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2020 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT POND 003 NEW MADRID POWER PLANT NEW MADRID, MISSOURI

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List of List of List of	Figur		ts	ii ii ii
1.	Introd	duction	า	1
	1.1		§ 257.90(E)(6) SUMMARY	1
		1.1.1	40 CFR § 257.90(e)(6)(i) – Initial Monitoring Program	1
		1.1.2 1.1.3	40 CFR § 257.90(e)(6)(ii) – Final Monitoring Program 40 CFR § 257.90(e)(6)(iii) – Statistically Significant Increases	1 1
			40 CFR § 257.90(e)(6)(iv) – Statistically Significant Levels	2
			40 CFR 257.90(e)(6)(v) - Selection of Remedy	3
		1.1.6	40 CFR § 257.90(e)(6)(vi) – Remedial Activities	3
2.	40 CF	R § 25	7.90 Applicability	4
	2.1	40 CFR	§ 257.90(A)	4
	2.2	40 CFR	§ 257.90(E) – SUMMARY	4
		2.2.1	Status of the Groundwater Monitoring Program	4
			Key Actions Completed	5
			Problems Encountered	5
			Actions to Resolve Problems	5
	2.2	2.2.5	Project Key Activities for Upcoming Year	6
	2.3		§ 257.90(E) – INFORMATION	6
		2.3.1 2.3.2	40 CFR § 257.90(e)(1) 40 CFR § 257.90(e)(2) – Monitoring System Changes	6 6
			40 CFR § 257.90(e)(3) – Summary of Sampling Events	6
			40 CFR § 257.90(e)(4) – Monitoring Transition Narrative	7
		2.3.5	40 CFR 257.90(e)(5) - Other Requirements	, 7
	2.4		§ 257.90(F)	9

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<u>February 1, 2021</u> Date



List of Tables

Table No.	Title
I	SSL Summary Table
П	Summary of Analytical Results – 2020 Annual Assessment Monitoring
ш	Summary of 2020 Nature and Extent Analytical Results
IV	Background Concentrations and Groundwater Protection Standards

List of Figures

Figure No.	Title
1	Pond 003 Monitoring Well Location Map
2	Pond 003 Nature and Extent Monitoring Well Location Map

List of Attachments

Attachments	Title
1	Appendix IV SSL Alternate Source Demonstration for Pond 003, September 2019



1. Introduction

This 2020 Annual Groundwater Monitoring and Corrective Action Report (Annual Report) addresses Pond 003 at the New Madrid Power Plant (NMPP), operated by the Associated Electric Cooperative, Inc. (AECI). This Annual Report was developed in accordance with the U.S. Environmental Protection Agency Coal Combustion Residual (CCR) Rule effective 19 October 2015 (Rule) including subsequent revisions, specifically Code of Federal Regulations Title 40 (40 CFR), subsection 257.90(e). The Annual Report documents the groundwater monitoring system for Pond 003 consistent with applicable sections of 257.90 through 257.98, and describes activities conducted in the prior calendar year (2020) and documents compliance with the Rule. The specific requirements listed in § 257.90(e)(1)-(6) of the Rule are provided in Sections 1 and 2 of this Annual Report and are in bold italic font, followed by a short narrative describing how each Rule requirement has been met.

1.1 40 CFR § 257.90(e)(6) SUMMARY

A section at the beginning of the annual report that provides an overview of the current status of groundwater monitoring and corrective action programs for the CCR unit. At a minimum, the summary must specify all of the following:

1.1.1 40 CFR § 257.90(e)(6)(i) – Initial Monitoring Program

At the start of the current annual reporting period, whether the CCR unit was operating under the detection monitoring program in § 257.94 or the assessment monitoring program in § 257.95;

At the start of the current annual reporting period (1 January 2020), Pond 003 was operating under an assessment monitoring program in compliance with 40 CFR § 257.95 for all constituents except molybdenum. Pond 003 is implementing a corrective measures program in accordance with 40 CFR § 257.96 for molybdenum.

1.1.2 40 CFR § 257.90(e)(6)(ii) – Final Monitoring Program

At the end of the current annual reporting period, whether the CCR unit was operating under the detection monitoring program in § 257.94 or the assessment monitoring program in § 257.95;

At the end of the current annual reporting period (31 December 2020), Pond 003 was operating under an assessment monitoring program in compliance with 40 CFR § 257.95 for all constituents except molybdenum. Pond 003 is implementing a corrective measures program in accordance with 40 CFR § 257.96 for molybdenum.

1.1.3 40 CFR § 257.90(e)(6)(iii) – Statistically Significant Increases

If it was determined that there was a statistically significant increase over background for one or more constituents listed in appendix III to this part pursuant to § 257.94(e):

1.1.3.1 40 CFR § 257.90(e)(6)(iii)(a)

Identify those constituents listed in appendix III to this part and the names of the monitoring wells associated with such an increase; and



Pond 003 at NMPP is operating under an assessment monitoring program; therefore, no statistical evaluations were conducted on appendix III constituents in 2020.

1.1.3.2 40 CFR § 257.90(e)(6)(iii)(b)

Provide the date when the assessment monitoring program was initiated for the CCR unit.

An assessment monitoring program for Pond 003 was established on 15 August 2018 to meet the requirements of 40 CFR § 257.95. Pond 003 remained in assessment monitoring in 2020 for all constituents, with a corrective measures program implemented for molybdenum in accordance with 40 CFR § 257.96.

1.1.4 40 CFR § 257.90(e)(6)(iv) – Statistically Significant Levels

If it was determined that there was a statistically significant level above the groundwater protection standard for one or more constituents listed in appendix IV to this part pursuant to § 257.95(g) include all of the following:

1.1.4.1 40 CFR § 257.90(e)(6)(iv)(a) – Statistically Significant Level Constituents

Identify those constituents listed in appendix IV to this part and the names of the monitoring wells associated with such an increase;

Statistically significant levels (SSL) above the groundwater protection standards (GWPS) identified in 2020 at Pond 003 for the September 2019 and February 2020 semi-annual sampling events are listed in Table I.

1.1.4.2 40 CFR § 257.90(e)(6)(iv)(b) – Initiation of the Assessment of Corrective Measures

Provide the date when the assessment of corrective measures was initiated for the CCR unit;

No assessment of corrective measures was required to be initiated in 2020 for this unit. Pond 003 remained in assessment monitoring during 2020.

1.1.4.3 40 CFR § 257.90(e)(6)(iv)(c) – Assessment of Corrective Measures Public Meeting Provide the date when the public meeting was held for the assessment of corrective measures for the CCR unit; and

An assessment of corrective measures was not initiated for Pond 003 in 2020; therefore, a public meeting was not held.

1.1.4.4 40 CFR § 257.90(e)(6)(iv)(d) – Completion of the Assessment of Corrective Measures Provide the date when the assessment of corrective measures was completed for the CCR unit.

No assessment of corrective measures was required to be completed in 2020 for this unit. Pond 003 remained in assessment monitoring during 2020.



1.1.5 40 CFR § 257.90(e)(6)(v) – Selection of Remedy

Whether a remedy was selected pursuant to § 257.97 during the current annual reporting period, and if so, the date of remedy selection; and

The selection of remedy required under § 257.97 was ongoing in 2020 for molybdenum at select monitoring wells at Pond 003.

1.1.6 40 CFR § 257.90(e)(6)(vi) – Remedial Activities

Whether remedial activities were initiated or are ongoing pursuant to § 257.98 during the current annual reporting period.

No remedial activities have been initiated in 2020; therefore, no demonstration or certification is applicable for this unit.



2. 40 CFR § 257.90 Applicability

2.1 40 CFR § 257.90(a)

All CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under §§ 257.90 through 257.99, except as provided in paragraph (g) [Suspension of groundwater monitoring requirements] of this section.

AECI has installed and certified a groundwater monitoring system at the NMPP Pond 003. Pond 003 is subject to the groundwater monitoring and corrective action requirements described under 40 CFR §§ 257.90 through 257.98. This document addresses the requirement for the Owner/Operator to prepare an Annual Report per § 257.90(e) (Rule).

2.2 40 CFR § 257.90(e) – SUMMARY

Annual groundwater monitoring and corrective action report. For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1).

This Annual Report describes the monitoring completed and actions taken at the NMPP Pond 003 as required by the Rule. Groundwater sampling and analysis was conducted in accordance with requirements described in § 257.93, and the status of the groundwater monitoring program described in § 257.94 and § 257.95 is also provided in this report. This Annual Report documents the applicable groundwater-related activities completed in the calendar year 2020.

2.2.1 Status of the Groundwater Monitoring Program

Results of the detection monitoring statistical analyses completed in January 2018 identified statistically significant increased (SSI) concentration of appendix III constituents in downgradient monitoring wells relative to concentrations observed in upgradient monitoring wells. No alternative source was identified for the SSI constituents. Accordingly, the groundwater monitoring program transitioned to assessment monitoring in May 2018. Appendix IV SSLs were detected above the GWPS for molybdenum during the October 2018 and March 2019 assessment monitoring sampling events. Therefore, a corrective measures assessment was initiated and completed in 2019. The selection of remedy required under § 257.97 was ongoing in 2020. AECI is currently implementing an assessment monitoring program for all other constituents.



2.2.2 Key Actions Completed

The 2019 Annual Groundwater Monitoring and Corrective Action Report was completed in January 2020. Statistical analysis of analytical data from the September 2019 semi-annual assessment monitoring sampling event was completed in January 2020. A summary including the sample names, dates of sample collection, field parameters, and monitoring data obtained for the groundwater monitoring program of the NMPP Pond 003 is presented in Table II of this report. The statistical analyses completed in January 2020 indicated appendix IV SSLs above the GWPS for molybdenum at monitoring wells MW-7, MW-8, MW-9, P-2, P-3, and P-5 and for lithium at P-4 from the September 2019 sampling event. AECI completed and certified a successful alternative source demonstration (ASD) for lithium at P-4 in April 2020 determining that a source other than the CCR unit caused the SSL.

A semi-annual assessment monitoring event was completed in February 2020 for detected appendix IV constituents identified from the June 2019 annual assessment monitoring sampling event. Statistical analysis was completed within 90 days of receipt of verified laboratory data for the February 2020 sampling event. Appendix IV SSLs were identified consistent with previous monitoring events for molybdenum. A summary of appendix IV SSLs identified in the September 2019 and February 2020 assessment monitoring events are provided in Table I. Notifications documenting the identified SSLs have been entered into the facility's operating record in accordance with § 257.95(g).

The determination of the nature and extent of the appendix IV SSLs was initiated in 2019 pursuant to § 257.95(g) with the installation of 15 additional groundwater monitoring wells. Analytical results from the groundwater monitoring events completed at the nature and extent monitoring wells from March and August 2020 are provided in Table III.

An annual assessment monitoring sampling event was completed in May 2020 to identify detected appendix IV constituents for subsequent semi-annual sampling events in August 2020 and planned for February 2021. GWPSs for detected appendix IV constituents were established. GWPS utilized for the statistical analyses completed in 2020 are presented in Table IV. Semi-annual assessment monitoring was completed in August 2020 for detected appendix IV constituents identified during the May 2020 annual monitoring event. Statistical analysis of the results from the August 2020 semi-annual assessment monitoring sampling event are due to be completed in January 2021 and will be reported in the next annual report.

2.2.3 Problems Encountered

No problems (i.e., problems could include damaged wells, issues with sample collection or lack of sampling, or problems with analytical analysis) were encountered at the NMPP Pond 003 in 2020.

2.2.4 Actions to Resolve Problems

No problems were encountered at the NMPP Pond 003 in 2020; therefore, no actions to resolve problems were required.



2.2.5 Project Key Activities for Upcoming Year

Key activities planned for 2021 include completion of the 2020 Annual Groundwater Monitoring and Corrective Action Report, statistical analysis of assessment monitoring analytical data collected in August 2020, and conducting semi-annual assessment monitoring and subsequent statistical analysis. AECI is also completing additional steps of the corrective measures program including working towards a selection of remedy.

2.3 40 CFR § 257.90(e) – INFORMATION

At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

2.3.1 40 CFR § 257.90(e)(1)

A map, aerial image, or diagram showing the CCR unit and all background (or up gradient) and down gradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

As required by § 257.90(e)(1), a map showing the locations of the CCR unit and associated upgradient and downgradient monitoring wells for Pond 003 is included in this report as Figure 1. In addition, this information is presented in the CCR Groundwater Monitoring Network Description Report prepared for AECI, which was placed in the facility's operating record by 17 October 2017 as required by § 257.105(h)(2) and updated in April 2019. Monitoring wells installed to assist with the nature and extent investigation at Pond 003 are presented in Figure 2.

2.3.2 40 CFR § 257.90(e)(2) – Monitoring System Changes

Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

No monitoring wells were installed or decommissioned during 2020.

2.3.3 40 CFR § 257.90(e)(3) – Summary of Sampling Events

In addition to all the monitoring data obtained under §257.90 through §257.98, a summary including the number of groundwater samples that were collected for analysis for each background and down gradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

In accordance with § 257.94(b), three independent assessment monitoring samples were collected from each background and downgradient monitoring well that are a part of the certified groundwater monitoring network in 2020. A summary including the sample names, dates of sample collection, field parameters, and monitoring data obtained for the groundwater monitoring program of the NMPP Pond 003 is presented in Table II of this report.

Two independent nature and extent samples from each nature and extent monitoring well were collected in 2020 during the semi-annual sampling events pursuant to § 257.95(g)(1)(iv). Analytical results associated with the nature and extent investigation collected in 2020 are reported in Table III.



2.3.4 40 CFR § 257.90(e)(4) – Monitoring Transition Narrative

A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

An assessment monitoring program was established on 15 August 2018 to meet the requirements of 40 CFR § 257.95. Statistical analyses of analytical data from October 2018 and March 2019 indicated appendix IV SSLs above the GWPS for molybdenum at monitoring wells MW-7, MW-8, MW-9, P-2, P-3, and P-5. AECI pursued an ASD in April 2019 to determine if a source other than the CCR unit caused the SSL, which was unsuccessful. Therefore, a corrective measures assessment was initiated, which was completed in September 2019. The selection of remedy required under § 257.97 was ongoing in 2020. AECI is currently implementing an assessment monitoring program for all other constituents.

2.3.5 40 CFR § 257.90(e)(5) – Other Requirements

Other information required to be included in the annual report as specified in § 257.90 through § 257.98.

This Annual Report documents activities conducted to comply with §§ 257.90 through 257.95 of the Rule. It is understood that there are supplemental references in §§ 257.90 through 257.98 that must be placed in the Annual Report. The following requirements include relevant and required information in the Annual Report for activities completed in calendar year 2020.

2.3.5.1 40 CFR § 257.94(d)(3) – Demonstration for Alternative Detection Monitoring Frequency

The owner or operator must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer or the approval from the Participating State Director or approval from EPA where EPA is the permitting authority in the annual groundwater monitoring and corrective action report required by § 257.90(e).

An alternative groundwater detection monitoring sampling and analysis frequency has not been established for this CCR unit; therefore, no demonstration or certification is applicable.

2.3.5.2 40 CFR § 257.94(e)(2) – Detection Monitoring Alternate Source Demonstration

The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner or operator of the CCR unit may continue with a detection monitoring program under this section. If a



successful demonstration is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under § 257.95. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority.

This unit is in assessment monitoring; therefore, no detection monitoring ASD or certification is applicable.

2.3.5.3 40 CFR § 257.95(c)(3) – Demonstration for Alternative Assessment Monitoring Frequency The owner or operator must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer or the approval from the Participating State Director or approval from EPA where EPA is the permitting authority in the annual groundwater monitoring and corrective action report required by § 257.90(e).

An alternative groundwater assessment monitoring sampling and analysis frequency has not been established for this CCR unit; therefore, no demonstration or certification is applicable.

2.3.5.4 40 CFR § 257.95(d)(3) – Assessment Monitoring Concentrations and Groundwater Protection Standards

Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

An assessment monitoring program is currently being implemented at the CCR unit. Three rounds of assessment monitoring sampling were completed in 2020. Analytical results for both downgradient and upgradient wells are provided in Table II. The background concentrations (upper tolerance limits) and GWPSs established for the NMPP Pond 003 that were utilized for statistical analyses completed in 2020 are included in Table IV.

2.3.5.5 40 CFR § 257.95(g)(3)(ii) – Assessment Monitoring Alternate Source Demonstration

Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section and may return to detection monitoring if the constituents in appendices III and IV to this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report



required by § 257.90(e), in addition to the certification by a qualified professional engineer or the approval from the Participating State Director or approval from EPA where EPA is the permitting authority.

A successful assessment monitoring ASD completed in April 2020 for the September 2019 sampling event SSL for lithium is included in this report as Attachment 1. Pond 003 remained in assessment monitoring during 2020 for all constituents other than molybdenum.

2.3.5.6 40 CFR § 257.96(a) – Demonstration for Additional Time for Assessment of Corrective Measures

Within 90 days of finding that any constituent listed in appendix IV to this part has been detected at a statistically significant level exceeding the groundwater protection standard defined under § 257.95(h), or immediately upon detection of a release from a CCR unit, the owner or operator must initiate an assessment of corrective measures to prevent further releases, to remediate any releases and to restore affected area to original conditions. The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measures due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for no longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer or the approval from the Participating State Director or approval from EPA where EPA is the permitting authority.

A new assessment of corrective measures was not required to be initiated in 2020; therefore, no demonstration or certification is applicable for this unit.

2.4 40 CFR § 257.90(f)

The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

In order to comply with the Rule recordkeeping requirements, the following actions must be completed:

- Pursuant to § 257.105(h)(1), this Annual Report must be placed in the facility's operating record.
- Pursuant to § 257.106(h)(1), notification must be sent to the relevant State Director and/or Tribal authority within 30 days of this Annual Report being placed on the facility's operating record [§ 257.106(d)].
- Pursuant to § 257.107(h)(1), this Annual Report must be posted to the AECI CCR website within 30 days of this Annual Report being placed on the facility's operating record [§ 257.107(d)].



TABLES

TABLE I SSL SUMMARY TABLE ASSOCIATED ELECTRIC COOPERATIVE, INC. NEW MADRID POWER PLANT - POND 003 NEW MADRID, MISSOURI

Constituent	Sampling Event	Well ID	Groundwater Protection Standard (mg/L)
Lithium	September 2019	P-4	0.040*
		MW-7	
		MW-8	
	September 2019	MW-9	
	September 2019	P-2	
		P-3	
Molybdenum		P-5	0.100*
Worybdenum		MW-7	0.100
		MW-8	
	February 2020	MW-9	
	rebruary 2020	P-2	
		P-3]
		P-5	

Notes:

* Value set based on Regional Screening Levels.

mg/L = milligrams per liter

SSL = statistically significant level



Location		Upgradient								
Location		B-123			B-126			MW-16		
Measure Point (TOC)		292.7		293.63			292.85			
Sample Name	B-123	B-123	B-123	B-126	B-126	B-126	MW-16	MW-16	MW-16	
Sample Date	02/21/2020	5/20/2020	8/10/2020	02/21/2020	5/20/2020	8/10/2020	02/21/2020	5/19/2020	8/10/2020	
Final Lab Report Date	4/3/2020	7/2/2020	9/29/2020	4/3/2020	7/2/2020	9/29/2020	4/3/2020	7/2/2020	9/29/2020	
Final Lab Report Revision Date	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Final Radiation Lab Report Date	4/2/2020	7/2/2020	9/29/2020	4/2/2020	7/2/2020	9/29/2020	4/2/2020	7/2/2020	9/29/2020	
Final Radiation Lab Report Revision Date	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Lab Data Reviewed and Accepted	4/8/2020	7/14/2020	10/19/2020	4/8/2020	7/14/2020	10/19/2020	4/8/2020	7/14/2020	10/19/2020	
Depth to Water (ft btoc)	11.00	7.85	12.89	12.68	9.23	13.85	10.90	10.86	18.58	
Temperature, Field (Deg C)	16.26	16.05	17.71	16.56	16.35	18.75	16.95	17.19	18.46	
Conductivity, Field (μS/cm)	616	631	675	417	594	575	804	821	872	
Turbidity, Field (NTU)	90.7	98.3	10.0	98.7	61.7	34.6	0	8.7	0.0	
Boron, Total (mg/L)	0.029	-	0.059	0.031	-	0.058	0.064	-	0.13	
Calcium, Total (mg/L)	62	-	75	62	-	74	120	-	120	
Chloride (mg/L)	3.1	-	3.1	3.9	-	11	13	-	14	
Fluoride (mg/L)	0.457	0.518	0.415	0.376	0.339	0.329	1.68	1.52	1.58	
Sulfate (mg/L)	28	-	29	27	-	46	56	-	74	
pH (lab) (su)	7.43	-	7.51	7.07	-	7.27	7.08	-	7.18	
TDS (mg/L)	270	-	380	230	-	370	510	-	490	
Antimony, Total (mg/L)	-	<0.0030	-	-	<0.0030	-	-	<0.0030	-	
Arsenic, Total (mg/L)	0.0041	0.0034	0.0018	0.0040	0.0037	0.0039	0.0024	0.0021	0.0018	
Barium, Total (mg/L)	0.18	0.21	0.18	0.18	0.20	0.22	0.56	0.53	0.56	
Beryllium, Total (mg/L)	-	<0.0010	-	-	<0.0010	-	-	<0.0010	-	
Cadmium, Total (mg/L)	< 0.00089	<0.00089	-	< 0.00089	<0.00089	-	< 0.00089	<0.00089	-	
Chromium, Total (mg/L)	< 0.0040	<0.0040	-	< 0.0040	<0.0040	-	< 0.0040	<0.0040	-	
Cobalt, Total (mg/L)	0.00098	<0.00086	< 0.0020	0.00086	0.0015	< 0.0020	< 0.00086	<0.00086	< 0.0020	
Lead, Total (mg/L)	< 0.0010	<0.0010	< 0.0010	< 0.0010	<0.0010	< 0.0010	< 0.0010	<0.0010	< 0.0010	
Lithium, Total (mg/L)	0.017	0.024	0.027	0.018	0.011	0.013	0.030	0.022	0.025	
Molybdenum, Total (mg/L)	< 0.0010	0.0037	0.0036	< 0.0010	<0.0010	< 0.0010	< 0.0010	<0.0010	< 0.0010	
Selenium, Total (mg/L)	< 0.0010	<0.0010	< 0.0010	< 0.0010	<0.0010	0.0011	< 0.0010	<0.0010	< 0.0010	
Thallium, Total, (mg/L)	-	<0.0010	<0.0010	-	<0.0010	<0.0010	-	<0.0010	<0.0010	
Mercury, Total (mg/L)	-	<0.00020	-	-	<0.00020	-	-	<0.00020	-	
Radium 226 & 228 Combined (pCi/L)	0.892 ± 0.810 (1.39)	0.467 +/- 0.834 (1.72)	0.470 +/- 0.812 (1.75)	0.469 ± 0.556 (1.03)	1.08 +/- 0.841 (1.43)	1.25 +/- 0.728 (1.16)	1.26 ± 0.793 (1.19)	1.31 +/- 0.928 (1.61)	1.37 +/- 0.835 (1.35)	

Notes:

Bold value: Detection above laboratory reporting limit or minimum detectable concentration (MDC).

Radiological results are presented as activity plus or minus uncertainty with MDC.

Data presented in this table were verified against the laboratory reports.

μS/cm = micro Siemens per centimeter

Deg C = degrees Celsius

ft btoc = feet below top of casing

mg/L = milligrams per liter

N/A = Not Applicable

NTU = Nephelometric Turbidity Unit

pCi/L = picoCuries per liter

su = standard unit

TDS = total dissolved solids

TOC = top of casing



Location					Downg	gradient					
Location		MW-6			MV	N-7			MW-8		
Measure Point (TOC)		300.27			301	L.50		310.63			
Sample Name	MW-6	MW-6	MW-6	MW-7	MW-7	MW-7	MW-7 RESAMPLE	MW-8	MW-8	DUPLICATE	
Sample Date	02/25/2020	5/20/2020	8/12/2020	02/25/2020	5/20/2020	8/11/2020	10/20/2020	02/19/2020	5/20/2020	5/20/2020	
Final Lab Report Date	3/31/2020	7/2/2020	9/18/2020	3/31/2020	7/2/2020	9/18/2020	10/23/2020	3/31/2020	7/2/2020	7/2/2020	
Final Lab Report Revision Date	N/A	N/A	9/29/2020	N/A	N/A	9/29/2020	-	N/A	N/A	N/A	
Final Radiation Lab Report Date	3/30/2020	7/2/2020	9/18/2020	3/30/2020	7/2/2020	9/18/2020	-	3/26/2020	7/2/2020	7/2/2020	
Final Radiation Lab Report Revision Date	N/A	N/A	9/29/2020	N/A	N/A	9/29/2020	-	N/A	-	N/A	
Lab Data Reviewed and Accepted	4/8/2020	7/14/2020	10/19/2020	4/8/2020	7/14/2020	10/19/2020	10/26/2020	4/8/2020	7/16/2020	7/14/2020	
Depth to Water (ft btoc)	16.15	19.03	27.95	18.38	18.33	27.07	35.14	27.10	27.50	-	
Temperature, Field (Deg C)	17.02	17.59	17.29	19.07	19.32	18.33	18.27	17	17.93	-	
Conductivity, Field (µS/cm)	774	778	552	1258	1370	1360	1219	1305	1110	-	
Turbidity, Field (NTU)	14.8	0.4	0.1	15.7	10.0	10.3	0.0	0	3.4	-	
Boron, Total (mg/L)	0.80	-	0.15	14	-	13	-	33	-	-	
Calcium, Total (mg/L)	130	-	71	180	-	200	-	210	-	-	
Chloride (mg/L)	5.6	-	17	13	-	12	-	5.7	-	-	
Fluoride (mg/L)	0.354	<0.250	0.605	0.348	0.601	0.469	-	0.289	<0.250	< 0.250	
Sulfate (mg/L)	58	-	63	480	-	350	-	290	-	-	
pH (lab) (su)	7.08	-	7.28	6.43	-	6.97	-	7.21	-	-	
TDS (mg/L)	480	-	260	970	-	810	-	880	-	-	
Antimony, Total (mg/L)	-	<0.0030	-	-	<0.0030	-	-	-	<0.0030	<0.0030	
Arsenic, Total (mg/L)	< 0.0010	<0.0010	< 0.0010	0.0039	0.0032	0.0060	-	0.0064	0.0045	0.0046	
Barium, Total (mg/L)	0.12	0.13	0.072	0.12	0.15	0.14	-	0.097	0.093	0.095	
Beryllium, Total (mg/L)	-	<0.0010	-	-	<0.0010	-	-	-	<0.0010	<0.0010	
Cadmium, Total (mg/L)	< 0.00089	<0.00089	-	0.0010	<0.00089	-	-	< 0.00089	<0.00089	<0.00089	
Chromium, Total (mg/L)	< 0.0040	<0.0040	-	< 0.0040	<0.0040	-	-	< 0.0040	<0.0040	<0.0040	
Cobalt, Total (mg/L)	0.0038	0.0041	< 0.0020	0.0030	0.0069	0.0062	0.0054	< 0.00086	0.0022	0.0013	
Lead, Total (mg/L)	< 0.0010	<0.0010	-	< 0.0010	<0.0010	-	-	< 0.0010	<0.0010	<0.0010	
Lithium, Total (mg/L)	0.020	0.016	0.018	0.033	0.026	0.029	-	0.024	0.020	0.020	
Molybdenum, Total (mg/L)	0.0074	0.0085	0.0032	2.2	2.0	2.2	-	1.5	1.1	1.0	
Selenium, Total (mg/L)	< 0.0010	<0.0010	< 0.0010	< 0.0010	<0.0010	< 0.0010	-	< 0.0010	<0.0010	<0.0010	
Thallium, Total, (mg/L)	-	<0.0010	-	-	<0.0010	-	-	-	<0.0010	0.0014	
Mercury, Total (mg/L)	-	<0.00020	-	-	<0.00020	-	-	-	<0.00020	<0.00020	
Radium 226 & 228 Combined (pCi/L)	0.645 ± 0.691 (1.22)	3.08 +/- 1.37 (1.96)	0.0639 +/- 0.907 (2.04)	0.873 ± 0.701 (1.15)	0.893 +/- 0.847 (1.45)	1.10 +/- 1.04 (1.85)	-	0.902 ± 0.689 (1.21)	1.10 +/- 0.830 (1.48)	0.676 +/- 0.732 (1.39)	

Location					Downgradient				
Location	MW-8		MW-9			P-1		Р	-2
Measure Point (TOC)	310.63		310.24			313.35	309.84		
Sample Name	MW-8	MW-9	MW-9	MW-9	P-1	P-1	P-1	P-2	P-2
Sample Date	8/10/2020	02/19/2020	5/20/2020	8/10/2020	02/24/2020	5/20/2020	8/11/2020	02/24/2020	5/20/2020
Final Lab Report Date	9/29/2020	3/31/2020	7/2/2020	9/29/2020	3/31/2020	7/2/2020	9/18/2020	3/31/2020	7/2/2020
Final Lab Report Revision Date	-	N/A	N/A	-	N/A	N/A	9/29/2020	N/A	N/A
Final Radiation Lab Report Date	9/29/2020	3/26/2020	7/2/2020	9/29/2020	3/30/2020	7/2/2020	9/18/2020	3/30/2020	7/2/2020
Final Radiation Lab Report Revision Date	-	N/A	N/A	-	N/A	N/A	9/29/2020	N/A	N/A
Lab Data Reviewed and Accepted	10/19/2020	4/8/2020	7/14/2020	10/19/2020	4/8/2020	7/14/2020	10/19/2020	4/8/2020	7/14/2020
Depth to Water (ft btoc)	36.00	25.53	28.39	37.05	26.39	34.38	42.96	22.79	30.91
Temperature, Field (Deg C)	19.11	17.39	18.23	19.38	18.65	19.48	23.03	18.95	22.67
Conductivity, Field (µS/cm)	1400	883	760	997	928	944	803	975	271
Turbidity, Field (NTU)	0.0	0	0.0	0.0	14.6	1.50	0.1	15.2	26.2
Boron, Total (mg/L)	18	2.9	-	2.1	1.7	-	1.9	2.7	-
Calcium, Total (mg/L)	200	130	-	130	150	-	140	150	-
Chloride (mg/L)	8.0	22	-	19	16	-	18	16	-
Fluoride (mg/L)	0.336	0.38	0.499	0.452	0.357	0.348	0.456	0.408	0.476
Sulfate (mg/L)	360	100	-	150	210	-	170	280	-
pH (lab) (su)	8.15	7.12	-	8.09	6.32	-	7.19	7.43	-
TDS (mg/L)	1100	480	-	620	610	-	590	650	-
Antimony, Total (mg/L)	-	-	<0.0030	-	-	<0.0030	-	-	<0.0030
Arsenic, Total (mg/L)	0.0043	< 0.0010	<0.0010	0.0013	< 0.0010	<0.0010	0.0011	< 0.0010	<0.0010
Barium, Total (mg/L)	0.086	0.088	0.086	0.087	0.069	0.074	0.065	0.079	0.077
Beryllium, Total (mg/L)	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010
Cadmium, Total (mg/L)	-	< 0.00089	<0.00089	-	< 0.00089	<0.00089	-	< 0.00089	<0.00089
Chromium, Total (mg/L)	-	< 0.0040	<0.0040	-	< 0.0040	<0.0040	-	< 0.0040	<0.0040
Cobalt, Total (mg/L)	< 0.0020	< 0.00086	<0.00086	< 0.0020	< 0.00086	<0.00086	< 0.0020	< 0.00086	<0.00086
Lead, Total (mg/L)	< 0.0010	< 0.0010	<0.0010	<0.0010	< 0.0010	<0.0010	-	< 0.0010	<0.0010
Lithium, Total (mg/L)	0.036	0.034	0.029	0.043	0.028	0.023	0.029	0.024	0.019
Molybdenum, Total (mg/L)	1.0	0.30	0.28	0.23	0.016	0.013	0.013	0.27	0.27
Selenium, Total (mg/L)	< 0.0010	< 0.0010	<0.0010	< 0.0010	< 0.0010	0.0020	< 0.0010	< 0.0010	<0.0010
Thallium, Total, (mg/L)	-	-	<0.0010	-	-	<0.0010	-	-	<0.0010
Mercury, Total (mg/L)	-	-	<0.00020	-	-	<0.00020	-	-	<0.00020
Radium 226 & 228 Combined (pCi/L)	0.320 +/- 0.899 (1.85)	0.511 ± 0.660 (1.39)	0.426 +/- 0.673 (1.37)	1.04 +/- 0.779 (1.31)	0.529 ± 0.690 (1.42)	0.572 +/- 0.753 (1.54)	1.04 +/- 1.01 (1.90)	0.302 ± 0.615 (1.29)	0.271 +/- 0.754 (1.58)

Location					Downgradient					
Location	P-2		Р	-3				P-4		
Measure Point (TOC)	309.84		310).72		311.067				
Sample Name	P-2	P-3	P-3	P-3	DUPLICATE	P-4	DUPLICATE	P-4	P-4	
Sample Date	8/11/2020	02/24/2020	5/20/2020	8/10/2020	8/10/2020	02/25/2020	02/25/2020	5/20/2020	8/10/2020	
Final Lab Report Date	9/18/2020	3/31/2020	7/2/2020	9/18/2020	9/18/2020	3/31/2020	3/31/2020	7/2/2020	9/18/2020	
Final Lab Report Revision Date	9/29/2020	N/A	N/A	9/29/2020	9/29/2020	N/A	N/A	N/A	9/29/2020	
Final Radiation Lab Report Date	9/18/2020	3/30/2020	7/2/2020	9/18/2020	9/18/2020	3/30/2020	3/30/2020	7/2/2020	9/18/2020	
Final Radiation Lab Report Revision Date	9/29/2020	N/A	N/A	9/29/2020	9/29/2020	N/A	N/A	N/A	9/29/2020	
Lab Data Reviewed and Accepted	10/19/2020	4/8/2020	7/14/2020	10/19/2020	10/19/2020	4/8/2020	4/8/2020	7/14/2020	10/19/2020	
Depth to Water (ft btoc)	39.54	23.88	31.50	40.11	-	24.15	-	31.74	41.23	
Temperature, Field (Deg C)	19.45	16.39	17.46	20.52	-	17.23	-	18.29	19.00	
Conductivity, Field (µS/cm)	1148	1560	1500	1462	-	692	-	636	798	
Turbidity, Field (NTU)	0.0	13	1.0	19	-	18.9	-	0.3	0	
Boron, Total (mg/L)	3.7	9.8	-	11	9.7	0.46	0.46	-	0.49	
Calcium, Total (mg/L)	160	290	-	240	240	97	97	-	110	
Chloride (mg/L)	18	16	-	14	14	19	19	-	22	
Fluoride (mg/L)	0.540	0.367	0.351	0.455	0.493	0.336	0.351	<0.250	0.331	
Sulfate (mg/L)	350	320	-	230	240	84	79	-	71	
pH (lab) (su)	7.27	7.08	-	7.33	7.34	7.41	6.74	-	7.49	
TDS (mg/L)	760	1000	-	970	980	450	440	-	460	
Antimony, Total (mg/L)	-	-	<0.0030	-	-	-	-	<0.0030	-	
Arsenic, Total (mg/L)	0.0011	< 0.0010	<0.0010	0.0012	< 0.0010	< 0.0010	< 0.0010	<0.0010	0.0010	
Barium, Total (mg/L)	0.084	0.13	0.11	0.11	0.11	0.10	0.10	0.11	0.11	
Beryllium, Total (mg/L)	-	-	<0.0010	-	-	-	-	<0.0010	-	
Cadmium, Total (mg/L)	-	< 0.00089	<0.00089	-	-	< 0.00089	< 0.00089	<0.00089	-	
Chromium, Total (mg/L)	-	< 0.0040	<0.0040	-	-	< 0.0040	< 0.0040	<0.0040	-	
Cobalt, Total (mg/L)	< 0.0020	< 0.00086	<0.00086	< 0.0020	< 0.0020	< 0.00086	< 0.00086	<0.00086	< 0.0020	
Lead, Total (mg/L)	-	< 0.0010	<0.0010	-	-	< 0.0010	< 0.0010	<0.0010	-	
Lithium, Total (mg/L)	0.028	0.035	0.027	0.036	0.031	0.033	0.035	0.032	0.042	
Molybdenum, Total (mg/L)	0.29	1.0	0.92	1.0	1.1	0.028	0.027	0.026	0.024	
Selenium, Total (mg/L)	< 0.0010	0.012	0.0086	0.0038	0.0037	< 0.0010	< 0.0010	<0.0010	< 0.0010	
Thallium, Total, (mg/L)	-	-	<0.0010	-	-	-	-	<0.0010	-	
Mercury, Total (mg/L)	-	-	<0.00020	-	-	-	-	<0.00020	-	
Radium 226 & 228 Combined (pCi/L)	0.581 +/- 0.803 (1.67)	0.987 ± 0.802 (1.46)	0.356 +/- 0.941 (2.11)	0.561 +/- 0.874 (1.78)	1.48 +/- 1.04 (1.76)	0.446 ± 0.684 (1.46)	1.22 ± 0.722 (1.26)	1.63 +/- 1.07 (1.71)	0.357 +/- 0.725 (1.57)	

NEW MADRID, MISSOURI

Location	Downgradient						
Location		P-5					
Measure Point (TOC)		301.97					
Sample Name	P-5	P-5	P-5				
Sample Date	02/25/2020	5/20/2020	8/12/2020				
Final Lab Report Date	3/31/2020	7/2/2020	9/18/2020				
Final Lab Report Revision Date	N/A	N/A	9/29/2020				
Final Radiation Lab Report Date	3/30/2020	7/2/2020	9/18/2020				
Final Radiation Lab Report Revision Date	N/A	N/A	9/29/2020				
Lab Data Reviewed and Accepted	4/8/2020	7/14/2020	10/19/2020				
Depth to Water (ft btoc)	19.33	18.24	26.91				
Temperature, Field (Deg C)	16.28	17.08	16.78				
Conductivity, Field (µS/cm)	1190	1130	1160				
Turbidity, Field (NTU)	11.3	0.3	0.0				
Boron, Total (mg/L)	16	-	14				
Calcium, Total (mg/L)	160	-	140				
Chloride (mg/L)	5.1	-	5.1				
Fluoride (mg/L)	< 0.25	<0.250	0.257				
Sulfate (mg/L)	290	-	260				
pH (lab) (su)	6.85	-	6.70				
TDS (mg/L)	860	-	780				
Antimony, Total (mg/L)	-	<0.0030	-				
Arsenic, Total (mg/L)	0.0056	0.0063	0.0070				
Barium, Total (mg/L)	0.16	0.14	0.13				
Beryllium, Total (mg/L)	-	<0.0010	-				
Cadmium, Total (mg/L)	< 0.00089	<0.00089	-				
Chromium, Total (mg/L)	< 0.0040	<0.0040	-				
Cobalt, Total (mg/L)	0.00086	0.0023	0.0042				
Lead, Total (mg/L)	< 0.0010	<0.0010	-				
Lithium, Total (mg/L)	0.029	0.018	0.025				
Molybdenum, Total (mg/L)	0.34	0.44	0.35				
Selenium, Total (mg/L)	< 0.0010	<0.0010	< 0.0010				
Thallium, Total, (mg/L)	-	<0.0010	-				
Mercury, Total (mg/L)	-	<0.00020	-				
Radium 226 & 228 Combined (pCi/L)	0.967 ± 0.800 (1.41)	1.78 +/- 0.965 (1.46)	1.11 +/- 0.919 (1.22)				

FEBRUARY 2021

SUMMARY OF 2020 NATURE AND EXTENT ANALYTICAL RESULTS ASSOCIATED ELECTRIC COOPERATIVE, INC.

NEW MADRID POWER PLANT - POND 003 NEW MADRID, MISSOURI

Location				Down	gradient			
Location		MW-7D		MW	-195		MW-20S	
Measure Point (TOC)		302.070		293.	.870		293.560	
Sample Name	MW-7D	Duplicate 2	MW-7D	MW-19S	MW-19S	MW-20S	MW20S	DUP POND 003N&E
Sample Date	3/4/2020	3/4/2020	8/11/2020	3/6/2020	8/13/2020	3/6/2020	8/17/2020	8/17/2020
Lab Data Reviewed and Accepted	4/8/2020	4/8/2020	10/19/2020	4/8/2020	10/19/2020	4/8/2020	10/19/2020	10/19/2020
Depth to Water (ft btoc)	16.20	-	27.42	10.14	23.77	9.25	23.26	-
Temperature (Deg C)	18.59	-	20.84	16.08	17.76	15.76	16.68	-
Conductivity (µS/cm)	0.736	-	0.765	1.028	1.21	1.171	1.13	-
Turbidity (NTU)	0.0	-	0.9	8.5	23.9	0.0	0.0	-
Boron, Total (mg/L)	5.6	5.5	12	0.50	1.4	2.1	3.0	3.0
Calcium, Total (mg/L)	85	84	120	160	170	180	140	140
Chloride (mg/L)	17	17	15	23	14	17	17	17
Fluoride (mg/L)	1.00	1.00	0.780	0.265	0.270	0.380	0.395	0.463
Sulfate (mg/L)	150	160	250	180	290	250	270	270
pH (su)	7.48	7.49	7.28	7.31	7.15	7.20	7.28	7.32
TDS (mg/L)	510	490	720	630	800	720	720	730
Arsenic, Total (mg/L)	0.0050	0.0048	0.0047	<0.0010	0.0011	0.0029	0.0030	0.0028
Barium, Total (mg/L)	0.061	0.060	0.086	0.11	0.12	0.16	0.14	0.14
Cadmium, Total (mg/L)	<0.00089	<0.00089	-	<0.00089	-	<0.00089	-	-
Chromium, Total (mg/L)	<0.0040	<0.0040	-	<0.0040	-	<0.0040	-	-
Cobalt, Total (mg/L)	<0.00086	<0.00086	< 0.0010	<0.00086	< 0.0010	<0.00086	<0.0020	<0.0020
Lead, Total (mg/L)	<0.0010	<0.0010	-	<0.0010	-	<0.0010	-	-
Lithium, Total (mg/L)	0.022	0.022	0.022	0.024	0.025	0.027	0.022	0.020
Molybdenum, Total (mg/L)	0.84	0.82	0.94	0.0095	0.010	0.19	0.29	0.28
Selenium, Total (mg/L)	<0.0010	<0.0010	<0.0010	0.0030	<0.0010	<0.0010	<0.0010	<0.0010
Radium-226 & 228 Combined (pCi/L)	1.35 +/- 0.806 (1.22)	0.728 +/- 0.617 (1.06)	1.40 +/- 0.764 (1.11)	0.221 +/- 0.604 (1.41)	0.810 +/- 0.836 (1.58)	0.996 +/- 0.589 (0.887)	0.551 +/- 1.01 (1.97)	1.21 +/- 0.838 (1.40)

Notes:

Radiological results are presented as activity plus or minus uncertainty with MDC.

Bold value: Detection above laboratory reporting limit or minimum detectable concentration (MDC).

µS/cm = micro Siemens per centimeter

- Deg C = degrees Celsius
- ft btoc = feet below top of casing
- mg/L = milligrams per liter
- NTU = Nephelometric Turbidity Unit
- pCi/L = picoCuries per liter
- su = standard unit
- TDS = total dissolved solids
- TOC = top of casing

SUMMARY OF 2020 NATURE AND EXTENT ANALYTICAL RESULTS ASSOCIATED ELECTRIC COOPERATIVE, INC.

NEW MADRID POWER PLANT - POND 003 NEW MADRID, MISSOURI

Location				Downg	gradient				
Location	MW-20D		MW-21S		MW-21D		MW-22S		
Measure Point (TOC)	293	3.450	289	9.900	289.	950	293	293.660	
Sample Name	MW-20D	MW-20D	MW-21S	MW-21S	MW-21D	MW-21D	MW-22S	MW-22S	
Sample Date	3/6/2020	8/17/2020	3/6/2020	8/17/2020	3/6/2020	8/17/2020	3/6/2020	8/17/2020	
Lab Data Reviewed and Accepted	4/8/2020	10/19/2020	4/8/2020	10/19/2020	4/8/2020	10/19/2020	4/8/2020	10/19/2020	
Depth to Water (ft btoc)	9.30	23.28	5.40	19.60	5.43	19.60	9.10	23.68	
Temperature (Deg C)	15.64	17.56	13.74	14.17	13.96	15.53	15.11	15.28	
Conductivity (µS/cm)	0.999	1.17	0.842	1.01	0.817	1.11	1.152	1.23	
Turbidity (NTU)	90.5	0.0	98.4	4.2	99.6	5.6	65.6	0.0	
Boron, Total (mg/L)	2.3	2.5	0.87	1.8	2.8	3.9	3.2	2.9	
Calcium, Total (mg/L)	140	150	140	150	120	150	180	170	
Chloride (mg/L)	20	15	25	17	19	17	27	23	
Fluoride (mg/L)	0.663	0.581	0.562	0.457	0.450	0.346	<0.250	<0.250	
Sulfate (mg/L)	220	270	80	95	170	200	100	84	
pH (su)	7.52	7.50	7.20	7.17	7.37	7.52	7.07	7.08	
TDS (mg/L)	610	710	470	600	500	630	670	690	
Arsenic, Total (mg/L)	0.0016	0.0013	0.0022	< 0.0010	0.0037	0.0021	0.0015	0.0030	
Barium, Total (mg/L)	0.11	0.11	0.11	0.10	0.17	0.16	0.20	0.20	
Cadmium, Total (mg/L)	<0.00089	-	<0.00089	-	<0.00089	-	<0.00089	-	
Chromium, Total (mg/L)	<0.0040	-	<0.0040	-	0.0069	-	<0.0040	-	
Cobalt, Total (mg/L)	<0.00086	<0.0020	0.0048	0.0025	0.0051	< 0.0020	0.0026	< 0.0020	
Lead, Total (mg/L)	0.0011	-	0.0021	-	0.0064	-	<0.0010	-	
Lithium, Total (mg/L)	0.020	0.017	0.019	0.014	0.021	0.025	0.023	0.021	
Molybdenum, Total (mg/L)	0.23	0.21	0.60	0.47	0.26	0.37	0.096	0.089	
Selenium, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Radium-226 & 228 Combined (pCi/L)	1.11 +/- 0.744 (1.13)	0.880 +/- 0.948 (1.78)	1.22 +/- 0.776 (1.17)	0.888 +/- 0.855 (1.54)	0.541 +/- 0.588 (1.09)	1.77 +/- 0.948 (1.41)	1.01 +/- 0.729 (1.34)	1.60 +/- 1.04 (1.66)	

SUMMARY OF 2020 NATURE AND EXTENT ANALYTICAL RESULTS ASSOCIATED ELECTRIC COOPERATIVE, INC.

NEW MADRID POWER PLANT - POND 003 NEW MADRID, MISSOURI

Location	Downgradient								
Location	MW-22D		MW-23S		MW-24S		MW-24D		
Measure Point (TOC)	293.540		292.320		300.660		300.670		
Sample Name	MW-22D	MW-22D	MW-23S	MW-23S	MW-24S	MW-24S	MW-24D	MW-24D	
Sample Date	3/6/2020	8/17/2020	3/6/2020	8/13/2020	3/3/2020	8/13/2020	3/3/2020	8/13/2020	
Lab Data Reviewed and Accepted	4/8/2020	10/19/2020	4/8/2020	10/19/2020	4/8/2020	10/19/2020	4/8/2020	10/19/2020	
Depth to Water (ft btoc)	9.10	23.58	7.93	23.00	15.35	24.42	15.32	24.41	
Temperature (Deg C)	15.48	15.79	16.36	18.12	16.51	18.60	16.42	18.35	
Conductivity (µS/cm)	0.738	1.090	0.991	1.28	1.22	0.858	0.630	0.716	
Turbidity (NTU)	94.4	0.0	28.7	2.1	63.8	7.6	155	72.9	
Boron, Total (mg/L)	3.8	4.8	0.54	0.57	0.15	0.14	0.34	0.13	
Calcium, Total (mg/L)	96	140	140	180	120	120	88	87	
Chloride (mg/L)	20	16	25	29	11	11	8.9	9.7	
Fluoride (mg/L)	0.831	0.579	0.306	< 0.250	<0.250	< 0.250	<0.250	<0.250	
Sulfate (mg/L)	140	160	100	140	48	55	56	42	
pH (su)	7.11	7.62	6.99	6.88	7.17	7.13	7.18	7.09	
TDS (mg/L)	440	610	500	670	410	460	340	430	
Arsenic, Total (mg/L)	0.0046	0.0044	<0.0010	<0.0010	0.0059	0.0051	0.0043	0.0034	
Barium, Total (mg/L)	0.086	0.11	0.12	0.15	0.26	0.26	0.19	0.16	
Cadmium, Total (mg/L)	<0.00089	-	<0.00089	-	<0.00089	-	<0.00089	-	
Chromium, Total (mg/L)	<0.0040	-	<0.0040	-	<0.0040	-	0.0041	-	
Cobalt, Total (mg/L)	0.0015	< 0.0020	<0.00086	< 0.0010	<0.00086	< 0.0010	0.00097	< 0.0010	
Lead, Total (mg/L)	0.0037	-	<0.0010	-	0.0010	-	0.0018	-	
Lithium, Total (mg/L)	0.022	0.023	0.034	0.031	0.022	0.019	0.020	0.013	
Molybdenum, Total (mg/L)	0.75	0.80	0.013	0.012	0.0020	< 0.0010	0.029	0.0088	
Selenium, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Radium-226 & 228 Combined (pCi/L)	1.39 +/- 0.734 (1.12)	0.671 +/- 0.886 (1.67)	0.276 +/- 0.726 (1.47)	1.08 +/- 1.06 (1.75)	0.724 +/- 0.724 (1.34)	1.28 +/- 1.03 (1.80)	1.19 +/- 0.745 (0.936)	1.29 +/- 0.926 (1.55)	

SUMMARY OF 2020 NATURE AND EXTENT ANALYTICAL RESULTS ASSOCIATED ELECTRIC COOPERATIVE, INC.

NEW MADRID POWER PLANT - POND 003 NEW MADRID, MISSOURI

Location.	Downgradient									
Location	MW-25S		MW-25D		MW-26S			MW-26D		
Measure Point (TOC)	299.350		299.250			298.960		298.920		
Sample Name	MW-25S	MW-25S	MW-25D	MW-25D	MW-26S	Duplicate 3	MW-26S	MW-26D	MW-26D	
Sample Date	3/3/2020	8/13/2020	3/3/2020	8/13/2020	3/4/2020	3/4/2020	8/11/2020	3/4/2020	8/11/2020	
Lab Data Reviewed and Accepted	4/8/2020	10/19/2020	4/8/2020	10/19/2020	4/8/2020	4/8/2020	10/19/2020	4/8/2020	10/19/2020	
Depth to Water (ft btoc)	14.24	23.10	14.02	22.96	13.07	-	24.83	13.22	24.86	
Temperature (Deg C)	16.54	18.73	17.07	18.84	18.56	-	18.54	19.00	19.55	
Conductivity (µS/cm)	0.655	0.609	0.778	0.883	0.685	-	1.15	1.112	0.969	
Turbidity (NTU)	99.5	74.3	69.0	7.1	0.0	-	4.6	0.0	1.2	
Boron, Total (mg/L)	0.086	0.14	2.10	2.1	3.4	3.5	8.3	8.6	7.0	
Calcium, Total (mg/L)	61	45	93	90	86	88	170	150	110	
Chloride (mg/L)	22	23	9.8	9.6	16	17	14	12	16	
Fluoride (mg/L)	<0.250	<0.250	0.322	< 0.250	0.990	1.01	0.666	0.575	0.790	
Sulfate (mg/L)	87	84	130	150	120	130	340	260	250	
pH (su)	6.84	6.72	7.01	6.92	7.51	6.62	7.00	7.07	7.28	
TDS (mg/L)	350	390	430	550	390	400	790	760	740	
Arsenic, Total (mg/L)	0.0065	0.0049	0.0039	0.0033	0.0045	0.0046	0.0026	0.0026	0.0053	
Barium, Total (mg/L)	0.36	0.27	0.20	0.21	0.061	0.061	0.077	0.079	0.077	
Cadmium, Total (mg/L)	<0.00089	-	<0.00089	-	<0.00089	<0.00089	-	<0.00089	-	
Chromium, Total (mg/L)	<0.0040	-	<0.0040	-	<0.0040	<0.0040	-	<0.0040	-	
Cobalt, Total (mg/L)	0.0012	< 0.0010	<0.00086	< 0.0010	<0.00086	<0.00086	0.0029	0.0016	< 0.0010	
Lead, Total (mg/L)	0.0024	-	<0.0010	-	<0.0010	<0.0010	-	<0.0010	-	
Lithium, Total (mg/L)	0.017	0.011	0.016	0.012	0.020	0.020	0.025	0.034	0.022	
Molybdenum, Total (mg/L)	0.037	0.020	0.076	0.058	0.65	0.66	1.2	1.5	1.0	
Selenium, Total (mg/L)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	
Radium-226 & 228 Combined (pCi/L)	1.98 +/- 0.946 (1.25)	1.50 +/- 0.927 (1.38)	1.19 +/- 0.707 (1.14)	1.69 +/- 1.05 (1.57)	1.40 +/- 0.814 (1.32)	0.0803 +/- 0.566 (0.930)	0.886 +/- 1.02 (1.90)	1.28 +/- 0.706 (0.917)	1.07 +/- 1.04 (1.95)	

TABLE IVBACKGROUND CONCENTRATIONS AND GROUNDWATER PROTECTION STANDARDSASSOCIATED ELECTRIC COOPERATIVE, INC.NEW MADRID POWER PLANT - POND 003NEW MADRID, MISSOURI

Constituent	Background Concentration (UTL)	Groundwater Protection Standard
Arsenic (mg/L)	0.0099	0.010*
Barium (mg/L)	0.800	2*
Cadmium (mg/L)	0.0010	0.005*
Chromium (mg/L)	0.0098	0.1*
Cobalt (mg/L)	0.005	0.006**
Fluoride (mg/L)	1.71	4.0*
Lead (mg/L)	0.0047	0.015*
Lithium (mg/L)	0.033	0.040**
Molybdenum (mg/L)	0.01	0.100**
Radium 226 & 228 (pCi/L)	2.5157	5*
Selenium (mg/L)	0.0012	0.05*

Notes:

1. Groundwater Protection Standards listed were utilized for statistical analyses for the September 2019 and February 2020 semi-annual assessment monitoring sampling events.

* Value set equal to the maximum contaminant level.

** Value set based on 40 CFR § 257.95(h)(1)

mg/L = milligrams per liter

pCi/L = picoCuries per liter

UTL = upper tolerance limit



FIGURES



LEGEND



MONITORING WELL

POND 003

NOTES

- 1. ALL DIMENSIONS AND LOCATIONS ARE APPROXIMATE.
- 4. AERIAL IMAGERY SOURCE: ESRI, 21 APRIL 2019



2,400

1,200 SCALE IN FEET

ASSOCIATED ELECTRIC COOPERATIVE, INC. NEW MADRID POWER PLANT MARSTON, MISSOURI

POND 003 MONITORING WELL LOCATION MAP

FEBRUARY 2021

FIGURE 1



LEGEND

COMPLIANCE MONITORING WELL



NATURE AND EXTENT MONITORING WELL

POND 003

NOTES

- 1. ALL DIMENSIONS AND LOCATIONS ARE APPROXIMATE.
- 4. AERIAL IMAGERY SOURCE: ESRI, 21 APRIL 2019



2,400

1,200 SCALE IN FEET

ASSOCIATED ELECTRIC COOPERATIVE, INC. NEW MADRID POWER PLANT MARSTON, MISSOURI

POND 003 NATURE AND EXTENT MONITORING WELL LOCATION MAP

FEBRUARY 2021

FIGURE 2

ATTACHMENT 1

Appendix IV SSL Alternate Source Demonstration for Pond 003, September 2019

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SUMMARY REPORT APPENDIX VI SSL ALTERNATE SOURCE DEMONSTRATION FOR POND 003 NEW MADRID POWER PLANT NEW MADRID, MISSOURI



By Haley & Aldrich, Inc. Cleveland, Ohio

For Associated Electric Cooperative, Inc. Springfield, Missouri



List of Tables **List of Figures List of Appendices** Introduction 1. 1.1 BACKGROUND 1.2 SITE SETTING 1.3 SITE DESCRIPTION 2. Site Geology and Hydrogeology 2.1 SITE GEOLOGY 2.2 SITE HYDROGEOLOGY AND HYDROLOGY

3. Alternative Source Demonstration

Alte	rnative	e Source Demonstration	5
3.1	REVIE	W OF SAMPLING, ANALYSIS, AND STATISTICAL PROCEDURES	5
	3.1.1	Field Sampling Procedures	5
	3.1.2	Laboratory Quality Control	5
	3.1.3	Analytical Data	5
	3.1.4	Statistical Evaluation	6
3.2	POTEN	NTIAL POINT AND NON-POINT SOURCES	6
	3.2.1	Point Sources	6
	3.2.2	Non-Point Sources	7
3.3	HISTO	RICAL LAND USE REVIEW	7
	3.3.1	Historical Aerial Photographs	7
	3.3.2	Historical Topographic Maps	8
3.4	REGIO	NAL WATER QUALITY OBSERVATIONS	8
	3.4.1	Lithium Values in Regional Groundwater	8
	3.4.2	Geogenic Lithium Sources	8
Find	lings an	nd Conclusions	10
Clos	ing		11
Refe	erences	5	12

Tables

4.

5.

6.

Figures

Appendix A – EDR Historical Aerial Photograph Report

Appendix B – EDR Topographic Map Research Results



Page

ii

ii

ii

1

1

1

2

3

3

3

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List of Tables

Table No.	Title
1	Summary of P-4 Lithium Analytical Results
II	Historical Regional Groundwater Lithium Data

List of Figures

Figure No.	Title
1	Pond 003 Monitoring Well Location Map
2	P-4 Lithium Data
3	LCL Statistical Analysis NM-P-4 Lithium

List of Appendices

Appendix No. Title

- A Historical Aerial Photograph Review Summary
- B Historical Topographic Map Review Summary



1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Associated Electric Cooperative, Inc. (AECI) to perform an evaluation of groundwater quality at Pond 003 combustion coal residual (CCR) management unit at the New Madrid Power Plant (NMPP) located in New Madrid, Missouri. The purpose of the evaluation is to identify the source of elevated lithium concentrations detected in groundwater samples collected from monitoring well P-4 located down gradient of Pond 003.

1.1 BACKGROUND

Consistent with Code of Federal Regulations Title 40 (40 CFR) §257.90 through §257.95, AECI has installed and certified a groundwater monitoring network for Pond 003 at NMPP and collected 10 rounds of groundwater samples for the analysis of Appendix III and IV baseline constituents. Results of the detection monitoring statistical analyses completed in January 2018 identified statistically significant increased (SSI) concentrations of Appendix III constituents in down gradient monitoring wells relative to concentrations observed in up gradient monitoring wells. No alternative source was identified for the Appendix III constituents with SSIs. Accordingly, the groundwater monitoring program transitioned to assessment monitoring in May 2018, and AECI is currently implementing an assessment monitoring program.

In January 2020, AECI completed statistical analyses of groundwater quality results collected in September 2019, with data reviewed and accepted in October 2019, to determine if any of the Appendix IV constituents were present in groundwater samples collected from down-gradient monitoring wells at concentrations at a statistically significant level (SSL) above background. The statistical evaluation of the Appendix IV constituents detected a potential SSL for lithium above background at monitoring well P-4, down gradient of Pond 003. The analyses described in this report were conducted to identify the source of the elevated lithium concentration down gradient of Pond 003.

Pursuant to 40 CFR §257.95(g)(3)(ii), the owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The Rule provides 90 days from determination that an SSL over background exists to complete an Alternate Source Demonstration (ASD) for Appendix IV constituents. If a successful demonstration is completed and certified by a qualified professional engineer, the CCR unit may continue in assessment monitoring. If, however, an alternate source of the Appendix IV SSL is not identified, the owner or operator must initiate the assessment of corrective measures. This report documents the findings and conclusions of an ASD completed for lithium at Pond 003 at NMPP.

1.2 SITE SETTING

The NMPP is located approximately 2 miles east of Marston on the western bank of the Mississippi River in New Madrid County, Missouri. The location of NMPP is shown on Figure 1. The site is located within the Southern Lowlands physiographic province which is the northernmost extent of the larger Mississippi Alluvial Plain and is characterized as a relatively flat alluvial plain which is used extensively for agricultural production. Pond 003 is a surface impoundment that encompasses approximately 110 acres and is located approximately 0.3 mile southeast of the NMPP plant site. Pond 003 has ground



surface elevations varying from 290 to 360 feet above mean sea level. The western boundary for Pond 003 is the Mississippi River Levee which is operated and maintained by the St. Francis Levee District of Missouri and the United States Army Corps of Engineers. Pond 003 and the associated groundwater monitoring network are shown on Figure 1.

1.3 SITE DESCRIPTION

NMPP is an active energy production facility that generates electricity through coal combustion. The CCR materials are generated as byproducts of the combustion process and include fly ash and boiler slag material. Boiler slag and economizer ash are sluiced from the power generating system to the northern end of Pond 003, where it travels south through a maintained channel. The slag is removed from Pond 003 for either beneficial use or disposal in the Utility Waste Landfill (UWL). Suspended economizer ash is settled in a channel, dewatered, and stockpiled adjacent to the channel or transported by truck to the UWL.



2. Site Geology and Hydrogeology

Geologic and hydrogeologic conditions beneath Pond 003 have been characterized based on information obtained during installation and testing of the monitoring wells installed around Pond 003 in 2009 and 2016, and monitoring wells installed as part of the CCR groundwater monitoring network.

2.1 SITE GEOLOGY

Pond 003 is located in the Southeastern Lowlands physiographic province. The Southeastern Lowlands is the northernmost extent of the larger Mississippi Alluvial Plain and is characterized by alluvial, fluvial, and deltaic deposits ranging in age from Cretaceous to Holocene. The plant site and Pond 003 are underlain by an unconsolidated alluvium which constitutes a regionally extensive aquifer.

In order from ground surface downward, Pond 003 is underlain by unconsolidated alluvium, the Wilcox Group, the Porters Creek Clay, the Clayton, Owl Creek, and McNairy formations. Only the Tertiary formations (unconsolidated alluvium, Wilcox Group, and Porters Creek formation) are described below because they represent the uppermost and regional aquifer system.

Surficial geologic materials in the vicinity of and beneath Pond 003 include alluvium consisting of moderate to poorly sorted clay, silt, sand, and gravel of Holocene age (Miller and Vandike, 1997). The alluvium varies from approximately 250 to 300 feet thick in the vicinity of Pond 003 (Gredell Engineering Resources, Inc. [Gredell], 2003). Alluvial sediments were predominantly deposited by the Mississippi and Ohio River systems. The alluvium yields substantial quantities of water to shallow wells installed primarily for irrigation use and is considered the primary local aquifer (Burns & McDonnell, 2006).

The Holocene alluvium is underlain by unconsolidated Tertiary strata representing transgressions and regressions of marine, near-shore, and onshore depositional environments. The uppermost Tertiary unit is the Wilcox Group consisting primarily of sand deposits with some interbedded clays and lignites (Burns & McDonnell, 2006). The Wilcox Group is 400 to 500 feet thick at the plant site, lying approximately 250 to 300 feet below ground surface, and stratigraphically overlies the Porters Creek Clay.

The Porters Creek Clay is approximately 650 feet in thickness in the vicinity of Pond 003. The Porters Creek Clay is composed entirely of light grey to black clay (Burns & McDonnell, 2006). The clay is a groundwater flow barrier and barrier to infiltration (Miller and Vandike, 1997). The Porters Creek Clay overlies the Clayton Formation. The Clayton Formation has a total thickness of approximately 30 feet near the plant site and is comprised of sand and limestone (Burns & McDonnell, 2006).

2.2 SITE HYDROGEOLOGY AND HYDROLOGY

The water-bearing geologic formation nearest the natural ground surface at Pond 003 is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The aquifer is used locally for irrigation and by a treatment plant for domestic water supply, but known existing wells are located upgradient of Pond 003. Water levels in the uppermost aquifer are influenced by the Mississippi River stage.



Based on groundwater elevations measured between November 2016 and August 2017, the groundwater gradient in the upper aquifer unit is approximately 0.0008 to 0.003 feet per foot (feet/foot) and is unconfined. The predominate groundwater flow direction beneath Pond 003 is to the northeast; however, since Pond 003 lies adjacent to the Mississippi River and the alluvial aquifer immediately beneath Pond 003 is in communication with the river, seasonal changes in river stage cause the groundwater flow direction to change and occasionally reverse. Due to the heavy influence of the adjacent Mississippi River, the groundwater flow in the alluvial aquifer is generally to the southwest during high river stage and generally to the northeast during low river stage. Due to the changing groundwater flow directions, monitoring wells were sited at locations to encircle Pond 003.

Hydraulic conductivity of the uppermost aquifer is based on data collected during slug testing of wells installed during development of the CCR monitoring network. The hydraulic conductivity was calculated to be 75 to 81 feet per day.

The Wilcox Formation underlying the alluvial aquifer is comprised of sand deposits with interbedded clay and lignite. Because the alluvial aquifer provides a more accessible resource for groundwater production in the area, the Wilcox Formation has not been developed locally as a source of groundwater. The clay and lignite present within the Wilcox Formation have lower hydraulic conductivity than the overlying alluvial aquifer. Published hydraulic conductivity values for the Wilcox Formation are available from areas where it has been investigated that indicate the hydraulic conductivity ranges from 9 to 25 feet per day (Office of Nuclear Waste Isolation [ONWI], 1982; Prudic, 1991). The Wilcox Formation in the vicinity of Pond 003 is estimated to be approximately 400 to 500 feet thick (Gredell, 2003).



3. Alternative Source Demonstration

Haley & Aldrich conducted an evaluation of potential alternative sources that included review of sampling procedures, laboratory procedures, and statistical analyses to determine if potential errors may have been made that would result in the apparent SSL of lithium down gradient of Pond 003. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity of Pond 003 and evaluated natural geologic conditions and the effect of those conditions on native groundwater chemistry. Each of these analyses and the resulting findings are described below.

3.1 REVIEW OF SAMPLING, ANALYSIS, AND STATISTICAL PROCEDURES

3.1.1 Field Sampling Procedures

AECI and Haley & Aldrich conducted the field sampling activities in accordance with a Groundwater Sampling and Analysis Plan (SAP; Haley & Aldrich, 2019) that was prepared in accordance with § 257.93 of the CCR Rule. The SAP prescribes the site-specific activities and methodologies for groundwater sampling and included procedures for field data collection, sample collection, sample preservation and shipment, interpretation, laboratory analytical methods, and reporting for groundwater sampling for Pond 003. The administrative procedures and frequency for collection of groundwater elevation measurements, determination of flow directions, and gradients were also provided in the SAP.

Haley & Aldrich reviewed the field sampling and equipment calibration logs and the field indicator parameters and did not identify apparent deviations or errors in sampling that would result in a potential SSL for lithium down gradient of Pond 003.

3.1.2 Laboratory Quality Control

The groundwater samples collected down gradient of Pond 003 were initially analyzed using standard methods. The data generated from these laboratory analyses are stored in a project database that incorporates hydrogeologic and groundwater quality data and was established to allow efficient management of chemical and physical data collected in the field and produced in the laboratory. The analytes, analytical methods, sample containers, field preservation, and maximum analytical holding times for monitoring are summarized in the SAP (Haley & Aldrich, 2019).

Haley & Aldrich conducted a quality assurance/quality control review of each groundwater quality dataset generated for Pond 003 and has not identified apparent errors that would result in a potential SSL for lithium down gradient of Pond 003.

3.1.3 Analytical Data

Twenty groundwater samples, including one duplicate, have been collected at P-4 since November 2016, of which 19 were analyzed for lithium. Total lithium concentrations at P-4 have fluctuated over time, with concentrations ranging from 0.0251 milligrams per liter (mg/L) to 0.05 mg/L. The highest concentration of lithium was detected in August 2017, which was collected during background groundwater sampling. A summary of field parameters and lithium results are provided in Table I.



During the September 2019 sampling event, the lithium concentration at monitoring well P-4 was detected at 0.048 mg/L, which was above the Groundwater Protection Standard (GWPS) of 0.040 mg/L; therefore, a potential SSL was recorded. The September 2019 lithium concentration was below the highest detected lithium concentration detected at monitoring well P-4 during baseline monitoring. Subsequent groundwater sampling was completed at P-4 after the September 2019 sampling event produced lithium concentrations of 0.035, 0.030, and 0.028 mg/L, respectively, which are below the lithium GWPS. A graphical depiction of lithium values over time at monitoring well P-4 are presented in Figure 2.

3.1.4 Statistical Evaluation

AECI collected groundwater samples from each of the up gradient (MW-16, B-123, and B-126) and down gradient (MW-1, MW-2, MW-3, MW-4, MW-5, B-2, B-5R, and B-41) monitoring wells at Pond 003 in September 2019 for CCR Rule compliance. Haley & Aldrich has reviewed the statistical analysis of groundwater quality data for monitoring well P-4 and has not identified apparent errors that would result in a potential SSL for lithium at monitoring well P-4. The September 2019 concentration at monitoring well P-4 is not an outlier and the lithium concentrations at monitoring well P-4 present a stable trend. The statistical test method used met the performance standard established in the CCR Rule and statistical evaluation complies with the requirements of the Rule.

The Statistical Procedure Certification for Pond 003 states that if a constituent concentration is greater than the GWPS for that unit, pursuant to 40 CFR § 257.93 (f)(5), the confidence interval method can be used to evaluate if that Appendix IV constituent is present at a statistically significant level. Specifically, the lower confidence limit (LCL) will be compared to the GWPS. An LCL greater than the GWPS would confirm an SSL for the constituent. The LCL of the mean was analyzed for monitoring well P-4 and has a result of 0.032 mg/L, which is below the GWPS, indicating that an SSL for lithium at P-4 is not present. Supporting documents used in calculating the LCL are provided in Figure 3.

3.2 POTENTIAL POINT AND NON-POINT SOURCES

Haley & Aldrich conducted a review of potential point and non-point sources of elevated lithium values in the vicinity of Pond 003 to determine if previous or adjacent site activities, land uses, or practices might have caused elevated lithium values to occur down gradient of Pond 003. Potential point sources would include discharging activities or other activities occurring at a discrete location in the vicinity of the observed SSL that may potentially concentrate lithium in that area. Non-point sources would include diffuse discharging activities or practices that may result in a low level but widespread increase in lithium concentrations detected at the down gradient side of Pond 003.

3.2.1 Point Sources

Prior to construction of Pond 003, the site and the surrounding vicinity was agricultural land. Review of historical aerial photographs and topographic maps show undeveloped land prior to the construction of the plant site and Pond 003. No known industrial, mining, or other activities were conducted at the site prior to construction of the pond that would potentially constitute a point source to concentrate lithium in groundwater in the vicinity of the observed SSL. Agricultural land use is not expected to constitute a point source of lithium at the location of the observed SSL.



3.2.2 Non-Point Sources

No mining, industrial, or other activities have been documented in the vicinity of Pond 003 that might constitute a non-point source of lithium at the location of the observed SSL. Agricultural land use is not expected to constitute a non-point source of lithium at the location of the observed SSL.

3.3 HISTORICAL LAND USE REVIEW

Haley & Aldrich assessed past usage of the site and adjoining properties through a review of the following records:

- Environmental Data Resources, Inc. (EDR) Aerial Photographs dated 1950, 1952, 1969, 1985, 1988, 1991, 1993, 2006, 2009, 2012, and 2016 (Appendix A); and
- EDR Topographic Maps dated 1931/1934, 1939, 1951, 1954/1955, 1971, 1973, 1982, and 2015 (Appendix B).

Unless otherwise noted below, sources were reviewed dating back to 1940 or first developed use, whichever is earlier, and at 5-year intervals if the use of the property has changed within the time period. This review was completed to assess potential alternate sources based on land use.

3.3.1 Historical Aerial Photographs

Haley & Aldrich reviewed aerial photographs depicting the development of the site and vicinity as summarized in the table below. The historical aerial photograph search includes photographs from the United States Geological Survey, United States Department of Agriculture, Digital Orthophoto Quarter Quads, National Aerial Photography Program, and the National Agriculture Information Program (EDR, 2020) and are included in Appendix A.

Photographs suggest that the site was undeveloped up until at least 1988. Aerial photos from 2007 through 2016 show the history of Pond 003 activities and configuration through to its current footprint.

Historical Aerial Photograph Review Summary								
Dates	Dates Description of Site and Adjacent Properties Sources							
1950 – 1969	Agricultural use of site and adjacent properties with some road use.	USGS						
1985 – 1988	The plant site is active. CCR ponds appear present at subject site. Agricultural use of adjacent properties surrounding the subject site.	USGS						
1991 – 1993	Presence of structure in river northeast of Pond 003	NAPP						
1993	No apparent changes observed.	USGS, DOQQ						
2006	Development of additional pond south of Pond 003	USDA, NAIP						
2009 – 2016	The plant site and Pond 003 are active. No apparent changes observed.	USDA, NAIP						



Historical Aerial Photograph Review Summary						
Dates Description of Site and Adjacent Properties Sources						
Notes:						
DOQQ = Digital	DOQQ = Digital Orthophoto Quarter Quads					
NAIP = Nationa	Agriculture Information Program					
NAPP = National Aerial Photography Program						
USDA = United States Department of Agriculture						
USGS = United S	USGS = United States Geological Survey					

3.3.2 Historical Topographic Maps

Haley & Aldrich reviewed historical topographic maps depicting the development of the site and vicinity, as summarized in the table below. The topographic maps were provided for review by EDR. Copies of the topographic maps are included in Appendix B.

Historical Topographic Map Review Summary								
Dates	Description of Site and Adjacent Properties	Map Name						
1931 – 1955	The map shows the site as undeveloped land with several roads and a railroad within the site vicinity.	15-Minute Series, New Madrid, Missouri Quadrangle						
1971	Plant site appears to be active.	7.5-Minute Series, New Madrid SE, Missouri Quadrangle						
1982	Additional development of the plant and apparent Pond 003 development	7.5-Minute Series, New Madrid, Missouri Quadrangle						
2015	Development of roadways on adjacent properties observed.	7.5-Minute Series, New Madrid, Missouri Quadrangle						

3.4 REGIONAL WATER QUALITY OBSERVATIONS

3.4.1 Lithium Values in Regional Groundwater

The NMPP site is located in the Southeast Missouri groundwater province, which includes aquifers composed of Missouri and Mississippi River alluvium (Brookshire, 1997). This aquifer is used as a regional water supply aquifer. Table II shows reported dissolved lithium values in groundwater reported by the National Water Quality Monitoring Council for select historical monitoring wells in New Madrid County, Missouri. Dissolved lithium values range from 0.003 to 0.210 mg/L (National Water Quality Monitoring Council, 2020). The lithium values are reported as dissolved lithium, whereas lithium values collected from AECI compliance monitoring were analyzed as total lithium. Based on this information, it is evident that regionally reported lithium concentrations had lithium values that are higher than the dissolved lithium values at monitoring wells P-4 reported in September 2019. Total lithium concentrations from P-4 have ranged from 0.0251 to 0.05 mg/L, which are below reported naturally occurring lithium values in groundwater in the region.

3.4.2 Geogenic Lithium Sources

Geogenic lithium is found in three main types of deposits: 1) pegmatites, 2) brines/evaporites, and 3) hydrothermally altered clays (Munk, et al., 2016), with brines and evaporites being the most relevant



to Pond 003. The presence and variability of lithium concentrations in site groundwater is most likely dependent upon two separate mechanisms both occurring at varying degrees:

- Deposition and weathering of lithium-bearing alluvial sediments transported from the Mississippi and Ohio River systems; and
- Weathering of Tertiary-aged marine deposits reported to underlie the site (e.g., Wilcox group, Porters Creek Clay) (see discussion in Section 2.1).

The weathering and dissolution from geogenic host material into groundwater is a kinetically slow process controlled by lithium's small ionic radius. Since lithium is smaller than most other analytes, it is retained more tightly in mineral structure than other analytes. Its structural position in clay minerals cause it to be relatively less easily hydrated than other analytes (sodium, chloride, etc.), and will remain behind when other elements have weathered out of the structure or mineral grain. In general, naturally occurring lithium is removed far less rapidly than sodium and follows magnesium in the weathering cycle of slow leaching and weathering mechanisms. These slow weathering/dissolution processes help explain why elevated concentrations of lithium may occur in groundwater in the absence of other marine indicators (total dissolved solids, sodium, and chloride).



4. Findings and Conclusions

Haley & Aldrich conducted an evaluation of groundwater quality at the NMPP Pond 003 to identify the source of the potential SSL of lithium detected in the groundwater sample collected from monitoring well P-4 located down gradient of Pond 003. The evaluation included review of sampling procedures, laboratory procedures, and statistical analyses to determine if potential errors may have been made that would result in the apparent SSL of lithium down gradient of Pond 003. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity of Pond 003 and evaluated natural geologic conditions and the effect of those conditions on native groundwater chemistry.

Haley & Aldrich found no apparent errors in sampling, laboratory analysis, data management, or statistical analysis that would result in a potential SSL for lithium down gradient of Pond 003. Haley & Aldrich found no apparent evidence of historical point or non-point sources of potential lithium values in the vicinity of Pond 003.

Haley & Aldrich evaluated data and information describing the historical regional water quality, reviewed the historical lithium data of P-4, and confirmed statistical analyses of lithium concentrations at P-4. Key findings regarding the lithium in groundwater at P-4 are summarized below:

- Fluctuating lithium values observed in P-4 (average 0.036 mg/L) are lower than regional observed lithium values (up to 0.21 mg/L).
- The lithium concentrations observed in P-4 are statistically stable and do not present an upward trend.
- The Statistical Procedure allows for the confidence interval method to be used to evaluate the condition if the Appendix IV constituent is present at a statistically significant level. Specifically, the LCL is compared to the GWPS. Statistical analyses evaluated the LCL of the mean at P-4 and determined a result of 0.032 mg/L, which is below the GWPS, indicating that an SSL for lithium at P-4 is not present.
- Geogenic lithium can be found in brines and evaporites that are present in Tertiary-aged marine deposits that are reported to underlie the site (e.g., Wilcox group and Porters Creek Clay) at concentrations up to 70 mg/kg. Weathering and dissolution of lithium from geogenic host material into groundwater may be contributing to elevated lithium concentrations near Pond 003.

Based on these findings, it is evident that lithium in the groundwater at Pond 003 monitoring well P-4 is within the range of natural variability of groundwater from the regional aquifer and presents a statistically stable concentration trend and an LCL below the GWPS.

Based on the data, information, research, and analyses conducted to date and presented in this document, Haley & Aldrich concludes that the source of lithium resulting in an SSL at P-4, down gradient of Pond 003, is natural groundwater quality variability, along with statistical evaluations that do not confirm the apparent lithium SSL.



5. Closing

Pursuant to 40 CFR § 257.94(e)(2), AECI conducted an alternate source evaluation to demonstrate that a source other than Pond 003 caused the SSL over background identified during assessment monitoring. This demonstration and the underlying data support the conclusion that a source other than the CCR unit is the cause of the SSL over background levels for the Appendix IV constituent (lithium) detected during assessment monitoring of this unit.

The information contained in this evaluation is, to the best of our knowledge, true, accurate and complete.

HALEY & ALDRICH, INC.

Steven F. Putrich, P.E. Project Principal

M.C.N.

Mark Nicholls, P.G. Lead Hydrogeologist



6. References

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TABLES

TABLE I SUMMARY OF P-4 LITHIUM ANALYTICAL RESULTS

ASSOCIATED ELECTRIC COOPERATIVE, INC. NEW MADRID POWER PLANT - POND 003

NEW MADRID, MISSOURI

		Depth to Water	Groundwater	Field Paramters				Lithium, Total	
Sample ID	Sample Date	(ft btoc)	Elevation (ft AMSL)	Temperature (Deg C)	Conductivity (μS/cm)	Turbidity (NTU)	pH (su)	(mg/L)	
P-4-11042016	11/4/2016	46.91	264.157	18.78	819	1.00	6.82	0.0379	
P-4-120716	12/7/2016	50.91	260.157	16.5	683	1.58	7.64	0.0251	
P-4-010517	1/5/2017	43.02	268.047	14.9	770	1.01	7.01	0.031	
P-4-012817	1/28/2017	37.45	273.617	16.2	730	0.82	7.14	0.029	
P-4-022117	2/21/2017	42.01	269.057	17.5	830	0.26	7.01	0.043	
P-4-033017	3/30/2017	41.74	269.327	18	847	0.40	6.98	0.041	
P-4-042617	4/26/2017	35.27	275.797	18.2	800	1.73	7.0	0.032	
P-4-051717	5/17/2017	21.99	289.077	18.5	770	0.78	7.1	0.038	
DUP-051717	5/17/2017							0.038	
P-4-062017	6/20/2017	38.83	272.237	19.6	838	1.59	6.9	0.043	
P-4-081617	8/16/2017	46.55	264.517	19.96	782	0.30	7.17	0.050	
P-4	3/15/2018	21.51	289.557	17.32	803	44.00	7.22		
P-4	5/29/2018	34.57	276.497	23.07	787	-	7.93	0.030	
P-4	9/12/2018	45.59	265.477	17.81	786	0.30	7.48	0.028	
P-4	3/8/2019	17.3	293.767	17.41	815	92.50	7.09	0.035	
P-4	6/6/2019	23.38	287.687	18.89	796	34.10	7.41	0.041	
P-4	9/3/2019	39.75	271.317	18.74	894	0.00	7.80	0.048	
P-4	10/2/2019	42.03	269.037	18.25	0.797	0.30	8.09	0.035	
P-4	10/16/2019	38.94	272.127	18.02	0.715	1.10	8.11	0.030	
P-4	11/9/2019	35.46	275.607	17.32	0.704	2.80	7.39	0.028	

Notes:

BOLD value: Detection above Groundwater Protection Standard

µS/cm = micro Siemens per centimeter

Deg C = degrees Celsius

ft btoc = feet below top of casing

mg/L = milligrams per liter

NTU = Nephelometric Turbidity Unit

su = standard unit

TDS = total dissolved solids



TABLE IIHISTORICAL REGIONAL GROUNDWATER LITHIUM DATAASSOCIATED ELECTRIC COOPERATIVE, INC.NEW MADRID POWER PLANT - POND 003

NEW MADRID, MISSOURI

Organization	Sample Media	Sample Date	Sample Time	Location Identifier	Latitude	Longitude	Aquifer	Formation Type	Dissolved Lithium Results (mg/L)	Data Provider Name
USGS Missouri Water Science Center	Groundwater	8/2/1984	11:00	USGS-363107089363401	36.51867256	-89.6095233	Mississippi Embayment Aquifer System	Quaternary System	0.2	NWIS
	Groundwater	10/23/2018	11:00	MO005-363533089365801	36.5925	-89.6161111	Mississippi River Valley Alluvial Aquifer	Holocene Alluvium	0.00331	NWIS
	Groundwater	11/2/1983	7:45	USGS-363107089363401	36.51867256	-89.6095233	Mississippi Embayment Aquifer System	Quaternary System	0.21	NWIS
	Groundwater	10/13/1983	13:15	USGS-362705089544801	36.4514502	-89.9139778	Mississippi Embayment Aquifer System	McNairy Formation	0.04	NWIS
	Groundwater	10/27/1983	17:45	USGS-363309089492001	36.5525595	-89.8223076	Mississippi Embayment Aquifer System	Quaternary System	0.08	NWIS

Notes:

BOLD value : Detection above Groundwater Protection Standard

Data from the National Water Quality Monitoring Council, https://www.waterqualitydata.us/portal/#statecode=US%3A29&countycode=US%3A29%3A143&mimeType=csv

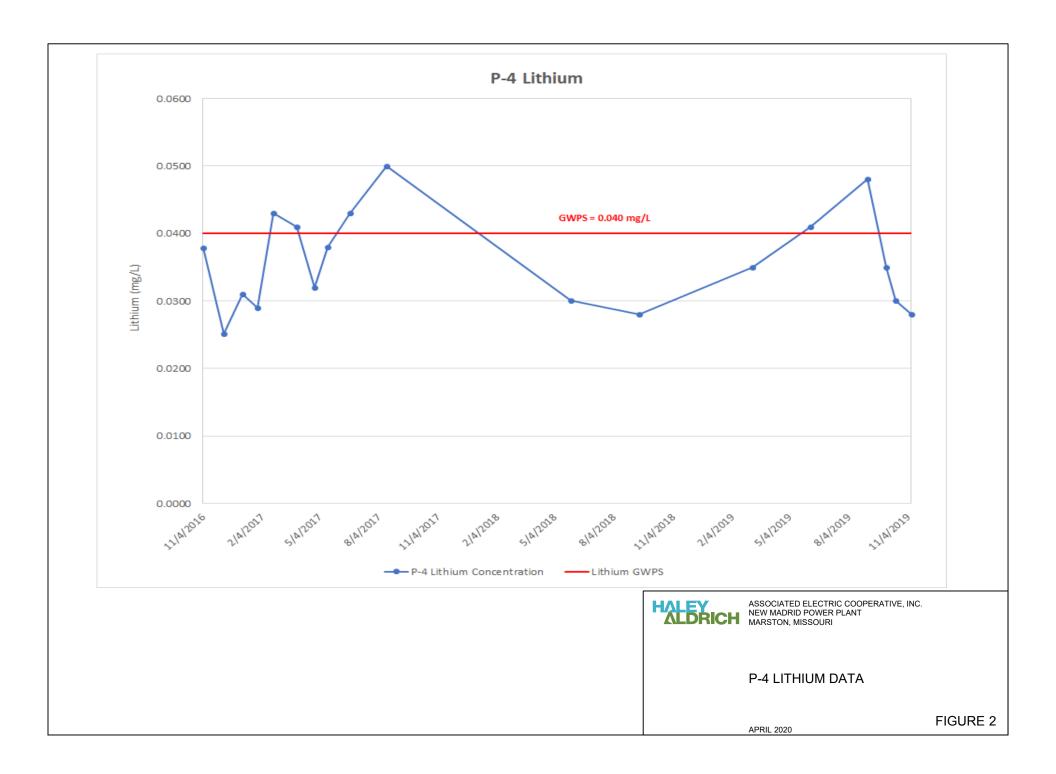
mg/L = milligrams per liter

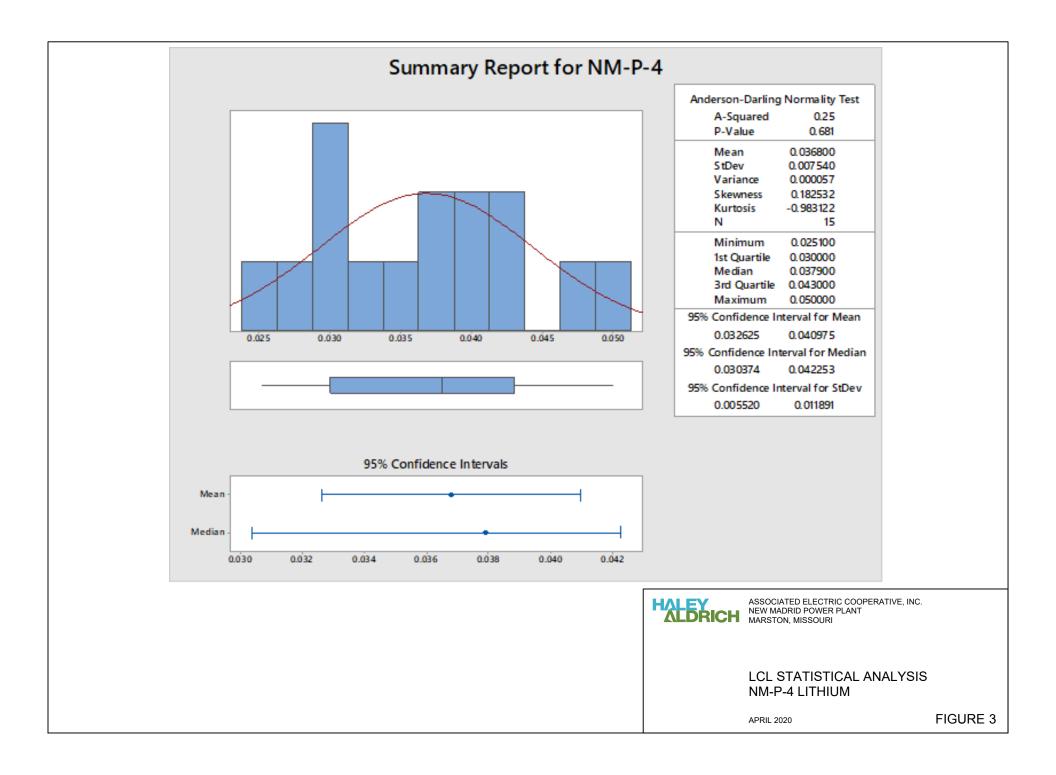
USGS = United States Geological Survey



FIGURES







APPENDIX A

EDR Historical Aerial Photograph Report

AECI New Madrid

1400-1498 St Jude Rd Marston, MO 63866

Inquiry Number: 5970452.2 February 13, 2020

The EDR Aerial Photo Decade Package



6 Armstrong Road, 4th floor Shelton, CT 06484 Toll Free: 800.352.0050 www.edrnet.com

EDR Aerial Photo Decade Package

Site Name:

Client Name:

02/13/20

AECI New Madrid 1400-1498 St Jude Rd Marston, MO 63866 EDR Inquiry # 5970452.2

Haley & Aldrich 600 South Meyer Ave Suite 100 Tucson, AZ 85701-0000 Contact: Samantha Kaney



Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

Search Results:						
Year	<u>Scale</u>	Details	Source			
2016	1"=500'	Flight Year: 2016	USDA/NAIP			
2012	1"=500'	Flight Year: 2012	USDA/NAIP			
2009	1"=500'	Flight Year: 2009	USDA/NAIP			
2006	1"=500'	Flight Year: 2006	USDA/NAIP			
1993	1"=500'	Acquisition Date: March 06, 1993	USGS/DOQQ			
1991	1"=500'	Flight Date: March 25, 1991	NAPP			
1988	1"=1000'	Flight Date: March 22, 1988	USGS			
1985	1"=1000'	Flight Date: September 28, 1985	USGS			
1969	1"=500'	Flight Date: March 17, 1969	USGS			
1952	1"=500'	Flight Date: November 12, 1952	USGS			
1950	1"=750'	Flight Date: April 01, 1950	USGS			

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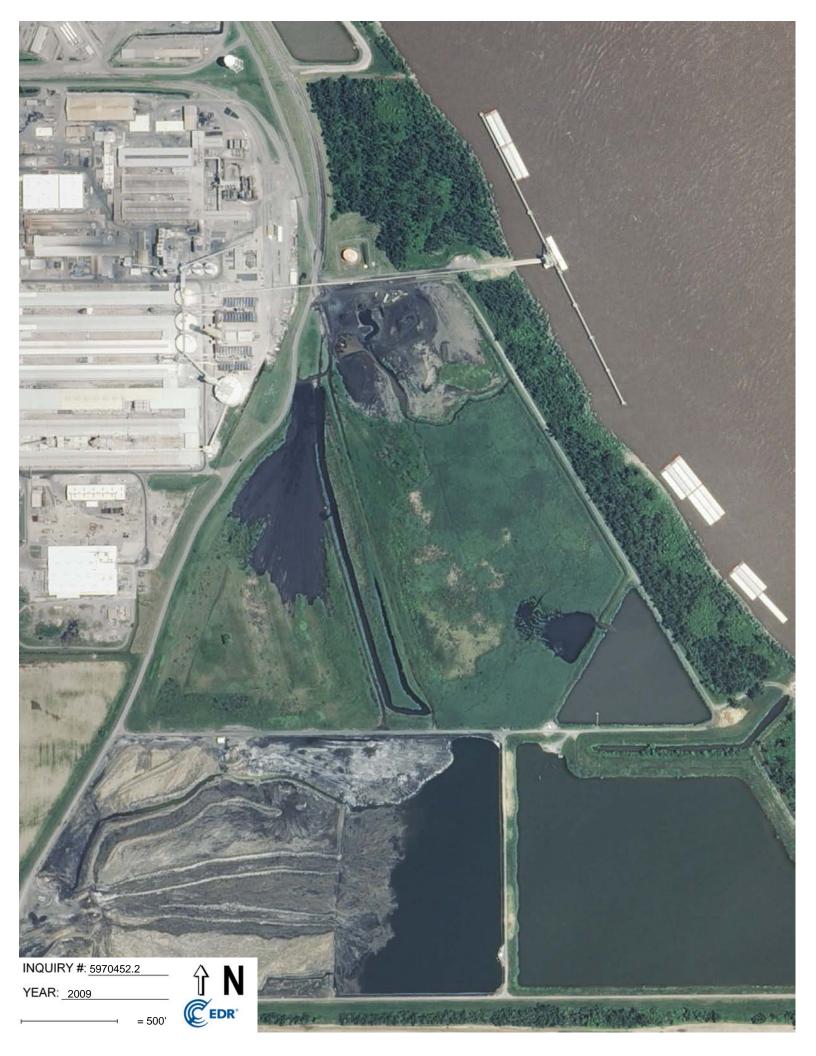
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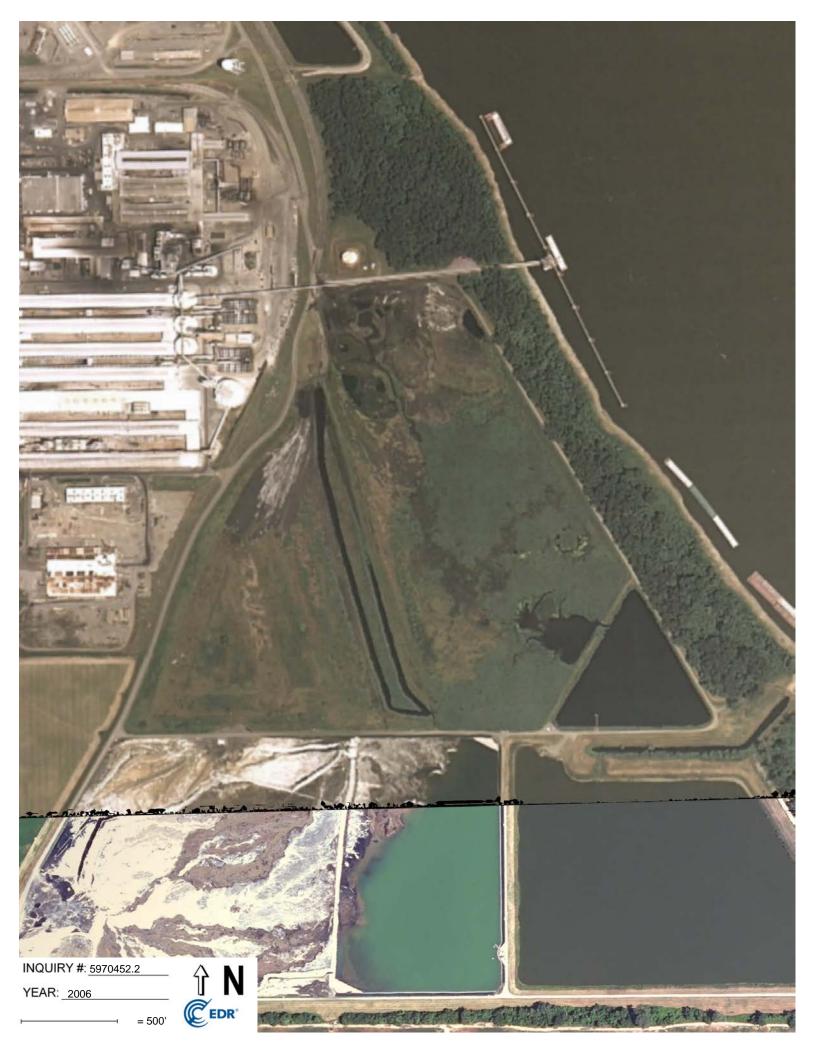
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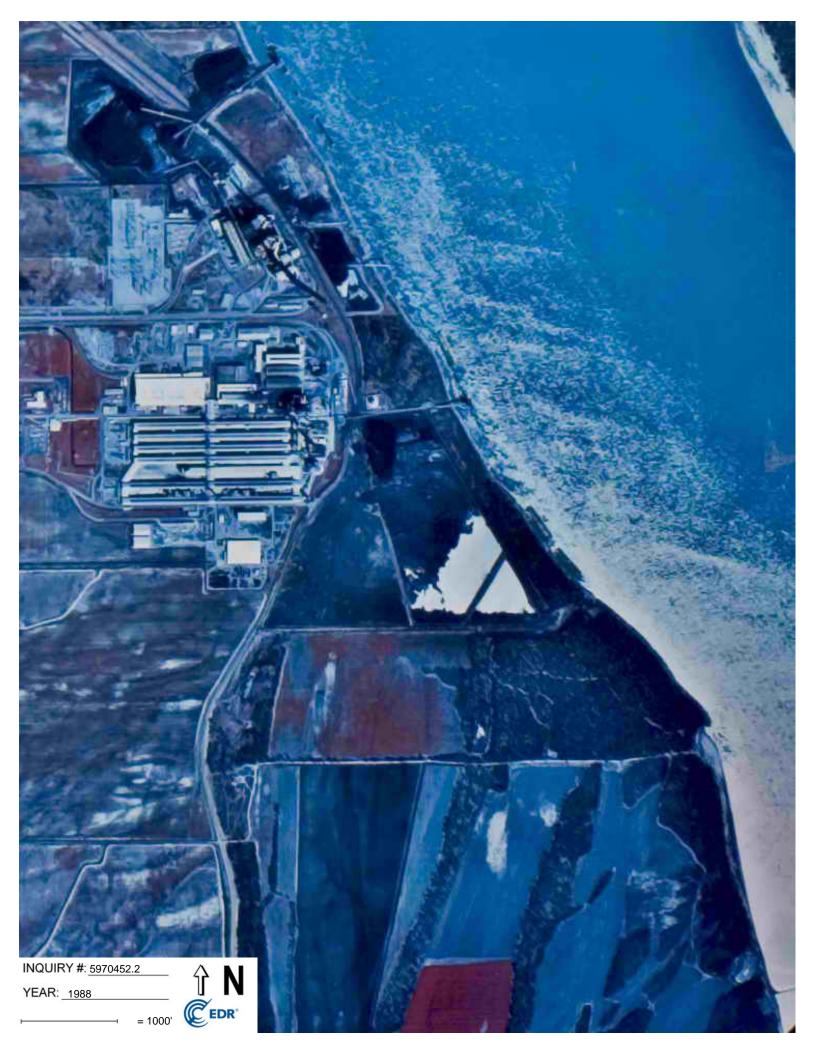




















APPENDIX B

EDR Topographic Map Research Results

AECI New Madrid 1400-1498 St Jude Rd Marston, MO 63866

Inquiry Number: 5970452.1 February 12, 2020

EDR Historical Topo Map Report with QuadMatch™



6 Armstrong Road, 4th floor Shelton, CT 06484 Toll Free: 800.352.0050 www.edrnet.com

EDR Historical Topo Map Report

Site Name:

AECI New Madrid

1400-1498 St Jude Rd

EDR Inquiry # 5970452.1

Marston, MO 63866

Client Name:

Haley & Aldrich 600 South Meyer Ave Suite 100 Tucson, AZ 85701-0000 Contact: Samantha Kaney



02/12/20

EDR Topographic Map Library has been searched by EDR and maps covering the target property location as provided by Haley & Aldrich were identified for the years listed below. EDR's Historical Topo Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topo Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the late 1800s.

Search Resu	ults:	Coordinates:	Coordinates:			
P.O.#	129342-020	Latitude:	36.506993 36° 30' 25" North			
Project:	AECI NMPP	Longitude:	-89.557744 -89° 33' 28" West			
-		UTM Zone:	Zone 16 North			
		UTM X Meters:	270938.74			
		UTM Y Meters:	4043226.63			
		Elevation:	295.00' above sea level			
Maps Provid	led:					
2015						
1982						
1973						
1971						
1954, 1955	5					
1951						
1939						
1931, 1934	4					

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Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

2015 Source Sheets



Point Pleasant 2015 7.5-minute, 24000



New Madrid 2015 7.5-minute, 24000

New Madrid

7.5-minute, 24000

Aerial Photo Revised 1981

1982

1982 Source Sheets



Point Pleasant 1982 7.5-minute, 24000 Aerial Photo Revised 1981

1973 Source Sheets



Portageville 1973 15-minute, 62500 Aerial Photo Revised 1969

1971 Source Sheets



New Madrid 1971 7.5-minute, 24000 Aerial Photo Revised 1969



Point Pleasant 1971 7.5-minute, 24000 Aerial Photo Revised 1969

Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

Portageville 1955

15-minute, 62500

Aerial Photo Revised 1950

1954, 1955 Source Sheets



New Madrid 1954 15-minute, 62500 Aerial Photo Revised 1950





New Madrid SE 1951 7.5-minute, 24000 Aerial Photo Revised 1950

1939 Source Sheets



New Madrid 1939 15-minute, 62500



Portageville 1939 15-minute, 62500

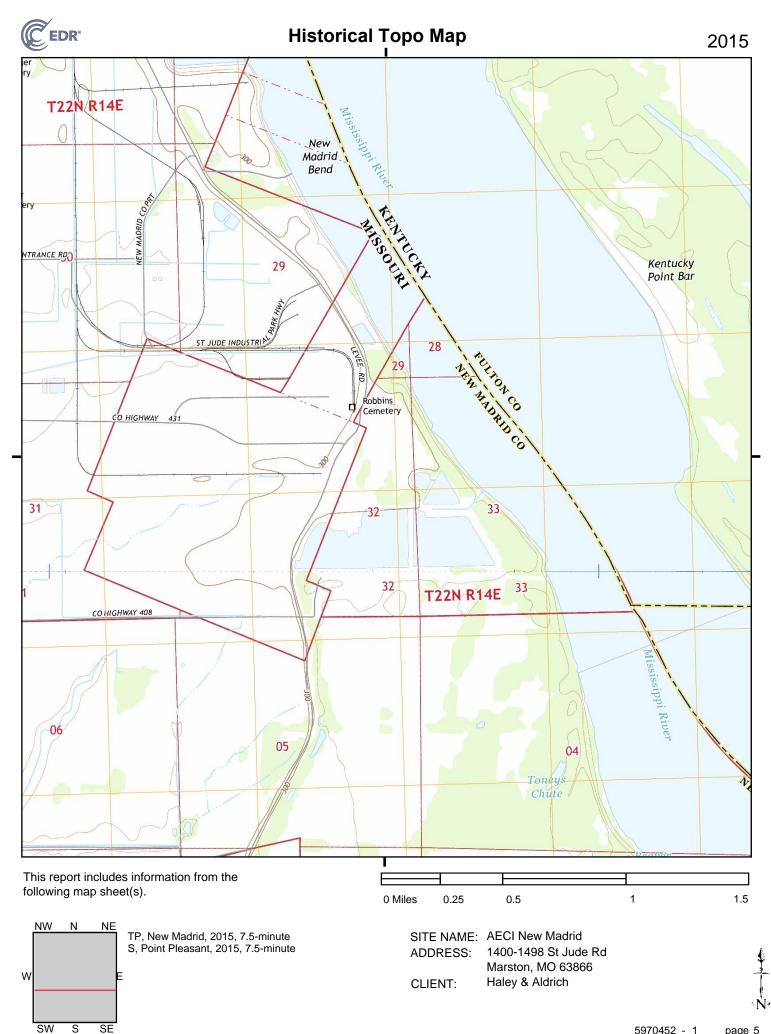
1931, 1934 Source Sheets



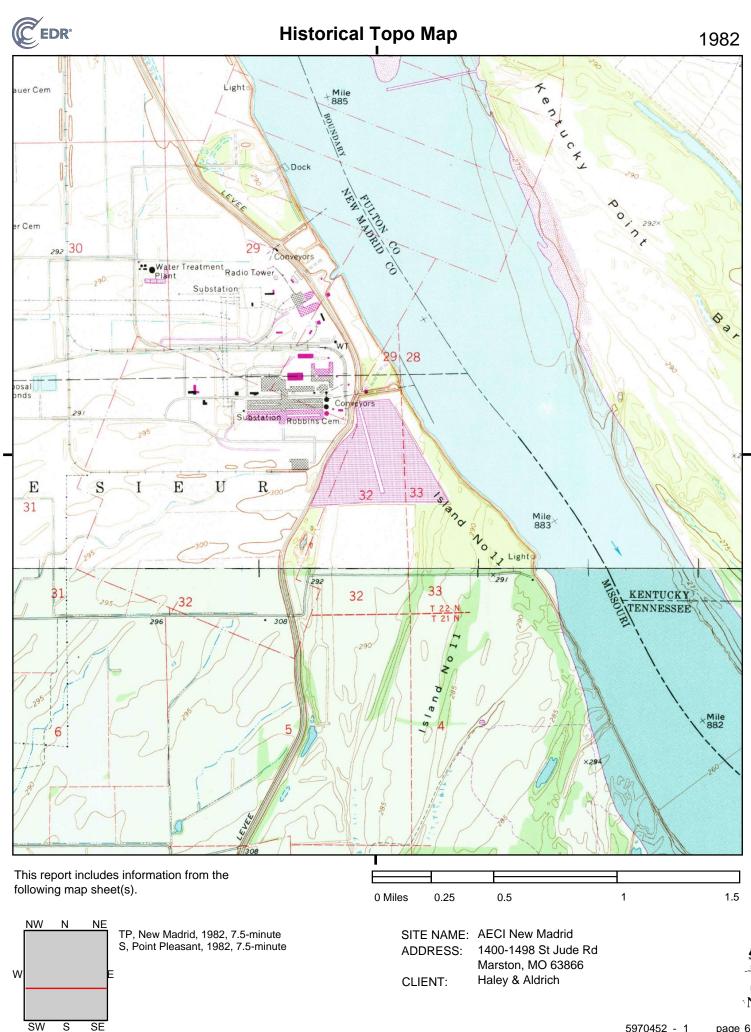
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NEW MADRID 1934 15-minute, 62500



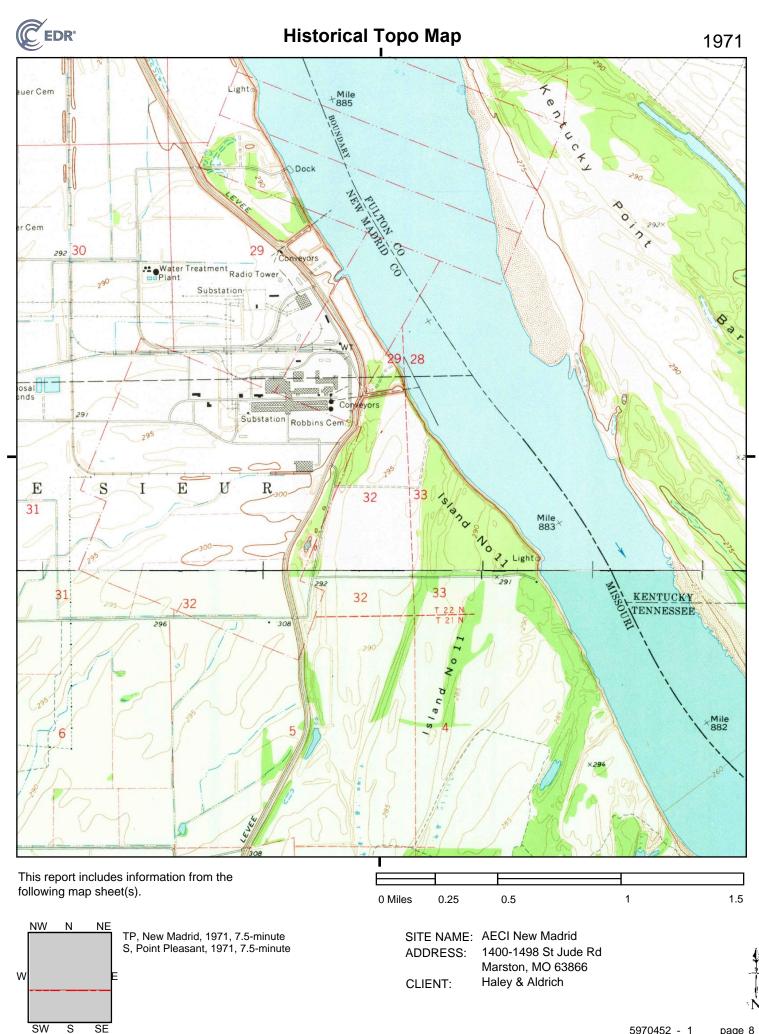
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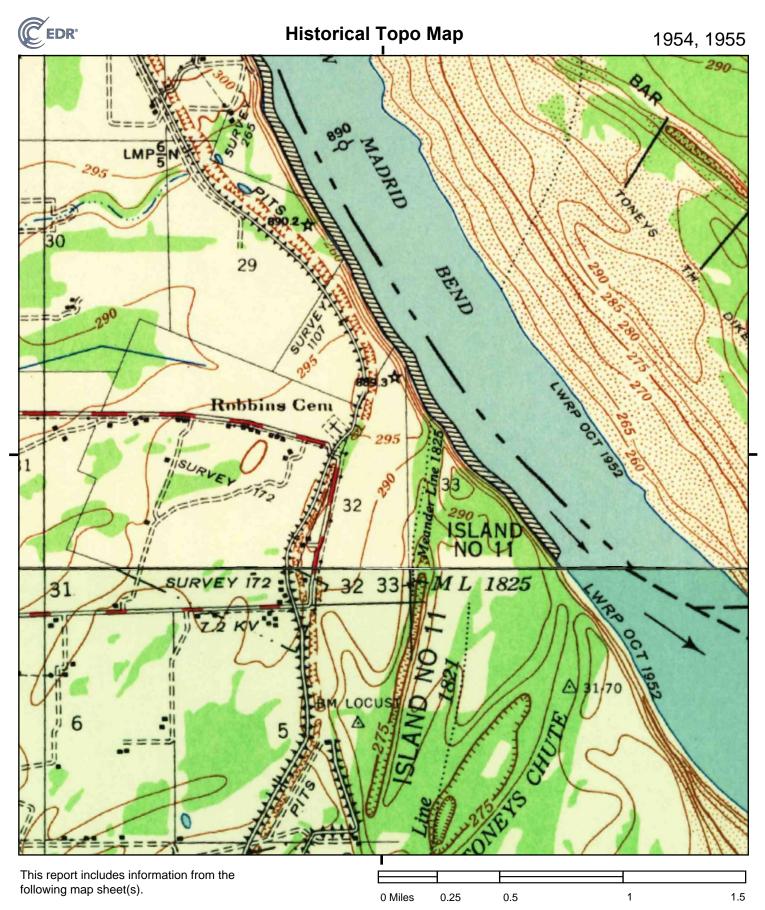


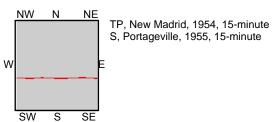
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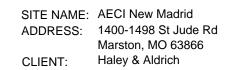
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SW S SE

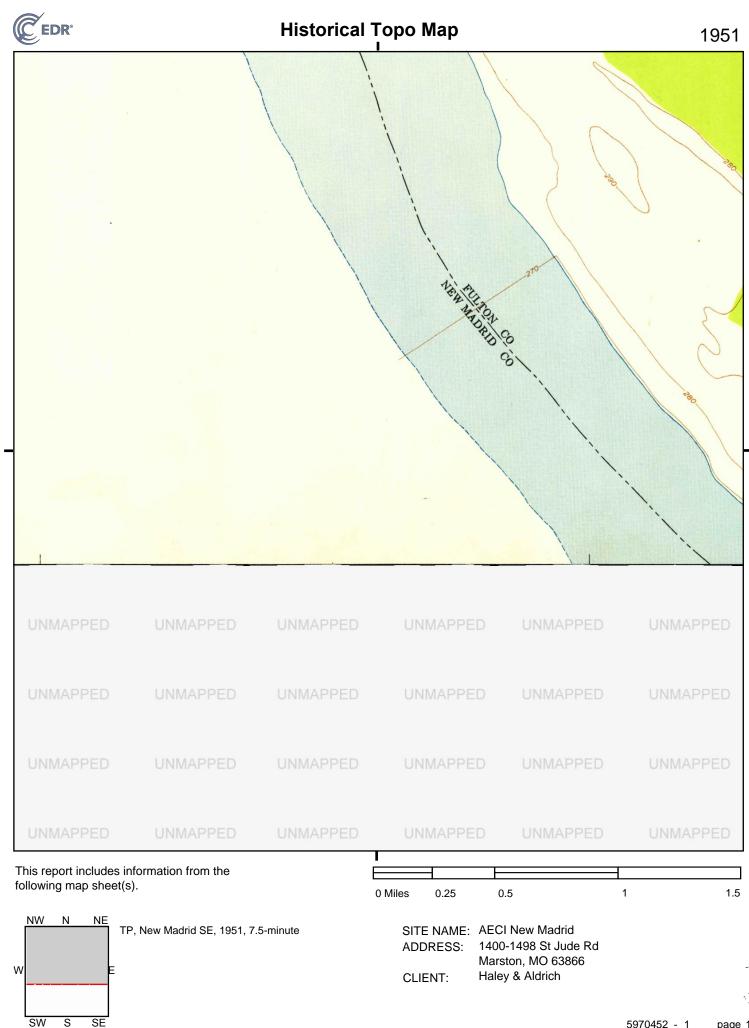




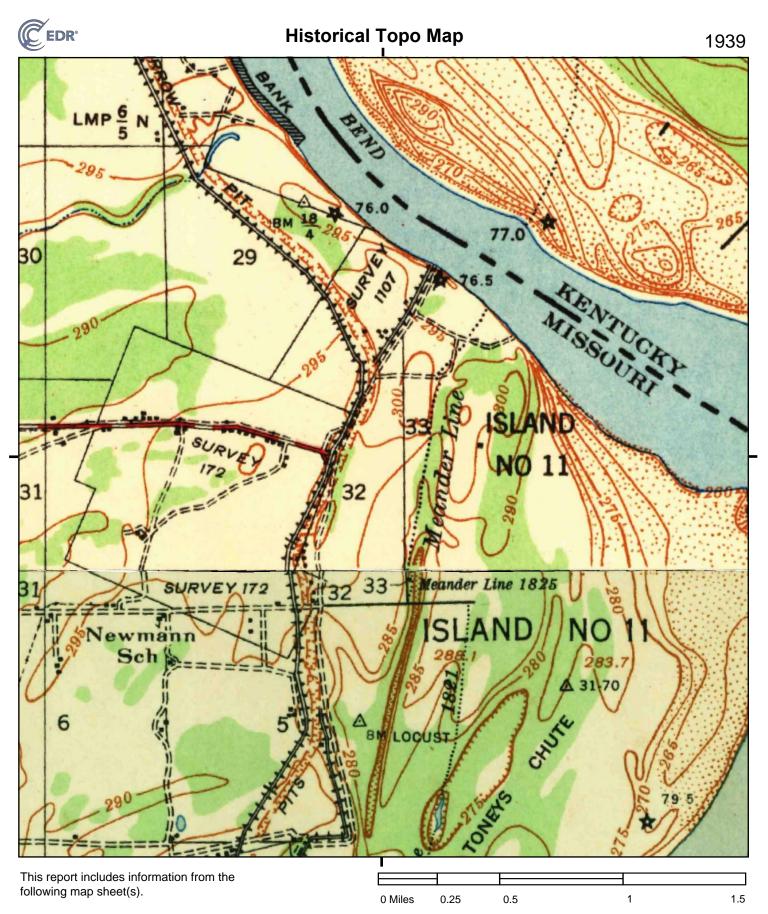


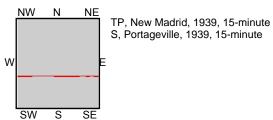


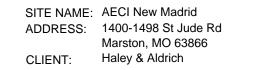
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page 12