HALEY ALDRICH

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# 2018 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
## UTILITY WASTE LANDFILL
## NEW MADRID POWER PLANT
## NEW MADRID, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 129342-016
January 2019

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| | | |

Mark Nicholls
Name

Signature

Technical Expert 2
Title

1/31/2019
Date



HALEY ALDRICH

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# 1. Introduction

This 2018 Annual Groundwater Monitoring and Corrective Action Report (Annual Report) addresses the Utility Waste Landfill (UWL) at the New Madrid Power Plant (NMPP), operated by the Associated Electric Cooperative, Inc. (AECI). This Annual Report was developed in accordance with the United States Environmental Protection Agency Coal Combustion Residual (CCR) Rule effective 19 October 2015 (Rule), specifically Code of Federal Regulations Title 40 (40 CFR), subsection § 257.90(e). The Annual Report documents the groundwater monitoring system for the UWL consistent with applicable sections of § 257.90 through 257.98, and describes activities conducted in the prior calendar year (2018) and documents compliance with the Rule. The specific requirements listed in § 257.90(e)(1)-(5) of the Rule are provided in Section 2 of this Annual Report and are in bold italic font, followed by a short narrative describing how each Rule requirement has been met.

# 2. 40 CFR § 257.90 Applicability

## 2.1 40 CFR § 257.90(a)

***Except as provided for in §257.100 for inactive CCR surface impoundments, 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 257.98.***

AECI has installed and certified a groundwater monitoring system at the NMPP UWL. The UWL is the CCR management unit addressed in this report and 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 monitoring completed and actions taken at the NMPP UWL 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 relevant activities completed in the calendar year 2018.

### 2.2.1 Status of the Groundwater Monitoring Program

Statistical analyses completed in January 2018 using detection monitoring analytical data received in October 2017 showed a statistically significant increase (SSI) above background concentrations of pH at well MW-4. An alternative source demonstration (ASD) was completed and certified on 15 April 2018, which is within 90 days of the completion of statistical analyses that indicated the SSI. The ASD demonstrated that the SSI was the result of natural variability of groundwater quality. Because the ASD was completed and certified within 90 days of the SSI being identified the UWL remained in the detection monitoring program.

### 2.2.2 Key Actions Completed

The 2017 Annual Groundwater Monitoring and Corrective Action Report was completed in January 2018. Statistical analysis was completed in January 2018 on analytical data from the first detection monitoring sampling event (laboratory data finalized in October 2017). A successful Alternate Source Demonstration was completed for all SSIs. The first semi-annual detection monitoring event including sampling and laboratory analyses was completed in April 2018. It was determined that a resampling event was appropriate for data acquired in the February 2018 sampling event, and a re-sampling event was completed in July 2018. Statistical analysis was completed within 90 days of receipt of finalized laboratory data. No SSIs were determined for this sampling event. The second semi-annual detection monitoring sampling and final laboratory analyses were completed in October 2018. Statistical analysis of the results from the second semi-annual detection monitoring sampling event are due to be completed in January 2019 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, and problems with analytical analysis) were encountered at the NMPP UWL in 2018.

### 2.2.4 Actions to Resolve Problems

No problems were encountered at the NMPP UWL in 2018; therefore, no actions to resolve problems were required.

### 2.2.5 Project Key Activities for Upcoming Year

Key activities to be completed in 2019 include statistical analysis of detection monitoring analytical data from October 2018 and conducting semi-annual detection monitoring 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 § 257.90(e)(1), a map showing the locations of the CCR unit and associated upgradient and downgradient monitoring wells for the UWL 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).

### 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 2018.

### 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), two independent detection monitoring samples from each background and downgradient monitoring well were collected in 2018. Detection monitoring samples are summarized in Table I. Table I includes the sample names, sample dates, and analytical results.

### 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***

Initial detection monitoring statistical analyses were completed in January 2018 in accordance with § 257.94(b). The analyte concentrations from the downgradient wells for each of the Appendix III constituents from the 2017 detection monitoring sampling event from each location were compared to their respective prediction limit (PL). A sample concentration greater than the PL is considered to represent a SSI. A SSI over background levels for one or more constituents listed in Appendix III was identified (pH at well MW-4). A summary of the Appendix III SSIs identified in January 2018 is provided in Table II.

A successful ASD was completed within 90 days of the SSI determination in accordance with 40 CFR §257.94(e)(2), and the UWL continued in the detection monitoring program.

### 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 to information 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 2018.

#### *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 required at this time.

#### *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.***

A SSI over background levels for pH was identified at well MW-4 during the first detection monitoring event. A successful ASD was completed and certified by a qualified professional engineer on 15 April 2018, which is within 90 days of the SSI determination in accordance with 40 CFR §257.94(e)(2), and the UWL continued in the detection monitoring program. The ASD is included as Attachment 1 to this report.

#### *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 UWL remains in detection monitoring and an alternative groundwater assessment monitoring sampling and analysis frequency has not been established for this CCR unit; therefore, no demonstration or certification is required at this time.

#### 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).***

The UWL has not transitioned into assessment monitoring and no assessment monitoring samples were collected or analyzed in 2018. Consequently, AECI is not required to establish groundwater protection standards for this CCR unit and this criterion is not applicable to the unit at this time.

#### 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 2018. Therefore, this criterion is not applicable to the CCR unit at this time.

#### 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 2018. Therefore, this criterion is not applicable to the CCR unit at this time.

### 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**
**SUMMARY OF ANALYTICAL RESULTS - DETECTION MONITORING**
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
UTILITY WASTE LANDFILL
NEW MADRID, MISSOURI

| Location | Upgradient | | | | | | Downgradient | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MW-16 | | B-123 | | B-126 | | MW-1 | | MW-2 | | MW-3 | | MW-4 | | MW-5 | | B-2 | | | B-5R | | B-41 | |
| Measure Point (TOC) | 292.853 | | 292.7 | | 293.63 | | 298.083 | | 297.693 | | 292.982 | | 293.942 | | 296.631 | | 291.91 | | | 288.69 | | 294.58 | |
| Sample Name | MW-16 | MW-16 | B-123 | B-123 | B-126 | B-126 | MW-1 | MW-1 | MW-2 | MW-2 | MW-3 | MW-3 | MW-4 | MW-4 | MW-5 | MW-5 | B-2 | B-2 | B-2 | B-5R | B-5R | B-41 | B-41 |
| Sample Date | 3/15/2018 | 9/12/2018 | 3/14/2018 | 9/12/2018 | 3/14/2018 | 9/11/2018 | 3/14/2018 | 9/12/2018 | 3/14/2018 | 9/12/2018 | 3/14/2018 | 9/12/2018 | 3/14/2018 | 9/13/2018 | 3/14/2018 | 9/12/2018 | 3/14/2018 | 7/25/2018 | 9/12/2018 | 3/14/2018 | 9/12/2018 | 3/14/2018 | 9/12/2018 |
| Lab Data Reviewed and Accepted | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 8/28/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 | 4/16/2018 | 10/15/2018 |
| Depth to Water (ft btoc) | 16.77 | 24.80 | 20.15 | 20.65 | 23.10 | 21.32 | 28.61 | 25.85 | 28.10 | 25.88 | 22.91 | 21.40 | 23.93 | 22.05 | 26.88 | 24.50 | 22.02 | -- | 19.35 | 21.32 | 19.30 | 24.17 | 22.62 |
| Temperature (Deg C) | 17.63 | 17.13 | 16.30 | 16.41 | 16.29 | 17.2 | 14.47 | 16.65 | 17.19 | 17.75 | 16.18 | 16.37 | 13.47 | 18.77 | 16.12 | 16.28 | 16.39 | -- | 16.38 | 16.92 | 17.45 | 16.13 | 16.6 |
| Conductivity (µS/cm) | 1.062 | 0.880 | 0.722 | 0.684 | 0.563 | 1017 | 0.399 | 0.559 | 0.388 | 0.369 | 0.564 | 0.566 | 0.149 | 0.115 | 0.472 | 0.492 | 0.716 | -- | 0.618 | 0.304 | 0.281 | 0.171 | 0.252 |
| Turbidity (NTU) | 124 | 4.9 | 22.1 | 30.9 | 1352 | 90.3 | 730 | 4.9 | 3.1 | 16.8 | 59.5 | 11.8 | 157 | 308 | 50.5 | 0.1 | 13.6 | -- | 3.4 | 3.1 | 1.8 | 44.0 | 13.8 |
| Boron, Total (mg/L) | **0.054** | **0.051** | **0.023** | **0.027** | **0.032** | **0.034** | **0.016** | **0.029** | **0.024** | **0.028** | **0.019** | **0.025** | **0.013** | **0.095** | **0.014** | **0.018** | **0.076** | **0.039** | **0.14** | **0.013** | **0.024** | <0.010 | 0.011 |
| Calcium, Total (mg/L) | **140** | **150** | **79** | **87** | **82** | **130** | **51** | **77** | **44** | **41** | **73** | **77** | **22** | **16** | **61** | **70** | **86** | **--** | **110** | **25** | **26** | **15** | **29** |
| Chloride (mg/L) | **12** | **16** | **3.3** | **3.7** | **3.6** | **1.0** | **8.5** | **9.2** | **12** | **11** | **5.8** | **7.8** | **1.0** | <1.0 | **7.6** | **12** | **4.5** | **--** | **5.9** | **9.6** | **9.4** | **3.1** | **4.8** |
| Fluoride (mg/L) | **1.45** | **1.20** | **0.547** | **0.521** | **0.369** | **0.284** | **0.296** | <.250 | **0.311** | <.250 | **0.342** | **0.341** | <0.250 | <0.250 | **0.279** | **0.291** | **0.359** | **--** | **0.298** | **0.280** | **0.254** | <0.250 | <0.250 |
| Sulfate (mg/L) | **84** | **73** | **32** | **31** | **26** | **90** | **31** | **19** | **18** | **8.8** | **34** | **30** | **1.8** | **1.1** | **29** | **24** | **65** | **--** | **71** | **20** | **20** | **12** | **12** |
| pH (su) | **7.03** | **6.99** | **7.35** | **7.36** | **7.00** | **7.00** | **7.16** | **7.12** | **6.72** | **6.90** | **6.81** | **6.96** | **6.94** | **6.70** | **7.35** | **7.32** | **7.19** | **--** | **7.07** | **6.48** | **6.46** | **6.49** | **7.20** |
| TDS (mg/L) | **580** | **400** | **370** | **330** | **280** | **440** | **220** | **280** | **190** | **170** | **280** | **260** | **87** | **90** | **250** | **220** | **360** | **--** | **320** | **140** | **140** | **130** | **160** |

**Notes:**

*µS/cm = micro Siemens per centimeter*
*ft btoc = feet below top of casing*
*Deg C = degrees Celsius*
*mg/L = milligrams per liter*
*NTU = Nephelometric Turbidity Unit*
*su = standard unit*
*TDS = total dissolved solids*
*TOC = top of casing*
***Bold value: Detection above laboratory reporting limit***

**TABLE II**
**SUMMARY OF APPENDIX III SSIs**
ASSOCIATED ELECTRIC COOPERATIVE, INC.
NEW MADRID POWER PLANT
UTILITY WASTE LANDFILL
NEW MADRID, MISSOURI

| Well ID | Statistical Analysis Completed | Constituent |
|---|---|---|
| MW-4 | January 2018 | pH |

***Notes:***

*SSIs = statistically significant increases*

**FIGURE**


**LEGEND**

MONITORING WELL

UTILITY WASTE LANDFILL (UWL) BOUNDARY

**NOTE**
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 1,500 3,000
SCALE IN FEET

HALEY ALDRICH

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

# UTILITY WASTE LANDFILL MONITORING WELL LOCATION MAP

aeci

JANUARY 2019
SCALE: AS SHOWN

FIGURE 1

GIS FILE PATH: \\haleyaldrich.com\share\phx_common\Projects\AECI\New Madrid\GIS\MXDs\2018_1\UWL LOCATION MAP_REV1.mxd — USER: DZinsmaster — LAST SAVED: 3/16/2018 9:57:00 AM

# ATTACHMENT 1

# Appendix III SSI Alternate Source Demonstration for the Utility Waste Landfill

HALEY & ALDRICH, INC.
6500 Rockside Road
Suite 200
Cleveland, OH 44131
216.739.0555

15 April 2018
File No. 129342-016

SUBJECT: New Madrid Power Plant – UWL Groundwater Monitoring System
Appendix III Statistically Significant Increase
Alternate Source Demonstration Certification
Associated Electric Cooperative, Inc.

Associated Electric Cooperative, Inc. (AECI) operates a groundwater monitoring system at the New Madrid Power Plant (NMPP) located in New Madrid, Missouri for compliance monitoring under the United States Environmental Protection Agency (EPA) Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals from Electric Utilities, set forth at Code of Federal Regulations Title 40 (40 CFR) Part 257 Subpart D (CCR Rule), effective 19 October 2015. The groundwater monitoring system includes wells installed to monitor groundwater quality downgradient of the coal combustion residuals (CCR) management unit referred to as the Utility Waste Landfill (UWL).

Haley & Aldrich, Inc. (Haley & Aldrich) understands that AECI has initiated detection monitoring for constituents listed in Appendix III of the CCR Rule pursuant to Section 257.94 of the CCR Rule. AECI has finalized statistical analysis of the groundwater quality data generated from the Detection Monitoring program pursuant to 40 CFR 257.93. The statistical analyses completed on 15 January 2018 have identified a statistically significant increase (SSI) in downgradient concentrations above background at the UWL for pH at MW-4.

Section 257.94(e)(2) of the CCR Rule includes provisions for the facility owner to conduct an alternate source demonstration (ASD) to demonstrate that an SSI over background levels for an Appendix III constituent originated from a source other than the CCR management unit, or that the SSI resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The CCR Rule provides for a period of 90 days to complete an ASD for Appendix III constituents after an SSI has been identified. Haley & Aldrich has completed an evaluation and developed a written demonstration titled "Summary Report, Appendix III SSI Alternate Source Demonstration for the Utility Waste Landfill, New Madrid Power Plant, New Madrid, Missouri" which summarizes the data evaluated and the results of the evaluation.

Pursuant to 40 CFR §257.94(e)(2), AECI conducted an alternate source evaluation to demonstrate that a source other than the Utility Waste Landfill caused the statistically significant increase over background identified during detection monitoring. I certify that I have reviewed the ASD written demonstration and all attachments and verify the accuracy of the information in the report. The information contained in the evaluation is, to the best of my knowledge, true, accurate, and complete.

This certification and the underlying data support the conclusion that a source other than the CCR unit is the cause of the SSI over background levels for Appendix III constituents detected during detection monitoring of this groundwater monitoring system. That alternate source is natural variation in

groundwater quality. The ASD written demonstration and this certification apply to the previously detected SSIs for pH at MW-4 at the UWL downgradient monitoring wells.

HALEY & ALDRICH, INC.

Signed:_____
Certifying Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal

HALEY ALDRICH

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# SUMMARY REPORT
# APPENDIX III SSI
# ALTERNATE SOURCE DEMONSTRATION
# FOR THE UTILITY WASTE LANDFILL
# NEW MADRID POWER PLANT
# NEW MADRID, MISSOURI

By Haley & Aldrich, Inc.
Cleveland, Ohio

For Associated Electric Cooperative, Inc.
Springfield, Missouri

File No. 129342-016
April 2018

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# 1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Associated Electric Cooperative Inc. (AECI) to perform an evaluation of groundwater quality at the Utility Waste Landfill (UWL) 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 pH concentrations detected in groundwater samples collected from monitoring wells located down gradient of the UWL.

## 1.1 BACKGROUND

Consistent with Code of Federal Regulations Title 40 (40 CFR) §257.90 through §257.94, AECI has installed and certified a groundwater monitoring network for the UWL at NMPP and has collected 10 rounds of groundwater samples for the analysis of Appendix III baseline 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 down-gradient monitoring wells at concentrations with a statistically significant increase (SSI) above background. The statistical evaluation of the Appendix III constituents detected an SSI for pH above background down gradient of the UWL at monitoring well MW-4. The analyses described in this report were conducted in an attempt to identify the source of the elevated pH concentrations down gradient of the UWL.

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 Alternate Source Demonstration (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 pH at the UWL 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 with extensive agricultural use. The UWL is a CCR landfill that encompasses approximately 50 acres and is located approximately 1.7 miles southwest of the NMPP site. The UWL has ground surface elevations varying from 290 to 320 feet above mean sea level. The UWL and 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 generated are byproducts of the combustion process and include fly ash and boiler slag material.

The UWL was constructed with 2-foot thick 1 x $10^{-5}$ centimeter/second clay, followed by a 60-mil high-density polyethylene (HDPE) geomembrane layer, a leachate collection system consisting of a geocomposite drainage layer, perforated HDPE leachate collection pipes wrapped with a filter sock and embedded in granular sand drainage material, and a geotextile layer over the leachate pipe trenches to provide separation between the granular sand drainage material and the overlying protective soil layer; followed by a protective soil layer (Haley & Aldrich, 2017a). The leachate collection system discharges to the leachate collection pond, located approximately 0.35 mile to the east of the UWL.

# 2. Site Geology and Hydrogeology

Geologic and hydrogeologic conditions beneath the UWL have been characterized based on information obtained during installation and testing of the monitoring wells installed around the UWL in 2004 and monitoring wells installed as part of the CCR groundwater monitoring network.

## 2.1 SITE GEOLOGY

The UWL 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 the UWL are underlain by an unconsolidated alluvium which constitutes a regionally extensive aquifer.

In order from ground surface downward, the UWL 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 the UWL 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 the UWL (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, 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 the UWL. 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 the UWL is alluvium consisting of moderately to poorly sorted clay, silt, sand, and gravel of Holocene age. The aquifer is used locally for irrigation and domestic use.

Based on groundwater elevations measured between November 2016 and August 2017, the groundwater gradient in the upper aquifer unit is approximately 0.0005 to 0.006 and is unconfined. The groundwater flow direction is primarily to the northeast but at times flows to the east. The UWL is

located approximately 1.75 miles from the Mississippi River. Seasonal changes in river stage cause the groundwater flow direction to change periodically indicating that the river is in hydraulic communication with the local groundwater system.

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 53 to 101 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 represent 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 (ONWI, 1982 and Prudic, 1991).

# 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 SSI of pH down gradient of the UWL. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity of the UWL 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, 2017b) 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 the UWL. 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 SSI for pH down gradient of the UWL.

### 3.1.2 Laboratory Quality Control

The groundwater samples collected down gradient of the UWL were initially analyzed using standard analytical 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, 2017).

Haley & Aldrich conducted a quality assurance/quality control review of each groundwater quality dataset generated for the UWL and has not identified apparent errors that would result in a potential SSI for pH down gradient of the UWL.

### 3.1.3 Statistical Evaluation

AECI and Haley & Aldrich collected a total of 10 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 the UWL over a period spanning from November 2016 through August 2017 for CCR Rule compliance. Statistical analysis of the analytical results was completed in accordance with the CCR Rule.

Haley & Aldrich has reviewed the statistical analysis of groundwater quality data for the up-gradient and down-gradient wells at the UWL and has not identified apparent errors that would result in a potential

SSI for pH down gradient of the UWL. The statistical test method used met the performance standard established in the CCR Rule, and statistical evaluation complies with the requirements of the Rule.

## 3.2 POTENTIAL POINT AND NON-POINT SOURCES

Haley & Aldrich conducted a review of potential point and non-point sources of elevated pH values in the vicinity of the UWL to determine if previous or adjacent site activities, land uses, or practices might have caused elevated pH values to occur down gradient of the UWL. 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 pH 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 pH concentrations, that is detected at the down-gradient side of the UWL.

### 3.2.1 Point Sources

Prior to construction of the UWL, the landfill site and the surrounding vicinity was agricultural land. Review of historical United States Geological Survey (USGS) topographic maps show undeveloped land prior to the construction of the plant site and the UWL. No known industrial, mining, or other activities were conducted at the UWL site prior to construction of the landfill that would potentially constitute a point source to concentrate pH in groundwater in the vicinity of the observed SSIs. Agricultural land use is not expected to constitute a point source of pH at the location of the observed SSI.

### 3.2.2 Non-Point Sources

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

## 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 Risk Information Services (ERIS) – Aerial Photographs, dated 1952, 1969, 1978, 1981, 1988, 1996, 2003, 2004, 2005, 2006, 2007, 2009, 2010, 2012, 2014, and 2016 (Appendix A); and
- ERIS – Topographic Maps, dated 1964, 1978, and 2012 (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 Table I below. The historical aerial photograph search includes photographs from the

Army Mapping Service, USGS, United States Army Corps of Engineers, National High-Altitude Photography, National Aerial Photography Program, and the National Agriculture Information Program (ERIS, 2018) 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 growth of the landfill to its current footprint.

**Table I – Historical Aerial Photograph Review Summary**

| Dates | Description of Site and Adjacent Properties | Sources |
|---|---|---|
| 1952 – 1969 | Agricultural use of site and adjacent properties with some road use. | Aerial photos – USGS; AMS |
| 1978 – 2006 | The plant site is active. Agricultural use of site and adjacent properties surrounding the UWL. The plant site is active. | Aerial photos – USACE; NHAP; NAPP; USGS; NAIP |
| 2007 – 2016 | The plant site and the UWL are active. Agricultural use of site and adjacent properties surrounding the UWL. | Aerial photos – NAIP |

***Notes:***

*AMS = Army Mapping Service*
*NAIP = National Agriculture Information Program*
*NAPP = National Aerial Photography Program*
*NHAP = National High-Altitude Photography*
*USACE = United States Army Corps of Engineers*
*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 ERIS. Copies of the topographic maps are included in Appendix B.

**Table II – Historical Topographic Map Review Summary**

| Dates | Description of Site and Adjacent Properties | Map Name |
|---|---|---|
| 1939 | 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 |
| 1951 | Partial map only showing the Mississippi River. | 7.5-Minute Series, New Madrid SE, Missouri Quadrangle |
| 1954 | Partial 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 | The map shows no development at the UWL site. The plant site and adjacent industrial facility are shown on the map. | 7.5-Minute Series, New Madrid, Missouri Quadrangle |
| 1982 | The UWL, plant site, and industrial facility located to the northeast of the UWL are shown on the map. | 7.5-Minute Series, New Madrid, Missouri Quadrangle |
| 2015 | The UWL is shown on the map. The plant site and the industrial facility located to the northeast of the UWL are not shown on the map, however, access roads to both are shown. | 7.5-Minute Series, New Madrid, Missouri Quadrangle |

## 3.4 LOCAL AND REGIONAL WATER QUALITY OBSERVATIONS

The Mississippi River constitutes a major source of recharge to the uppermost aquifer beneath the UWL throughout the year. When the River is at high stage, it is the dominant source of recharge to the uppermost aquifer. Consequently, groundwater quality in the uppermost aquifer is controlled, at least partly, by the water quality of Mississippi River water.

The pH values observed at UWL monitoring well MW-4 ranged from 7.40 to 7.99. The highest pH values observed at UWL monitoring well MW-4 were observed on 9 January 2017, and 25 January 2017 with respective values of 7.92 and 7.99. The pH values observed at this monitoring well in the subsequent six sampling rounds after 25 January 2017 ranged between 7.41 and 7.62. These values are lower than the January 2017 sampling events.

Since January 2017, pH values in MW-4 have been below the maximum values observed in the up-gradient monitoring wells. If this trend continues in subsequent sampling events, the pH SSI previously observed at UWL monitoring well MW-4 has the potential to be eliminated through updates to the statistical analysis.

### 3.4.1 USGS Surface Water Quality Data

Analysis of Mississippi River water quality, up-stream from NMPP near Cape Girardeau, indicate that the pH range of the River ranges between 7.8 and 8.5 (USGS, 2018), as depicted in Figure 2. Consequently, groundwater in the shallow alluvial aquifer near the Mississippi River has a pH of 7.5 or higher. The pH values reported for the Lower Mississippi River tributaries in Missouri near New Madrid County are generally above 7.5 (Brookshire, 1997), consistent with the pH range observed in Mississippi River water.

The NMPP site has 15 monitoring wells completed for the purpose of monitoring groundwater quality beneath impoundments located at the plant site. Of these monitoring wells, those located closest to the River consistently exhibit the highest groundwater pH. These monitoring wells are located between 182 and 560 feet from the River and exhibit pH values ranging from 6.89 to 8.21. Monitoring well MW-4 is located approximately 12,500 feet from the River and exhibits an average pH of 7.58, and a maximum pH of 7.99. The Mississippi River has been at Flood Stage or higher during 11 events in the last 10 years. The most recent documented occurrence of the River flowing at Flood Stage or higher was in May 2017. The pH observed at monitoring well MW-4 at the UWL is lower than the pH observed in Mississippi River water, a major source of recharge water to the uppermost aquifer beneath the UWL. The average pH observed at monitoring well MW-4 is lower than the average pH observed at monitoring wells located immediately adjacent to the Mississippi River.

### 3.4.2 Range of pH 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. Figure 3 shows reported groundwater pH values in several municipal water supply wells in the New Madrid County and nearby counties. The reported pH values for water supply wells producing groundwater from the Mississippi and Missouri River alluvium range between 6.5 and 8.2. The pH values observed in MW-4 are consistent with pH variability observed regionally in groundwater withdrawn from Mississippi and Missouri River sediments.

# 4. Findings and Conclusions

Haley & Aldrich conducted an evaluation of groundwater quality at the NMPP UWL to identify the source of SSIs of pH values detected in groundwater samples collected from one monitoring well (MW-4) located down gradient of the UWL. 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 SSI of pH down gradient of the UWL. Haley & Aldrich also evaluated potential point and non-point sources of contamination in the vicinity of the UWL 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 SSI for pH down gradient of the UWL. Haley & Aldrich found no apparent evidence of historical point or non-point sources of potential pH values in the vicinity of the UWL.

Haley & Aldrich evaluated data and information describing the surface water quality of the Mississippi River and regional water quality of the shallow alluvial groundwater aquifer. The evaluation also included a review of data describing the natural variability of pH values in the uppermost aquifer beneath the UWL. Key findings regarding the regional groundwater pH variability and natural groundwater quality variability are summarized below:

- The UWL is constructed with a composite liner, consisting of a low permeable clay, HDPE geomembrane layer, leachate collection system, geotextile layer, and natural soil cover. This construction reduces the likelihood of seepage of leachate from the UWL into the uppermost aquifer.
- The shallow aquifer beneath the UWL is part of the Mississippi River alluvium and is in direct communication with the Mississippi River which has a higher pH than groundwater in the uppermost aquifer.
- The pH values observed in MW-4 (average 7.58 and maximum 7.99) are within the range of pH values of Mississippi River water (between 7.5 and 8.5).
- The pH values observed in MW-4 (average 7.58 and maximum 7.99) are generally within the range observed in the site up gradient monitoring wells (average 7.12 and maximum 7.88), with the exception of the January 2017 sampling events which produced pH values higher than the maximum up gradient pH value. All subsequent pH values observed at MW-4 were below the maximum observed in the up-gradient wells and within the range of values observed at the up-gradient wells.
- The pH values observed in MW-4 (average 7.58 and maximum 7.99) are within the range of regional groundwater in proximity to the UWL (7.7 to 8.2).
- Monitoring wells located adjacent to the River, have pH values ranging between 6.91 and 8.21, and appear to be influenced by River water. This pH value is comparable to that observed in monitoring well MW-4.
- The pH variability observed at monitoring well MW-4 is the result of natural groundwater quality variability.

Based on these findings, it is evident that the pH of groundwater at UWL monitoring well MW-4 is within the range of pH of groundwater withdrawn from the regional aquifer composed of Mississippi and Missouri River alluvium and is consistent with pH values in groundwater that has been influenced by recharge form the Mississippi River. The statistically significant increased pH values observed in MW-4 down gradient of the UWL fall within the range of observed natural variability of pH values observed in water supply wells within the region.

Based on the data, information, research, and analyses conducted to date and presented in this document, Haley & Aldrich concludes that the source of pH resulting in a SSI at MW-4, down gradient of the UWL, is natural groundwater quality variability.

## 5. Closing

Pursuant to 40 CFR §257.94(e)(2), AECI conducted an alternate source evaluation to demonstrate that a source other than the UWL caused the statistically significant increase over background identified during detection monitoring. This demonstration and the underlying data support the conclusion that a source other than the CCR unit is the cause of the statistically significant increase (SSI) over background levels for Appendix III constituents detected during detection 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

Mark Nicholls, P.G.
Lead Hydrogeologist

# 6. References


1. Brookshire C.N., 1997. Missouri Water Quality Assessment, Missouri State Water Plan Series Volume III, Water Resources Report Number 47. Missouri Department of Natural Resources.

2. Burns & McDonnell, 2006. Groundwater Monitoring Program. 2006.

3. Environmental Risk Information Services. 2018. Database Report, March 2018.

4. Gredell Engineering Resources, Inc., 2003. Detailed Site Investigation Work Plan, Proposed AECI New Madrid Utility Waste Landfill. 13 June.

5. Haley & Aldrich, 2017a. Report on Phase III (Cell 2) Utility Waste Landfill Authorization to Operate Application, New Madrid Power Plant. September 2017.

6. Haley & Aldrich, 2017b. Groundwater Sampling and Analysis Pan, New Madrid Power Plant. October 2017.

7. Miller, Don E., and Vandike, James E., 1997. *Missouri State Water Plan Series Volume II, Groundwater Resources of Missouri,* Missouri Department of Natural Resources Division of Geology and Land Survey, Water Resources Report No. 46, 1997.

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9. Prudic, David E., United States Geological Survey, 1991. Estimates of Hydraulic Conductivity from Aquifer-Test Analyses and Specific-Capacity Data, Gulf Coast Regional Aquifer Systems, South-Central United States. Water Resources Investigations Report 90-4121.

10. USGS, 1939. Topographic Map, New Madrid, 15-minute series.

11. USGS, 1951. Topographic Map, New Madrid SE, 7.5-minute series.

12. USGS, 1954. Topographic Map, New Madrid, 15-minute series.

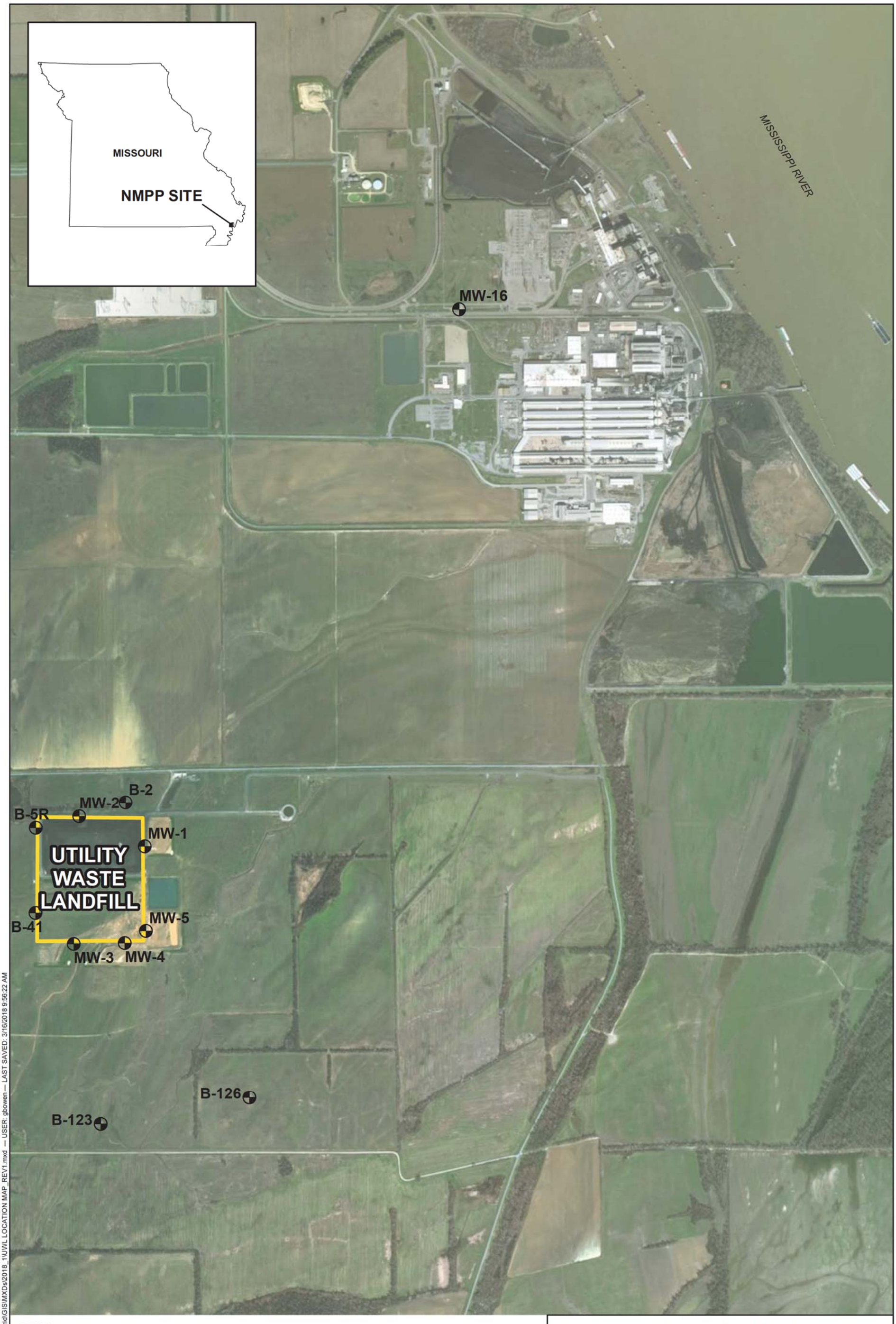
13. USGS, 1971. Topographic Map, New Madrid, 7.5-minute series.

14. USGS, 1982. Topographic Map, New Madrid, 7.5-minute series.

15. USGS, 2015. Topographic Map, New Madrid, 7.5-minute series.

16. USGS, 2018. pH Data at the USGS Station – 07020850 Mississippi River at Cape Girardeau, MO. Accessed on 13 March 2018.

# FIGURES




**LEGEND**

MONITORING WELL

UTILITY WASTE LANDFILL (UWL) BOUNDARY

**NOTE**
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. AERIAL IMAGERY SOURCE: ESRI, 19 MAY 2016.

N

0 1,500 3,000
SCALE IN FEET

HALEY ALDRICH

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

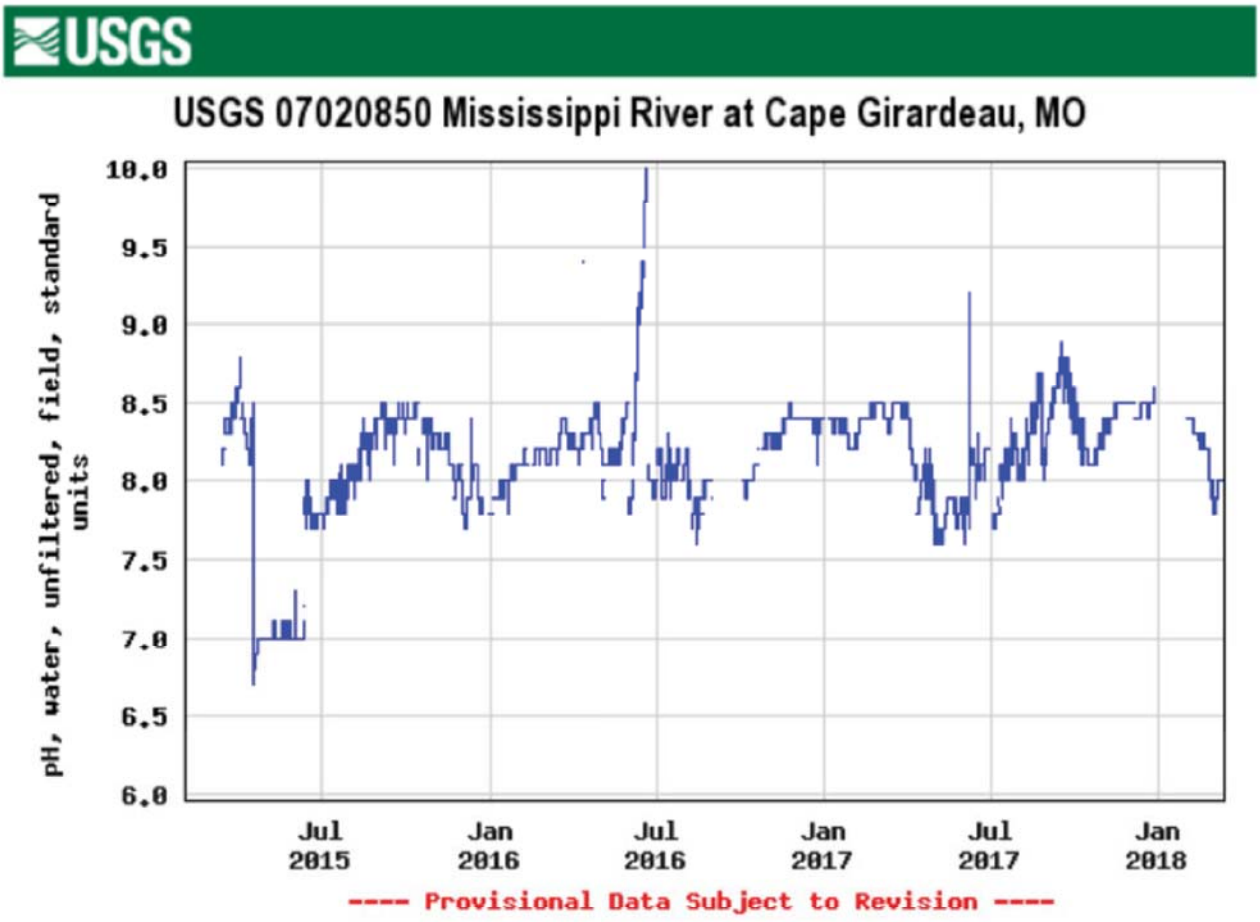
# UTILITY WASTE LANDFILL MONITORING WELL LOCATION MAP

aeci

APRIL 2018
SCALE: AS SHOWN

FIGURE 1

GIS FILE PATH: G:\Projects\AECI\New Madrid\GIS\MXDs\2018_1\UWL LOCATION MAP_REV1.mxd — USER: gbowen — LAST SAVED: 3/16/2018 9:56:22 AM



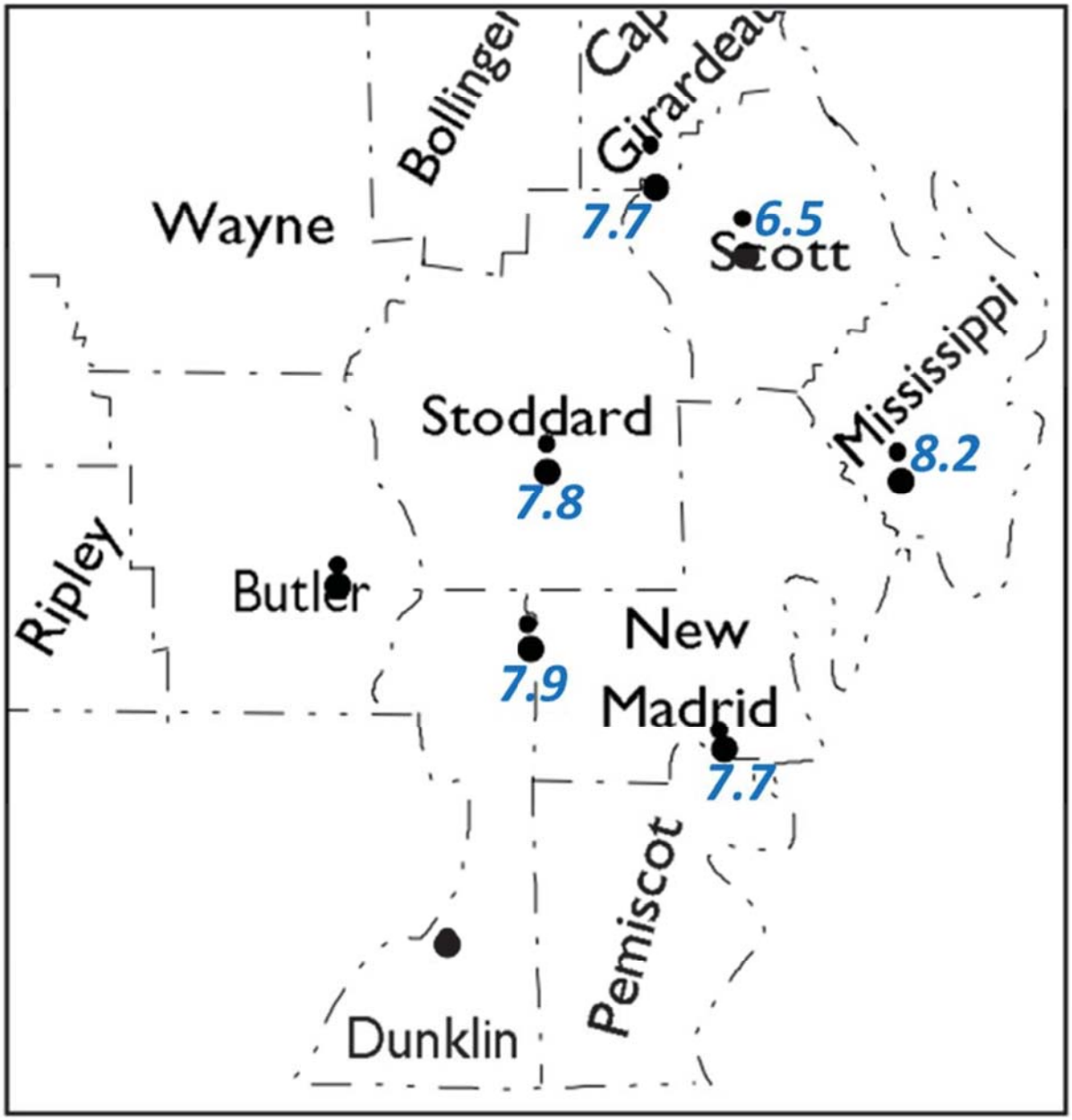

HALEY ALDRICH

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

USGS CAPE GIRARDEAU STATION
MISSISSIPPI RIVER WATER
PH VALUES

MARCH 2018

FIGURE 2




**NOTE**
MEASURED GROUNDWATER PH VALUES (BLUE ITALIC NUMBER) FOR SELECTED SOUTHEASTERN MISSOURI MUNICIPAL WATER SUPPLY WELLS IN COUNTY OF NEW MADRID AND NEARBY COUNTIES. THESE WELLS OBTAIN WATER FROM THE ALLUVIAL AQUIFER. THE FIGURE AND DATA WERE ADAPTED FROM BROOKSHIRE (1997).

HALEY ALDRICH

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

PH VALUES FOR MUNICIPAL WATER SUPPLY WELLS - NEW MADRID AND NEARBY COUNTIES

MARCH 2018

FIGURE 3

# APPENDIX A

## ERIS Historical Aerial Photograph Report

ENVIRONMENTAL RISK INFORMATION SERVICES

# HISTORICAL AERIAL REPORT

*for the site:*
**NMPP**
41 St Jude Industrial
Marston, MO 63873
PO #:

Report ID: 20180302350
Completed: 3/14/2018

**ERIS Information Inc.**
Environmental Risk Information Services (ERIS)
A division of Glacier Media Inc.
T: 1.866.517.5204
E: info@erisinfo.com

**www.erisinfo.com**

## Search Results Summary

| Date | Source | Scale | Comment |
|---|---|---|---|
| 2016 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2014 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2012 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2010 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2009 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2007 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2006 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2005 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2004 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 2003 | **NAIP** - National Agriculture Information Program | 1"=2500' | |
| 1996 | **USGS** - US Geological Survey | 1"=2500' | |
| 1988 | **NAPP** - National Aerial Photography Program | 1"=2500' | *BEST COPY AVAILABLE* |
| 1981 | **NHAP** - National High Altitude Photography | 1"=2500' | |
| 1978 | **ACE** - Army Corps of Engineers | 1"=2500' | *BEST COPY AVAILABLE* |
| 1969 | **USGS** - US Geological Survey | 1"=2500' | *BEST COPY AVAILABLE* |
| 1952 | **AMS** - Army Mapping Service | 1"=2500' | |


Date: **2016**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2014**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2012**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2010**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2009**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2007**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2006**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2005**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2004**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **2003**
Source: **NAIP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **1996**
Source: **USGS**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **1988**
Source: **NAPP**
Scale: **1" to 2500'**
Comments: *BEST COPY AVAILABLE*

N

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **1981**
Source: **NHAP**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **1978**
Source: **ACE**
Scale: **1" to 2500'**
Comments: *BEST COPY AVAILABLE*

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **1969**
Source: **USGS**
Scale: **1" to 2500'**
Comments: *BEST COPY AVAILABLE*

N

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

www.erisinfo.com | 1.866.517.5204


Date: **1952**
Source: **AMS**
Scale: **1" to 2500'**
Comments:

*Subject: 41 St Jude Industrial Marston MO*
Approx Center: 36.50316 / -89.56863

N

ERIS
ENVIRONMENTAL RISK INFORMATION SERVICES

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# APPENDIX B

## ERIS Topographic Map Research Results

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# TOPOGRAPHIC MAP RESEARCH RESULTS

**Date: 2018-03-02**

## Project Property: 41 St Jude Industrial, Marston, MO

ERIS Order Number: 20180302350

We have searched USGS collections of current topographic maps and historical topographic maps for the project property. Below is a list of maps found for the project property and adjacent area. Maps are from 7.5 and 15 minute topographic map series, if available.

| Year | Map Series |
|---|---|
| 2015 | 7.5 |
| 1982 | 7.5 |
| 1971 | 7.5 |
| 1951 | 7.5 |
| 1954 | 15 |
| 1939 | 15 |



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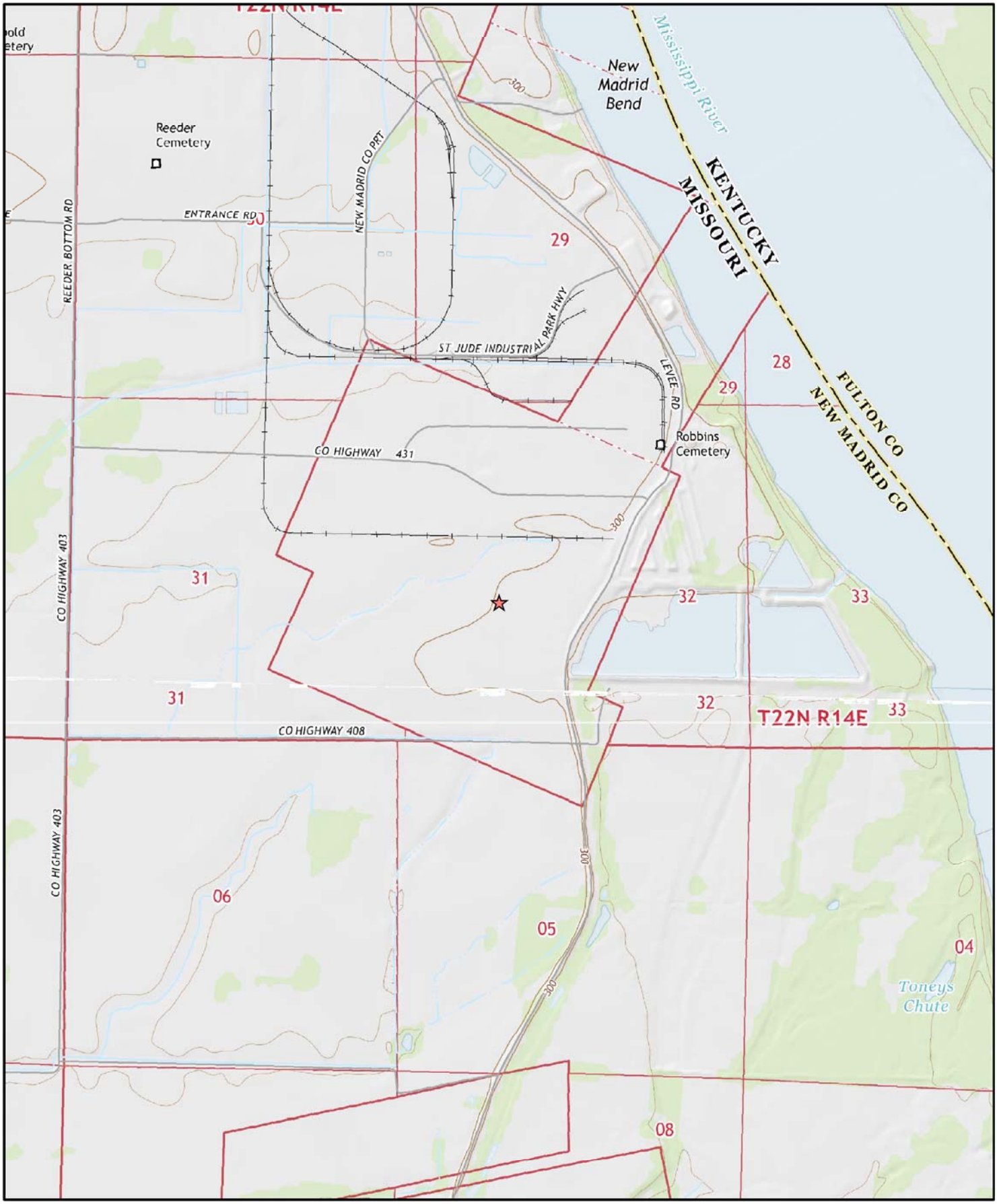


**2015**

0 0.2 0.4 0.8 Miles

Order No. 20180302350

**Quadrangle(s): New Madrid,MO**

Source: USGS 7.5 Minute Topographic Map

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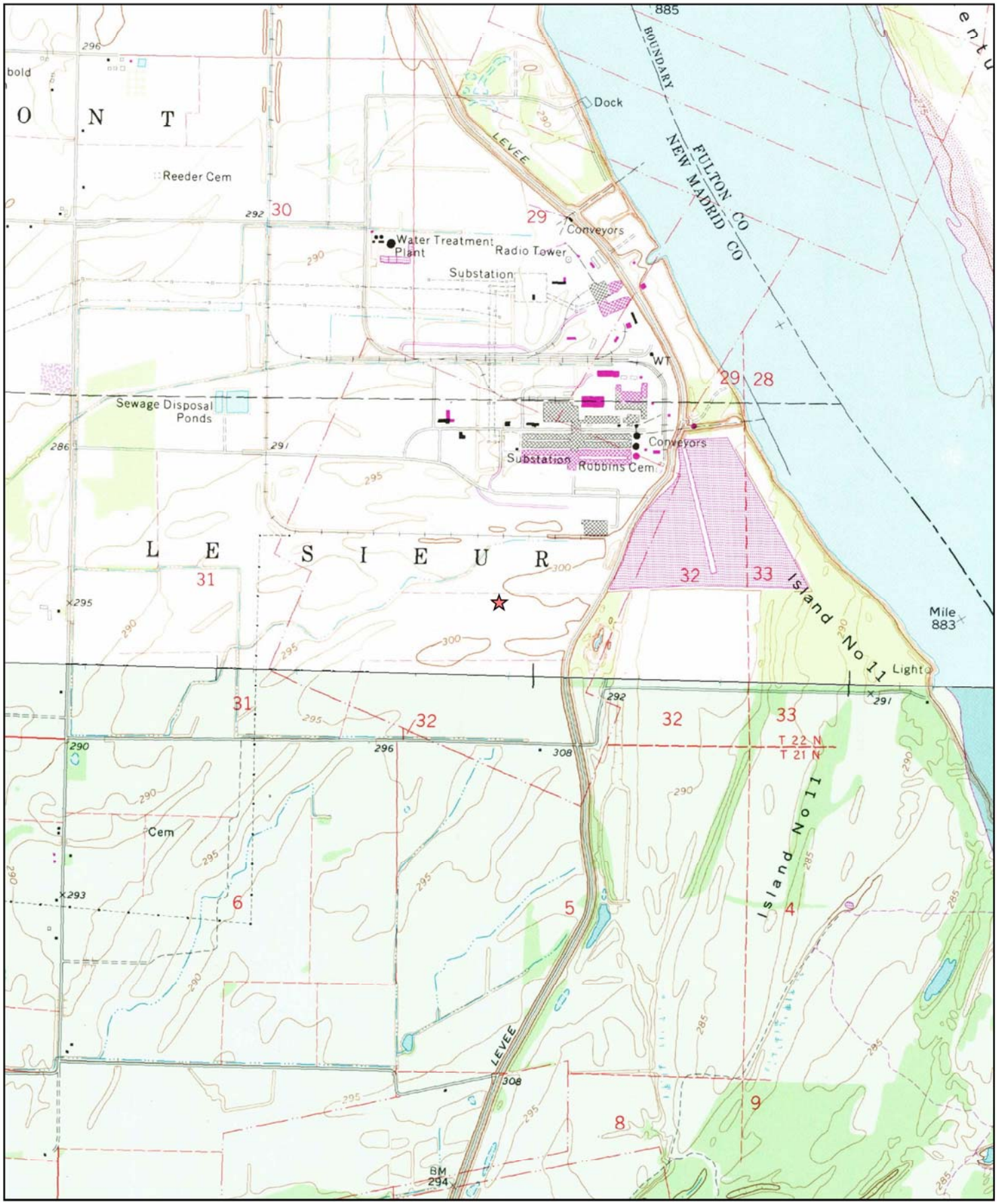



**1982**

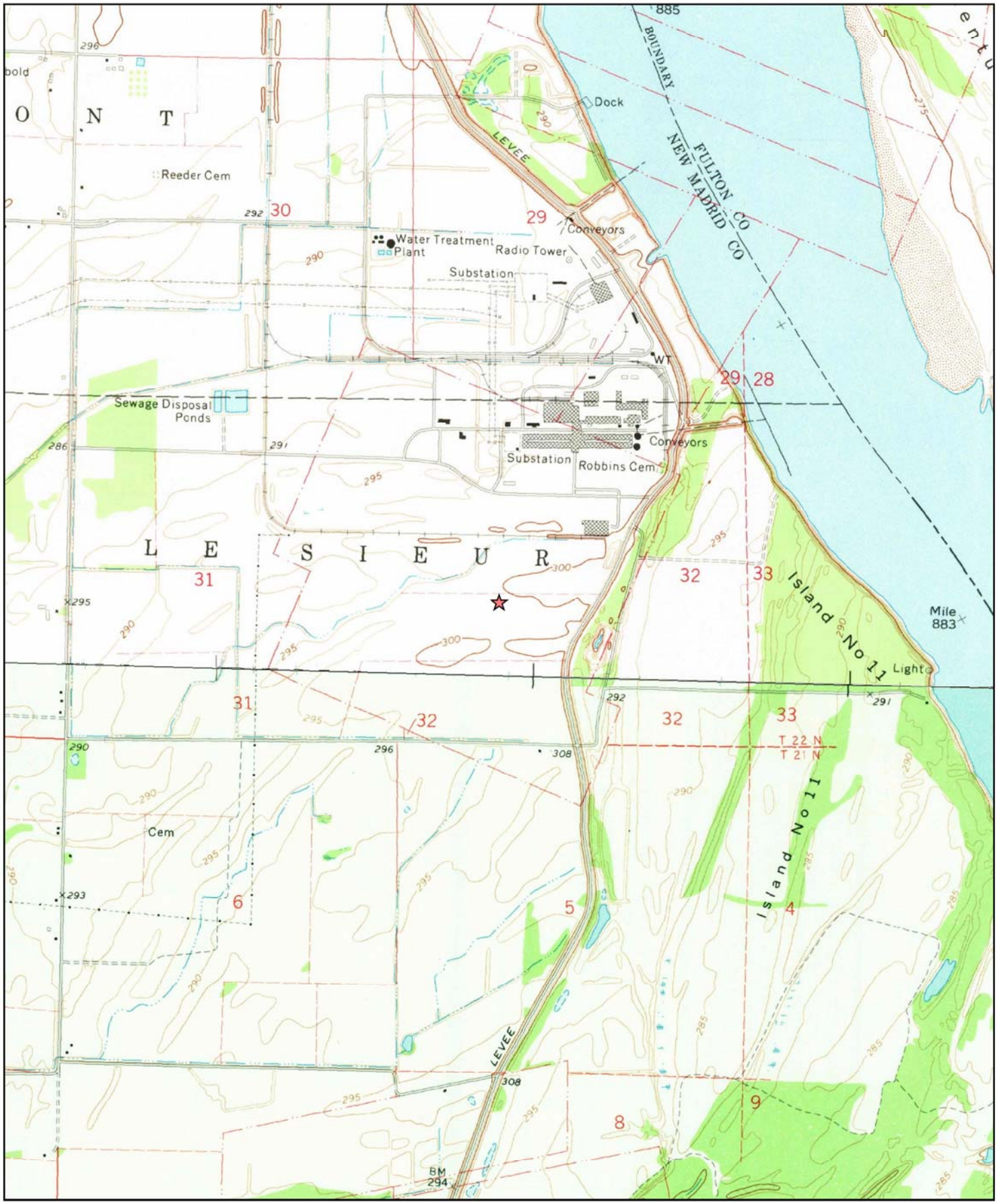
0 0.2 0.4 0.8 Miles

Order No. 20180302350

**Quadrangle(s): New Madrid,MO**

Source: USGS 7.5 Minute Topographic Map

ERIS ENVIRONMENTAL RISK INFORMATION SERVICE




**1971**

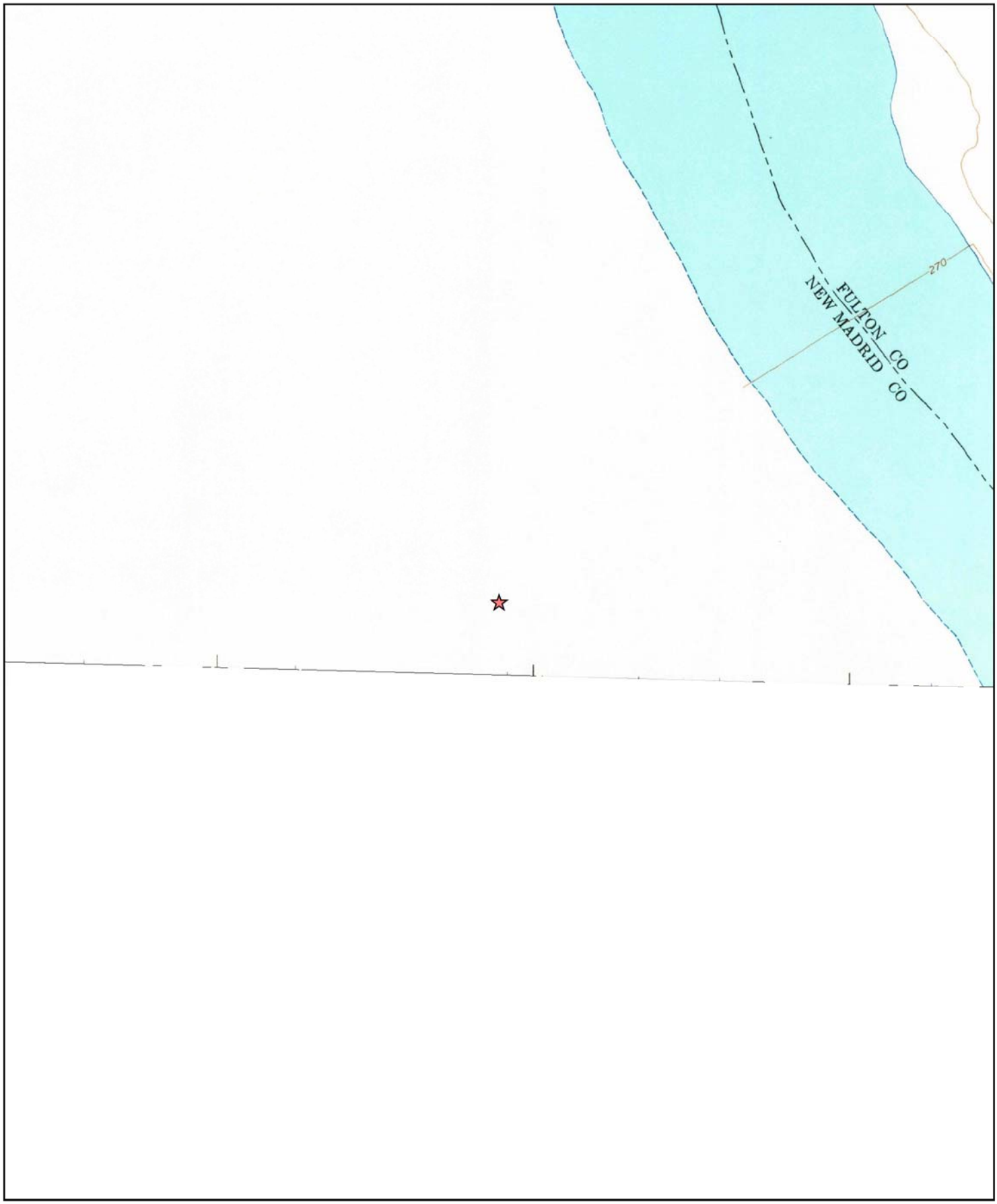
0 0.2 0.4 0.8 Miles

Order No. 20180302350

**Quadrangle(s): New Madrid,MO**

Source: USGS 7.5 Minute Topographic Map

ERIS ENVIRONMENTAL RISK INFORMATION SERVICE




**1951**

0 0.2 0.4 0.8 Miles

Order No. 20180302350

**Quadrangle(s): New Madrid SE,MO**

Source: USGS 7.5 Minute Topographic Map

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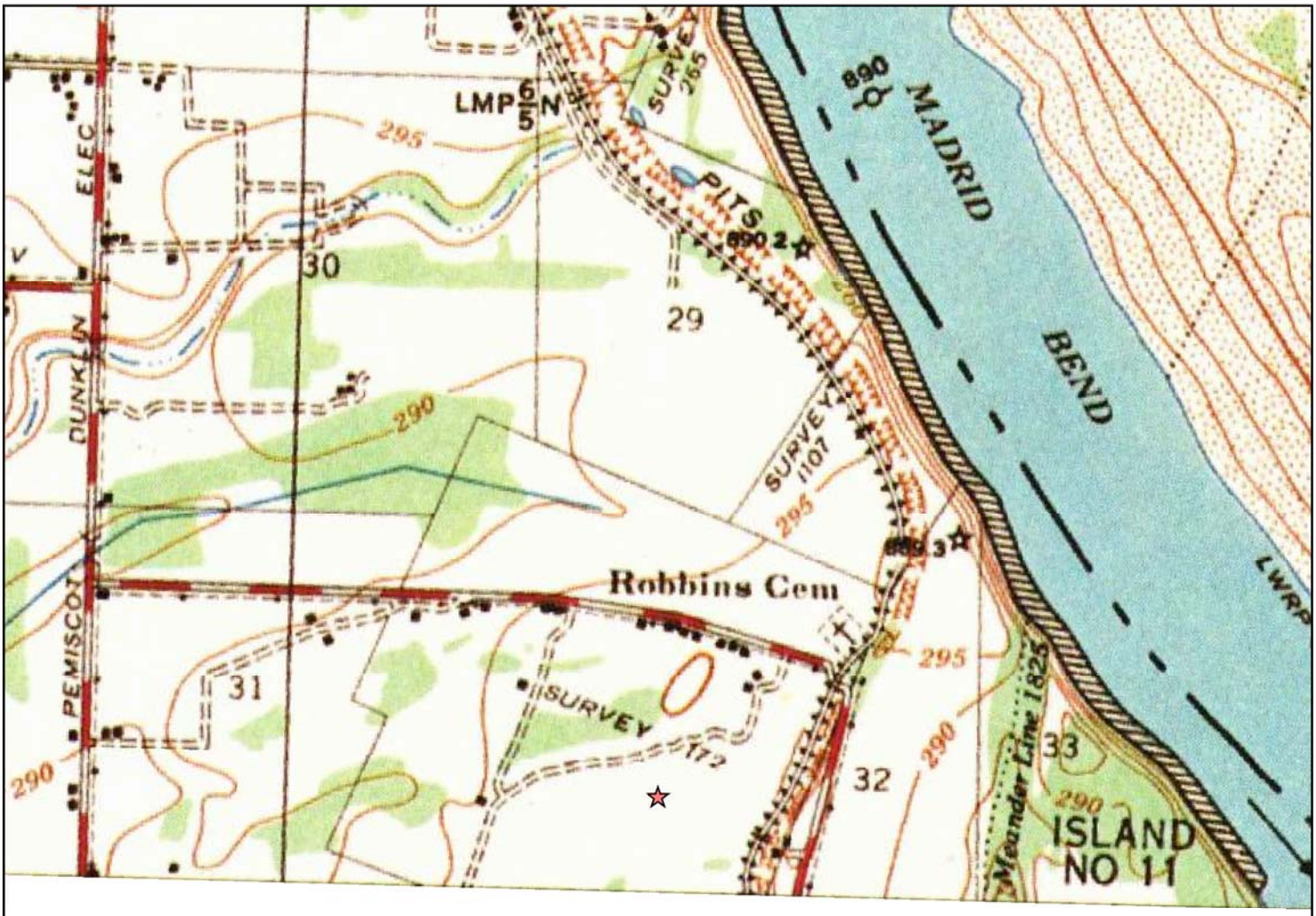


**1954**

0 0.2 0.4 0.8 Miles

Order No. 20180302350

**Quadrangle(s): New Madrid,MO**

Source: USGS 15 Minute Topographic Map

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**1939**

0 0.2 0.4 0.8 Miles

Order No. 20180302350

**Quadrangle(s): New Madrid,MO**

Source: USGS 15 Minute Topographic Map

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