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2024 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
ASH POND SYSTEM
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

by
Haley & Aldrich, Inc.
Cleveland, Ohio

for
Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 211418-000
January 2025

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Mark Nicholls, PG
Name

Signature

Principal Consultant
Title

January 31, 2025
Date

1. Introduction

This 2024 Annual Groundwater Monitoring and Corrective Action Report (Annual Report) addresses the Ash Pond System (consisting of the multi-unit system of Cell 001, Cell 003, and Cell 004) at the Thomas Hill Energy Complex (THEC), 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 Title 40 Code of Federal Regulations (40 CFR) § 257.90(e). The Annual Report documents the groundwater monitoring system for the Ash Pond System consistent with applicable sections of 40 CFR §§ 257.90 through 257.98, and describes activities conducted in the prior calendar year (2024) and document compliance with the Rule. The specific requirements listed in 40 CFR § 257.90(e)(1) through (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 2024), the Ash Pond System was operating under a detection monitoring program in compliance with 40 CFR § 257.94.

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 2024), the Ash Pond System was operating under a detection monitoring program in compliance with 40 CFR § 257.94.

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) – Statistically Significant Increase Constituents

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

A statistically significant increase (SSI) above the background concentration identified for the February 2024 semiannual detection monitoring sampling event is listed in Table I.

1.1.3.2 40 CFR § 257.90(e)(6)(iii)(b) – Assessment Monitoring Program

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

An alternate source demonstration (ASD) was completed and certified on 9 October 2024 to address the SSI for boron at MW-6 identified during the February 2024 semiannual sampling event. The ASD was completed and certified within 90 days of the SSI being identified. Therefore, the Ash Pond System remained in detection monitoring during 2024.

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;

The Ash Pond System remains in detection monitoring, and no assessment monitoring samples were collected for analysis of Appendix IV constituents in 2024.

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 2024 for this multi-unit system. The Ash Pond System remained in detection monitoring during 2024.

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 required for the Ash Pond System in 2024. 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 initiated in 2024 for this multi-unit system. The Ash Pond System remained in detection monitoring during 2024.

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 Ash Pond System remains in detection monitoring, and no remedy was required to be selected.

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 were required to be initiated in 2024; therefore, no demonstration or certification is applicable for this multi-unit system.

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 multi-unit groundwater monitoring system at the THEC Ash Pond System. The THEC Ash Pond System 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 40 CFR § 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 monitoring completed and actions taken at the THEC Ash Pond System as required by the Rule. Groundwater sampling and analysis was conducted in accordance with requirements described in 40 CFR § 257.93, and the status of the groundwater monitoring program described in 40 CFR § 257.94 and § 257.95 is also provided in this report. This Annual Report documents the applicable groundwater-related activities completed in calendar year 2024.

2.2.1 Status of the Groundwater Monitoring Program

Statistical analyses of semiannual detection monitoring data collected in August 2023 and February 2024 were completed in 2024. An Appendix III SSI for boron at MW-6 was identified at the THEC Ash Pond System during the February 2024 semiannual detection monitoring sampling event. An ASD was completed and certified on 9 October 2024. The combined unit remains in a detection monitoring program.

2.2.2 Key Actions Completed

The 2023 Annual Groundwater Monitoring and Corrective Action Report was completed in January 2024. Statistical analysis was completed in January 2024 on analytical data from the August 2023 semiannual detection monitoring sampling event. The statistical analysis indicated no SSIs for

Appendix III constituents. Semiannual detection monitoring events were completed in February and August 2024. Statistical analysis was completed within 90 days of receipt of verified laboratory data for the February 2024 sampling event. A SSI was identified for boron at MW-6 for the February 2024 sampling event. AECI completed and certified an ASD which identified a source other than the CCR unit caused the SSI. Statistical analysis of the results from the August 2024 semiannual detection monitoring sampling event are due to be completed in January 2025 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 THEC Ash Pond System in 2024.

2.2.4 Actions to Resolve Problems

No problems were encountered at the THEC Ash Pond System in 2024; therefore, no actions to resolve problems were required.

2.2.5 Project Key Activities for Upcoming Year

Key activities planned for 2025 include completion of the 2024 Annual Groundwater Monitoring and Corrective Action Report, statistical analysis of analytical data collected in August 2024 semiannual detection monitoring sampling event, and semiannual detection monitoring sampling events and subsequent statistical analysis.

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 40 CFR § 257.90(e)(1), a map showing the locations of the CCR units and associated upgradient and downgradient monitoring wells for the Ash Pond System 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 operating record by 17 October 2017 as required by 40 CFR § 257.105(h)(2) and revised in April 2019.

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 2024.

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 40 CFR § 257.94(b), two independent detection monitoring samples from each background and downgradient monitoring well were collected during 2024. A summary including the sample names, sample dates, field parameters, and analytical results obtained for the groundwater monitoring program for the THEC Ash Pond System is presented in Table II of this report.

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

Data from the groundwater sampling events for the downgradient monitoring wells were compared to the calculated prediction limits (PL) for the Appendix III constituents. Once data are verified, a sample concentration greater than the PL is considered to represent a SSI. The statistical analyses completed in 2024 for the August 2023 semiannual detection monitoring sampling events indicated no SSIs for Appendix III constituents. The statistical analyses completed for the February 2024 semiannual detection monitoring sampling event indicated a SSI for boron at MW-6. An ASD was completed and certified on 9 October 2024. The Ash Pond System remains in detection monitoring. Therefore, there was no transition between monitoring programs in 2024.

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 40 CFR §§ 257.90 through 257.95 of the Rule. It is understood that there are supplemental references in 40 CFR §§ 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 2024.

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 multi-unit system. 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.

An ASD was completed and certified in October 2024 for the February 2024 sampling event SSI for boron at MW-6 and is included in this report as Attachment 1. The Ash Pond System remained in assessment monitoring in 2024.

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).

The Ash Pond System remains in detection monitoring, and an alternative groundwater assessment monitoring sampling and analysis frequency has not been established for this multi-unit system. Therefore, no demonstration or certification is applicable.

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

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).

The Ash Pond System remains in detection monitoring; no assessment monitoring samples were collected or analyzed in 2024. Consequently, AECI is not required to establish groundwater protection standards for this multi-unit system, and this criterion is not applicable.

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.

Assessment monitoring statistical analyses were not required or completed in 2024. Therefore, this criterion is not applicable.

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.

Assessment monitoring statistical analyses were not required or completed in 2024. Therefore, this criterion is not applicable.

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 40 CFR § 257.105(h)(1), this Annual Report must be placed in the facility operating record.
- Pursuant to 40 CFR § 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 operating record [40 CFR § 257.106(d)].
- Pursuant to 40 CFR § 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 operating record [40 CFR § 257.107(d)].

TABLES

TABLE I
SSI SUMMARY TABLE
ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER - ASH POND SYSTEM
CLIFTON HILL, MISSOURI

Constituent	Sampling Event	Well ID	Background Concentration (mg/L)
Boron	February 2024	MW-6	0.718*

Notes:
** Value obtained via intrawell statistical analysis.*
mg/L = milligrams per liter
SSI = statistically significant increase

TABLE II
SUMMARY OF ANALYTICAL RESULTS - 2024 GROUNDWATER MONITORING
ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER - ASH POND SYSTEM
CLIFTON HILL, MISSOURI

Location	Upgradient					Downgradient									
	MW-1			MW-2R		MW-3			MW-4		MW-5		MW-6		
Measure Point (TOC)	746.94			779.96		692.19			683.48		687.53		705.05		
Sample Name	MW-1	DUPLICATE-02-2024	MW-1	MW-2R	MW-2R	MW-3	MW-3	DUPLICATE-08-2024	MW-4	MW-4	MW-5	MW-5	MW-6	MW-6	MW-6
Sample Date	2/27/2024	2/27/2024	8/7/2024	2/27/2024	8/7/2024	2/27/2024	8/7/2024	8/7/2024	2/27/2024	8/7/2024	2/27/2024	8/7/2024	2/27/2024	4/11/2024	8/7/2024
Final Lab Report Date	3/13/2024	3/13/2024	9/18/2024	3/13/2024	9/18/2024	3/13/2024	9/18/2024	9/18/2024	3/13/2024	9/18/2024	3/13/2024	9/18/2024	3/13/2024	4/29/2024	9/18/2024
Final Lab Report Revision Date	4/11/2024	4/11/2024	10/1/2024	4/11/2024	10/1/2024	4/11/2024	10/1/2024	10/1/2024	4/11/2024	10/1/2024	4/11/2024	10/1/2024	4/11/2024	N/A	10/1/2024
Lab Data Reviewed and Accepted	7/2/2024	7/2/2024	12/17/2024	7/2/2024	12/17/2024	7/2/2024	12/17/2024	12/17/2024	7/2/2024	12/17/2024	7/2/2024	12/17/2024	7/2/2024	7/2/2024	12/17/2024
Depth to Water (ft btoc)	2.58	2.58	2.22	40.73	42.22	4.93	5.32	5.32	4.76	6.62	2.20	4.46	15.43	-	16.23
Temperature (Deg C)	12.22	-	17.18	13.66	15.10	14.10	14.66	-	12.83	13.79	12.72	14.09	15.31	-	16.25
Conductivity, Field (µS/cm)	3690	-	3710	2200	2210	3750	3710	-	738	732	959	951	1367	-	1383
Turbidity, Field (NTU)	3.20	-	2.42	1.26	3.79	7.90	9.40	-	6.34	9.34	5.21	9.92	1.47	-	0.74
pH (field) (su)	7.20	-	7.02	7.38	7.39	6.65	6.69	-	7.59	7.58	7.98	7.49	7.26	-	7.72
Boron, Total (mg/L)	**0.13**	**0.13**	**0.14**	**0.20**	**0.19**	**0.31**	**0.27**	**0.26**	**0.049**	**0.048**	**0.54**	**0.49**	**0.85**	**0.81**	**0.76**
Calcium, Total (mg/L)	**570**	**570**	**490**	**280**	**280**	**420**	**430**	**400**	**95**	**96**	**140**	**140**	**210**	**220**	**210**
Chloride (mg/L)	**48**	**50**	**61**	**5.2**	**5.1**	**14**	**13**	**13**	**8.4**	**7.9**	**7.9**	**7.4**	**16**	**15**	**15**
Fluoride (mg/L)	**0.762**	**0.385**	**0.364**	**0.467**	**0.486**	< 0.250	< 0.250	< 0.250	**0.287**	**0.318**	< 0.250	< 0.250	**0.314**	**0.305**	**0.320**
Sulfate (mg/L)	**2100**	**1900**	**2000**	**690**	**760**	**1800**	**1800**	**1700**	**90**	**98**	**270**	**280**	**440**	**450**	**510**
pH (lab) (su)	**7.11**	**7.15**	**6.74**	**7.40**	**7.12**	**6.75**	**6.53**	**6.48**	**7.37**	**6.98**	**7.47**	**7.08**	**7.41**	**6.93**	**6.86**
TDS (mg/L)	**3300**	**3300**	**3500**	**1600**	**1700**	**3000**	**3100**	**3000**	**480**	**450**	**640**	**620**	**900**	**920**	**980**

Notes:

__Bold value:__ Detection above laboratory reporting limit.
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
su = standard unit
TDS = total dissolved solids
TOC = top of casing

FIGURE

LEGEND

- MONITORING WELL
- PIEZOMETRIC OBSERVATION
- ACTIVE COAL COMBUSTION RESIDUAL
- INACTIVE/CLOSED CELL

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. THE COAL COMBUSTION RESIDUAL MONITORING ACCOMPLISHED VIA A MULTI-UNIT GROUNDWATER MONITORING SYSTEM, REFERRED TO AS THE ASH POND SYSTEM, THAT INCLUDES: CELL 001, INACTIVE/CLOSED CELL 002, CELL 003, AND CELL 004.

3. AERIAL IMAGERY SOURCE: ESRI

N

0 400 800

SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

ASH POND SYSTEM
MONITORING WELL LOCATION MAP

aeci

JANUARY 2025

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\128064-CCR Groundwater Monitoring Program, Thomas Hill\GIS\MXDs\2021_01\ANNUAL_REPORT\128064_006_0001_MONITORING_WELL_LOCATION_MAP.mxd — USER: awatson — LAST SAVED: 1/5/2021 3:51:48 PM

ATTACHMENT 1

Appendix III SSI Alternate Source Demonstration for the Ash Pond System – February 2024

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ALTERNATE SOURCE DEMONSTRATION
APPENDIX III STATISTICALLY SIGNIFICANT INCREASE
ASH POND SYSTEM
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

STATE OF MISSOURI
STEVEN F. PUTRICH
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For Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 0211418-000
October 2024

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Revision No.	Date	Notes
0	April 2018	Original
1	December 2022	Updated to reflect analytical data at unit Ash Pond System compliance monitoring wells and supporting well data.
2	October 2024	Updated to reflect analytical data at unit Ash Pond System compliance monitoring wells.

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Associated Electric Cooperative Inc. (AECI) to investigate groundwater quality at the multi-unit coal combustion residuals (CCR) management unit referred to as the Ash Pond System, which is composed of Cell 001, Cell 003, and Cell 004 at the Thomas Hill Energy Center (THEC) located in Clifton Hill, Missouri. The purpose of the evaluation is to identify the source of elevated boron, sulfate, and total dissolved solid (TDS) concentrations detected in groundwater samples collected from monitoring wells located downgradient of the Ash Pond System.

1.1 BACKGROUND

Consistent with Title 40 Code of Federal Regulations (40 CFR) § 257.90 through § 257.94, AECI has installed and certified a groundwater monitoring network for the Ash Pond System at THEC (Haley & Aldrich, 2019a) and has collected groundwater samples for the analysis of Appendix III constituents. AECI conducted statistical analyses of the groundwater quality results to determine if any of the Appendix III constituents were present in groundwater samples collected from downgradient monitoring wells at concentrations with a statistically significant increase (SSI) above background. Statistical evaluation of baseline samples for Appendix III constituents detected SSIs above background levels downgradient of the Ash Pond System for boron, sulfate, and TDS at MW-3; boron at MW-5; and boron at MW-6. The original Alternate Source Demonstration (ASD) document was prepared in April 2018 in response to the SSIs observed during baseline sampling, and described the source of the elevated boron, sulfate, and TDS concentrations in CCR monitoring wells downgradient of the Ash Pond System. A revision of the 2018 ASD was completed in December 2022 which included more recent analytical data from the February 2022 semiannual monitoring event, and additional site-specific background data which supported the original conclusions of the 2018 ASD. This updated ASD document incorporates recent groundwater quality data from the February 2024 semiannual detection monitoring sampling event, further supporting conclusions of the ASD.

Pursuant to 40 CFR § 257.94(e)(2), ***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 a SSI over background exists to complete an ASD for Appendix III constituents. If a successful demonstration is completed and certified by a qualified professional engineer, the CCR unit may continue in detection monitoring. If, however, an alternate source of the Appendix III SSI is not identified, the owner or operator must initiate an assessment monitoring program within 90 days following the ASD period. This report documents the findings and conclusions of an ASD completed for boron, sulfate, and TDS at the Ash Pond System at THEC prepared in response to SSIs observed during sampling events.

1.2 SITE SETTING

The THEC is located approximately 7 miles north of Clifton Hill in Randolph County, Missouri (Figure 1). The Ash Pond System is a series of surface impoundments that encompasses approximately 90 acres and is located south of the THEC power plant site and immediately adjacent to the Prairie Hill Coal Mine. The majority of previously mined areas associated with the Prairie Hill Coal Mine have been released by the Missouri Department of Natural Resources (MDNR) Land Reclamation Program bond liability. The

Ash Pond System has ground surface elevations varying from 700 to 760 feet above mean sea level. The Ash Pond System and associated groundwater monitoring network are shown on Figure 2.

1.3 SITE DESCRIPTION

The THEC is an active coal-fired energy production facility located near Clifton Hill, Missouri. A portion of the CCR material produced by THEC is managed in the Ash Pond System, including boiler slag from generation units 1 and 2. Other CCRs produced by the plant are beneficially reused for mine reclamation and are managed separately from the impoundment system. The adjacent Prairie Hill Coal Mine site includes former coal mine pits that have been, or are actively being, reclaimed by AECI. The Ash Pond System is shown on Figure 2 and a broader relationship of the Ash Pond System and Prairie Hill Coal Mine are shown on Figure 3.

The operational sequence in the THEC Ash Pond System is as follows:

- Boiler slag and bottom ash was historically sluiced from the power generating system to Cell 001, where the majority of CCR was settled out and removed to an adjacent dewatering pad for subsequent management and hauling off-site for beneficial use or to the on-site landfill for disposal.
- In 2021, AECI constructed a concrete dewatering tank (CDT) to manage the sluiced flows instead of Cell 001. CCR material was removed from Cell 001 and the pond was reconfigured as a non-CCR retention pond.
- As of September 2024:
  - Boiler slag and bottom ash is sluiced from the power generating system to the CDT, where CCR material is treated and settled out, removed to an adjacent staging area for subsequent management and hauling off-site for beneficial use, or to the on-site landfill for disposal. The CDT operates as a closed-loop system, sending treated water back to the power generating system for continued use in conveying boiler slag and bottom ash.
  - On a regular basis, treated water from the CDT system is purged to Cell 001. Water from Cell 001 is discharged via an existing concrete outlet structure to the West Ditch.
  - Flows from Cell 001, along with coal pile stormwater runoff and other low volume wastewaters from the plant, are conveyed via the West Ditch into the reconfigured Cell 002 West. Flows from Cell 002 West are discharged to Cell 002 East, and Cell 002 East discharges via a National Pollutant Discharge Elimination System permitted outfall to the East Ditch, which flows to the Middle Fork of the Little Chariton River.
  - Cell 003 and Cell 004 ceased receipt of all CCR and non-CCR waste streams and initiated closure, which is ongoing.

2. Site Geology and Hydrogeology

Geologic and hydrogeologic conditions beneath the Ash Pond System have been characterized based on information obtained during drilling and testing of the monitoring wells and piezometers installed around the Ash Pond System. The drilling program was conducted to characterize the uppermost aquifer and install a Rule compliant CCR groundwater monitoring network in compliance with the CCR Rule.

2.1 SITE GEOLOGY

The THEC plant site and Ash Pond System are located in the eastern portion of the Western Interior Coal Province of the Central Lowlands physiographic province. The Central Lowland is characterized by horizontal sequences of predominantly marine sedimentary rocks that span more than 400 million years of deposition from the Paleozoic and Mesozoic eras. The CCR area is within an area of Pleistocene glacial activity. Several of the sedimentary formations of the Central Lowland constitute regional scale hydrogeologic units with widely variable groundwater production and groundwater quality characteristics.

Geologic units that underlie the THEC Ash Pond System are principally horizontal with a slight regional dip northwest about 2 to 3 feet per mile (Association of Missouri Geologists, 1995). Surficial geologic materials in the vicinity of and beneath the THEC Ash Pond System include Pleistocene glacial till, loess deposits, and Holocene alluvium. The poorly sorted glacial deposits are composed of Kansan and Nebraskan age clays, silts, and sands; lenses of gravel, cobbles, and boulders may be present (Association of Missouri Geologists, 1995). The till varies from approximately 8.5 to 80 feet thick near the Ash Pond System. Aeolian deposited loess occurs above the till, on hilltops near the units at thicknesses up to 10 feet. The glacial till directly underlies most of the THEC Ash Pond System. The Pleistocene glacial deposits are underlain by strata representing transgressions and regressions of marine and onshore depositional environments.

2.2 SITE HYDROGEOLOGY AND HYDROLOGY

The Pleistocene glacial till constitutes the uppermost aquifer beneath the Ash Pond System, hereafter referred to as the glacial till or till aquifer. The glacial till material is locally in hydraulic communication with an underlying limestone formation. Spoil material generated from the Prairie Hill Coal Mine is also locally water bearing and is in hydraulic communication with the glacial till of the uppermost aquifer. The spoils are composed of excavated glacial material and limited amounts of limestone and shale formation materials and coal residuals. Spoil material has been reported to have been deposited laterally to the east of Cell 004. Groundwater occurs in the sand and gravel lenses of the glacial till (Association of Missouri Geologists, 1995) and generally within the spoil materials. Although the glacial till and underlying limestone are not continuous at the site, they are in hydraulic communication, are primarily unconfined, and constitute a single aquifer.

Based on groundwater elevations measured at CCR monitoring wells between August 2016 and February 2024, the groundwater gradient in the uppermost aquifer unit is approximately 0.012 to 0.015 feet per foot. Although the uppermost aquifer unit is primarily unconfined, heterogeneity of the aquifer material causes isolated areas of confined or semi-confined conditions. The groundwater flow direction in the uppermost aquifer beneath the CCR pond system is toward the southwest.

Hydraulic conductivity of the uppermost aquifer was calculated using data collected during development of the CCR groundwater monitoring network and published information. The hydraulic conductivity of the glacial till ranges from 1.1 x 10^{-5} feet per day (feet/day) in gray till to 0.57 feet/day in the sandy till (Shell Engineering and Associates [Shell], 1981).

The limestone and shale that lie beneath the uppermost aquifer are underlain by a coal seam and an underclay layer. At the adjacent Prairie Hill Coal Mine site, the permeability of the underclay below the Bevier coal is approximately 2 x 10^{-6} feet/day (Shell, 1981). This value is a geometric mean of several hydraulic permeameter tests conducted by Shell during site characterization. The combined Bevier coal and underclay have a thickness of between 3 and 5 feet. Shell (1981) reports that wells completed in limestone below the Bevier coal and underclay, have piezometric groundwater elevations that extend above the coal throughout the site, indicating an upward hydraulic gradient. Hydraulic potentials encountered in water-bearing rocks below the Bevier coal and underclay have hydraulic potential approximately 60 feet or more above the coal (Shell, 1981). This upward hydraulic gradient provides a mechanism for constituents found in the Bevier coal and underclay to be present in glacial till.

Review of the MDNR GeoStrat Database indicates that the glacial till aquifer is not used for water supply wells in the vicinity of the Ash Pond System. The nearest water well (#00226694) listed in the GeoStrat Database is a low-yield, domestic well located approximately 5.1 miles east of the complex. It is reported to be completed at a depth of 670 feet below ground surface (bgs), producing groundwater at a reported rate of 80 gallons per minute (gpm). It is stratigraphically separated from the glacial till aquifer at the Ash Pond System and does not draw water from the glacial till aquifer.

3. Alternative Source Demonstration

Haley & Aldrich conducted an evaluation of potential alternative sources of boron, sulfate, and TDS, which included review of sampling procedures, laboratory processes, and statistical analyses, to determine if potential errors may have been made that would result in the apparent SSIs for these constituents downgradient of the Ash Pond System. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity of the Ash Pond System, and evaluated natural geologic conditions and the effect of those conditions on native groundwater chemistry. These analyses successfully identified individual alternate sources of boron, sulfate, and TDS. The alternate source findings are described below.

3.1 REVIEW OF SAMPLING, ANALYSIS, AND STATISTICAL PROCEDURES

3.1.1 Field Sampling Procedures

AECI conducted the field sampling activities in accordance with a Groundwater Sampling and Analysis Plan (SAP; Haley & Aldrich, 2021) that was prepared in accordance with 40 CFR § 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 the Ash Pond System. 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 potential SSIs for boron, sulfate, or TDS in the CCR wells downgradient of the Ash Pond System.

3.1.2 Laboratory Quality Control

The compliance monitoring groundwater samples collected downgradient of the Ash Pond System are analyzed using standard U.S. Environmental Protection Agency 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, 2021).

Haley & Aldrich conducted a quality assurance/quality control review of each groundwater quality dataset generated for the Ash Pond System and has not identified apparent errors that would result in potential SSIs for boron, sulfate, or TDS in the CCR wells downgradient of the Ash Pond System.

3.1.3 Statistical Evaluation

AECI and Haley & Aldrich collected a total of at least 28 groundwater samples from each of the upgradient (MW-1 and MW-2R) and downgradient (MW-3, MW-4, MW-5, and MW-6) monitoring wells at the Ash Pond System over a period spanning from August 2016 through February 2024. Statistical analysis of the analytical results was completed using the Prediction Limits statistical method as certified in the *Certification of Statistical Methods – Ash Pond System, Thomas Hill Energy Center, Clifton Hill, Missouri* (Haley & Aldrich, 2019b).

Haley & Aldrich has reviewed the statistical analysis of groundwater quality data for the upgradient and downgradient wells at the Ash Pond System and has not identified any errors in those analyses that would result in a potential SSI for boron, sulfate, or TDS in the CCR wells downgradient of the Ash Pond System. The statistical test method used met the performance standard established in the CCR Rule, and statistical evaluation complies with the requirements of the CCR Rule.

3.2 POTENTIAL POINT AND NON-POINT SOURCES

Haley & Aldrich conducted a review of potential point and non-point sources of elevated boron, sulfate, and TDS values in the vicinity of the Ash Pond System to determine if previous or adjacent site activities, land uses, or practices might have caused SSIs to occur downgradient of the Ash Pond System. Potential point sources would include discharging activities or other activities occurring at a discrete location in the vicinity of the observed SSI that may potentially concentrate boron, sulfate, and TDS in that area. Non-point sources would include diffuse discharging activities or practices that may result in a low level but wide-spread increase in CCR constituents detected at the downgradient side of the Ash Pond System.

3.2.1 Point Sources

Prior to construction of the Ash Pond System, land uses near the site and the surrounding vicinity consisted of agricultural land and coal mining. Coal mining ceased at nearby coal mines in 1993. Review of historical United States Geological Survey (USGS) topographic maps show undeveloped land prior to the construction of the plant site and the Ash Pond System. No known industrial activities were conducted at the Ash Pond System site prior to construction of the ponds.

The Prairie Hill Coal Mine was an active surface coal mine adjacent to and surrounding the Ash Pond System and plant site. Mine spoils were placed in and adjacent to the mine pits and at other locations throughout the Prairie Hill Coal Mine site. Site conditions are consistent with coal mining and reclamation activities.

Agricultural land use is not expected to constitute a point source of boron, sulfate, or TDS at the locations of the apparent SSIs. However, coal mining activities surrounding the Ash Pond System do constitute a legacy potential point source for boron, sulfate, and TDS at the locations of the observed SSIs and this is discussed in more detail in Section 3.4.

3.2.2 Non-Point Sources

Historic agricultural activities conducted near the Ash Pond System are not expected to constitute a non-point source of boron, sulfate, or TDS at the locations of the observed SSIs. Surface coal mining occurred adjacent to the Ash Pond System and this activity and the existence of undisturbed naturally occurring coal seams represent non-point sources of boron, sulfate, and TDS at the locations of the observed SSIs. Coal seams and coal mine spoils are potential sources for boron, sulfate, and TDS at the locations of the observed SSIs in CCR wells.

3.3 HISTORICAL LAND USE REVIEW

Haley & Aldrich reviewed past usage of the site and adjoining properties based on the following records:

- Environmental Data Resources, Inc. (EDR) – Aerial Photographs, dated 1949, 1950, 1971, 1977, 1986, 1991, 1995, 2006, 2009, 2012, 2016, and 2020 (Appendix A);
- EDR – Topographic Maps, dated 1953, 1979, 2014, 2017, and 2021 (Appendix B); and
- Personal communication with THEC Staff.

Unless otherwise noted below, sources were reviewed dating back to 1940 or first developed use, whichever is earlier, and at five-year intervals if the use of the property has changed within the time period.

3.3.1 Historical Aerial Photographs

Haley & Aldrich reviewed aerial photographs depicting the development of the site and vicinity, as summarized in Table I. The historical aerial photograph search included photographs from the USGS, the U.S. Department of Agriculture, and the National Agriculture Information Program (EDR, 2024a) and are included in Appendix A.

Photographs show that the Ash Pond System was undeveloped in 1950. Buildings and structures on the power plant site are visible in 1971, along with agricultural activity in what is now the Ash Pond System area by 1970. By 1986, the mine pits and the Ash Pond System appear to have transitioned to their current configuration.

3.3.2 Historical Topographic Maps

Haley & Aldrich reviewed historical topographic maps depicting the development of the site and vicinity, as summarized in Table II. The topographic maps were provided for review by EDR (2024b). Copies of the topographic maps are included in Appendix B.

3.4 GEOLOGIC AND MINING EFFECTS ON GROUNDWATER QUALITY

3.4.1 Groundwater Quality in Unmined Portions of the THEC Property

The site is located in the eastern portion of the Western Interior Coal Province of the Central Lowlands physiographic province. The THEC Ash Pond System is located in an unmined area immediately adjacent to the Prairie Hill Coal Mine.[1] The Ash Pond System and surrounding area is underlain by shallow, thin coal seams (and deeper underlying coal deposits) of variable thickness and spatial coverage. The shallower coal seams range in thickness between 1 to 2.5 feet, based on observations from historical site mining, site characterization activities, and recently completed confirmatory site characterization piezometers TPZ-16 and TPZ-17. Piezometers TPZ-16 and TPZ-17 (Figure 2) were installed previously

[1] The limits of the Prairie Hill Coal Mine permitted land relative to the THEC Ash Pond System and the THEC power block are shown on Figure 3. Although the majority of the land comprising the Prairie Hill Coal Mine permitted space has been effectively mined in the past to support the THEC power production, there is a buffer zone on the perimeter of the mine permit footprint that has been left unmined. Other significant portions of the THEC property which are outside of the Prairie Hill Coal Mine permit area and are unmined, have been used for plant operations and CCR management facilities.

near the Ash Pond System by AECI in support of the 2018 ASD and are screened in, and adjacent to, the shallow coal seams. Groundwater quality results from these piezometers include boron concentrations ranging from 0.39 to 1.27 milligrams per liter (mg/L); sulfate concentrations ranging from 220 mg/L to 326 mg/L; and TDS concentrations ranging from 776 mg/L to 963 mg/L.

In addition to the data obtained from TPZ-16 and TPZ-17, AECI also regularly monitors wells located in unmined portions of the Prairie Hill Coal Mine which are in a buffer zone near the outer perimeter, outside of the mine permit footprint. These wells include MW-202, MW-205, MW-211, and MW-214, which are screened in coal seams. Groundwater quality samples collected from these monitoring wells between 2010 and 2021 included boron concentrations ranging from 0.10 to 2.66 mg/L; sulfate ranging from 28.5 mg/L to 2,050 mg/L; and TDS ranging from 252 mg/L to 2,950 mg/L. Notably, the boron, sulfate, and TDS concentrations in these wells within unmined portions of the Prairie Hill Coal Mine site are similar to, or exceed, the concentrations of boron, sulfate, and TDS in piezometers TPZ-16 and TPZ-17 installed in unmined land immediately west of the Ash Pond System.

Similarly, the boron concentrations observed in MW-202, MW-205, MW-211, and MW-214, exceed the concentrations of boron in downgradient CCR monitoring wells MW-3, MW-5, and MW-6 which have a maximum boron concentration of 0.85 mg/L (found in MW-6). Wells MW-3, MW-5, and MW-6 were installed with well screens straddling, or placed immediately above, coal seams immediately downgradient of the Ash Pond System.

A summary of boron, sulfate, and TDS concentrations for the monitoring wells from mined areas and characterization piezometers located in the unmined portions of the THEC property are presented in Table III. The locations of the monitoring wells and piezometers are shown in Figure 4.

3.4.2 Groundwater Quality in Mined/Mine Spoil/Reclaimed Portions of the THEC Property

Pursuant to the Prairie Hill Coal Mine permit, AECI monitors wells installed in or adjacent to previously mined areas which contain mine spoils and that have been partially reclaimed. Representative monitoring wells from those areas include wells MW-216, MW-217, MW-220, MW-221, MW-226, and MW-227. Supplemental piezometers TPZ-9 and TPZ-11 were added by AECI on the east side of the Ash Pond System to evaluate the potential effects of the adjacent Prairie Hill Coal Mine spoils on the Ash Pond System CCR groundwater network.[2] Based on data collected between 2010 and 2021, the maximum boron concentrations observed in these wells and piezometers ranged from 0.244 to 5.180 mg/L, maximum sulfate concentrations ranged from 867 to 6,400 mg/L, and maximum TDS concentrations ranged from 1,738 to 6,524 mg/L. Boron, sulfate, and TDS concentrations observed in groundwater from piezometers and monitoring wells completed in close proximity to mine spoils are comparable to, or greater than, concentrations observed in the CCR downgradient monitoring wells (MW-3, MW-4, MW-5, and MW-6) at the Ash Pond System. The maximum observed boron, sulfate, and TDS concentrations from those downgradient CCR wells are 0.85 mg/L (MW-6), 4,830 mg/L (MW-3), and 4,138 mg/L (MW-3), respectively.

[2] In particular, elevated concentrations of sulfate and TDS were seen in CCR downgradient monitoring well MW-3 and are suspected to be sourced from mine spoils located immediately adjacent to the Ash Pond System. Piezometers TPZ-9 and TPZ-11 were installed by AECI in similar proximity to mine spoil to mirror the conditions at MW-3 (along the western boundary of the Ash Pond System) to illustrate the common effects of nearby mine spoil on groundwater quality. The THEC mine wells cited above (MW-216, MW-217, MW-220, MW-221, MW-226, and MW-227) show comparable effects.

A summary of boron, sulfate, and TDS concentrations for the monitoring wells and piezometers installed in disturbed or mined areas is presented in Table IV, and the locations are also shown in Figure 4.

3.5 THEC ASH POND SYSTEM WATER QUALITY OBSERVATIONS

Pond water samples were collected from the Ash Pond System Cell 001, Cell 003, and Cell 004, as well as the conveyance channel between Cell 001 and Cell 003. The samples were analyzed for boron, sulfate, and TDS. Concentrations of boron ranged between 0.034 to 0.300 mg/L; concentrations of sulfate ranged between 38.1 to 103 mg/L; and concentrations of TDS ranged between 159 to 378 mg/L. Boron, sulfate, and TDS concentrations observed in water samples collected from the Ash Pond System are significantly lower than concentrations observed in downgradient monitoring wells MW-3, MW-5, and MW-6 at the Ash Pond System.

Analytical results for boron, sulfate, and TDS concentrations in pond water from the Ash Pond System are presented in Table V.

4. Findings and Conclusions

Haley & Aldrich conducted an evaluation of groundwater quality at the THEC Ash Pond System to identify the sources of apparent SSIs of boron, sulfate, and TDS detected in groundwater samples collected from three CCR monitoring wells (MW-3, MW-5, and MW-6) located downgradient of the Ash Pond System. The evaluation included review of sampling procedures, laboratory processes, and statistical analyses to determine if potential errors may have been made that would result in the apparent SSIs of boron, sulfate, and TDS in downgradient CCR wells. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity of the Ash Pond System, and evaluated natural geologic conditions and historic coal mining activities and the potential effects of those conditions on both the native groundwater chemistry and groundwater quality in the Ash Pond System CCR well network.

Haley & Aldrich found no errors in sampling, laboratory analysis, data management, or statistical analysis that would result in a potential SSIs for boron, sulfate, or TDS downgradient of the Ash Pond System.

The existence for natural coal seams in shallow subsurface geology beneath the Ash Pond System and throughout the area, and the former Prairie Hill Coal Mine surface mining activities adjacent to the Ash Pond System, are known point and non-point sources of boron, sulfate, and TDS values. Key findings and conclusions regarding the geologic effects on groundwater quality and the CCR well groundwater quality of those site features are summarized below:

- The occurrence of boron SSIs in CCR wells MW-3, MW-5, and MW-6:
  - The Ash Pond System is underlain by naturally occurring coal seams which vary in thickness and spatial extent beneath the Ash Pond System. The maximum boron concentrations observed in CCR wells with SSIs downgradient of the Ash Pond System (MW-3, MW-5, and MW-6) are lower than the average boron concentrations observed in groundwater samples collected from piezometers adjacent to the Ash Pond System and wells from unmined areas screened in the same formation containing coal seams/deposits (Table III); and
  - The boron concentrations detected in water samples collected from the Ash Pond System Cell 001, Cell 003, and Cell 004, and the conveyance channel between Cell 001 and Cell 003, are significantly lower than those detected in wells with SSIs downgradient of the Ash Pond System. Consequently, the concentrations of boron detected at the downgradient monitoring wells do not originate from surface water in the Ash Pond System.
- The occurrence of sulfate and TDS SSIs in CCR Well MW-3:
  - The maximum sulfate and TDS concentrations observed at MW-3 downgradient of the Ash Pond System is significantly higher than the average sulfate concentrations observed in water samples collected in 2015 and 2018 from the Ash Pond System Cell 001, Cell 003, and Cell 004, and the conveyance channel between Cell 001 and Cell 003, indicating that MW-3 has greater potential to be influenced by water in contact with mine spoils than by CCR material in the Ash Pond System. Maximum sulfate and TDS concentrations in MW-3 are within the range of average sulfate and TDS concentrations detected in piezometers adjacent to the Ash Pond System and wells from mined areas adjacent to or in mine spoils (Table IV), indicating that MW-3 has greater potential to be influenced by water in contact with nearby mine spoils than by CCR material in the Ash Pond System.

Based on the facts presented above, the occurrence of elevated boron concentrations (and associated boron SSIs) in CCR wells MW-3, MW-5, and MW-6 are not related to the ongoing operation of the Ash Pond System, but rather are the result of naturally occurring coal seams, which vary in thickness and spatial coverage beneath and surrounding the Ash Pond System. Also, based on the facts presented above, it is our conclusion that the occurrence of elevated sulfate and TDS concentrations (and associated SSIs) in CCR well MW-3 are not related to the ongoing operation of the Ash Pond System. CCR monitoring well MW-3 is located in close proximity to an area of known mine spoil placement and is influenced by groundwater in contact with mine spoils. These findings indicate that the SSIs in the downgradient wells from the Ash Pond System are associated with an alternate source and do not reflect the performance of the Ash Pond System.

In accordance with 40 CFR § 257.94(e)(2) of the CCR Rule, if the owner or operator of a CCR unit (in this case the THEC Ash Pond System) successfully demonstrates a source for Appendix III SSIs other than the CCR unit (which is then certified by a qualified professional engineer), the CCR unit can continue in detection monitoring. A certification for this ASD has been prepared and certified by a Haley & Aldrich qualified professional engineer dated 10 October 2024. The ASD written demonstration applies to the previously detected SSIs for boron, sulfate, and TDS at MW-3, boron at MW-5, and boron at MW-6 at the Ash Pond System downgradient CCR monitoring wells.

5. Certification

Pursuant to 40 CFR § 257.94(e)(2), AECI conducted an alternate source evaluation to demonstrate that a source other than the Ash Pond System caused the SSI over background identified during detection monitoring. This demonstration and the underlying data support the conclusion that naturally occurring coal seams and widespread mine spoils and mining operations in the vicinity of the Ash Pond System is the cause of the SSI over background levels for the Appendix III constituents (boron, sulfate, and TDS) detected during detection monitoring of this unit.

I certify that the demonstration that a source other than the CCR unit caused the contamination, or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality is complete in accordance with 40 CFR § 257.94(e)(2). The certification submitted is, to the best of my knowledge, accurate and complete.

Signed:______________________________

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7. Shell Engineering and Associates, 1981. Engineering Study and Report for Solid Waste Disposal Permit, Thomas Hill Operation. 15 June.

8. United States Geological Survey (USGS), 1953. Topographic Map, Prairie Hill, 7.5-minute series.

9. USGS, 1979. Topographic Map, Prairie Hill, 7.5-minute series.

10. USGS, 2014. Topographic Map, Prairie Hill, 7.5-minute series.

11. Westphal, 1981. Letter report from Jerome Westphal describing geologic conditions at Thomas Hill Energy Center in response to MDNR comments dated 27 October.

TABLES

TABLE I
HISTORICAL AERIAL PHOTOGRAPH REVIEW SUMMARY
THOMAS HILL ENERGY CENTER – ASH POND SYSTEM
CLIFTON HILL, MISSOURI

Dates	Description of Site and Adjacent Properties	Sources
1949 - 1950	Agricultural use of site and adjacent properties with some road use.	Aerial photos – USGS
1971	Buildings and structures on the power plant site are visible Development of current road systems. Beginning of development of the Ash Pond System.	Aerial photos – USGS
1977	The Ash Pond System is active.	Aerial photos – USGS
1986 – 1991	Expansion of the Ash Pond System to the south and associated infrastructure to the west. Active coal mining to the west, east, and south of the Ash Pond System.	Aerial photos – USGS
1995 – 2020	The plant site and the Ash Pond System are active. Mine pits to the south and west are filled, and the mine pit to the east is actively being filled.	Aerial photos – USDA, NAIP

Notes:

NAIP = National Agriculture Information Program
USGS = United States Geological Survey
USDA = United States Department of Agriculture

TABLE II
HISTORICAL TOPOGRAPHIC MAP REVIEW SUMMARY
THOMAS HILL ENERGY CENTER – ASH POND SYSTEM
CLIFTON HILL, MISSOURI

Dates	Description of Site and Adjacent Properties	Map Name
1953	The map shows the site as undeveloped land with several roads within the site vicinity.	7.5-Minute Series, Prairie Hill, Missouri Quadrangle
1979	Development of roads and a rail line. The plant site is indicated as power plant.	7.5-Minute Series, Prairie Hill, Missouri Quadrangle
2014 – 2021	Further development of rail line to the northeast.	7.5-Minute Series, Prairie Hill, Missouri Quadrangle

TABLE III
SUMMARY OF BORON, SULFATE, AND TDS ANALYTICAL RESULTS -
MONITORING WELLS WITH UNMINED AMBIENT CONDITIONS
THOMAS HILL ENERGY CENTER - ASH POND SYSTEM
CLIFTON HILL, MISSOURI

Location		Media Screened	Sample Date	Boron, Total mg/L	Sulfate mg/L	TDS mg/L	Notes
TPZ-16		Coal Seam/Limestone	3/21/2018	0.39	326	776	West of Cell 004/Located in Unmined Area
TPZ-17		Coal Seam/Limestone	3/22/2018	1.27	220	963	
MW-1	average	Limestone	08/2016 - 08/2022	0.10	1,979	3,467	Upgradient of Ash Pond System
	peak			0.22	2,240	3,632	
MW-2R	average	Till	08/2016 - 08/2022	0.19	564	1,450	
	peak			0.24	751	1,670	
201	average	Floor	2010 - 2021	2.19	698	1,556	Upgradient of Prairie Hill Mine
	peak			2.35	785	2,280	
202	average	Coal	2010 - 2021	1.98	809	1,624	
	peak			2.08	1,040	2,950	
204	average	Floor	2010 - 2021	2.50	768	1,351	
	peak			2.66	942	1,723	
205	average	Coal	2010 - 2021	1.48	1,426	2,414	
	peak			1.57	2,050	2,600	
210	average	Floor	2010 - 2021	1.97	509	1,174	
	peak			2.42	689	1,458	
211	average	Coal	2010 - 2021	0.82	148	762	
	peak			1.06	353	1,270	
213	average	Floor	2010 - 2021	0.86	1,187	2,124	
	peak			1.45	1,540	2,286	
214	average	Coal	2010 - 2021	0.75	558	1,072	
	peak			1.16	1,260	2,262	
				1.21	766	1,561	Average, All
				2.66	2,240	3,632	Peak, All

Notes:
mg/L = milligrams per liter
TDS = total dissolved solids

TABLE IV
SUMMARY OF BORON, SULFATE, AND TDS ANALYTICAL RESULTS -
MONITORING WELLS WITH MINING/MINING SPOILS IMPACTS
THOMAS HILL ENERGY CENTER - ASH POND SYSTEM
CLIFTON HILL, MISSOURI

Location		Media Screened	Sample Date	Boron, Total mg/L	Sulfate mg/L	TDS mg/L	Notes
TPZ-9	average	Limestone above Coal Seam	Varies (8/15 - 3/18)	2.12	2,455	4,136	East of Cell 004/Adjacent to Mine Spoils
	peak		3/8/2018	2.26	2,650	4,350	
TPZ-11	average	Limestone	Varies (8/15 - 3/18)	0.269	2,820	5,097	
	peak		8/28/2015	0.294	2,860	5,313	
216	average	Mine Spoils	2010 - 2021	4.04	2,640	4,207	Monitoring Mine Spoils
	peak			4.52	3,340	4,498	
217	average	Mine Floor	2010 - 2021	4.72	3,216	5,127	
	peak			5.18	3,880	5,558	
220	average	Mine Spoils	2010 - 2021	1.73	2,292	3,584	
	peak			1.91	3,050	3,962	
221	average	Mine Floor	2010 - 2021	2.84	860	1,611	
	peak			3.25	1,320	2,090	
226	average	Mine Spoils	2010 - 2021	3.78	4,204	5,879	
	peak			4.20	6,400	6,524	
227	average	Mine Floor	2010 - 2021	3.92	3,807	5,617	
	peak			4.29	5,280	6,250	
				2.9	2,787	4,407	Average, All
				5.18	6,400	6,524	Peak, All

Notes:

mg/L = milligrams per liter

TDS = total dissolved solids

TABLE V
SUMMARY OF BORON, SULFATE, AND TDS ANALYTICAL RESULTS -
ASH POND SYSTEM CELLS SURFACE WATER
THOMAS HILL ENERGY CENTER - ASH POND SYSTEM
CLIFTON HILL, MISSOURI

Location	Sample Date	Boron, Total mg/L	Sulfate mg/L	TDS mg/L
Cell 001	3/8/2018	0.045	38.1	256
Convey 001-003	3/8/2018	0.034	43.1	251
Cell 003	8/28/2015	0.300	96.5	358
	3/8/2018	0.073	103	261
Cell 004	8/28/2015	0.219	72	378
	3/8/2018	0.067	98.6	159

Notes:

mg/L = milligrams per liter

TDS = total dissolved solids

FIGURES

LEGEND

ACTIVE COAL COMBUSTION RESIDUAL (CCR) UNIT

INACTIVE/CLOSED CELL

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. CELL 001 IS ACTIVELY IN CLOSURE AND ALL CCR HAS BEEN REMOVED FROM THE UNIT.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 200 400
SCALE IN FEET

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

THOMAS HILL ENERGY CENTER
SITE LOCATION MAP

OCTOBER 2024

FIGURE 1

LEGEND

- MONITORING WELL
- PIEZOMETRIC OBSERVATION ONLY
- ACTIVE COAL COMBUSTION RESIDUAL UNIT
- INACTIVE/CLOSED CELL

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. THE COAL COMBUSTION RESIDUAL MONITORING ACCOMPLISHED VIA A MULTI-UNIT GROUNDWATER MONITORING SYSTEM, REFERRED TO AS THE ASH POND SYSTEM, THAT INCLUDES: CELL 001, INACTIVE/CLOSED CELL 002, CELL 003, AND CELL 004.
3. AERIAL IMAGERY SOURCE: ESRI

N

0 400 800
SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

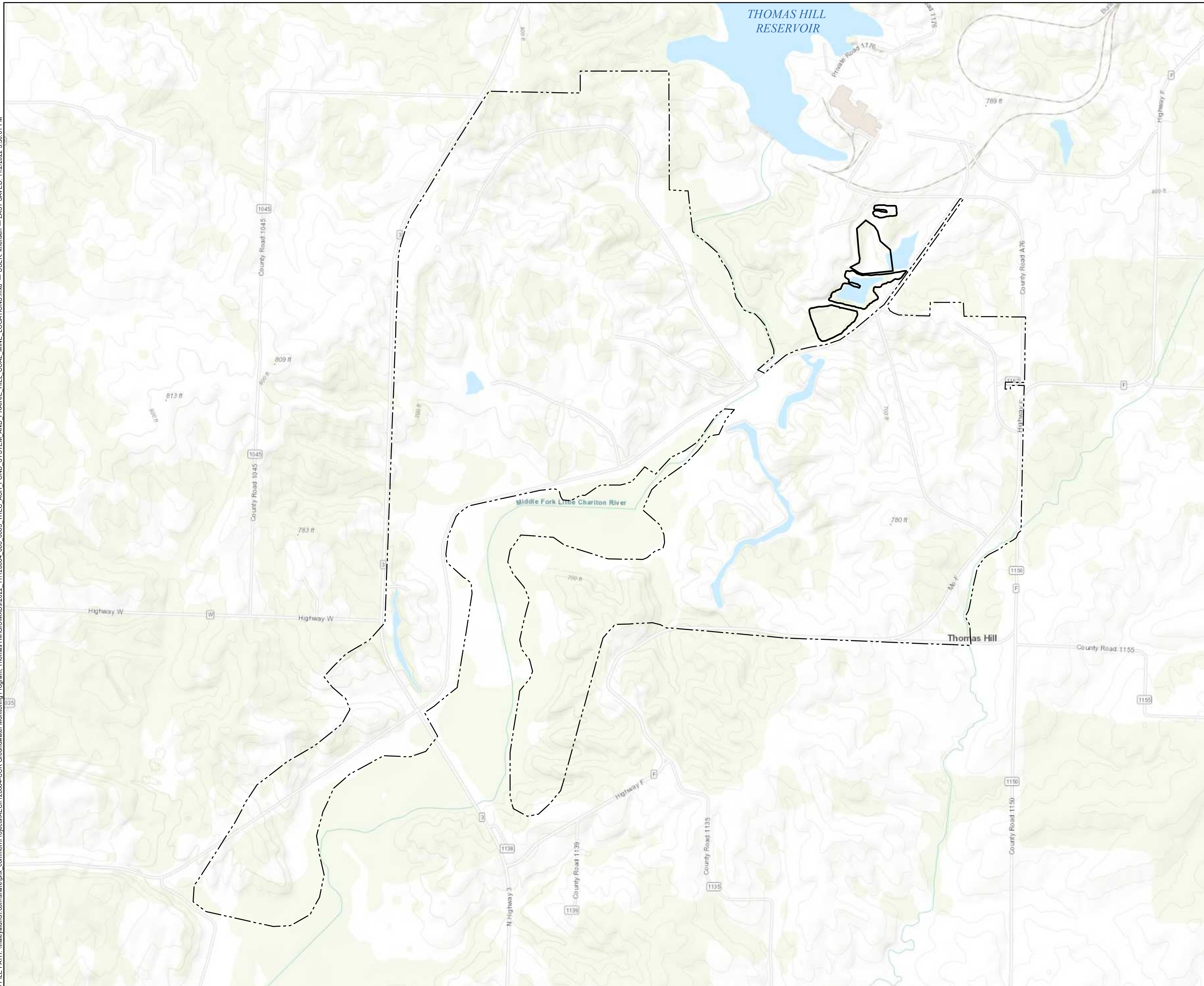
ASH POND SYSTEM
MONITORING WELL LOCATION MAP

aeci

OCTOBER 2024

FIGURE 2

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\128064-CCR Groundwater Monitoring Program, Thomas Hill\GIS\MXDs\2022_11\128064_006_0002_ASH_POND_SYSTEM_MONITORING_WELL_LOCATION_MAP.mxd — USER: khensen — LAST SAVED: 11/29/2022 5:21:41 PM



LEGEND

ASH POND SYSTEM BOUNDARY

PRAIRIE HILL MINE PERMIT BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. THE WESTERN PRAIRIE HILL MINE PERMIT BOUNDARY IS APPROXIMATE AND IS BASED ON A REVIEW OF HISTORICAL FIGURES.

3. BASE MAP SOURCE: ESRI

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

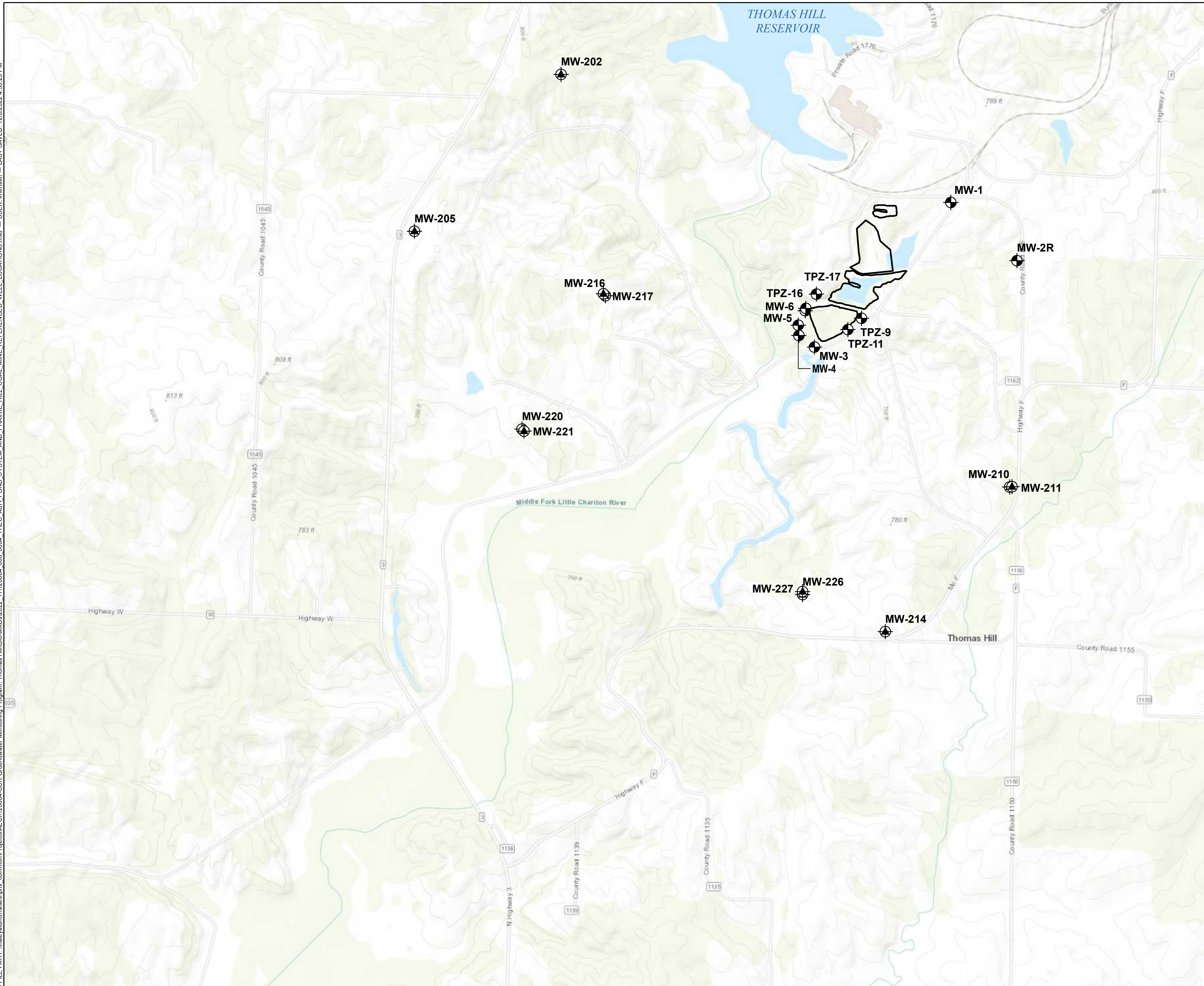
THOMAS HILL ENERGY CENTER AND PRAIRIE HILL COAL MINE LOCATIONS

aeci

OCTOBER 2024

FIGURE 3

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\128064-CCR Groundwater Monitoring Program, Thomas Hill\GIS\MXDs\2022_11\128064_006_0003_THEC_ASH_POND_SYSTEM_AND_PRAIRIE_HILL_COAL_MINE_LOCATIONS.mxd — USER: khensen — LAST SAVED: 11/2/2022 3:50:01 PM



LEGEND

- MINE WELL
- COAL COMBUSTION RESIDUE (CCR) COMPLIANCE/SITE EXPLORATORY WELL
- ASH POND SYSTEM BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. THE WESTERN PRAIRIE HILL MINE PERMIT BOUNDARY IS APPROXIMATE AND IS BASED ON A REVIEW OF HISTORICAL FIGURES.

3. BASE MAP SOURCE: ESRI

N

0 2,000 4,000

SCALE IN FEET

HALEY ALDRICH

ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

THOMAS HILL ENERGY CENTER
ASH POND SYSTEM AND
PRAIRIE HILL COAL MINE
REFERENCED WELL LOCATIONS

aeci

OCTOBER 2024

FIGURE 4

APPENDIX A
EDR Historical Aerial Photograph Report

AECI THEC

5693 Highway F

Clifton Hill, MO 65244

Inquiry Number: 7730305.2

August 12, 2024

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

08/12/24

Site Name:

AECI THEC
5693 Highway F
Clifton Hill, MO 65244
EDR Inquiry # 7730305.2

Client Name:

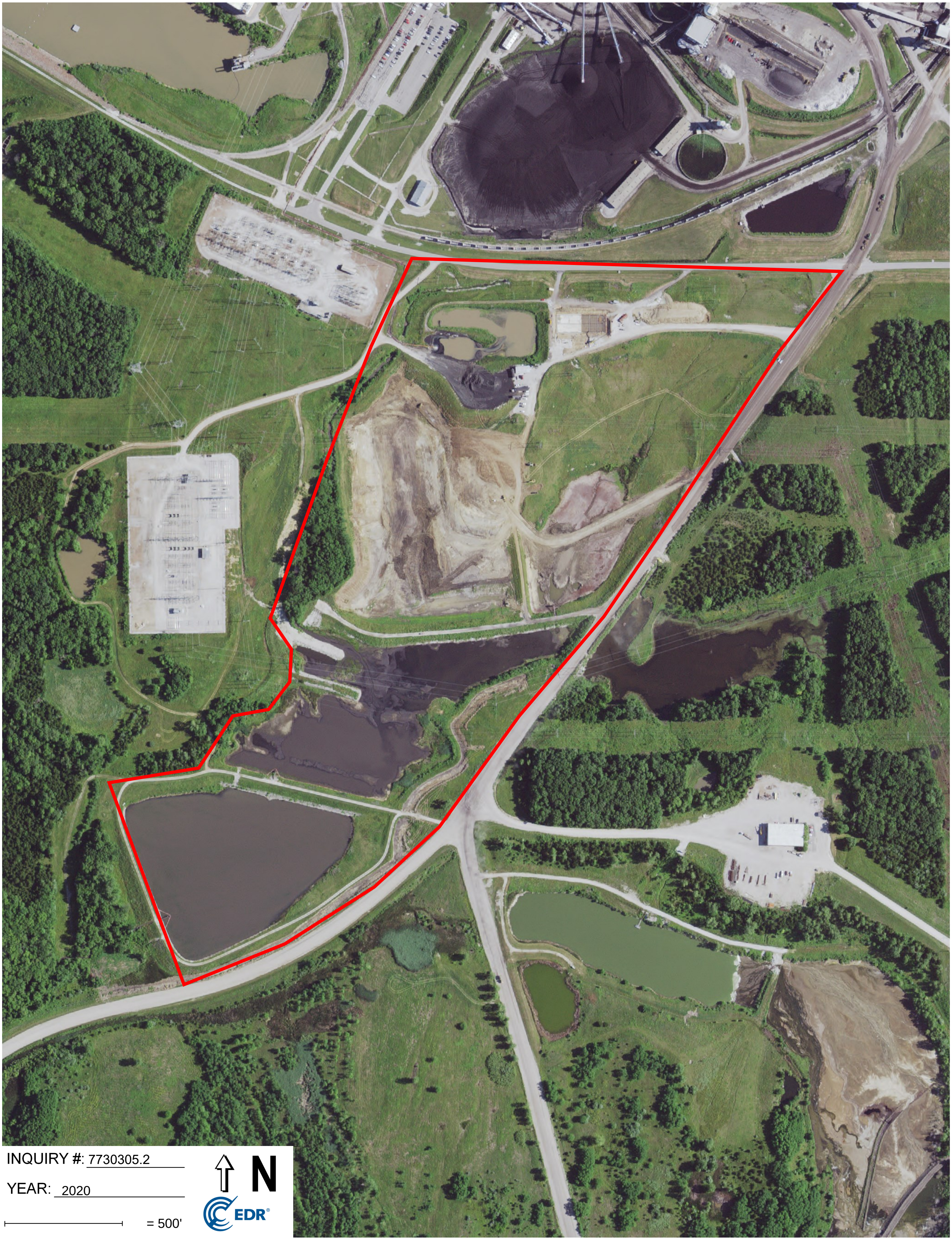
Haley & Aldrich
600 South Meyer Ave Suite 100
Tucson, AZ 85701-0000
Contact: Nick Williams

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	*Scale*	*Details*	*Source*
2020	1"=500'	Flight Year: 2020	USDA/NAIP
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
1995	1"=500'	Acquisition Date: April 02, 1995	USGS/DOQQ
1991	1"=500'	Flight Date: March 30, 1991	USGS
1986	1"=500'	Flight Date: March 07, 1986	USGS
1977	1"=500'	Flight Date: April 11, 1977	USGS
1971	1"=500'	Flight Date: April 29, 1971	USGS
1950	1"=500'	Flight Date: October 14, 1950	USGS
1949	1"=500'	Flight Date: December 14, 1949	USGS

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.


INQUIRY #: 7730305.2
YEAR: 2020
= 500'
N
EDR

INQUIRY #: 7730305.2

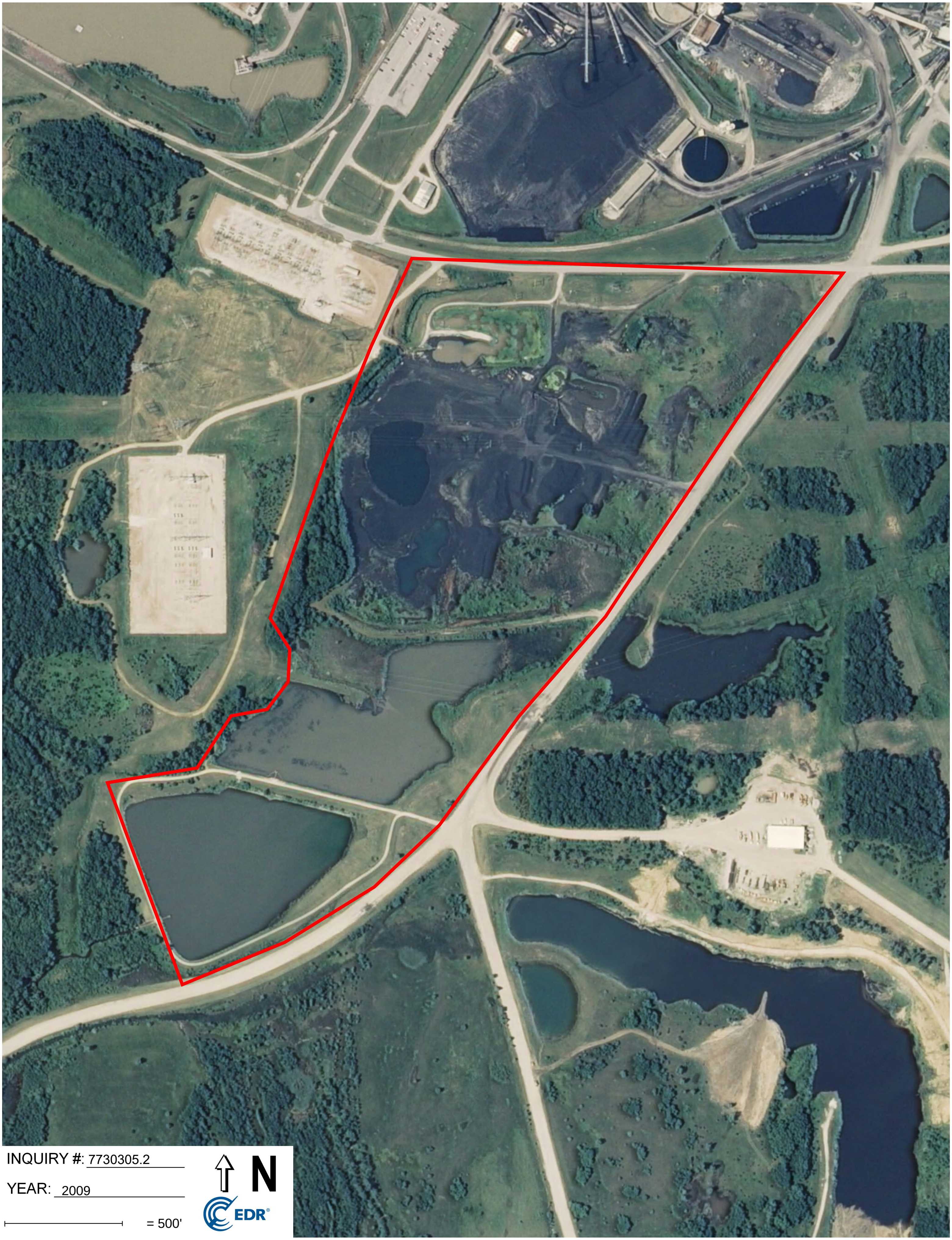
YEAR: 2016

= 500'

N

EDR


INQUIRY #: 7730305.2
YEAR: 2012
= 500'
N
EDR



INQUIRY #: 7730305.2

YEAR: 2009

= 500'

N

EDR


INQUIRY #: 7730305.2
YEAR: 2006
= 500'
N
EDR

INQUIRY #: 7730305.2

YEAR: 1995

= 500'

N

EDR


INQUIRY #: 7730305.2
YEAR: 1991
= 500'
N
EDR
Subject boundary not shown because it exceeds image extent or image is not georeferenced.

INQUIRY #: 7730305.2

YEAR: 1986

= 500'

N

EDR

Subject boundary not shown because it exceeds image extent or image is not georeferenced.

INQUIRY #: 7730305.2

YEAR: 1977

= 500'

N

EDR

Subject boundary not shown because it exceeds image extent or image is not georeferenced.

INQUIRY #: 7730305.2

YEAR: 1971

= 500'

N

EDR

Subject boundary not shown because it exceeds image extent or image is not georeferenced.


INQUIRY #: 7730305.2
YEAR: 1950
= 500'
N
EDR
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INQUIRY #: 7730305.2
YEAR: 1949
= 500'
N
EDR
Subject boundary not shown because it exceeds image extent or image is not georeferenced.

APPENDIX B
EDR Historical Topographic Map Report

AECI THEC

5693 Highway F

Clifton Hill, MO 65244

Inquiry Number: 7730305.1

August 08, 2024

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

08/08/24

Site Name:	**Client Name:**
AECI THEC	Haley & Aldrich
5693 Highway F	600 South Meyer Ave Suite 100
Clifton Hill, MO 65244	Tucson, AZ 85701-0000
EDR Inquiry # 7730305.1	Contact: Nick Williams

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 Results: ***Coordinates:***

P.O.#	NA	**Latitude:**	39.543853 39° 32' 38" North
Project:	AECI THEC	**Longitude:**	-92.63568 -92° 38' 8" West
		UTM Zone:	Zone 15 North
		UTM X Meters:	531304.22
		UTM Y Meters:	4377194.72
		Elevation:	721.61' above sea level

Maps Provided:

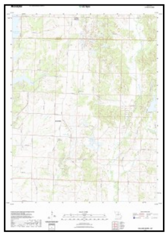
2021
2017
2014
1979
1953

Topo Sheet Key

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

2021 Source Sheets

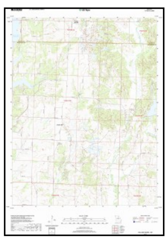
Prairie Hill
2021
7.5-minute, 24000



College Mound
2021
7.5-minute, 24000

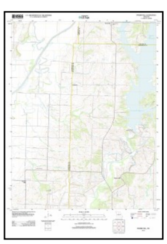
2017 Source Sheets

Prairie Hill
2017
7.5-minute, 24000

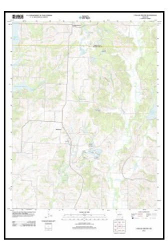


College Mound
2017
7.5-minute, 24000

2014 Source Sheets



Prairie Hill
2014
7.5-minute, 24000



College Mound
2014
7.5-minute, 24000

1979 Source Sheets

College Mound
1979
7.5-minute, 24000
Aerial Photo Revised 1977

Prairie Hill
1979
7.5-minute, 24000
Aerial Photo Revised 1977

Topo Sheet Key

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

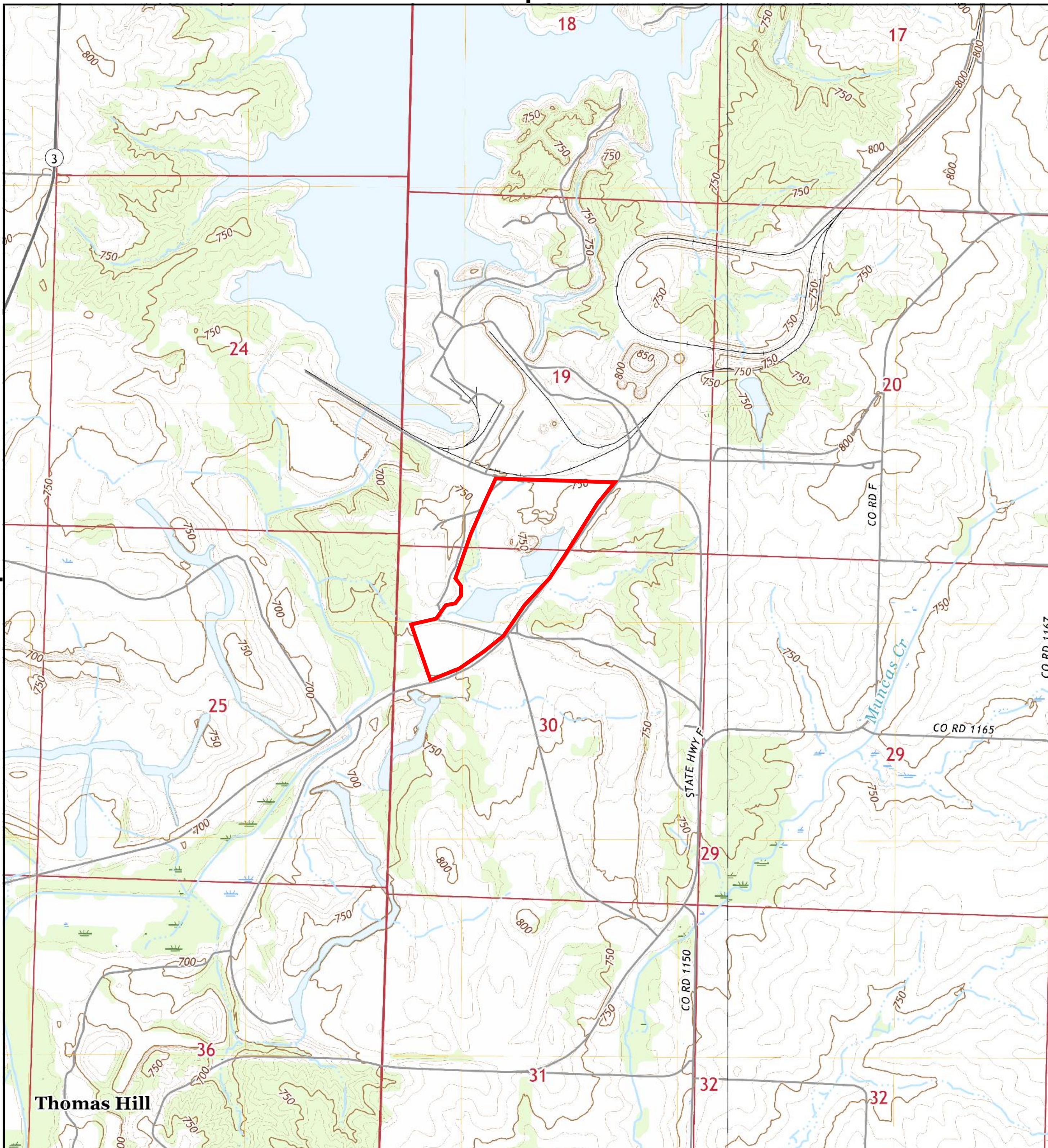
1953 Source Sheets

College Mound
1953
7.5-minute, 24000
Aerial Photo Revised 1950

Prairie Hill
1953
7.5-minute, 24000
Aerial Photo Revised 1950

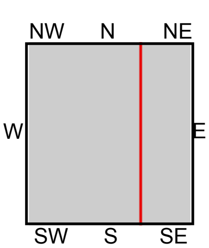
Historical Topo Map

2021



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5



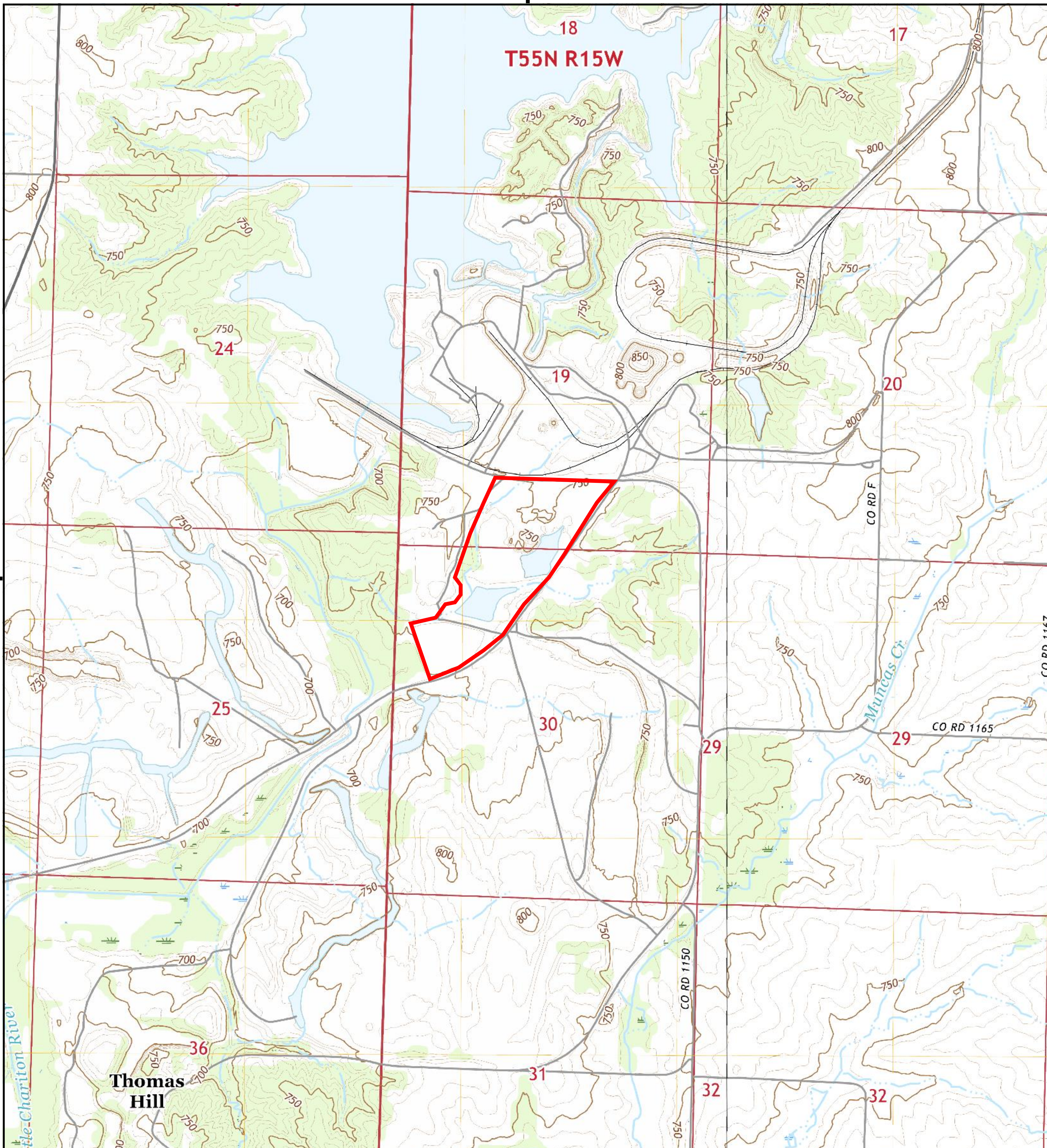
TP, Prairie Hill, 2021, 7.5-minute
E, College Mound, 2021, 7.5-minute

SITE NAME: AECI THEC
ADDRESS: 5693 Highway F
Clifton Hill, MO 65244
CLIENT: Haley & Aldrich

N

Historical Topo Map

2017



This report includes information from the following map sheet(s).

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NW N NE W E SW S SE

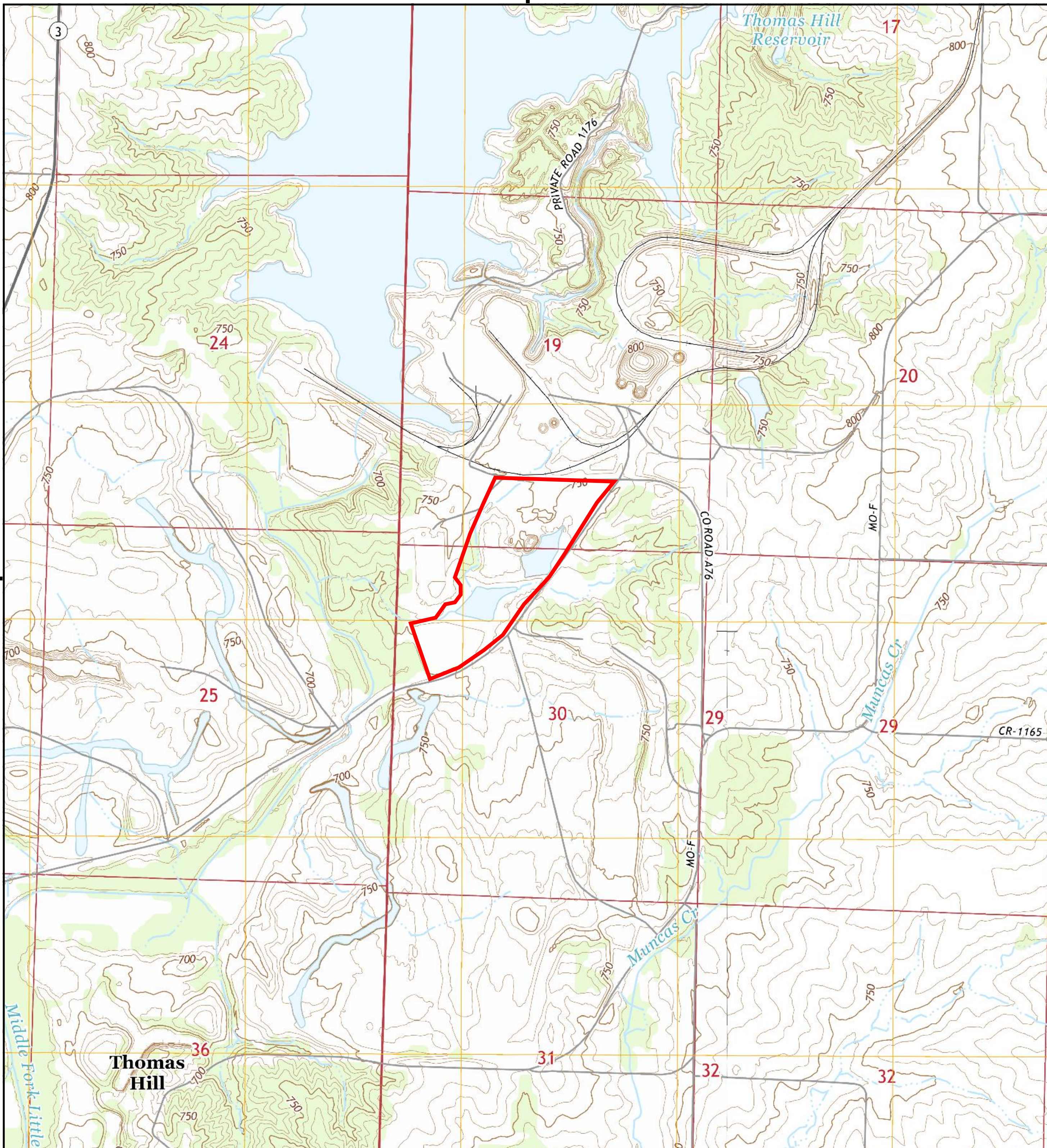
TP, Prairie Hill, 2017, 7.5-minute
E, College Mound, 2017, 7.5-minute

SITE NAME: AECI THEC
ADDRESS: 5693 Highway F
Clifton Hill, MO 65244
CLIENT: Haley & Aldrich

N

Historical Topo Map

2014



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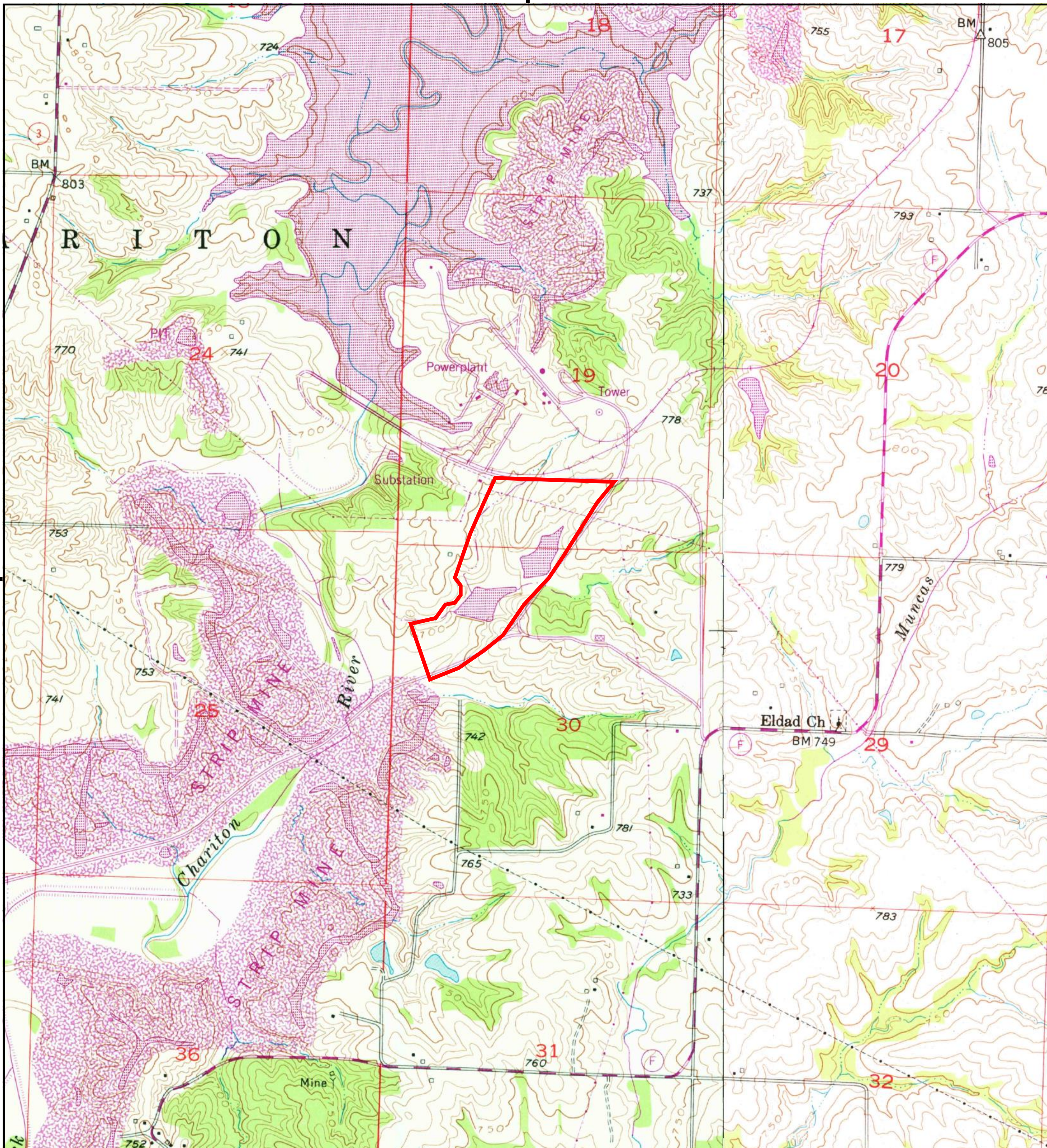
NW N NE W E SW S SE

TP, Prairie Hill, 2014, 7.5-minute
E, College Mound, 2014, 7.5-minute

SITE NAME: AECI THEC
ADDRESS: 5693 Highway F
Clifton Hill, MO 65244
CLIENT: Haley & Aldrich

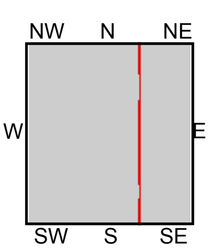
Historical Topo Map

1979



0 Miles 0.25 0.5 1 1.5

This report includes information from the following map sheet(s).



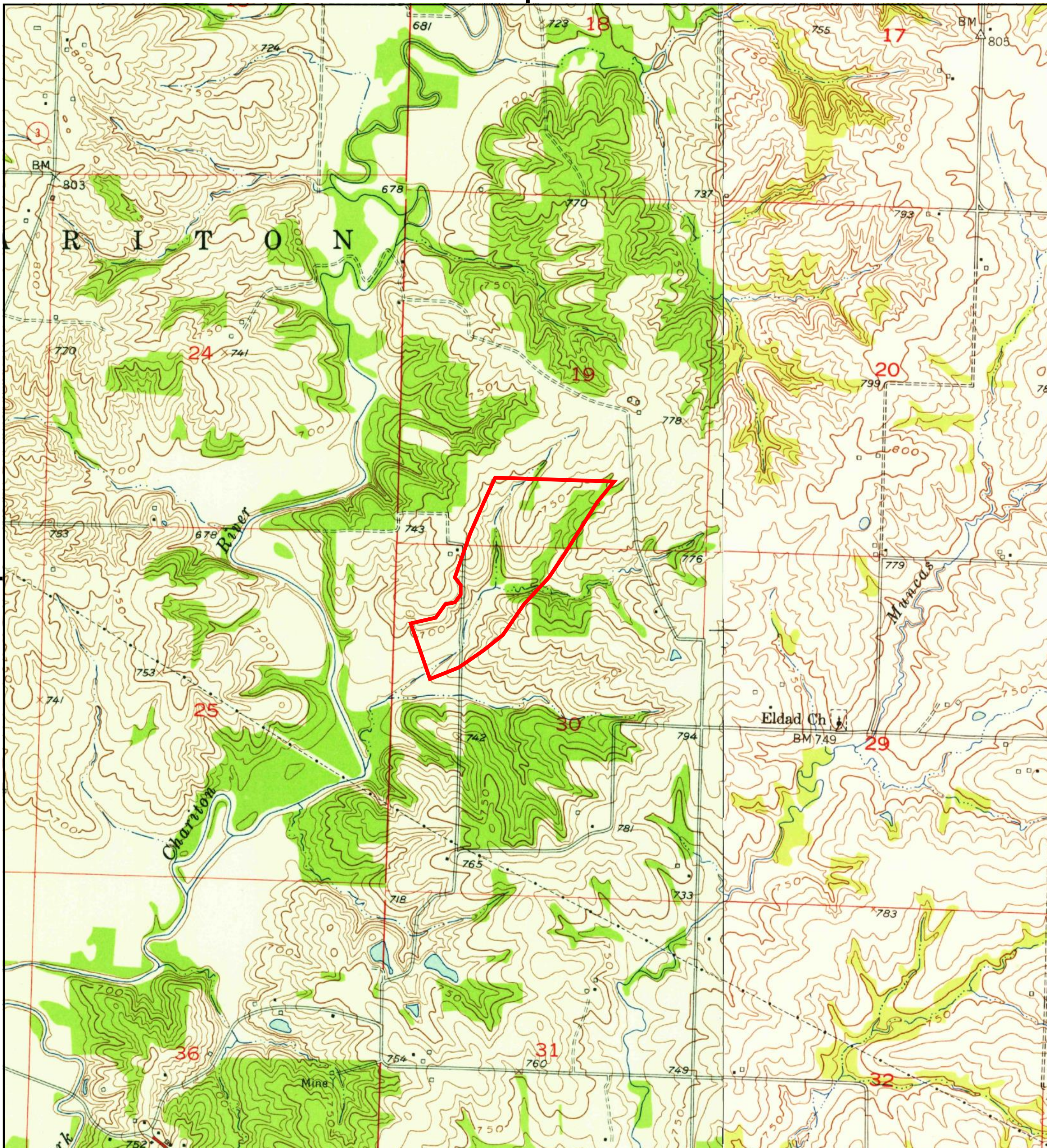
TP, Prairie Hill, 1979, 7.5-minute
E, College Mound, 1979, 7.5-minute

SITE NAME: AECI THEC
ADDRESS: 5693 Highway F
Clifton Hill, MO 65244
CLIENT: Haley & Aldrich

N

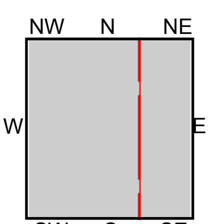
Historical Topo Map

1953



0 Miles	0.25	0.5	1	1.5

This report includes information from the following map sheet(s).



TP, Prairie Hill, 1953, 7.5-minute
E, College Mound, 1953, 7.5-minute

SITE NAME: AECI THEC
ADDRESS: 5693 Highway F
Clifton Hill, MO 65244
CLIENT: Haley & Aldrich

N