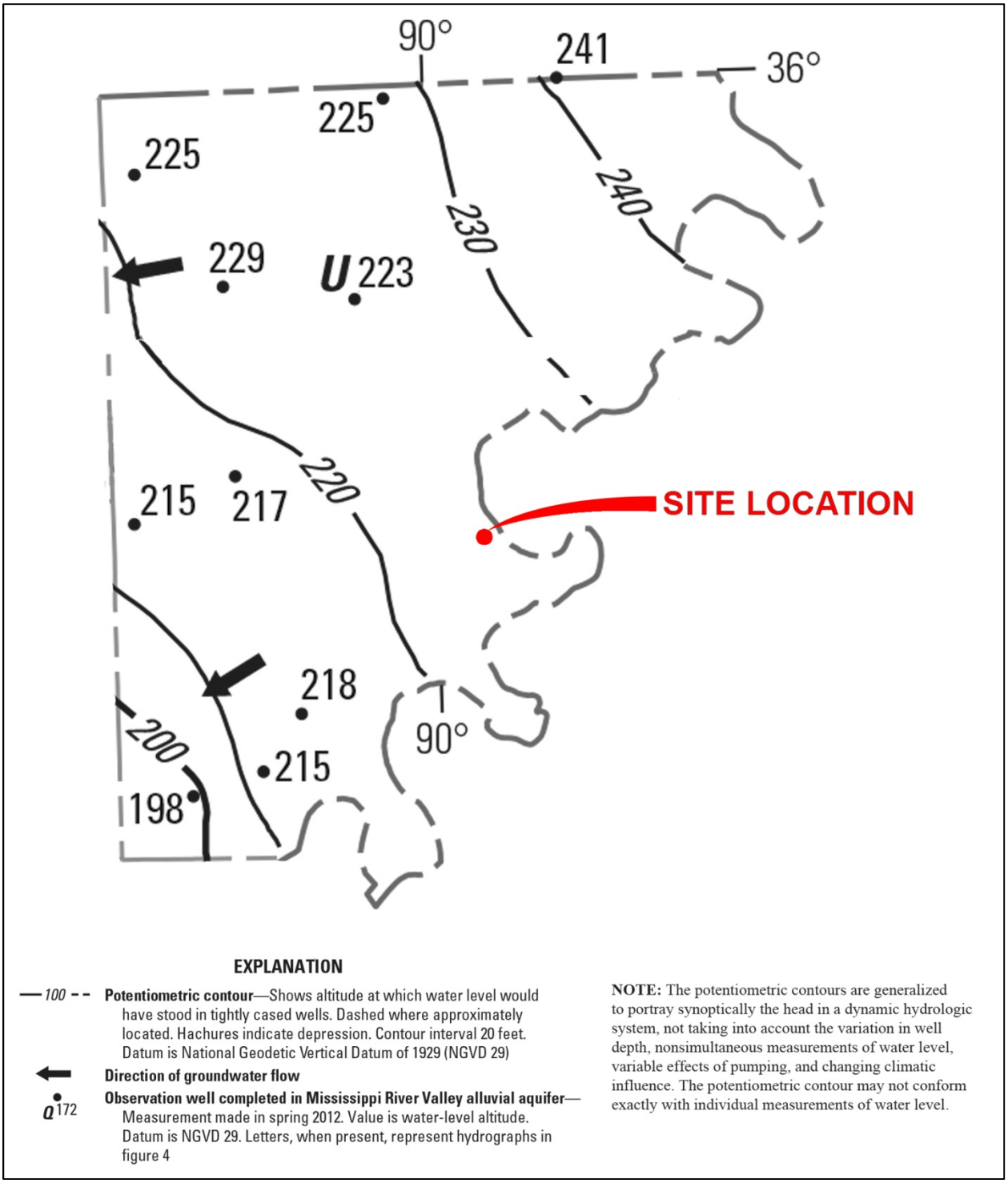

Figure 3.2. Regional potentiometric surface map (adapted from Schrader 2015).

3.2 Hydrogeological Data at the Landfill

The subsurface investigation described in the GHI report (GEC 2001) indicated that the local confining unit ranges from 0 ft to over 30 ft thick, with an average thickness of 15 ft. The local confining unit is comprised of brown to grey clay, silty clay, and sandy clays. Underlying the confining unit are fine- to coarse-grained sands of the alluvial aquifer, with fine- to coarse-grained gravel encountered at depth. Based on one deep boring, completed to a depth of 200 ft below ground surface (bgs), the coarse-grained aquifer materials reach a depth of 190 ft bgs in the vicinity of the landfill. Geologic cross-sections incorporating the landfill's monitoring wells and lithologic borings from the 2001 investigation are provided in Appendix B.

Laboratory geotechnical testing of confining unit soils indicate a vertical permeability of ranging from 6.7×10^{-4} centimeters per second (cm/s) to 3.7×10^{-8} cm/s. Field results from one pumping test and multiple slug tests indicate that the uppermost alluvial aquifer material has an average hydraulic conductivity of 1.09×10^{-2} cm/s (GEC 2001). The GHI reported an effective porosity for the aquifer of 27% (GEC 2001), which agrees with published values ranging from 10% to 30% for similar aquifer materials (EPA 1998, Yu et al. 2015).

3.3 Hydraulic Gradient, Rate, and Direction of Groundwater Flow

The direction of groundwater flow shifts on a seasonal basis at the landfill. Figures 3.3 through 3.6 include potentiometric surface maps that are typical based on measured water levels during the summer, fall, winter, and spring seasons.

The rate of groundwater flow beneath the landfill is estimated based on Darcy's law, modified to account for the open space available for groundwater flow within the aquifer. The resulting equation estimates the average linear groundwater velocity, or seepage flow, shown below (Kuo 1999):

$$V_x = K/n_e(dh/dl)$$

Where: V_x = average linear velocity,
K = hydraulic conductivity,
n_e = effective porosity, and
dh/dl = hydraulic gradient.

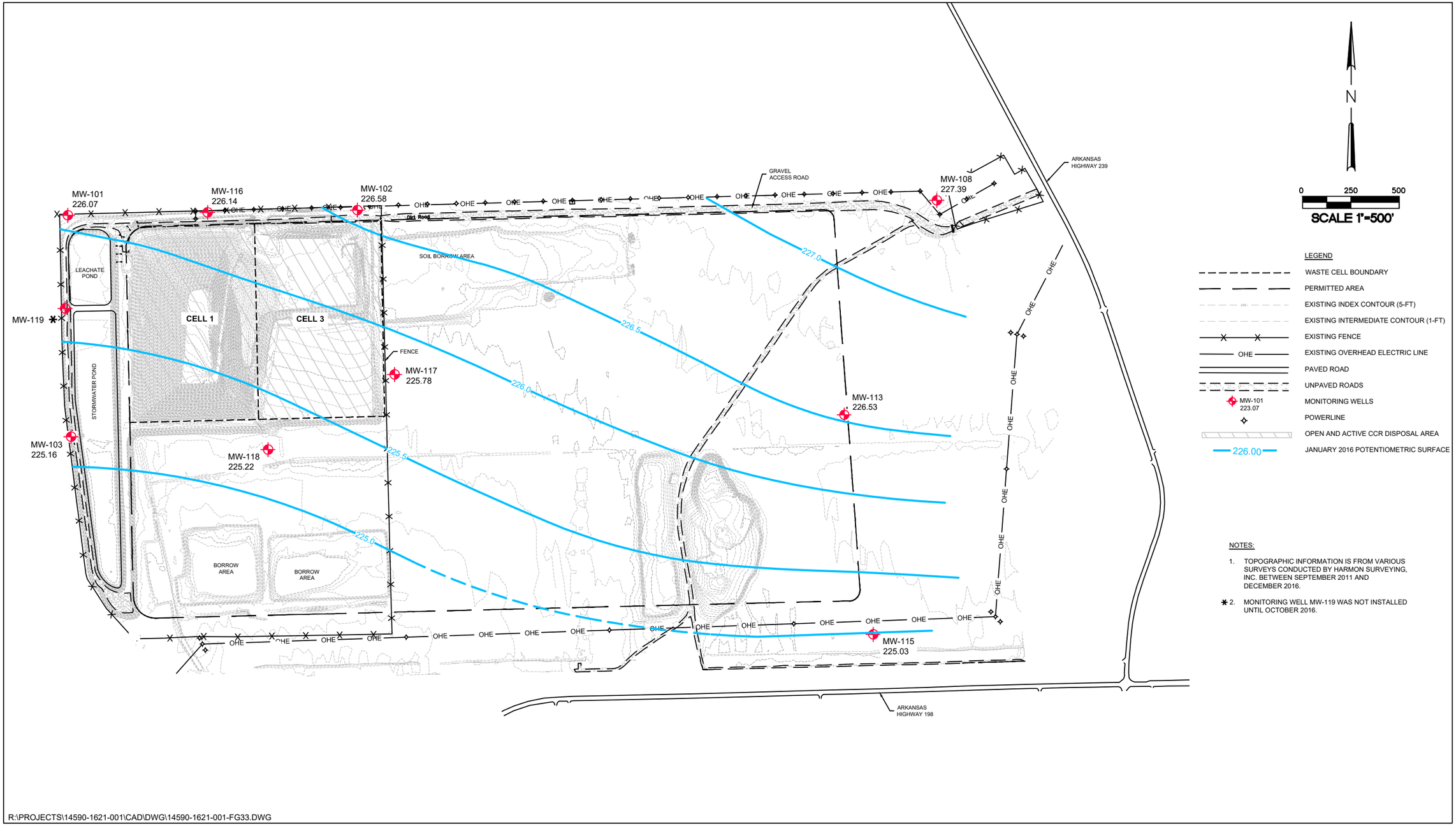

Figure 3.3. Potentiometric surface, January 2016.

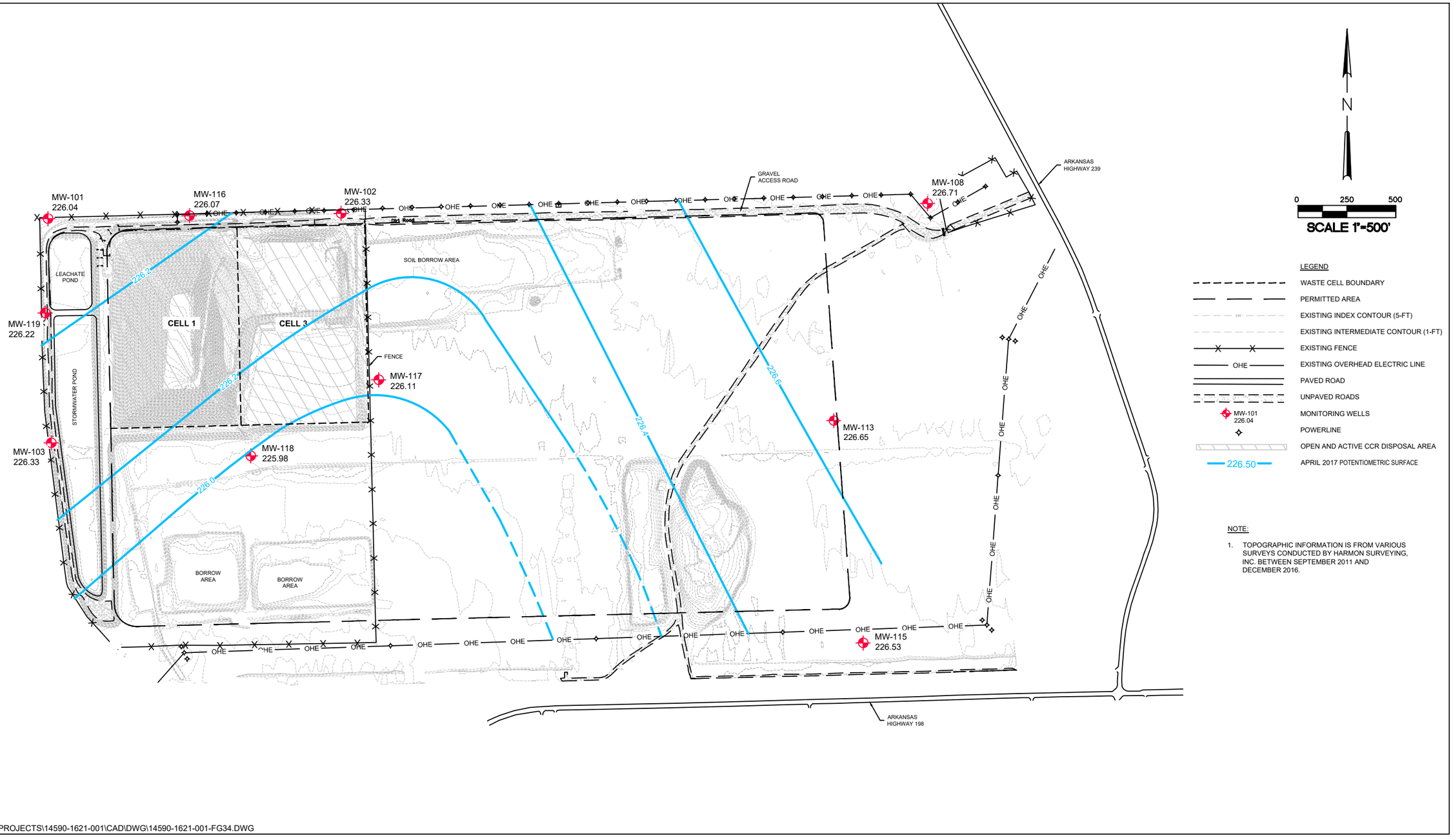

Figure 3.4. Potentiometric surface, April 2017.

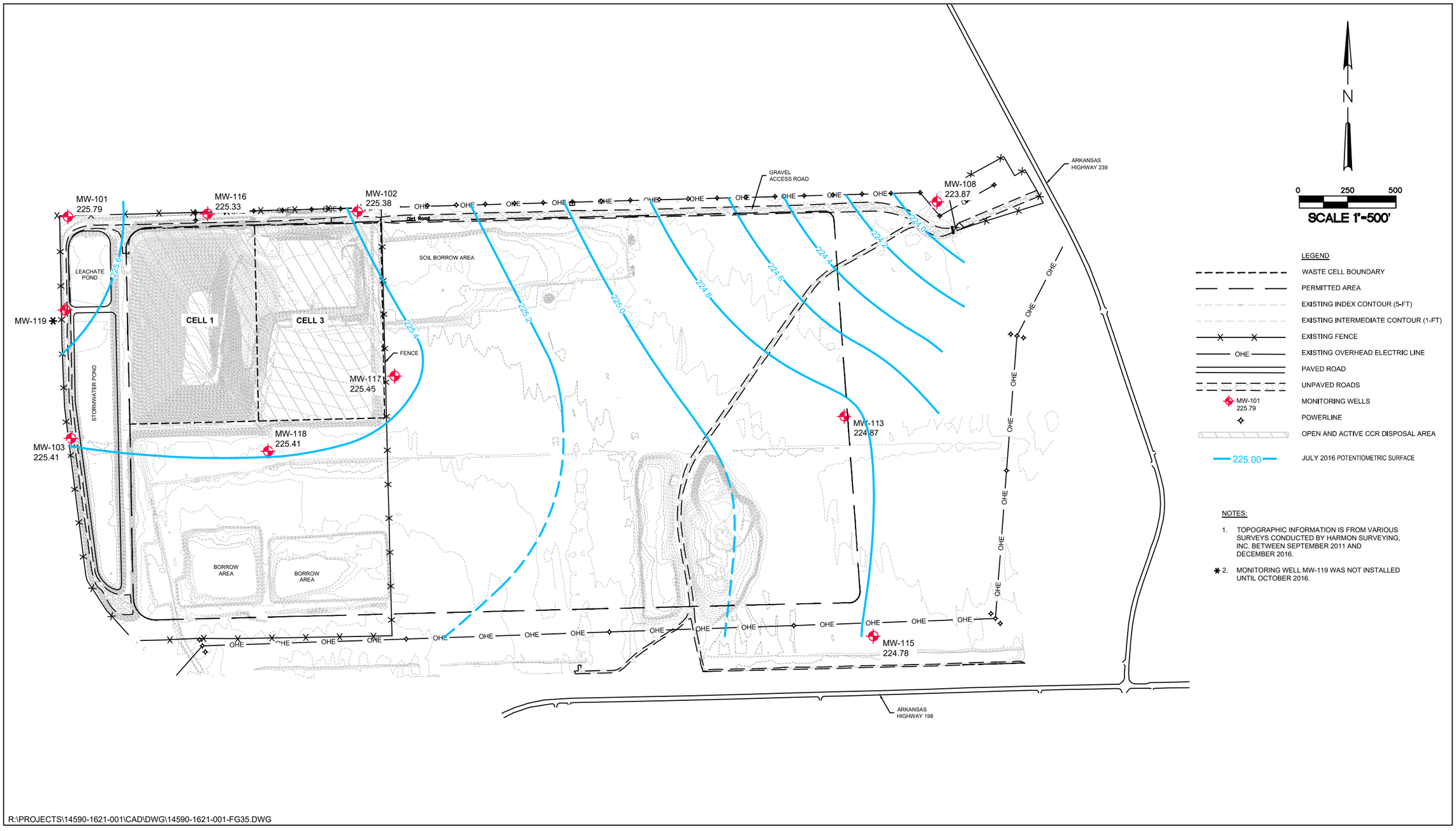

Figure 3.5. Potentiometric surface, July 2016.

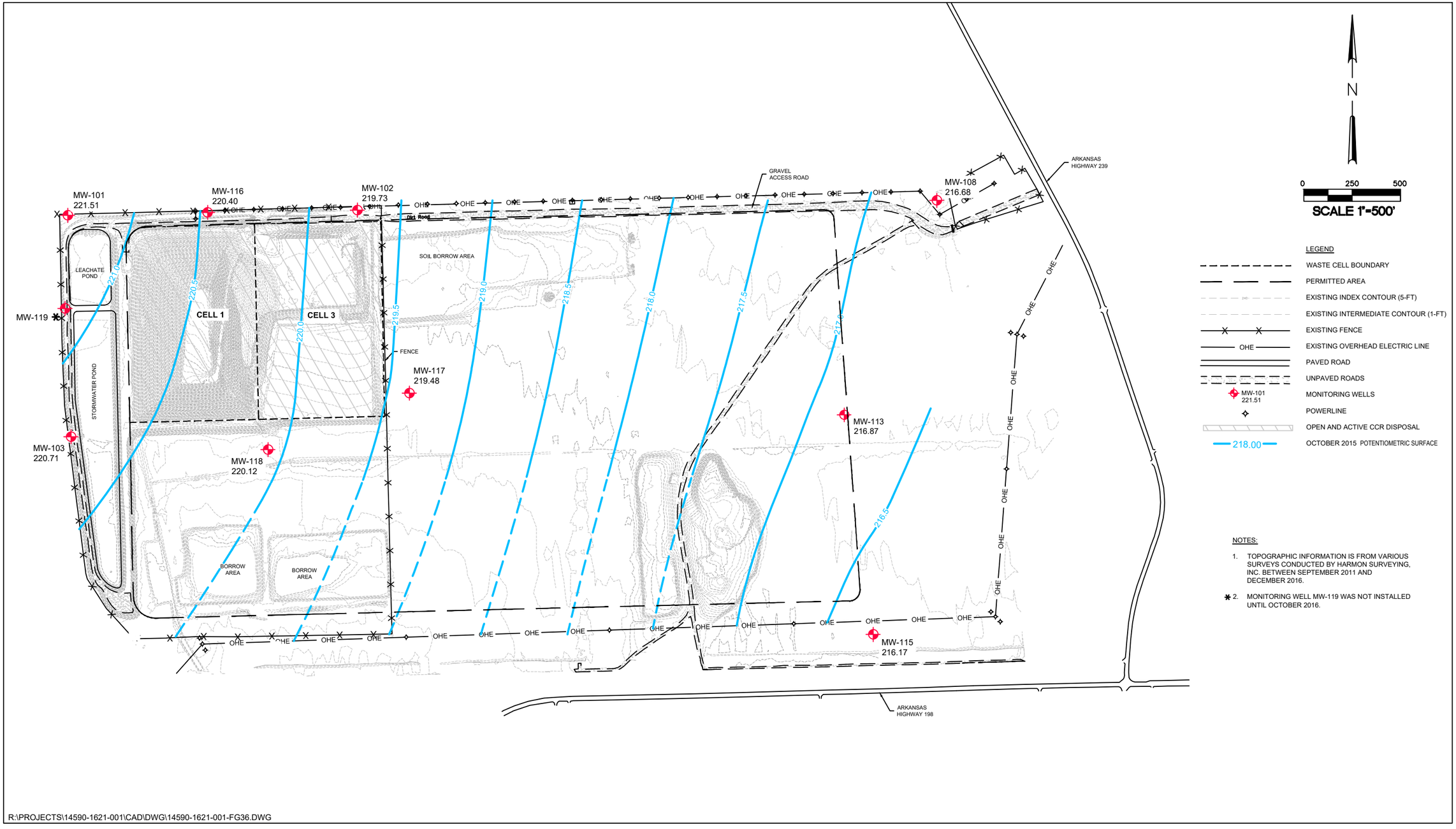

Figure 3.6. Potentiometric surface, October 2015.

As noted in the previous section, the hydraulic conductivity (K) and the effective porosity (n_e) of the alluvial aquifer are estimated to be 1.09 x 10^{-2} cm/sec and 27%, respectively (GEC 2001). The hydraulic gradient (dh/dl) is calculated based on potentiometric surface elevations at a given point in time. Table 3.1 summarizes the estimated dh/dl and the associated groundwater flow rate (V_x) beneath Cell 1 and Cell 3 based on the seasonal potentiometric surfaces maps included as Figures 3.3 through 3.6. These values are typical for the alluvial aquifer in the vicinity of the landfill, which has historically had a maximum observed V_x of approximately 40 ft/year.

Table 3.1. Estimated hydraulic gradient and groundwater flow rate across Cell 1 and Cell 3.

Date	Hydraulic Gradient (ft/ft)	Groundwater Velocity (ft/year)[(a)]	Flow Direction
10/7/2015	9.6 x 10^{-4}	40	East-southeast
1/28/2016	7.2 x 10^{-4}	30	South-southwest
7/25/2016	2.4 x 10^{-4}	10	East-southeast
4/24/2017[(b)]	3.1 x 10^{-4}	13	Southeast
	6.3 x 10^{-4}	25	Northwest

Notes:
a. Reported to the nearest foot.
b. Groundwater flow direction was divergent across Cell 1 and Cell 3.

4.0 REVIEW OF MONITORING NETWORK

4.1 Uppermost Aquifer and Vertical Placement of Monitoring Wells

The landfill is required by §257.91(a) to maintain a groundwater monitoring network that yields representative samples from the uppermost aquifer to ensure the detection of groundwater contamination. Based on a review of published literature and previous site investigations discussed in this report, the uppermost aquifer beneath the CCR management area is the alluvial aquifer. The well construction details provided in Appendix A show that each monitoring well is screened such that it penetrates the uppermost saturated portion of the alluvial aquifer.

The vertical position of the network's monitoring well screens in the uppermost saturated portion of the aquifer is appropriate due to the relatively low hydraulic gradient of the aquifer and the nature of the contaminants of concern (COCs) with respect to the CCR landfill. Should a release occur, each of the COCs listed in appendix III and appendix IV of the CCR Rule will either dissolve in groundwater or adsorb onto the aquifer soils. Any dissolved COCs will tend to travel at a relatively shallow elevation within the aquifer due to the low hydraulic gradient. None of the COCs are dense nonaqueous phase liquids, which tend to sink because they are more dense than water. Therefore, the target monitoring zone with respect to vertical placement is within the uppermost saturated portion of the alluvial aquifer.

The summary of well construction details provided in Table 2.1 also shows that the monitoring well screens are placed at hydrostratigraphically similar positions in the alluvial aquifer across the network. This placement is appropriate to ensure that groundwater quality data from the well network are comparable.

4.2 Location of Monitoring Wells Relative to CCR Unit

4.2.1 Monitoring Wells that Monitor Background Water Quality

As required by §257.91(c)(1), the groundwater monitoring network is required to contain a minimum of one monitoring well that is hydraulically upgradient of the CCR management area for the purpose of monitoring background water quality. However, there is not a hydraulically upgradient location at this facility because the direction of groundwater flow is seasonably

variable. As allowed by §257.91(a)(1), a facility may utilize wells for background water quality that are not hydraulically upgradient of the CCR management area. For this reason, the facility incorporated monitoring wells MW-108, MW-113, and MW-115 (Figure 2.2) to monitor background water quality because they are positioned outside the potential zone of impact from Cell 1 and Cell 3. The rationale for this is based on the age of the landfill, the estimated maximum rate of groundwater flow, and the distance of MW-108, MW-113, and MW-115 from the CCR management area. Specifically:

- MW-108, MW-113, and MW-115 are located more than 2,300 ft from the eastern edge of Cell 3,
- Groundwater at the landfill has historically exhibited a maximum flow rate of 40 ft/year, and
- The landfill became active during March 2010.

Using the information available above, a potential leachate plume would not be expected to have migrated more than 300 ft from the CCR management area as of the time of this evaluation. This estimate is conservative for the following reasons:

1. It assumes impact to groundwater occurred at the same time Cell 1 was activated and does not account for travel time through the confining unit soils;
2. It assumes that groundwater flows in one direction, but as previously discussed, groundwater flow is multidirectional and reverses flow on a seasonal basis; and
3. It does not account for any physical or chemical properties of the COCs that would cause them to travel at rates slower than groundwater (e.g., adsorption).

As such, it is expected that any potential impact would be much closer to the CCR management area as of the time of this evaluation.

The use of monitoring wells MW-108, MW-113, and MW-115 to monitor background water quality should be periodically reviewed based on the age and eastward progression of the CCR management area, measured hydraulic gradients, and estimated groundwater flow rates.

4.2.2 Downgradient Compliance Monitoring Wells

Pursuant to §257.91(c)(1), the groundwater network must include a minimum of three monitoring wells located hydraulically downgradient of the CCR management area. As shown on Figure 2.2, Cell 1 and Cell 3 are encircled by the following seven monitoring wells: MW-101, MW-102, MW-103, MW-116, MW-117, MW-118, and MW-119. Each of these wells is considered a downgradient compliance well due to the multidirectional groundwater flow at the site. As required by §257.91(c)(2), each well is horizontally positioned as close as practicable to the CCR management area to monitor the quality of groundwater passing the waste boundary of the CCR unit.

4.3 Monitoring Well Construction and Development

A review of the monitoring well installation records show that each well was installed by an Arkansas-licensed driller. As shown on the well construction details included in Appendix A, each well was constructed in a manner that maintains the integrity of the monitoring well accordance with §257.91(e). Well casings are screened and a filter pack consisting of sand was placed in the well annulus surrounding the screened intervals. The annular space above the filter pack in each well is sealed with bentonite and/or bentonite-cement grout to prevent downward migration of surface water to the sampling depth.

Monitoring well development records provided in the well installation reports referenced in Section 2.0 indicate that each monitoring well is capable of yielding samples that are representative of groundwater quality from the uppermost aquifer at the facility.

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APPENDIX A

Boring Logs and Monitoring Well Construction Diagrams

GEC // GENESIS ENVIRONMENTAL CONSULTING, INC.
11400 West Baseline Road Little Rock, AR 72209
Phone: (501) 455-2199 Fax (501) 455-4547

FIELD BOREHOLE LOG

BOREHOLE NO.: MW-101 TOTAL DEPTH: 30'
COORDINATES: 489496.27N 1915916.93E
ELEVATION: TOC ELEVATION: 242.75 ft

PROJECT INFORMATION

PROJECT: **Plum Point Energy Station**
SITE LOCATION: **Osceola, AR**
JOB NO.: **01008**
LOGGED BY: **ME**
DATE DRILLED: **4/09/01**

DRILLING INFORMATION

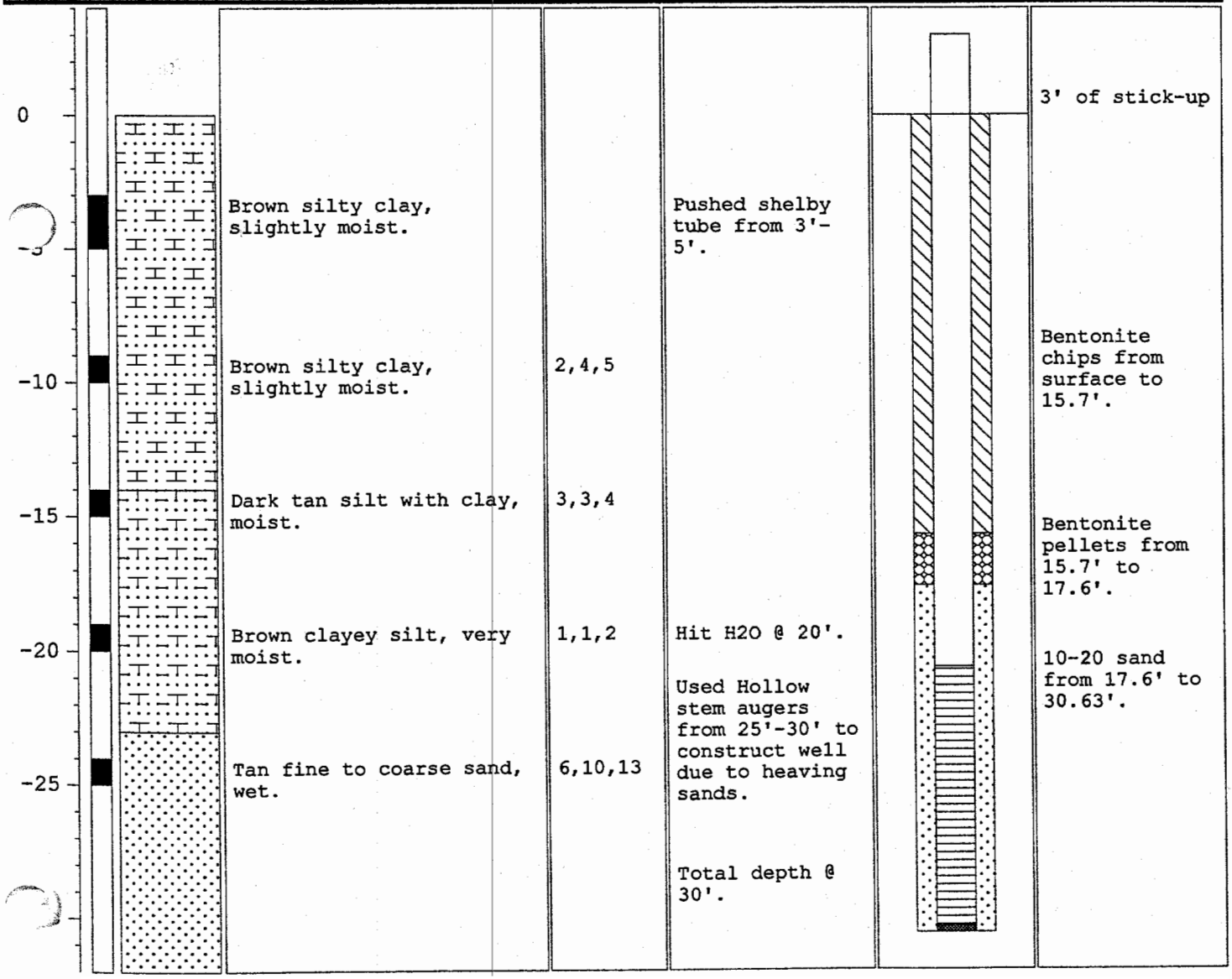
DRILLING CO.: **Anderson Engineering**
DRILLER: **Paul Harris**
RIG TYPE: **Simco 2400 SKL**
METHOD OF DRILLING: **6.25" diam. Solid flight auger**
SAMPLING METHODS: **Split Spoon**

GRAVEL PACK: 10-20 Sand | SEAL: Bentonite pellets | GROUT: Bentonite chips | Page 1 of 1

CASING/SCREEN TYPE: PVC | DIAMETER: 2-inch | CASING LENGTH: 23.63 | STATIC WATER LEVEL: 21.53' BELOW TOC

SCREEN LENGTH: 10' | SLOT SIZE: 0.010 | T.D. OF WELL 33.63' BELOW TOC | DATE OF WATER LEVEL: 5/02/01

DEPTH	SOIL SYMBOL	SOIL DESCRIPTION	BLOW COUNTS	COMMENTS	BORING COMPLETION	WELL DESCRIPTION
0						3' of stick-up
-5		Brown silty clay, slightly moist.		Pushed shelby tube from 3'-5'.		
-10		Brown silty clay, slightly moist.	2,4,5			Bentonite chips from surface to 15.7'.
-15		Dark tan silt with clay, moist.	3,3,4			Bentonite pellets from 15.7' to 17.6'.
-20		Brown clayey silt, very moist.	1,1,2	Hit H2O @ 20'. Used Hollow stem augers from 25'-30' to construct well due to heaving sands.		10-20 sand from 17.6' to 30.63'.
-25		Tan fine to coarse sand, wet.	6,10,13	Total depth @ 30'.		



Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated November 18, 2016. Vertical datum is based on NAVD88 and horizontal datum is based on Arkansas State Plane NAD83 North.

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11400 West Baseline Road Little Rock, AR 72209
Phone: (501) 455-2199 Fax (501) 455-4547

FIELD BOREHOLE LOG

BOREHOLE NO.: MW-102 TOTAL DEPTH: 30'
COORDINATES: 489523.55N 1917416.25E
ELEVATION: TOC ELEVATION: 243.99 ft

PROJECT INFORMATION

PROJECT: **Plum Point Energy Station**
SITE LOCATION: **Osceola, AR**
JOB NO.: **01008**
LOGGED BY: **ME**
DATE DRILLED: **4/09/01**

DRILLING INFORMATION

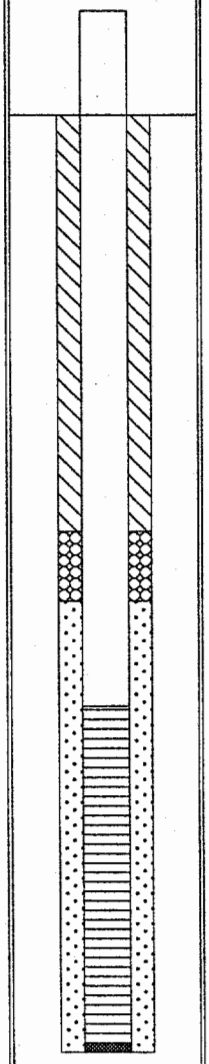
DRILLING CO.: **Anderson Engineering**
DRILLER: **Paul Harris**
RIG TYPE: **Simco 2400 SKL**
METHOD OF DRILLING: **6.25"diam. solid flight auger**
SAMPLING METHODS: **Split Spoon**

GRAVEL PACK: 10-20 Sand | SEAL: Bentonite pellets | GROUT: Bentonite chips | Page 1 of 1

CASING/SCREEN TYPE: PVC | DIAMETER: 2-inch | CASING LENGTH: 20.23' | STATIC WATER LEVEL: 22.13' BELOW TOC

SCREEN LENGTH: 10' | SLOT SIZE: 0.010 | T.D. OF WELL 30.23' BELOW TOC | DATE OF WATER LEVEL: 5/02/01

DEPTH	SOIL SYMBOL	SOIL DESCRIPTION	BLOW COUNTS	COMMENTS
0				Pushed shelby tube from 3'-5'.
-5		Brown and gray silty clay, slightly moist, medium plasticity.	1,1,2	
-10		Brown and gray silty clay, slightly moist, medium plasticity.	3,3,6	
-15		Dark brown to gray silty clay, moist.	2,2,3	
-20		Dark brown to gray silty clay, with fine to medium grained sand, wet.	3,4,6	Hit H2O @ 20'.
-25		Dark brown to gray silty clay, with increasing fine to medium sand, wet.		Hollow stem augers used to construct well due to heaving sands from 25'-30'.
-30		Tan to brown fine to medium grained sand with some silt, wet.		Total depth @ 30'.



Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated November 18, 2016. Vertical datum is based on NAVD88 and horizontal datum is based on Arkansas State Plane NAD83 North.

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FIELD BORING LOG

BORING NO.: MW-103 PAGE: 1 of 1

TOTAL DEPTH: 30' FEET BELOW GROUND SURFACE (BGS)

CLIENT: Dynegy Services Plum Point, LLC	PROJECT: Plum Point Well Installation
JOB NO.: LSP-AR-PPES-07-02	DRILLING CO.: Anderson Engineering
LOGGED BY: Lance Powell	DRILLER: Dennis Young
DATE DRILLED: 9-26-07	RIG TYPE: Simco 2800 HS (HT)
DRILLING METHOD: Hollow Stem Auger	
SAMPLING METHOD: Split Spoon	

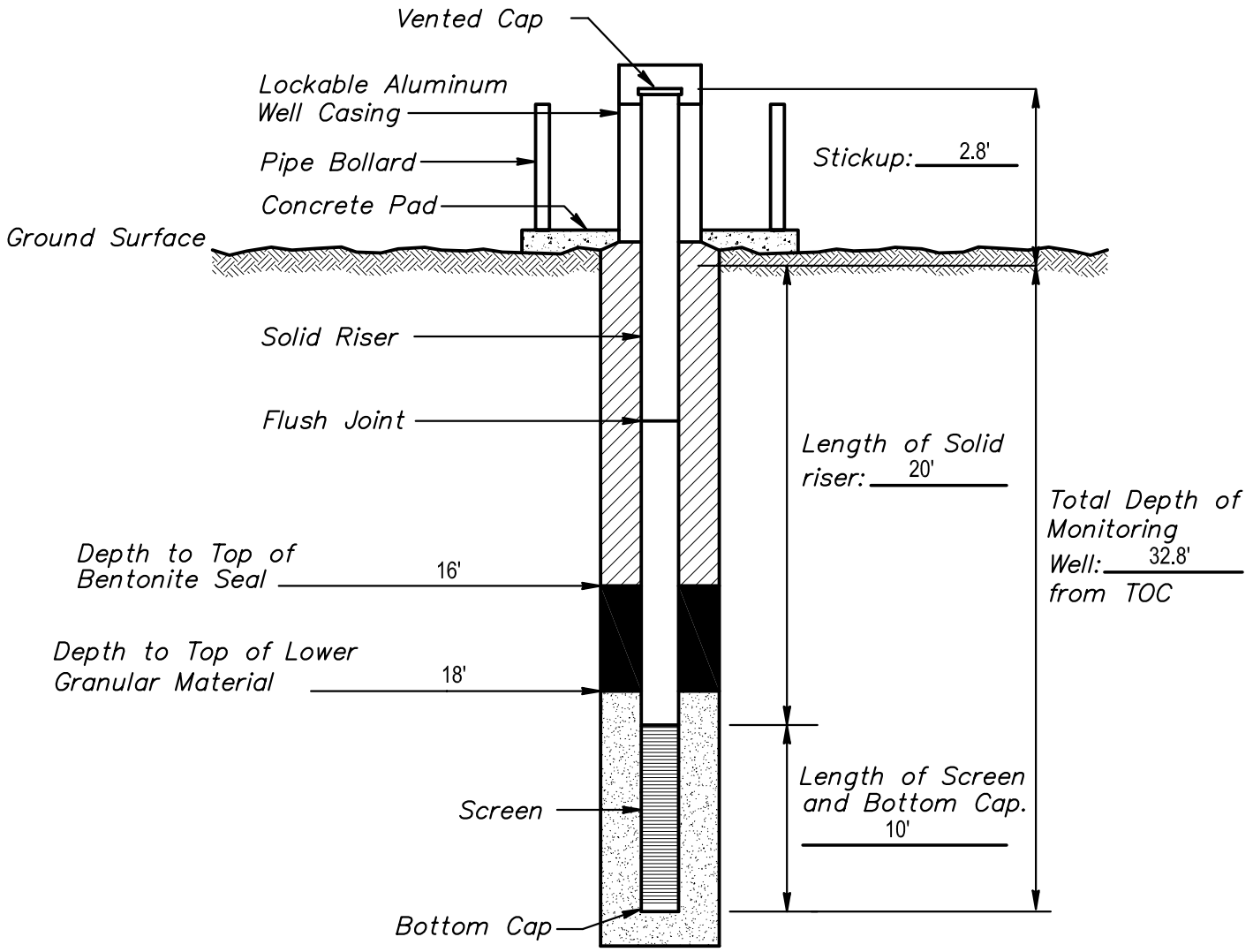
488350.05N 1915934.03E TOC: 243.25 ft

Depth BGS	Sample Interval	DESCRIPTION	Litho. Symbol	Blow Counts	Comments
0		Topsoil 0' - 0.5' Dark Brown Silty Clay			
		Gray to Brown Silty Clay, trace organics, Moist		1,2,2	
5		Gray Clay, Medium to High Plasticity Some Silt, Moist		1,2,4	
10		Gray Clay, Medium to High Plasticity Some Silt, Moist		2,5,4	
15		Gray , Medium to Coarse Sand, Some Clay, Wet, Grading into Silty Sand		1,1,2	Contact with medium to coarse sand at 16' Hit water at 20' ▽
20		Gray , Sandy Silt, Wet			Split Spoon samples not taken at 25' and 30' due to heaving sands
25		Gray , Silty, Coarse Sand, Some Clay, Wet			

Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated November 18, 2016. Vertical datum is based on NAVD88 and horizontal datum is based on Arkansas State Plane NAD83 North.

MONITORING WELL INSTALLATION RECORD

Job Name: Plum Point Energy Well Station
Well Number: MW-103
Job Number: LSP-AR-PPES-07-02
Installation Date: September 26, 2007
Location: PPES Class 3N Landfill
Datum Elevation: 243.25 ft
Surface Elevation: 240.5 ft
Datum for Water Level Measurement: Top of PVC Stickup
Screen Diameter & Material: 2" PVC
Slot Size: 0.010"
Riser Diameter & Material: 2" PVC
Borehole Diameter: 7.25"
Granular Backfill Material: Sand
Representative: Phillip Fields
Drilling Method: Hollow Stem Auger
Drilling Contractor: Anderson Engineering



Bentonite Pellets
Bentonite Plug
Granular Backfill

(Not to Scale)

Stabilized water level 22.15 feet below datum.
Measured on September 27, 2007

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MONITORING WELL INSTALLATION RECORD
PROJECT NUMBER: LSP-AR-PPES-07-02
WELL NUMBER: MW-3R
DRAWING NUMBER: 1
CHECKED BY: LP

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11400 West Baseline Road Little Rock, AR 72209
Phone: (501) 455-2199 Fax (501) 455-4547

FIELD BOREHOLE LOG

BOREHOLE NO.: MW-108 TOTAL DEPTH: 30'
COORDINATES: 489573.87N 1920414.52E
ELEVATION: TOC ELEVATION: 245.11 ft

PROJECT INFORMATION

PROJECT: **Plum Point Energy Station**
SITE LOCATION: **Osceola, AR**
JOB NO.: **01008**
LOGGED BY: **ME**
DATE DRILLED: **4/11/01**

DRILLING INFORMATION

DRILLING CO.: **Anderson Engineering**
DRILLER: **Paul Harris**
RIG TYPE: **Simco 2400 SKL**
METHOD OF DRILLING: **6.25"diam. solid flight auger**
SAMPLING METHODS: **Split Spoon**

GRAVEL PACK: 10-20 Sand | SEAL: Bentonite pellets | GROUT: Bentonite chips | Page 1 of 1

CASING/SCREEN TYPE: PVC | DIAMETER: 2-inch | CASING LENGTH: 22.40' | STATIC WATER LEVEL: 22.54' BELOW TOC

SCREEN LENGTH: 10' | SLOT SIZE: 0.010 | T.D. OF WELL 32.40' BELOW TOC | DATE OF WATER LEVEL: 5/02/01

DEPTH	SOIL SYMBOL	SOIL DESCRIPTION	BLOW COUNTS	COMMENTS	BORING COMPLETION	WELL DESCRIPTION
0						3' of stick-up
-5		Brown, silty clay, slightly moist, low plasticity.		Pushed shelby tube from 3'-5'.		Bentonite chips from surface to 14'.
-10		Light brown, clayey silt, slightly moist.	2,4,4			
-15		Brownish gray, silty clay, moist.	2,4,6			Bentonite pellets from 14' to 16'.
-20		Gray clay, moist, high plasticity (19'-19.5'). Gray, silty clay, very moist (19.5'-20').	1,2,5	Hit H2O @ 22'.		10-20 sand from 16' to 29.4'.
-25		Tan, fine to coarse grained sand, subangular to subrounded, wet.	2,5,5	Heaving sands @ 26', switched to hollow stem augers to construct well.		
-30				Total depth @ 30'.		

Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated November 18, 2016. Vertical datum is based on NAVD88 and horizontal datum is based on Arkansas State Plane NAD83 North.

FIELD BORING LOG

BORING NO.: MW-113 PAGE: 1 of 1

TOTAL DEPTH: 33' FEET BELOW GROUND SURFACE (BGS)

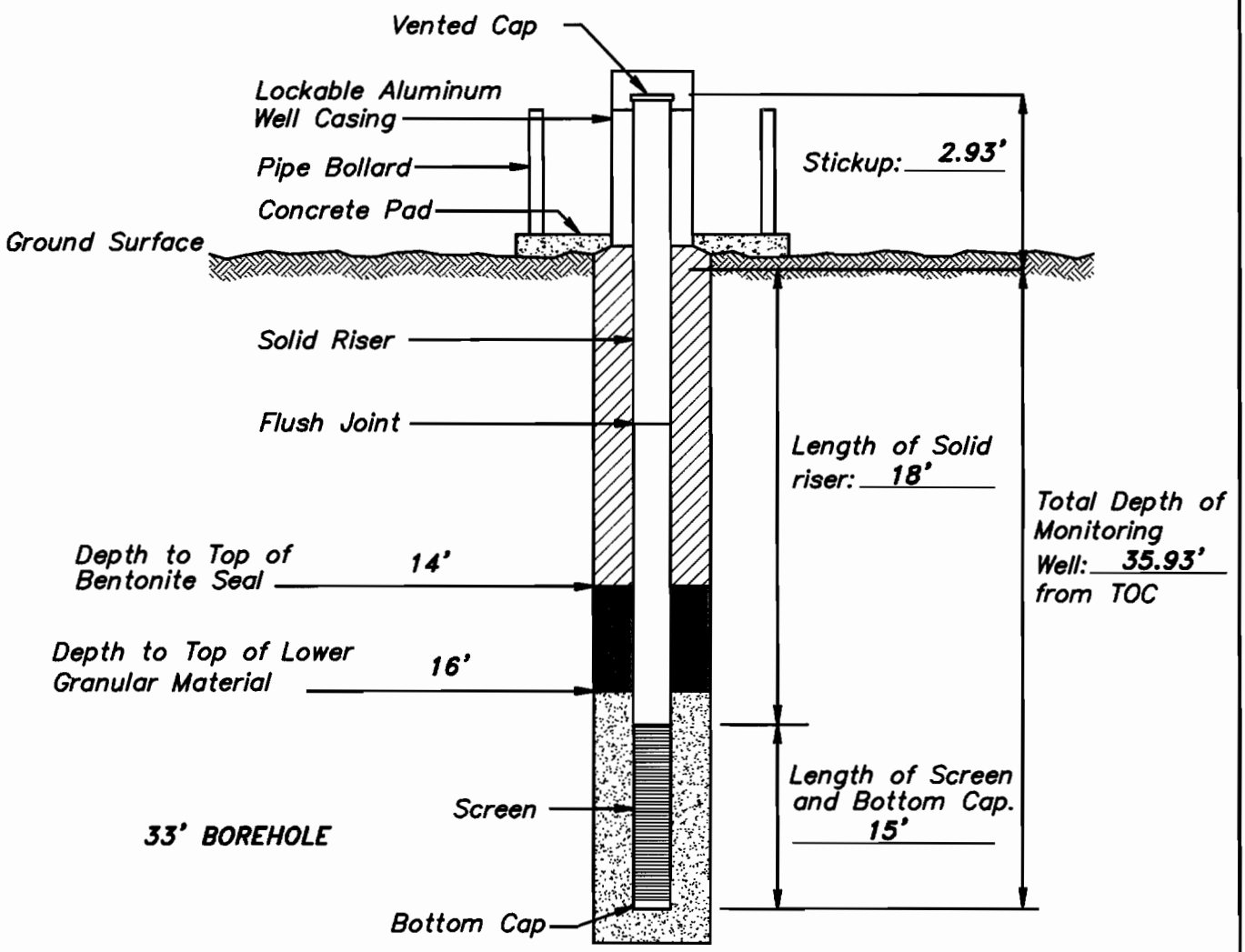
CLIENT: Dynegy Services Plum Point, LLC	PROJECT: Plum Point MW-13 Replacement
JOB NO.: DY-09-02	DRILLING CO.: Tri-State Testing Services, Inc.
LOGGED BY: Lance Powell	DRILLER: Mike Woolfolk
DATE DRILLED: 4/7/09	RIG TYPE: CME 55
DRILLING METHOD: Hollow Stem Auger	
SAMPLING METHOD: Continuous	

488463.15N 1919936.06E TOC: 244.63 ft

Depth BGS	Sample Interval	DESCRIPTION	Litho. Symbol	Comments
0		Topsoil 0' - 0.5' Dark Brown Silty Clay Gray to Brown Silty Clay, Moist, Trace Organics		
5		Tan to Brown Silty Sand, Fine to Medium grain, Moist		
10		Tan, Medium to Coarse Grain Sand, Subangular to Subrounded, Damp		
15		Tan, Medium to Coarse Grain Sand, Subangular to Subrounded, Damp		Hit water at 18' ▽
20		Tan, Fine to Medium Grain Sand with Trace Brown Clay, Subangular to Subrounded, Wet		
25		Tan, Fine to Coarse Grain Sand, Subangular to Subrounded, Wet		
30		Tan, Fine to Coarse Grain Sand, Subangular to Subrounded, Wet		Over 15' of wet sand. Auger started to lock up. Sample not taken at 33.

MONITORING WELL INSTALLATION RECORD

Job Name: Plum Point Energy Station MW-13 Replacement
Well Number: MW-113
Job Number: DY-09-02
Installation Date: 4/7/09
Location: PPES Class 3N Landfill
Datum Elevation: 244.63 ft
Surface Elevation: 241.5 ft
Datum for Water Level Measurement: Top of PVC Stickup
Screen Diameter & Material: 2" PVC
Slot Size: 0.010"
Riser Diameter & Material: 2" PVC
Borehole Diameter: 7 1/4"
Granular Backfill Material: Sand
Representative: Lance Powell
Drilling Method: Hollow Stem Auger
Drilling Contractor: Tri-State Testing Services, Inc.



Bentonite Pellets
Bentonite Plug
Granular Backfill

(Not to Scale)

Stabilized water level 18.07 feet below datum.
Measured on 4-09-09

CEA CIVIL ENGINEERING ASSOCIATES, LLC

MONITORING WELL INSTALLATION RECORD
PROJECT NUMBER: DY-09-02
WELL NUMBER: MW-13R
DRAWING NUMBER: 1
CHECKED BY: LP

Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated November 18, 2016. Vertical datum is based on NAVD88 and horizontal datum is based on Arkansas State Plane NAD83 North.

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FIELD BORING LOG

BORING NO.: MW-115 PAGE: 1 of 1

TOTAL DEPTH: 30' FEET BELOW GROUND SURFACE (BGS)

CLIENT: Dynegy Services Plum Point, LLC	PROJECT: Plum Point Well Installation
JOB NO.: LSP-AR-PPES-07-02	DRILLING CO.: Anderson Engineering
LOGGED BY: Phillip Fields	DRILLER: Dennis Young
DATE DRILLED: 9-25-07	RIG TYPE: Simco 2800 HS (HT)

DRILLING METHOD: Hollow Stem Auger

SAMPLING METHOD: Split Spoon

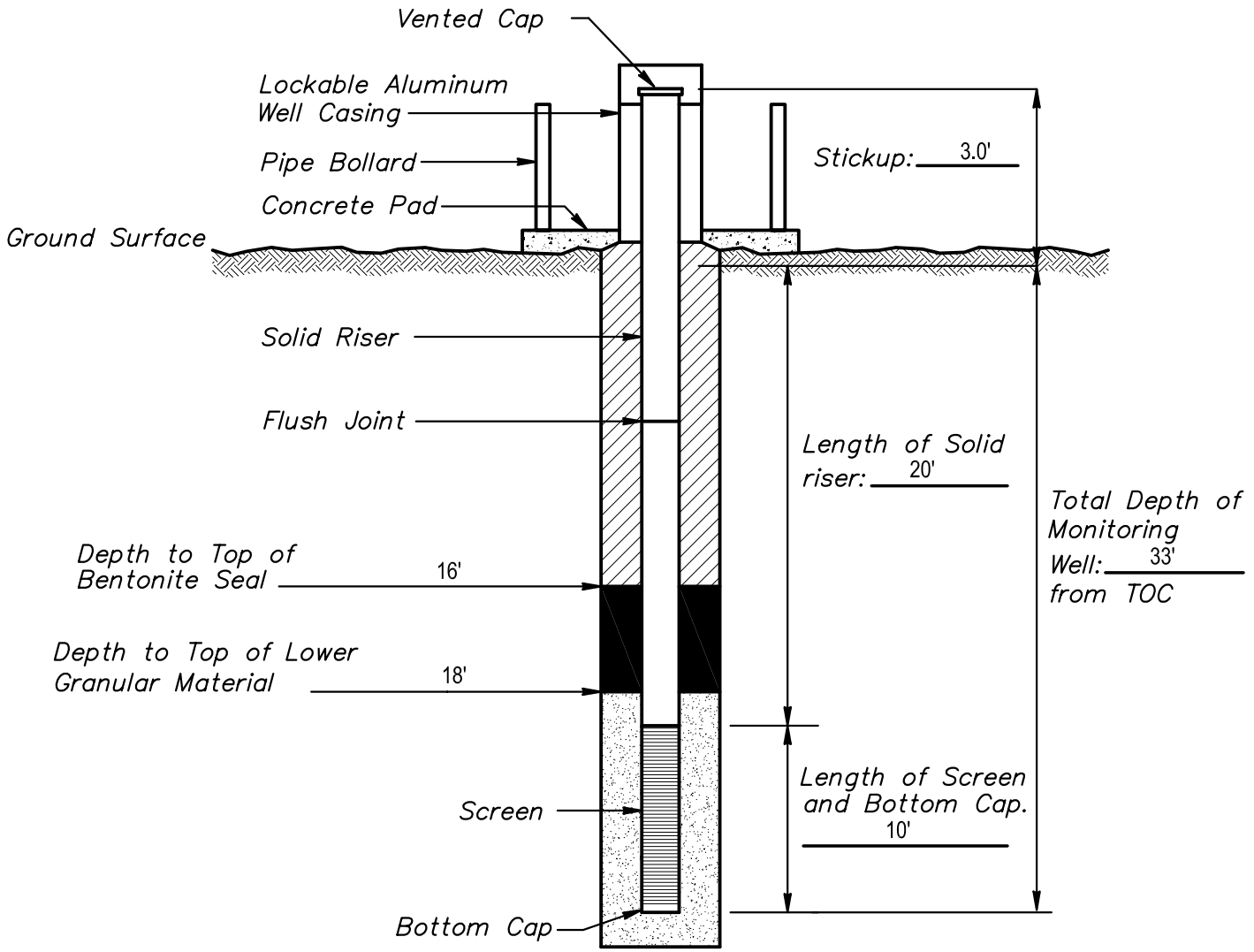
487326.36N 1920085.78E TOC: 243.55 ft

Depth BGS	Sample Interval	DESCRIPTION	Litho. Symbol	Blow Counts	Comments
0		Topsoil 0' - 0.5' Dark Brown Silty Clay			
		Gray to Brown Silty Clay, Moist		3,5,5	
5		Tan to Brown Silty Sand, Fine to Medium grain, Moist		3,3,4	
10		Tan, Fine to Medium grain Sand, Trace Organics, subangular to subrounded, Damp		2,3,3	
15		Tan, Fine to Medium grain Sand, subangular to subrounded, Damp		5,5,5	
20		Tan, Fine to Medium grain Sand, subangular to subrounded, Wet		2,1,3	Hit water at 24' ▽
25		Tan, Fine to Medium grain Sand, subangular to subrounded, Wet			Split Spoon samples not taken at 25' and 30' due to heaving sands

Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated November 18, 2016. Vertical datum is based on NAVD88 and horizontal datum is based on Arkansas State Plane NAD83 North.

MONITORING WELL INSTALLATION RECORD

Job Name: Plum Point Energy Well Station
Well Number: MW-115
Job Number: LSP-AR-PPES-07-02
Installation Date: September 25, 2007
Location: PPES Class 3N Landfill
Datum Elevation: 243.55 ft
Surface Elevation: 240.4 ft
Datum for Water Level Measurement: Top of PVC Stickup
Screen Diameter & Material: 2" PVC
Slot Size: 0.010"
Riser Diameter & Material: 2" PVC
Borehole Diameter: 7.25"
Granular Backfill Material: Sand
Representative: Phillip Fields
Drilling Method: Hollow Stem Auger
Drilling Contractor: Anderson Engineering



(Not to Scale)

Stabilized water level 27.01 feet below datum.

Measured on September 27, 2007

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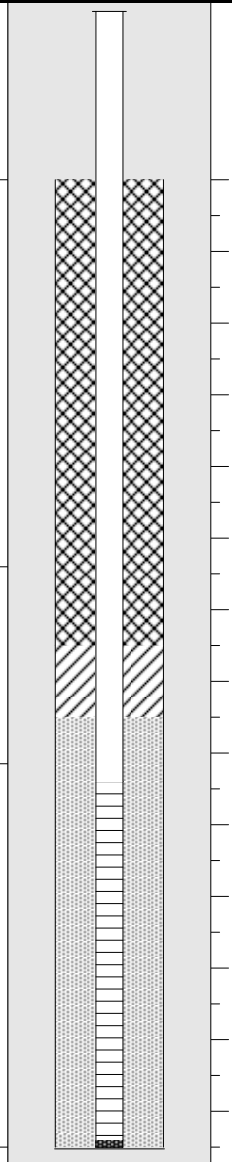
MONITORING WELL INSTALLATION RECORD

PROJECT NUMBER: LSP-AR-PPES-07-02
WELL NUMBER: MW-15
DRAWING NUMBER: 5
CHECKED BY: LP

	PROJECT: **Plum Point Energy Station Landfill**	BORING ID: **MW-116**	
	LOCATION: **Osceola, AR**	WELL ID: **MW-116**	
	DRILLING CONTRACTOR: **McCray Drilling Inc**	NORTHING: **489511.74**	EASTING: **1916640.87**
	DRILLING EQUIPMENT: **CME 750X**	GROUND SURFACE ELEV.: **239.3 ft**	TOC ELEVATION: **243.97 ft**
	DRILLING METHOD: **8.5" H.S.A.**	TOTAL DEPTH: **31.9 ft below TOC**	DEPTH TO WATER: **17 ft bgs**
LOGGED BY: **DLD**	SAMPLING METHOD: **5-ft split barrel**	DATE STARTED: **6/23/2015**	DATE COMPLETED: **6/23/2015**

Depth (feet)	% REC	USCS	Graphic Log	Description
0				
2	0	CL		LEAN CLAY, silty, with very fine-grained sand, olive grey to grey with orange mottles, medium stiff to soft, moist.
4				
6	70			
8				
10	100			
12		CH		FAT CLAY, grey with orange mottles, medium stiff to stiff, moist.
14	100			
16				
18				POORLY GRADED SAND, fine- to medium-grained, light brown, with carbonaceous material @ 17 ft, saturated @ 20 ft, hit heaving sands. Plugged augers to 27 ft.
20	60			
22		SP		
24	n/a			
26				
28				
30				



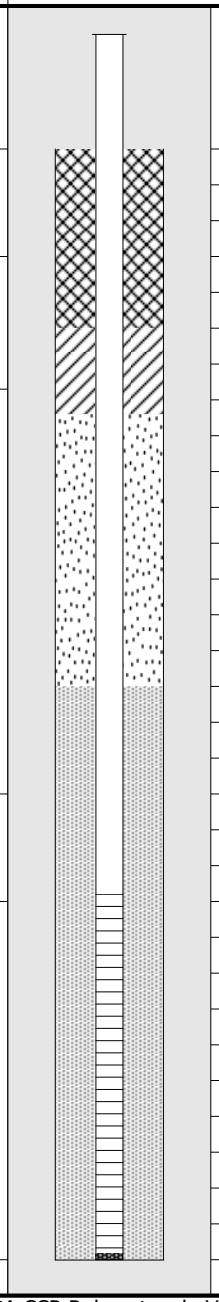
Well Construction

- 4.7 ft of stick up
- 21.5 ft of 2 in dia., Sch. 40 PVC Solid Riser to 16.8 ft bgs (including stickup)
- Cement/bentonite grout from 0 to 13 ft bgs
- Bentonite pellet seal from 13 to 15 ft bgs
- ▼ Silica size 10/20 filter pack from 15 to 27 ft bgs
- 10 ft of 2 in dia., 0.010 in slot, ScH 40 PVC screen from 16.8 to 26.8 ft bgs
- 0.35 ft, 2 in dia., Sch. 40 PVC end cap
- 27 ft BOH

NOTES: Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated July 29, 2015. Horizontal and vertical coordinates are based on Arkansas State Plane NAD83 North Coordinates and NAVD88.

PROJECT: **Plum Point Energy Station Landfill**		BORING ID: **MW-117**	
LOCATION: **Osceola, AR**		WELL ID: **MW-117**	
DRILLING CONTRACTOR: **McCray Drilling Inc**		NORTHING: **488672.25**	EASTING: **1917608.53**
DRILLING EQUIPMENT: **CME 750X**		GROUND SURFACE ELEV.: **239.4 ft**	TOC ELEVATION: **242.53 ft**
DRILLING METHOD: **8.5" H.S.A.**		TOTAL DEPTH: **34.1 ft below TOC**	DEPTH TO WATER: **17 ft bgs**
LOGGED BY: **DLD**	SAMPLING METHOD: **5-ft split barrel**	DATE STARTED: **6/24/2015**	DATE COMPLETED: **6/24/2015**

Depth (feet)	% REC	USCS	Description
0			
2	100	CL	LEAN CLAY, silty, brown, medium stiff to stiff, moist. @ 1.5 ft, clayey silt lens, brown, soft.
4			FAT CLAY, brown, medium stiff to soft, moist.
6	60	CH	@ 6.7 ft, with fine-grained sand. Sand content increases with depth.
8			POORLY GRADED SAND, very fine- to fine-grained, brown, with carbonaceous material.
10	50		@ 8 ft, no carbonaceous material.
12		SP	
14			@ 16.7, sand becomes laminated with carbonaceous material.
16	50		@ 17 ft, wet.
18			SILTY SAND, fine-grained, brown, saturated.
20	50	SM	
22			POORLY GRADED SAND, fine-grained, subangular to subrounded, brown, saturated.
24			@23 ft, hit heaving sands. Plugged augers to 31 ft.
26		SP	
28	n/a		
30			
32			



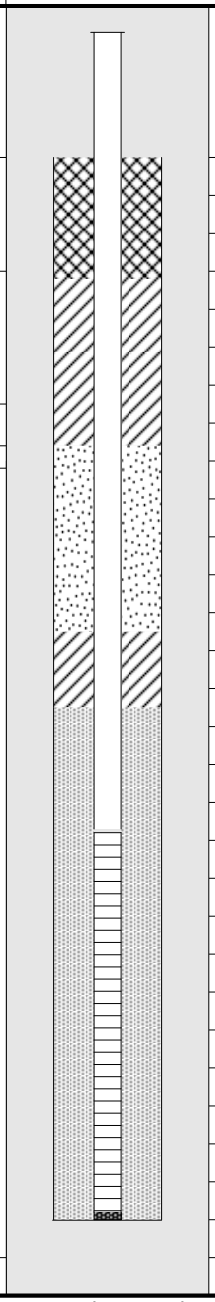
Well Construction

- 3.2 ft of stick up
- 24.0 ft of 2 in dia., Sch. 40 PVC Solid Riser to 20.8 ft bgs (including stickup)
- Cement/bentonite grout from 0 to 5 ft bgs
- Bentonite pellet seal from 5 to 7.4 ft bgs.
- Natural sand from 7.4 to 15 ft bgs.
- Silica size 10/20 filter pack from 15 to 31 ft bgs
- 10 ft of 2 in dia., 0.010 in slot, ScH 40 PVC screen from 20.8 to 30.8 ft bgs
- 0.18 ft, 2 in dia., Sch. 40 PVC end cap
- 31 ft BOH

NOTES: Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated July 29, 2015. Horizontal and vertical coordinates are based on Arkansas State Plane NAD83 North Coordinates and NAVD88.

	PROJECT: **Plum Point Energy Station Landfill**	BORING ID: **MW-118**	
	LOCATION: **Osceola, AR**	WELL ID: **MW-118**	
	DRILLING CONTRACTOR: **McCray Drilling Inc**	NORTHING: **488283.34**	EASTING: **1916953.52**
	DRILLING EQUIPMENT: **CME 750X**	GROUND SURFACE ELEV.: **238.0 ft**	TOC ELEVATION: **241.23 ft**
	DRILLING METHOD: **8.5" H.S.A.**	TOTAL DEPTH: **31.4 ft below TOC**	DEPTH TO WATER: **17 ft bgs**
LOGGED BY: **DLD**	SAMPLING METHOD: **5-ft split barrel**	DATE STARTED: **6/24/2015**	DATE COMPLETED: **6/24/2015**

Depth (feet)	% REC	USCS	Description
0			
2	100	CL	LEAN CLAY, silty with very fine-grained sand, brown, stiff, moist.
4		CH	FAT CLAY, brown and dark grey, stiff, moist.
6	100		
		CL/CH	SANDY LEAN to FAT CLAY, silty, brown, very soft, moist.
8		SM	SILTY SAND, poorly graded, fine-grained, brown, moist.
10	60		POORLY GRADED SAND, fine-grained, subrounded, brown, moist to dry.
12			
14			
16	50		@ 17 ft, saturated.
18		SP	@ 17.5 ft, laminated with carbonaceous material.
20			@ 20 ft, hit heaving sands. Plugged augers to 28 ft.
22	n/a		
24			
26			
28			
30			



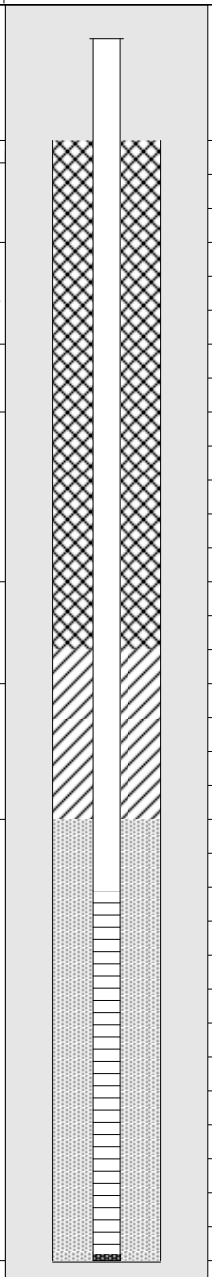
Well Construction

- 3.3 ft ft stick up.
- 21.0 ft of 2 in dia. Sch. 40 PVC solid riser to 17.7 ft bgs
- Cement/bentonite grout from 0 to 3.2 ft bgs
- Bentonite pellet seal from 3.2 to 7.6 ft bgs
- Natural sand from 7.6 to 12.5 ft bgs
- Bentonite pellet seal from 12.5 to 14.5 ft bgs
- Silica size 10/20 filter pack from 14.5 to 28 ft bgs
- 10 ft of 2 in dia. 0.010 in slot Sch. 40 PVC screen 17.7 to 27.7 ft bgs
- 0.35 ft 2 in dia., Sch 40 PVC end cap
- Drilling terminated at 28 ft bgs

NOTES: Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated July 29, 2015. Horizontal and vertical coordinates are based on Arkansas State Plane NAD83 North Coordinates and NAVD88.

PROJECT: **Plum Point Energy Station Landfill**		BORING ID: **MW-119**	
LOCATION: **Osceola, AR**		WELL ID: **MW-119**	
DRILLING CONTRACTOR: **McCray Drilling Inc**		NORTHING: **489014.22**	EASTING: **1915902.58**
DRILLING EQUIPMENT: **CME 750X**		GROUND SURFACE ELEV.: **243.6 ft**	TOC ELEVATION: **246.53**
DRILLING METHOD: **8.5" H.S.A.**		TOTAL WELL DEPTH: **35.4 ft bgs**	DEPTH TO WATER (10/17/2016): **23.35 ft below TOC**
LOGGED BY: **DLD/EWS**	SAMPLING METHOD: **5-ft split barrel**	DATE STARTED: **10/6/2016**	DATE COMPLETED: **10/6/2016**

Depth (feet)	% REC	USCS	Description
0	100		Road Base
2	100	CL	LEAN CLAY, olive gray, sitff, moist
4		CH	FAT CLAY, dark gray, stiff, moist, with bits of organic matter
6	100	CL	LEAN CLAY, silty, brownish gray, medium stiff to soft, moist
8			
10	100	CH	FAT CLAY, dark gray, stiff, moist
12			
14		CL	LEAN CLAY, brownish gray, medium stiff, moist
16	80		
18		ML	CLAYEY SILT, with fine grained sand, brownish gray, soft, very moist
20	80		
22			POORLY GRADED SAND, medium to fine-grained, medium dense, saturated.
24			
26	40	SP	
28			@ 28 ft, some carbonaceous material
30	40		
32			
34			



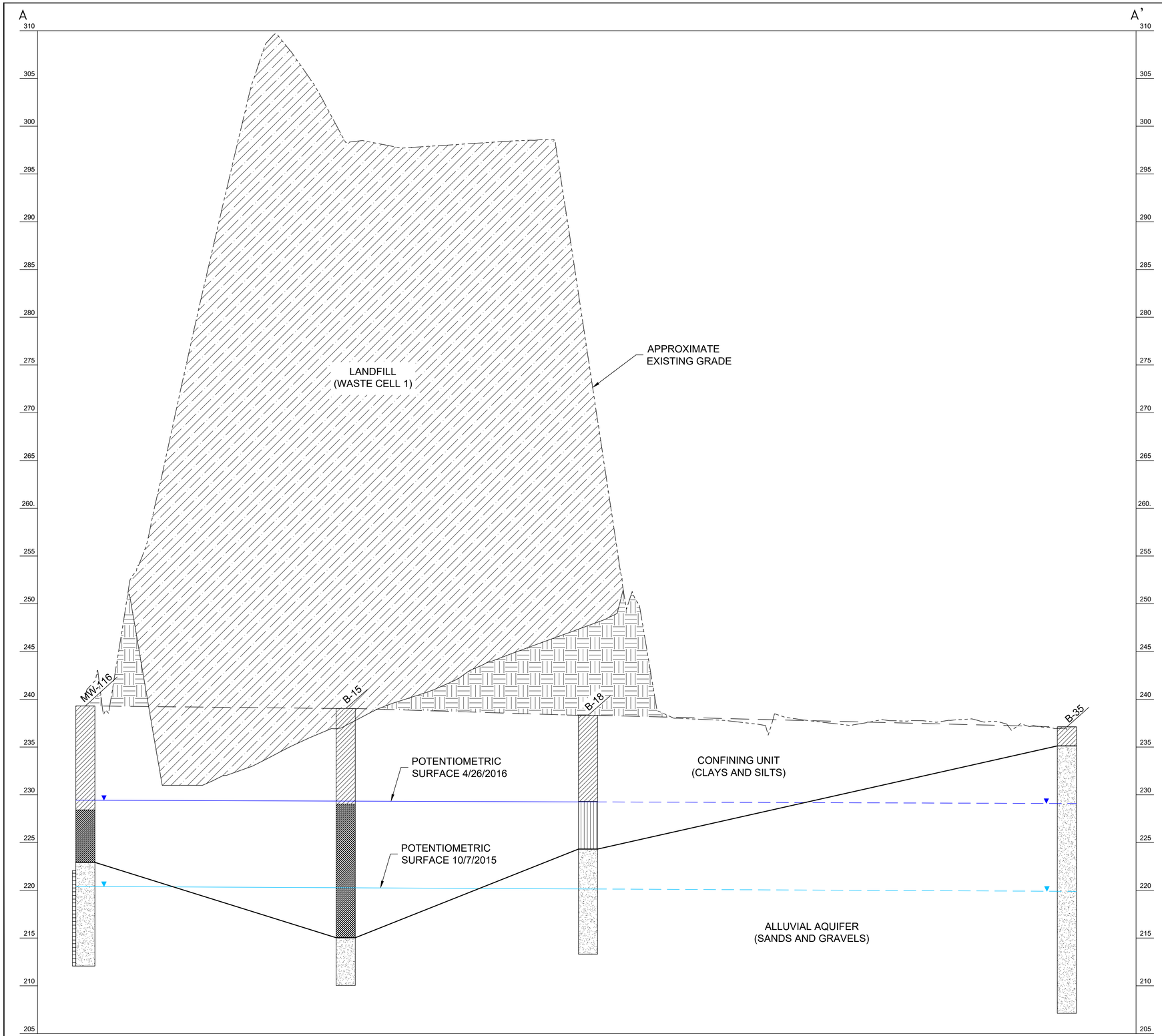
Well Construction

- Above ground completion including 2x2 ft concrete pad, four pipe bollards, and locking outer steel casing
- 2.9 ft stick up
- 25 ft of 2 in dia., Sch. 40 PVC solid riser (including stick up)
- Cement/bentonite grout from 0 ft to 15 ft bgs
- Bentonite pellet seal from 15 ft to 20 ft bgs
- Silica size 10/20 filter pack from 20 ft to 33 ft bgs
- 10 ft of 2 in dia. 0.010 in slot Sch. 40 PVC screen
- 0.35 ft 2 in dia., Sch. 40 PVC end cap
- Drilling terminated at 33 ft bgs

NOTES: Borehole and/or well IDs were updated to reflect the nomenclature used for the EPA CCR Rule network. Vertical and horizontal coordinates were updated based on survey report dated November 18, 2016. Horizontal and vertical coordinates are based on Arkansas State Plane NAD83 North Coordinates and NAVD88.

APPENDIX B

Geologic Cross-Sections

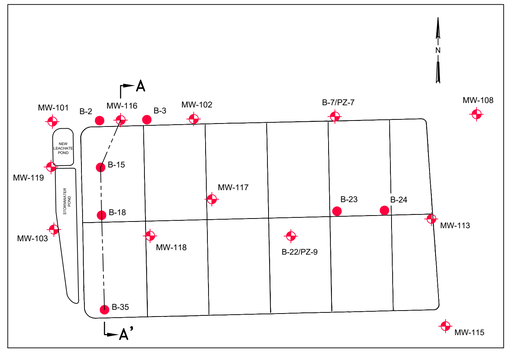


CROSS SECTION A-A'

SCALE: 1"=100' HORIZONTAL
SCALE: 1"=5' HORIZONTAL
VERTICAL EXAGERATION = 20X

LEGEND

- INORGANIC SILTS
- SAND
- LOW PLASTICITY INORGANIC CLAYS
- HIGH PLASTICITY INORGANIC CLAYS
- COMPACTED SOIL
- LANDFILL ASH
- APPROXIMATE EXISTING GRADE SEPTEMBER 2011 - DECEMBER 2016
- APPROXIMATE GROUND SURFACE, PRIOR TO LANDFILL DEVELOPMENT
- APPROXIMATE STRATUM BOUNDARY
- AND — POTENTIOMETRIC SURFACE (4/26/2016) MAXIMUM OBSERVED 2015 - 2017
- AND — POTENTIOMETRIC SURFACE (10/17/2015) MINIMUM OBSERVED 2015 - 2017
- SCREENED INTERVAL



CROSS SECTION
REFERENCE LOCATION

tn & ASSOCIATES, LTD.
water | resources | environmental | consultants

PLUM POINT ENERGY STATION
CCR LANDFILL
GEOLOGIC CROSS-SECTIONS
OSCEOLA, ARKANSAS

FIGURE 1
CROSS-SECTION A-A'

DRAWN BY: JT	FILE NAME: FG01.DWG
APPROVED: AVP	PROJECT NO. 14590-1621-001
SCALE: AS SHOWN	DATE: 09/25/17
SHEET NO. 1	

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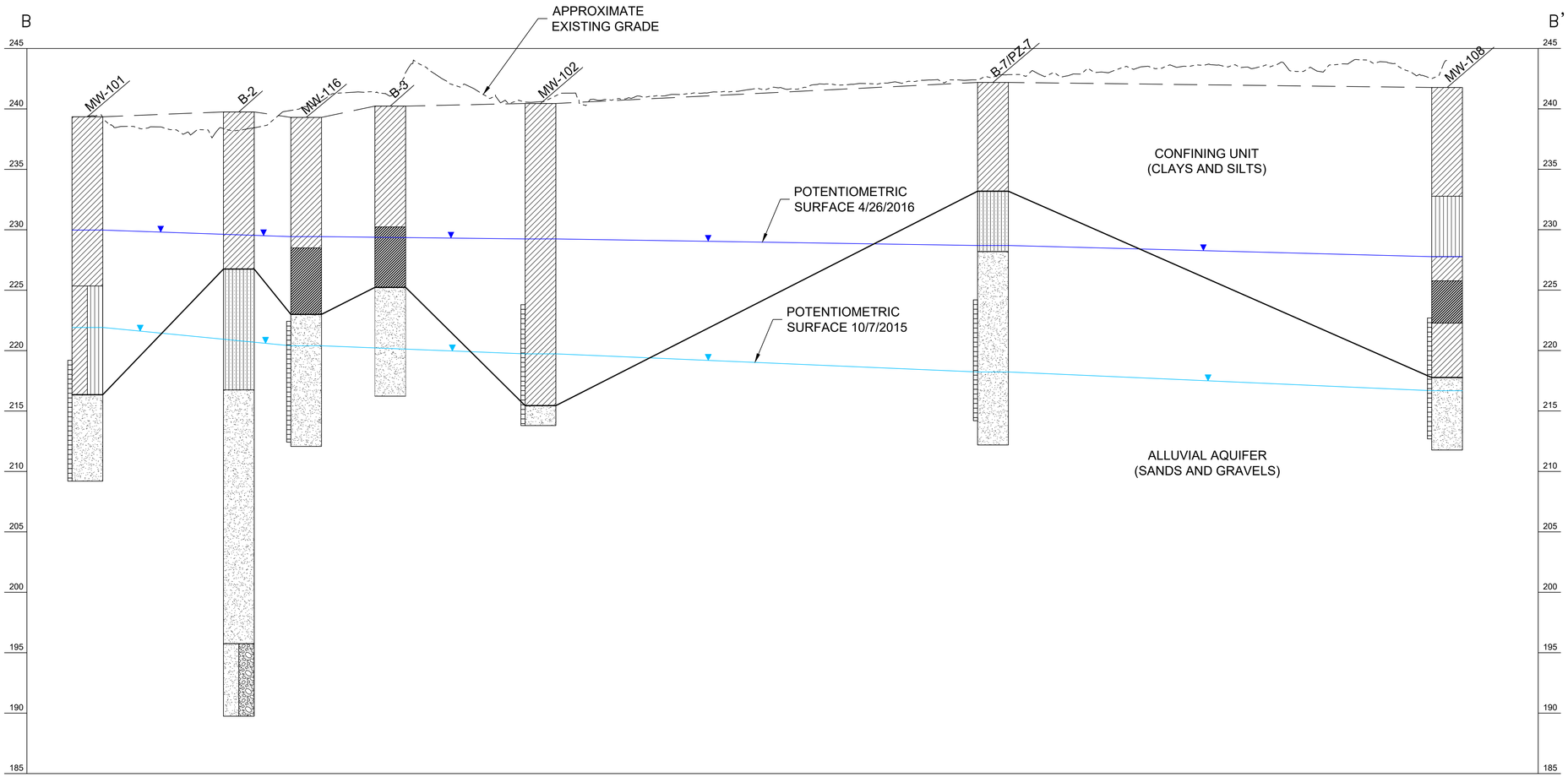
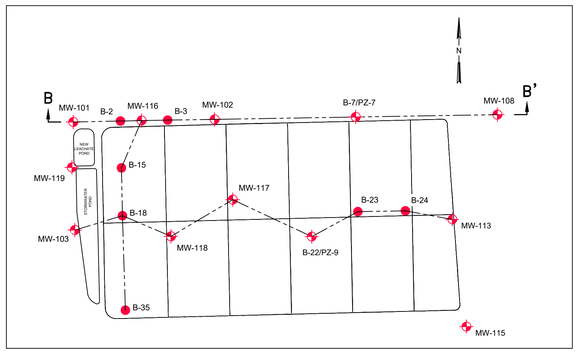


CROSS SECTION B-B'

SCALE: 1"=200' HORIZONTAL
SCALE: 1"=5' HORIZONTAL
VERTICAL EXAGERATION = 40X



CROSS SECTION
REFERENCE LOCATION

LEGEND

- INORGANIC SILTS
- SAND
- LOW PLASTICITY INORGANIC CLAYS
- SILTY SANDS
- HIGH PLASTICITY INORGANIC CLAYS
- POORLY GRADED GRAVELS
- WELL GRADED GRAVELS
- APPROXIMATE EXISTING GRADE SEPTEMBER 2011 - DECEMBER 2016
- APPROXIMATE GROUND SURFACE, PRIOR TO LANDFILL DEVELOPMENT
- APPROXIMATE STRATUM BOUNDARY
- POTENTIOMETRIC SURFACE (4/26/2016) MAXIMUM OBSERVED 2015 - 2017
- POTENTIOMETRIC SURFACE (10/17/2015) MINIMUM OBSERVED 2015 - 2017
- SCREENED INTERVAL

PLUM POINT ENERGY STATION
CCR LANDFILL
GEOLOGIC CROSS-SECTIONS
OSCEOLA, ARKANSAS

FIGURE 2
CROSS-SECTION B-B'

DRAWN BY: JT	FILE NAME: FG02.DWG
APPROVED: AJP	PROJECT NO. 14590-1621-001
SCALE: AS SHOWN	DATE: 09/25/17
SHEET NO. 1	

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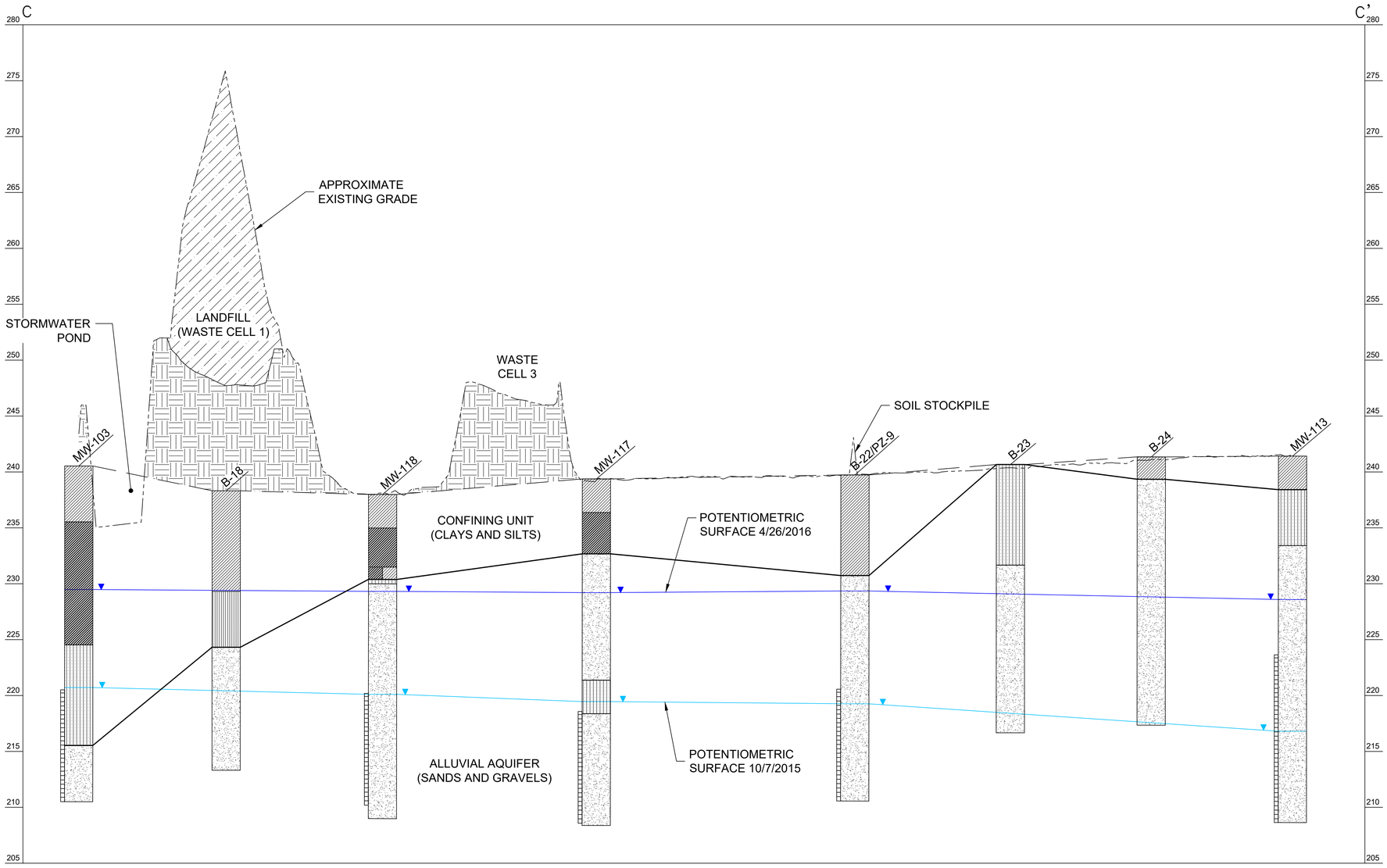
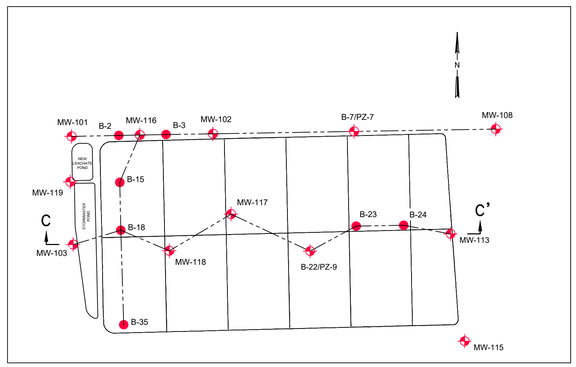


CROSS SECTION C-C'

SCALE: 1"=200' HORIZONTAL
SCALE: 1"=5' HORIZONTAL
VERTICAL EXAGERATION = 40X



CROSS SECTION REFERENCE LOCATION

LEGEND

- INORGANIC SILTS
- SAND
- LOW PLASTICITY INORGANIC CLAYS
- SILTY SANDS
- HIGH PLASTICITY INORGANIC CLAYS
- WELL GRADED GRAVELS
- COMPACTED SOIL
- LANDFILL ASH
- APPROXIMATE EXISTING GRADE SEPTEMBER 2011 - DECEMBER 2016
- APPROXIMATE GROUND SURFACE, PRIOR TO LANDFILL DEVELOPMENT
- APPROXIMATE STRATUM BOUNDARY
- POTENTIOMETRIC SURFACE (4/26/2016) MAXIMUM OBSERVED 2015 - 2017
- POTENTIOMETRIC SURFACE (10/17/2015) MINIMUM OBSERVED 2015 - 2017
- SCREENED INTERVAL

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PLUM POINT ENERGY STATION
CCR LANDFILL
GEOLOGIC CROSS-SECTIONS
OSCEOLA, ARKANSAS

FIGURE 3
CROSS-SECTION C-C'

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APPROVED:	PROJECT NO. 14590-1621-001
SCALE: AS SHOWN	DATE: 09/14/17
SHEET NO. 1	