OHIO VALLEY ELECTRIC CORPORATION
3932 U. S. Route 23
P. O. Box 468
Piketon, Ohio 45661
740-289-7200

WRITER'S DIRECT DIAL NO:
740-289-7259

January 31, 2024

Delivered Electronically

Mr. Brian Rockensuess
Commissioner
Indiana Department of Environmental Management
100 N. Senate Avenue
Mail Code 50-01
Indianapolis, IN 46204-2251

Re: Indiana-Kentucky Electric Corporation- Clifty Creek Station
2023 Annual Groundwater Monitoring and Corrective Actions Report

Dear Mr. Rockensuess:

As required by 40 CFR 257.106(h)(1), Indiana-Kentucky Electric Corporation (IKEC) is providing notification to the Commissioner of the Indiana Department of Environmental Management (IDEM) that the seventh Annual CCR Groundwater Monitoring and Corrective Actions Report has been completed in compliance with 40 CFR 257.90(e) for IKEC's Clifty Creek Station. The groundwater monitoring and corrective action report was prepared by AGES, Inc., the site's hydrogeologist, summarizing the findings for 2023. The report has been placed in the facility's operating record in accordance with 40 CRF 257.105(h)(1), as well as, on the company's publicly accessible internet site in accordance with 40 CFR 257.107(h)(1), which can be viewed at http://www.ovec.com/CCRCompliance.php

If you have any questions, or require any additional information, please call me at (740) 289-7259, or you can contact Gabe Coriell at (740) 289-7267.

Sincerely,

Jeremy Galloway
Environmental Specialist

JDG: tlf

Stantec Consulting Services Inc.
10200 Alliance Road, Suite 300
Cincinnati OH 45242-4754

January 31, 2024

Project/File: 175532014

Mr. Jeremy Galloway
Ohio Valley Electric Corporation
Indiana-Kentucky Electric Corporation
3932 U.S. Route 23
P.O. Box 468
Piketon, Ohio 45661

Reference: 2023 Annual Groundwater Monitoring and Corrective Action Report
EPA Final Coal Combustion Residuals (CCR) Rule
Clifty Creek Generating Station
Madison, Indiana

Dear Mr. Galloway,

The EPA Final CCR Rule requires owners or operators of existing CCR landfills and surface impoundments to prepare an 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 40 CFR 257.90(e). For the Indiana-Kentucky Electric Corporation (IKEC), this applies to the Clifty Creek Station's West Boiler Slag Pond, Landfill Runoff Collection Pond, and CCR Landfill.

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

1. A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;
2. 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;
3. 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 downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;
4. 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 level); and

Reference: **2023 Annual Groundwater Monitoring and Corrective Action Report**
EPA Final Coal Combustion Residuals (CCR) Rule
Clifty Creek Generating Station
Madison, Indiana

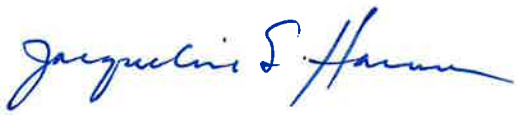
5. Other information required to be included in the annual report as specified in §§257.90 through 257.98.

IKEC has retained Applied Geology and Environmental Science, Inc. of Clinton, Pennsylvania (AGES) to perform the Clifty Creek Station's groundwater monitoring and corrective action support under the EPA Final CCR Rule. The 2023 CCR Regulation Groundwater Monitoring and Corrective Action Report (GWCAR) was prepared by AGES to present the annual groundwater monitoring at the West Boiler Slag Pond, Landfill Runoff Collection Pond, and CCR Landfill of the Clifty Creek Station. Stantec Consulting Services Inc. (Stantec) has reviewed AGES (2024), and it meets the requirements specified in 40 CFR 257.90(e).

Please contact us with any questions or concerns. We appreciate the opportunity to continue to work with the Clifty Creek Generating Station and the Indiana-Kentucky Electric Corporation.

Regards,

STANTEC CONSULTING SERVICES INC.



Jacqueline S. Harmon PE
Project Manager
Phone: (513) 842-8200 EXT 8220
jacqueline.harmon@stantec.com

Attachment: AGES (2024). Coal Combustion Residuals Regulation, 2023 Groundwater Monitoring and Corrective Action Report, Indiana-Kentucky Electric Corporation. Clifty Creek Station, Madison, Indiana, January.

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AGES
Applied Geology And Environmental Science, Inc.

2402 Hookstown Grade Road, Suite 200
Clinton, PA 15026
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P 412. 264. 6453
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COAL COMBUSTION RESIDUALS REGULATION
2023 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

JANUARY 2024

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
2023 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

JANUARY 2024

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

Prepared By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

Bethany Flaherty
Project Scientist II

Robert W. King, L.P.G. #1237
President/Chief Hydrogeologist

COAL COMBUSTION RESIDUALS REGULATION
2023 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

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INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

LIST OF ACRONYMS

ACM	Assessment of Corrective Measures
AGES	Applied Geology and Environmental Science, Inc.
ASD	Alternate Source Demonstration
CCR	Coal Combustion Residuals
GMPP	Groundwater Monitoring Program Plan
GWPS	Groundwater Protection Standard
IDEM	Indiana Department of Environmental Management
IKEC	Indiana-Kentucky Electric Corporation
LRCP	Landfill Runoff Collection Pond
MCL	Maximum Contaminant Level
MW	Megawatt
OVEC	Ohio Valley Electric Corporation
RCRA	Resource Conservation and Recovery Act
StAP	Statistical Analysis Plan
SSI	Statistically Significant Increase
Stantec	Stantec Consulting Services Inc.
Type I Landfill	Type I Residual Waste Landfill
S.U.	Standard Unit
ug/L	micrograms per liter
U.S. EPA	United States Environmental Protection Agency
WBSP	West Boiler Slag Pond

COAL COMBUSTION RESIDUALS REGULATION
2023 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

EXECUTIVE SUMMARY

The Clifty Creek Station, located in Madison, Indiana, is a 1,304-megawatt (MW) coal-fired generating plant operated by the Indiana-Kentucky Electric Corporation (IKEC), a subsidiary of the Ohio Valley Electric Corporation (OVEC). The Clifty Creek Station has six (6) 217.26-MW generating units and has been in operation since 1955. Beginning in 1955, ash products were sluiced to disposal ponds located in the plant site. During the course of plant operations, Coal Combustion Residuals (CCRs) have been managed and disposed of in various units at the station. There are three (3) CCR units at the Clifty Creek Station:

- Type I Residual Waste Landfill (Type I Landfill);
- Landfill Runoff Collection Pond (LRCP); and
- West Boiler Slag Pond (WBSP).

Under the CCR program, IKEC installed a groundwater monitoring system at each unit in accordance with the requirements of the CCR Rule; the Type I Landfill and LRCP are included in a multi-unit monitoring system. The units are discussed separately in this executive summary.

A brief overview of the current status of groundwater monitoring and corrective action programs for the CCR units is provided below:

Type I Landfill

At the start of this 2023 reporting period, the Type I Landfill was operating under the Detection Monitoring program in accordance with §257.94 of the CCR Rule. The 10th and 11th rounds of Detection Monitoring were conducted in March and September 2023, respectively. Based on the sampling results, it was determined that there were Appendix III Statistically Significant Increases (SSIs) over background for Boron in wells CF-15-08 and CF-15-09 during the March and September 2023 Detection Monitoring events. For both Detection Monitoring events, IKEC prepared an Alternate Source Demonstration (ASD) that indicated that the Boron detected in groundwater came from a source other than the Type I Landfill. Therefore, the Type I Landfill will remain operating under the Detection Monitoring program in accordance with §257.94 of the CCR Rule.

LRCP

At the start of this 2023 reporting period, the LRCP was operating under the Assessment Monitoring program in accordance with §257.95 of the CCR Rule. Based on exceedances of the Groundwater Protection Standard (GWPS) for an Appendix IV constituent (Molybdenum at wells CF-15-08 and CF-15-09), an assessment of corrective measures was initiated on May 15, 2019. An Assessment of Corrective Measures Report was completed on September 19, 2019 (Revision 1.0, November 2020); a public meeting was held on November 7, 2019.

As detailed in the 2022 Annual Report, during the September 2022 Assessment Monitoring event, it was confirmed that Arsenic in well CF-15-07 exceeded the GWPS, which was the first Arsenic exceedance at the unit. Therefore, in 2023, Arsenic at the unit was evaluated in accordance with §257.95 of the CCR Rule. IKEC prepared an ASD in general accordance with CCR Rule, which allows for a successful ASD in the case of an error in the sampling. In this case, the purge method allowed for the presence of micro-scale sediment in the samples, which became an alternate source of the Arsenic. Based on this demonstration, the LRCP is not the source of the Arsenic detected in CCR monitoring well CF-15-07 during the September 2022 Assessment Monitoring event.

In 2023, the 10th and 11th rounds of Assessment Monitoring were conducted in March and September, respectively. Based on the sampling results, it was determined that there were Appendix III SSIs over background. SSIs were confirmed for Boron in wells CF-15-08 and CF-15-09 during both Assessment Monitoring events. Molybdenum, an Appendix IV constituent, exceeded the GWPS in well CF-15-08 during both Assessment Monitoring events.

Molybdenum did not exceed the GWPS in wells located at the property boundary downgradient of the LRCP indicating that Molybdenum exceedances are confined to the site. Based on these results, the LRCP will remain operating under the Assessment Monitoring program in accordance with §257.95 of the CCR Rule.

To support the selection of a remedy, field monitoring activities, including the collection of water level measurements and ongoing groundwater sampling, were performed during 2023. Although a remedy was not selected pursuant to §257.97 of the CCR Rule during this current annual reporting period, the continued evaluation of remedial activities pursuant to §257.97 and §257.98 of the CCR Rule will continue during the 2024 annual reporting period.

WBSP

At the start of this 2023 reporting period, the WSBP was operating under the Assessment Monitoring program in accordance with §257.95 of the CCR Rule. In 2023, the second and third rounds of Assessment Monitoring were conducted in March and September, respectively. Based on the sampling results, it was determined that there was an Appendix III SSI over background for Fluoride in well WBSP-15-09 during the September 2023 Assessment Monitoring event. Arsenic,

an Appendix IV constituent, exceeded the GWPS in wells WBSP-15-07, WBSP-15-08 and WBSP-15-09 during both Assessment Monitoring events. Based on exceedances of the GWPS for an Appendix IV constituent (Arsenic at wells WBSP-15-08 and WBSP-15-09), a site characterization was conducted and an assessment of corrective measures was initiated in May 2023. An Assessment of Corrective Measures Report was completed on October 27, 2023.

Arsenic at the unit will continue to be evaluated in accordance with §257.95 of the CCR Rule. The WBSP will remain operating under the Assessment Monitoring program in accordance with §257.95 of the CCR Rule.

COAL COMBUSTION RESIDUALS REGULATION
2023 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

1.0 INTRODUCTION

On December 19, 2014, the United States Environmental Protection Agency (U.S. EPA) issued their final Coal Combustion Residuals (CCR) regulation which regulates CCR as a non-hazardous waste under Subtitle D of Resource Conservation and Recovery Act (RCRA) and became effective six (6) months from the date of its publication (April 17, 2015) in the Federal Register, referred to as the "CCR Rule." The rule applies to new and existing landfills, and surface impoundments used to dispose of or otherwise manage CCR generated by electric utilities and independent power producers. Because the rule was promulgated under Subtitle D of RCRA, it does not require regulated facilities to obtain permits, does not require state adoption, and cannot be enforced by U.S. EPA.

This Groundwater Monitoring and Corrective Action Report has been prepared in accordance with §257.90 (e) of the CCR Rule and documents the status of the groundwater monitoring and corrective action program for each CCR unit, summarizes the key actions completed during 2023, describes any problems encountered, discusses actions to resolve the problems, and projects key activities for the upcoming year.

2.0 BACKGROUND

The Clifty Creek Station, located in Madison, Indiana, is a 1,304-megawatt (MW) coal-fired generating plant operated by the Indiana-Kentucky Electric Corporation (IKEC), a subsidiary of the Ohio Valley Electric Corporation (OVEC). The Clifty Creek Station has six (6) 217.26-MW generating units and has been in operation since 1955. Beginning in 1955, ash products were sluiced to disposal ponds located in the plant site. During the course of plant operations, CCRs have been managed and disposed of in various units at the station. There are three (3) CCR units at the Clifty Creek Station (Figure 1):

- Type I Residual Waste Landfill (Type I Landfill);
- Landfill Runoff Collection Pond (LRCP); and
- West Boiler Slag Pond (WBSP).

A discussion of the status of the groundwater monitoring program for each CCR unit is presented in the following sections of this report. Under the CCR program, IKEC installed a groundwater monitoring system at each unit in accordance with the requirements of the CCR Rule; the Type I

Landfill and LRCP are included in a multi-unit monitoring system. The units are discussed separately in this report.

3.0 TYPE I RESIDUAL WASTE LANDFILL

The Type I Landfill and LRCP occupy an approximately 200-acre area situated within an eroded bedrock channel (Figures 1 and 2). Beginning in 1955, ash products were sluiced to disposal ponds located in the plant site. To allow for more disposal capacity, an on-site fly ash pond was developed into a Type III Landfill in 1988. All required permits for the Type III Landfill were obtained from the Indiana Department of Environmental Management (IDEM) and the Type III Landfill went operational in 1991. In March 1994, IDEM approved a pH variance for the disposal of low-sulfur coal ash in the fly ash Type III Landfill. Emplacement of low-sulfur coal ash in the Type III Landfill began in January 1995. In April 2007, IKEC submitted a permit application to IDEM to upgrade the former landfill from a Type III landfill to a Type I landfill. In 2013, IDEM issued a renewed permit and approved IKEC's request to upgrade the landfill to a Type I landfill.

The Type I Landfill consists of approximately 109 acres and has been approved by IDEM as a Type I Residual Waste Landfill. The remaining 91 acres consist of the LRCP located at the southwest end of the Type I Landfill (57 acres) and 34 acres closed under the IDEM landfill permit requirements (Figures 1 and 2). The LRCP is discussed in Section 4.0.

3.1 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (Applied Geology and Environmental Science, Inc. [AGES] 2018), the CCR groundwater monitoring network for the Type I Landfill consists of the following eight (8) monitoring wells:

- CF-15-04 (Background);
- CF-15-05 (Background);
- CF-15-06 (Background);
- CF-15-07 (Downgradient);
- CF-15-08 (Downgradient);
- CF-15-09 (Downgradient);
- WBSP-15-01 (Background); and
- WBSP-15-02 (Background).

The locations of the wells in the groundwater monitoring network are shown on Figure 2. As listed above and shown on Table 3-1, the CCR groundwater monitoring network includes five (5) background and three (3) downgradient monitoring wells, which satisfies the requirements of the CCR Rule.

Groundwater levels measured in 2023 are included in Table A-1 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2023 are included in Appendix B. As shown on the figures, groundwater generally flows to the southwest toward the Ohio River.

3.2 Groundwater Sampling

In accordance with §257.94 of the CCR Rule, the 10th round of Detection Monitoring was conducted in March 2023 and the 11th round of Detection Monitoring samples were collected in September 2023.

All groundwater samples were collected in accordance with the Groundwater Monitoring Program Plan (GMPP) (AGES 2024). The Detection Monitoring samples were analyzed for all Appendix III constituents, which are listed in Appendix C. In accordance with §257.90(e)(3), Table 3-2 presents a sampling summary, including the number of groundwater samples collected for analysis for each upgradient, background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection Monitoring program. Table 3-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were shipped to an analytical laboratory to be analyzed. Due to access restrictions (construction) in September, well CF-15-07 was sampled in November.

3.3 Analytical Results

Upon receipt of the March and September 2023 analytical results, the groundwater monitoring data were statistically evaluated in accordance with §257.93(h) of the CCR Rule and the Clifty Creek Station CCR Statistical Analysis Plan (StAP) (Stantec Consulting Services Inc. [Stantec] 2021). Appendix D summarizes the analytical results for groundwater samples collected in 2023. The statistical evaluation of the data identified potential Statistically Significant Increases (SSIs) for Boron in wells CF-15-08 and CF-15-09 for the March and September 2023 Detection Monitoring events (Table 3-4). In accordance with the StAP, resampling for Boron was conducted in wells CF-15-08 and CF-15-09 (June and November 2023). Based on the resampling results, SSIs were confirmed for Boron in wells CF-15-08 and CF-15-09 for the March and September 2023 Detection Monitoring events (Table 3-4).

3.4 March 2023 and September 2023 Detection Monitoring Events Alternate Source Demonstrations (ASDs)

For both 2023 Detection Monitoring events, IKEC prepared an ASD that indicated that the Boron detected in groundwater came from a source other than the Type I Landfill. Therefore, the Type I Landfill remains in Detection Monitoring. The ASDs for March 2023 and September 2023 are provided in Appendix E and Appendix F, respectively.

4.0 LANDFILL RUNOFF COLLECTION POND

The Type I Landfill and LRCP occupy an approximately 200-acre area situated within an eroded bedrock channel (Figures 1 and 2). The Type I Landfill, which is discussed above in Section 3.0, consists of approximately 109 acres, and the remaining 91 acres consist of the LRCP located at the southwest end of the Type I Landfill (57 acres) and 34 acres closed under the IDEM landfill permit requirements.

4.1 LRCP Assessment of Corrective Measures (ACM)

In 2019, IKEC conducted additional groundwater sampling to characterize the nature and extent of the release and an ACM in accordance with §257.95(g). As part of this assessment, in March 2019, two (2) additional wells (CF-19-14 and CF-19-15) were installed in the uppermost aquifer at the property boundary downgradient from the LRCP (Figure 2). Details regarding the installation of these wells and potential corrective measures are included in the ACM Report for the LRCP (AGES 2020a). All details regarding the monitoring and corrective action associated with this unit in 2019 are provided in the 2019 Groundwater Monitoring and Corrective Action Report (AGES 2020b).

4.2 September 2022 Assessment Monitoring Event ASD for Arsenic

As detailed in the 2022 Annual Report, during the September 2022 Assessment Monitoring event, it was confirmed that Arsenic in well CF-15-07 exceeded the GWPS, which was the first Arsenic exceedance at the unit. Therefore, in 2023, Arsenic at the unit was evaluated in accordance with §257.95 of the CCR Rule. IKEC prepared an ASD in general accordance with CCR Rule, which allows for a successful ASD in the case of an error in the sampling. In this case, the purge method allowed for the presence of micro-scale sediment in the samples, which became an alternate source of the Arsenic. Based on this demonstration, the LRCP is not the source of the Arsenic detected in CCR monitoring well CF-15-07 during the September 2022 Assessment Monitoring event.

The ASD for the September 2022 Assessment Monitoring event is provided in Appendix G.

4.3 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (AGES 2018) and 2019 Groundwater Monitoring and Corrective Action Report (AGES 2020), the CCR groundwater monitoring network for the LRCP consisted of the following ten (10) monitoring wells:

- CF-15-04 (Background);
- CF-15-05 (Background);
- CF-15-06 (Background);
- CF-15-07 (Downgradient);
- CF-15-08 (Downgradient);

- CF-15-09 (Downgradient);
- WBSP-15-01 (Background);
- WBSP-15-02 (Background);
- CF-19-14 (Downgradient/Boundary); and
- CF-19-15 (Downgradient/Boundary).

The locations of the wells in the groundwater monitoring network are shown on Figure 2. As listed above and shown on Table 4-1, the CCR groundwater monitoring network includes five (5) background and three (3) downgradient monitoring wells, which satisfies the requirements of the CCR Rule. Two (2) wells (CF-19-14 and CF-19-15) are located at the property boundary downgradient from the LRCP.

Groundwater levels measured in 2023 are included in Table A-2 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2023 are included in Appendix B. As shown on the figures, groundwater generally flows to the southwest toward the Ohio River.

4.4 Groundwater Sampling

In accordance with §257.95 of the CCR Rule, the 10th and 11th rounds of Assessment Monitoring were conducted in March and September 2023, respectively.

All groundwater samples were collected in accordance with the GMPP (AGES 2024). The Assessment Monitoring samples were analyzed for Appendix III and Appendix IV constituents, which are listed in Appendix C. In accordance with §257.90(e)(3), Table 4-2 presents a sampling summary, including the number of groundwater samples collected for analysis for each upgradient, background, downgradient and boundary well, the dates the samples were collected, and whether the sample was required by the Assessment Monitoring program. Table 4-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were shipped to an analytical laboratory to be analyzed. Due to access restrictions (construction) in September, well CF-15-07 was sampled in November and resampling occurred in January 2024.

4.5 Analytical Results

4.5.1 Analytical Results-Appendix III Constituents

Upon receipt, the groundwater monitoring data were statistically evaluated in accordance with §257.93(g) of the CCR Rule and the Clifty Creek Station CCR StAP (Stantec 2021). Appendix D summarizes the analytical results for groundwater samples collected in 2023.

The statistical evaluation of the data identified potential SSIs in wells CF-15-08 (Boron) and CF-15-09 (Boron and Calcium) for the March 2023 Assessment Monitoring event and in wells CF-15-08 (Boron) and CF-15-09 (Boron) for the September 2023 Assessment Monitoring event (Table

4-4). In accordance with the StAP, resampling for the potential SSIs was conducted in wells CF-15-08 and CF-15-09 in June and November 2023. Based on the resampling results, SSIs were confirmed for Boron in wells CF-15-08 and CF-15-09 for the March and September 2023 Assessment Monitoring events (Table 4-4).

4.5.2 Analytical Results-Appendix IV Constituents

Based on previous detections of Appendix IV constituents in groundwater at the LRCP, IKEC established a GWPS for each detected Appendix IV constituent in accordance with the §257.95(h)(1) through §257.95(h)(3) as follows:

(1) For constituents for which the U.S. EPA has established a Maximum Contaminant Level (MCL), the GWPS shall be the MCL for that constituent.

(2) On July 30, 2018, the U.S. EPA published alternate limits to be used for several constituents that did not have previously established MCLs to be used as the GWPS for those constituents.

(3) For constituents for which the background level is higher than the MCL or the alternate limit, the background concentration shall be the GWPS for that constituent.

Table 4-5 presents the list of GWPSs for the Assessment Monitoring program at the LRCP that were developed in accordance with the above requirements.

It was confirmed that Molybdenum exceeded the GWPS of 100 micrograms per liter (ug/L) in well CF-15-08 during the 10th (March 2023) and 11th (September 2023) Assessment Monitoring events (Table 4-6). Molybdenum concentrations did not exceed the GWPS at the wells located at the property boundary downgradient from the LRCP (wells CF-19-14 and CF-19-15). These results indicate that Molybdenum concentrations in the uppermost aquifer exceeding the GWPS are confined to the site and are not reaching the Ohio River.

5.0 WEST BOILER SLAG POND

The WBSP served as a settling facility for sluiced boiler slag produced at the plant. Flow to the WBSP ceased in October 2023. The pond is formed by natural grade to the north, east and west and a southern dike that runs along the bank of the Ohio River. The Devil's Backbone borders the northern side of the WBSP (Figures 1 and 3).

5.1 WBSP ACM

Based on the Arsenic exceedances identified in Assessment Monitoring, IKEC initiated additional groundwater sampling to characterize the nature and extent of the release and prepared an ACM in accordance with §257.95(g). The ACM Report (AGES 2023) provided an assessment of the

effectiveness of potential corrective measures in achieving the criteria provided in §257.96(c). The ACM report for the Clifty Creek WBSP was placed in the facility's operating record, as well as uploaded it to IKEC's CCR Rule Compliance internet site, in October 2023.

To meet the requirement §257.95 (d)(1), IKEC attempted to install four (4) wells at the facility boundary in the direction of contaminant migration. However, the property boundary in this area of the facility is heavily wooded and could not be safely accessed by a drilling rig without cutting down several trees. As the facility is located within the habitat of the Indiana Bat, the Programmatic Biological Opinion (BO) for Transportation Projects in the Range of the Indiana Bat and Northern Long-Eared Bat prepared by U.S. Fish and Wildlife Service (U.S. FWS) is applicable. Per this regulation, tree clearing in Indiana can only occur during inactive bat season. As the current inactive bat season is from October 1 to March 31 annually, IKEC could not clear trees and safely access the area along the Ohio River with a drilling rig until after October 1, 2023. Therefore, monitoring wells could not be installed along the property boundary within the timeframe required for the ACM Report.

IKEC installed interim boundary groundwater monitoring wells WBSP-23-01, WBSP-23-02, WBSP-23-03 and WBSP-23-04. Details regarding the installation of the interim boundary wells and potential corrective measures are included in the ACM Report for the WBSP (AGES 2023). Property boundary wells are planned to be installed in early 2024, pending weather conditions and the availability of a licensed driller.

5.2 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (AGES 2018) and 2021 Annual Report, the CCR groundwater monitoring network for the WBSP includes the following 13 wells:

- CF-15-04 (Background);
- CF-15-05 (Background);
- CF-15-06 (Background);
- WBSP-15-01 (Upgradient);
- WBSP-15-02 (Upgradient);
- WBSP-15-03 (Upgradient);
- WBSP-15-04a (Downgradient);
- WBSP-15-05a (Downgradient);
- WBSP-15-06a (Downgradient);
- WBSP-15-07 (Downgradient);
- WBSP-15-08 (Downgradient);
- WBSP-15-09 (Downgradient); and
- WBSP-15-10 (Downgradient).

The locations of the wells in the groundwater monitoring network are shown on Figures 2 and 3. As listed above and shown on Table 5-1, the CCR groundwater monitoring network for the WBSP

includes six (6) background and upgradient wells and seven (7) downgradient wells, which satisfies the requirements of the CCR Rule.

Results from the sampling events conducted in 2022 and 2023 indicate that wells WBSP-15-04a, WBSP-15-05a and WBSP-15-06a may not be a representative replacement for the original wells WBSP-15-04, WBSP-15-05 and WBSP-15-06, respectively, and the facility currently is evaluating whether the sampling results are the result of an error in accordance with §257.95(g)(3)(ii). The results are included in Appendix D.

Groundwater levels measured in 2023 are included in Table A-3 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2023 are included in Appendix B. As background wells WBSP-15-01, WBSP-15-02 and WBSP-15-03 are not screened in the uppermost aquifer at the unit, groundwater flow directions are based on the groundwater elevations in downgradient wells and the typical elevation of the nearby Ohio River. As shown on the figures in Appendix B, groundwater generally flows to the southeast toward the Ohio River.

5.3 Groundwater Sampling

In accordance with §257.95 of the CCR Rule, the second and third rounds of Assessment Monitoring were conducted in March and September 2023, respectively.

All groundwater samples were collected in accordance with the GMPP (AGES 2024). The Assessment Monitoring samples were analyzed for Appendix III and Appendix IV constituents, which are listed in Appendix C. In accordance with §257.90(e)(3), Table 5-2 presents a sampling summary, including the number of groundwater samples collected for analysis for each upgradient, background and downgradient well, the dates the samples were collected, and whether the sample was required by the Assessment Monitoring program. Table 5-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were shipped to an analytical laboratory to be analyzed.

5.4 Analytical Results

5.4.1 Analytical Results-Appendix III Constituents

Upon receipt of the March and September 2023 analytical results, the groundwater monitoring data were statistically evaluated in accordance with §257.93(h) of the CCR Rule and the Clifty Creek Station CCR StAP (Stantec 2021). Appendix D summarizes the analytical results for groundwater samples collected in 2023.

Potential SSIs were not identified in the March 2023 Assessment Monitoring event and potential SSIs in wells WBSP-15-08 (pH) and WBSP-15-09 (Fluoride) were identified in the September 2023 Assessment Monitoring event (Table 5-4). In accordance with the StAP, wells WBSP-15-08 and WBSP-15-09 were resampled for the potential SSIs during the resampling event in November

2023 (Table 5-4). Based on the resampling results, a SSI was confirmed for Fluoride in well WBSP-15-09 for the September 2023 Assessment Monitoring event (Table 5-4).

5.4.2 Analytical Results-Appendix IV Constituents

IKEC established a GWPS for each detected Appendix IV constituent in accordance with the §257.95(h)(1) through §257.95(h)(3) as follows:

(4) For constituents for which the U.S. EPA has established a Maximum Contaminant Level (MCL), the GWPS shall be the MCL for that constituent.

(5) On July 30, 2018, the U.S. EPA published alternate limits to be used for several constituents that did not have previously established MCLs to be used as the GWPS for those constituents.

(6) For constituents for which the background level is higher than the MCL or the alternate limit, the background concentration shall be the GWPS for that constituent.

Table 5-5 presents the list of GWPSs for the Assessment Monitoring program at the WBSP that were developed in accordance with the above requirements.

During the second (March 2023) and third (September 2023) rounds of Assessment Monitoring, it was confirmed that Arsenic in wells WBSP-15-07, WBSP-15-08 and WBSP-15-09 exceeded the GWPS of 10 ug/L (Table 5-6).

6.0 PROBLEMS ENCOUNTERED

Due to site conditions, well WBSP-15-01 was not safely accessible during the March 2023 sampling event; therefore, the well was not sampled.

Wells CF-15-06, CF-15-09, WBSP-15-01 and WBSP-15-02 were dry in September 2023 and samples could not be collected.

There were no other problems encountered during the 2023 groundwater monitoring program at Clifty Creek Station.

7.0 PROJECTED ACTIVITIES FOR 2024

The Type I Landfill will remain in Detection Monitoring and continue to be sampled on a semi-annual basis.

The LRCP will remain in Assessment Monitoring and continue to be sampled on a semi-annual basis. As described above, an ACM has been completed for this unit for Molybdenum and the process of the selection of remedy for the LRCP will continue in 2024.

The WBSP will remain in Assessment Monitoring and continue to be sampled on a semi-annual basis. Arsenic at the unit will be evaluated in accordance with §257.95 of the CCR Rule. As described above, an ACM has been completed for this unit for Arsenic. Property boundary wells are planned to be installed in early 2024, and the process of the selection of remedy for the WBSP will continue in 2024. Replacement wells WBSP-15-04a, WBSP-15-05a and WBSP-15-06a will be sampled during future events; the results of the sampling will be used to evaluate whether the wells are representative replacements for the respective original wells.

8.0 REFERENCES

Applied Geology and Environmental Science, Inc. (AGES) 2024. Coal Combustion Residuals Regulation Groundwater Monitoring Program Plan, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. Revision 2.0. January 2024.

Applied Geology and Environmental Science, Inc. (AGES) 2023. Coal Combustion Residuals Regulation Assessment of Corrective Measures Report for the West Boiler Slag Pond, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. October 2023.

Applied Geology and Environmental Science, Inc. (AGES) 2020b. Coal Combustion Residuals Regulation 2019 Groundwater Monitoring and Corrective Action Report, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. January 2020.

Applied Geology and Environmental Science, Inc. (AGES) 2020a. Coal Combustion Residuals Regulation Assessment of Corrective Measures Report Landfill Runoff Collection Pond, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. Revision 1.0. November 2020.

Applied Geology and Environmental Science, Inc. (AGES) 2018. Coal Combustion Residuals Regulation Monitoring Well Installation Report, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. Revision 1.0. November 2018.

Stantec Consulting Services Inc. (Stantec) 2021. Coal Combustion Residuals Regulation Statistical Analysis Plan, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. July 2021.

TABLES

TABLE 3-1
GROUNDWATER MONITORING NETWORK
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)[2]	Top of Casing Elevation (ft)[2]	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
CF-15-04	Background	12/3/2015	451482.81	569307.19	465.55	468.03	439.55	429.55	38.48
CF-15-05	Background	12/1/2015	447491.91	565533.64	439.85	442.58	422.85	412.85	29.73
CF-15-06	Background	11/30/2015	447026.92	565190.31	437.49	440.40	431.49	421.49	18.91
CF-15-07	Downgradient	11/23/2015	443135.08	562259.25	438.61	441.11	432.61	422.61	18.50
CF-15-08	Downgradient	11/19/2015	443219.57	562537.29	460.33	462.79	430.33	420.33	42.46
CF-15-09	Downgradient	11/25/2015	443445.96	562871.69	456.73	459.45	447.73	442.73	16.72
WBSP-15-01	Background	11/30/2015	449072.27	566322.12	466.93	469.36	458.93	448.93	20.43
WBSP-15-02	Background	11/11/2015	449803.91	566987.30	473.83	476.76	457.83	452.83	23.93

Notes:
1. The Well locations are referenced to the North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 3-2
SUMMARY OF SAMPLES COLLECTED DURING 2023
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Designation	Mar-23	Jun-23	Sep-23	Nov-23
CF-15-04	Background	DM	NS	DM	NS
CF-15-05	Background	DM	NS	DM	NS
CF-15-06	Background	DM	NS	Dry	NS
CF-15-07	Downgradient	DM	NS	DM	NS
CF-15-08	Downgradient	DM	DM	DM	DM
CF-15-09	Downgradient	DM	DM	DM	DM
WBSP-15-01	Background	NA	NS	Dry	NS
WBSP-15-02	Background	DM	NS	Dry	NS

Notes:
1. DM: Detection Monitoring.
2. Dry: Well Dry and Not Sampled.
3. NA: Well Not Accessible for Sample Collection.
4. NS: Not Sampled.

TABLE 3-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2023
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Sample ID	Date	Temperature (°C)	Conductivity (µohms/cm)	pH (S.U.)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)
CF-15-04	Mar-23	10.59	586	7.89	196	16.84	3.55
CF-15-05	Mar-23	12.9	1070	7.64	61	4.5	4.09
CF-15-06	Mar-23	10.49	1150	7.53	111	4.95	49.7
CF-15-07	Mar-23	11.78	1200	7.59	-141	3.26	11.2
CF-15-08	Mar-23	12.68	9997	7.95	130	2.63	3.41
CF-15-09	Mar-23	11.6	1030	7.71	140	10.51	80
WBSP-15-01	WELL NOT ACCESSIBLE						
WBSP-15-02	Mar-23	12.01	742	7.27	161.5	1.77	4.08
CF-15-08	Jun-23	17.70	1000	7.95	232	4.65	4.19
CF-15-09	Jun-23	17.80	1050	7.83	200	12.84	12.20
CF-15-04	Sep-23	17.69	637	7.98	193	10.49	3.81
CF-15-05	Sep-23	16.41	1030	7.56	-44	15.15	4.6
CF-15-06	WELL DRY						
CF-15-07	Nov-23	13.53	1025	6.83	-83.4	3.7	4.46
CF-15-08	Sep-23	16.02	988	7.72	194	5.94	4.31
CF-15-09	WELL DRY						
WBSP-15-01	WELL DRY						
WBSP-15-02	WELL DRY						
CF-15-08	Nov-23	14.01	834	7.2	65.2	0.54	3.77
CF-15-09	Nov-23	INSUFFICIENT WATER TO MEASURE FIELD PARAMETERS					

Notes:
1. °C: Degrees Celsius.
2. µohms/cm: Micro-ohms per centimeter.
3. S.U.: Standard Units.
4. mV: Millivolts.
5. mg/L: Milligrams per liter.
6. NTUs: Nephelometric Turbidity Units.
7. Due to access restrictions (construction) in September, well CF-15-07 was sampled in November.

TABLE 3-4
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential SSI Parameter (Units)	10th Detection Monitoring Sampling Event March 2023		10th Detection Monitoring Resampling Event June 2023		11th Detection Monitoring Sampling Event September 2023		11th Detection Monitoring Resampling Event November 2023	
		Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)	Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)
CF-15-08	Boron (mg/L)	12	4.9	11	**Yes**	11	4.91	12	**Yes**
CF-15-09	Boron (mg/L)	5.1	4.9	5.5	**Yes**	5.4	4.905	7	**Yes**

Notes:
1. SSI: Statistically Significant Increase.
2. UPL: Upper Prediction Limit (Maximum Interwell UPL).
3. mg/L: Milligrams per liter.

TABLE 4-1
GROUNDWATER MONITORING NETWORK
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)[2]	Top of Casing Elevation (ft)[2]	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
CF-15-04	Background	12/3/2015	451482.81	569307.19	465.55	468.03	439.55	429.55	38.48
CF-15-05	Background	12/1/2015	447491.91	565533.64	439.85	442.58	422.85	412.85	29.73
CF-15-06	Background	11/30/2015	447026.92	565190.31	437.49	440.40	431.49	421.49	18.91
CF-15-07	Downgradient	11/23/2015	443135.08	562259.25	438.61	441.11	432.61	422.61	18.50
CF-15-08	Downgradient	11/19/2015	443219.57	562537.29	460.33	462.79	430.33	420.33	42.46
CF-15-09	Downgradient	11/25/2015	443445.96	562871.69	456.73	459.45	447.73	442.73	16.72
WBSP-15-01	Background	11/30/2015	449072.27	566322.12	466.93	469.36	458.93	448.93	20.43
WBSP-15-02	Background	11/11/2015	449803.91	566987.30	473.83	476.76	457.83	452.83	23.93
CF-19-14	Downgradient	3/8/2019	443401.75	562901.93	452.29	454.88	440.05	430.05	24.83
CF-19-15	Downgradient	3/13/2019	442704.78	562483.02	441.10	443.61	415.19	405.19	38.42

Notes:
1. The Well locations are referenced to the North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 4-2
SUMMARY OF SAMPLES COLLECTED DURING 2023
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Designation	Mar-23	Jun-23	Sep-23	Nov-23
CF-15-04	Background	AM	NS	AM	NS
CF-15-05	Background	AM	NS	AM	NS
CF-15-06	Background	AM	NS	Dry	NS
CF-15-07	Downgradient	AM	NS	AM	AM
CF-15-08	Downgradient	AM	AM	AM	AM
CF-15-09	Downgradient	AM	AM	Dry	AM
WBSP-15-01	Background	NA	NS	Dry	NS
WBSP-15-02	Background	AM	NS	Dry	NS
CF-19-14	Downgradient	AM	NS	AM	NS
CF-19-15	Downgradient	AM	NS	AM	NS

Notes:
1. AM: Assessment Monitoring.
2. NS: Not Sampled.
3. NA: Well Not Accessible for Sample Collection.
4. NS: Not Sampled.

TABLE 4-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2023
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Sample ID	Date	Temperature (°C)	Conductivity (µohms/cm)	pH (S.U.)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)
CF-15-04	Mar-23	10.59	586	7.89	196	16.84	3.55
CF-15-05	Mar-23	12.9	1070	7.64	61	4.5	4.09
CF-15-06	Mar-23	10.49	1150	7.53	111	4.95	49.7
CF-15-07	Mar-23	11.78	1200	7.59	-141	3.26	11.2
CF-15-08	Mar-23	12.68	9997	7.95	130	2.63	3.41
CF-15-09	Mar-23	11.6	1030	7.71	140	10.51	80
WBSP-15-01	WELL NOT ACCESSIBLE						
WBSP-15-02	Mar-23	12.01	742	7.27	161.5	1.77	4.08
CF-19-14	Mar-23	12.31	703	7.42	204	8.86	4.58
CF-19-15	Mar-23	11.74	1560	7.61	175	17.59	4.70
CF-15-08	Jun-23	17.70	1000	7.95	232	4.65	4.19
CF-15-09	Jun-23	17.80	1050	7.83	200	12.84	12.20
CF-15-04	Sep-23	17.69	637	7.98	193	10.49	3.81
CF-15-05	Sep-23	16.41	1030	7.56	-44	15.15	4.6
CF-15-06	WELL DRY						
CF-15-07	Nov-23	13.53	1025	6.83	-83.4	3.70	4.46
CF-15-08	Sep-23	16.02	988	7.72	194	5.94	4.31
CF-15-09	WELL DRY						
WBSP-15-01	WELL DRY						
WBSP-15-02	WELL DRY						
CF-19-14	Sep-23	16.39	922	7.58	37	6.89	4.70
CF-19-15	Sep-23	16.00	1630	7.25	90	7.42	4.98
CF-15-07	Jan-24	9.82	1230	7.66	343	1.29	25.4
CF-15-08	Nov-23	14.01	834	7.2	65.2	0.54	3.77
CF-15-09	Nov-23	INSUFFICIENT WATER TO MEASURE FIELD PARAMETERS					

Notes:
1. °C: Degrees Celsius.
2. µohms/cm: Micro-ohms per centimeter.
3. S.U.: Standard Units.
4. mV: Millivolts.
5. mg/L: Milligrams per liter.
6. NTUs: Nephelometric Turbidity Units.
7. Due to access restrictions (construction) in September, well CF-15-07 was sampled in November and resampling occurred in January 2024.

TABLE 4-4
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential SSI Parameter (Units)	10th Assessment Monitoring Sampling Event March 2023		10th Assessment Monitoring Resampling Event June 2023		11th Assessment Monitoring Sampling Event September 2023		11th Assessment Monitoring Resampling Event November 2023	
		Potential SSI Result	UTL	Potential SSI Result	Confirmed SSI (Yes/No)	Potential SSI Result	UTL	Potential SSI Result	Confirmed SSI (Yes/No)
CF-15-08	Boron (mg/L)	12	5.02	11	**Yes**	11	5.02	12	**Yes**
CF-15-09	Boron (mg/L)	5.1	5.02	5.5	**Yes**	5.4	5.02	7.0	**Yes**
	Calcium (mg/L)	290	284	0.18	No	NA	NA	NA	NA

Notes:
1. SSI: Statistically Significant Increase.
2. UTL: Upper Tolerance Limit (Pooled Interwell UTL).
3. mg/L: Milligrams per liter.
4. NA: Not Applicable—no SSI.

TABLE 4-5
GROUNDWATER PROTECTION STANDARDS
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Appendix IV Constituents			
Constituent (Units)	**Background**	**MCL/SMCL**	**GWPS**
Antimony, Sb (µg/L)	2	6	6
Arsenic, As (µg/L)	5	10	10
Barium, Ba (µg/L)	99	2000	2000
Beryllium, Be (µg/L)	1.1	4	4
Cadmium, Cd (µg/L)	1	5	5
Chromium, Cr (µg/L)	3	100	100
Cobalt, Co (µg/L)	1.5	6*	6
Fluoride, F (mg/L)	0.56	4	4
Lead, Pb (µg/L)	1.1	15*	15
Lithium, Li (µg/L)	0.1	40*	40
Mercury, Hg (µg/L)	1.2	2	2
Molybdenum, Mo (µg/L)	6	100*	100
Radium 226 & 228 (combined) (pCi/L)	3	5	5
Selenium, Se (µg/L)	5	50	50
Thallium, Tl (µg/L)	1	2	2

Notes:
1. MCL: Maximum Contaminant Level.
2. SMCL: Secondary Maximum Contaminant Level.
3. *: Established by U.S. EPA as part of 2018 decision.
4. GWPS: Groundwater Protection Standard.
5. µg/L: Micrograms per liter.
6. mg/L: Milligrams per liter.
7. pCi/L: Picocuries per liter.

TABLE 4-6
SUMMARY OF GWPS EXCEEDANCES
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential Exceedance Parameter (Units)	10th Assessment Monitoring Sampling Event March 2023		10th Assessment Monitoring Resampling Event June 2023		11th Assessment Monitoring Sampling Event September 2023		11th Assessment Monitoring Resampling Event November 2023	
		Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)	Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)
CF-15-07	Arsenic (ug/L)	NA	NA	NA	NA	15	10	9.9	No
CF-15-08	Molybdenum (ug/L)	590	100	570	**Yes**	540	100	620	**Yes**
CF-15-09	Cobalt (ug/L)	14	6	0.4	No	9.5	6	1.8	No

Notes:
1. GWPS: Groundwater Protection Standard.
2. µg/L: Micrograms per liter.
3. NA: Not Applicable—no SSI.
4. Due to access restrictions (construction) in September, well CF-15-07 was sampled in November and resampling occurred in January 2024.

TABLE 5-1
GROUNDWATER MONITORING NETWORK
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)[2]	Top of Casing Elevation (ft)[2]	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
CF-15-04	Background	12/3/2015	451482.81	569307.19	465.55	468.03	439.55	429.55	38.48
CF-15-05	Background	12/1/2015	447491.91	565533.64	439.85	442.58	422.85	412.85	29.73
CF-15-06	Background	11/30/2015	447026.92	565190.31	437.49	440.40	431.49	421.49	18.91
WBSP-15-01	Upgradient	11/30/2015	449072.27	566322.12	466.93	469.36	458.93	448.93	20.43
WBSP-15-02	Upgradient	11/11/2015	449803.91	566987.30	473.83	476.76	457.83	452.83	23.93
WBSP-15-03	Upgradient	12/4/2015	451181.98	568093.60	484.91	488.03	476.91	471.91	16.12
WBSP-15-04a	Downgradient	7/28/2021	450669.20	568855.3	472.03	474.47	418.47	408.47	68.44
WBSP-15-05a	Downgradient	8/4/2021	450072.00	568895.20	473.66	476.20	413.20	402.20	76.54
WBSP-15-06a	Downgradient	8/6/2021	449478.8	568659.8	471.96	475.12	399.12	389.12	89.16
WBSP-15-07	Downgradient	11/23/2015	448947.93	567946.39	468.82	471.31	426.82	416.82	54.49
WBSP-15-08	Downgradient	11/25/2015	448625.46	567343.24	468.56	471.06	415.76	405.76	65.30
WBSP-15-09	Downgradient	1/6/2016	448359.31	566711.13	471.21	470.69	421.21	410.21	59.48
WBSP-15-10	Downgradient	1/5/2016	448125.51	566225.21	471.21	470.69	425.21	435.21	55.48

Notes:
1. The Well locations are referenced to the North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 5-2
SUMMARY OF SAMPLES COLLECTED DURING 2023
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Designation	Mar-23	Jun-23	Sep-23	Nov-23
CF-15-04	Background	AM	NS	AM	NS
CF-15-05	Background	AM	NS	AM	NS
CF-15-06	Background	AM	NS	AM	NS
WBSP-15-01	Upgradient	AM	NS	AM	NS
WBSP-15-02	Upgradient	AM	NS	AM	NS
WBSP-15-03	Upgradient	AM	NS	AM	NS
WBSP-15-04a	Downgradient	AM	NS	AM	NS
WBSP-15-05a	Downgradient	AM	NS	AM	NS
WBSP-15-06a	Downgradient	AM	NS	AM	NS
WBSP-15-07	Downgradient	AM	AM	AM	AM
WBSP-15-08	Downgradient	AM	AM	AM	AM
WBSP-15-09	Downgradient	AM	AM	AM	AM
WBSP-15-10	Downgradient	AM	AM	AM	AM

Notes:
1. AM: Assessment Monitoring.
2. NS: Not Sampled.
3. Wells WBSP-15-04a, WBSP-15-05a and WBSP-15-06a were sampled and are being evaluating to determine if they are representative of the original wells.

TABLE 5-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2023
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Sample ID	Date	Temperature (°C)	Conductivity (µohms/cm)	pH (S.U.)	Oxidation Reduction Potential (mV)	Dissolved Oxygen (mg/L)	Turbidity (NTUs)
CF-15-04	Mar-23	10.59	586	7.89	196	16.84	3.55
CF-15-05	Mar-23	12.9	1070	7.64	61	4.5	4.09
CF-15-06	Mar-23	10.49	1150	7.53	111	4.95	49.7
WBSP-15-01	WELL NOT ACCESSIBLE						
WBSP-15-02	Mar-23	12.01	742	7.27	161.5	1.77	4.08
WBSP-15-03	Mar-23	11.21	1125	7.01	72.4	1.77	4.11
WBSP-15-04a	Mar-23	11.15	100	7.95	-91.6	0.98	4.11
WBSP-15-05a	Mar-23	10.97	865	7.07	-97.7	0.37	2.25
WBSP-15-06a	Mar-23	11.41	995	7.34	-139.1	0.91	4.01
WBSP-15-07	Mar-23	11.55	1495	6.94	-78.1	1.71	4.61
WBSP-15-08	Mar-23	11.01	735	6.95	-127.5	2.55	4.28
WBSP-15-09	Mar-23	11.57	861	7.25	-122.4	0.99	4.17
WBSP-15-10	Mar-23	11.31	831	7.01	-71.5	1.07	32.6
WBSP-15-04a	Jun-23	15.26	991	7.15	364	1.28	4.31
WBSP-15-05a	Jun-23	17.76	804	7.24	296	1.72	4.25
WBSP-15-06a	Jun-23	18.52	862	7.81	-98	296	4.59
WBSP-15-07	Jun-23	19.4	1370	7.41	-140	2.7	12.8
WBSP-15-08	Jun-23	19.83	818	7.14	-72	4.83	999
WBSP-15-09	Jun-23	24.11	535	7.06	-173	2.16	4.96
WBSP-15-10	Jun-23	20.48	621	7.08	116	1.73	4.05
CF-15-04	Sep-23	17.69	637	7.98	193	10.49	3.81
CF-15-05	Sep-23	16.41	1030	7.56	-44	15.15	4.6
CF-15-06	WELL DRY						
WBSP-15-01	WELL DRY						
WBSP-15-02	WELL DRY						
WBSP-15-03	Sep-23	15.69	1410	7.31	248	0.53	4.12
WBSP-15-04a	Sep-23	16.84	1110	7.62	185	0.27	3.51
WBSP-15-05a	Sep-23	20.99	1005	7.83	213	0.94	4.78
WBSP-15-06a	Sep-23	18.79	919	7.99	169	0.83	4.38
WBSP-15-07	Sep-23	17.49	1580	7.49	-95	0.61	4.71
WBSP-15-08	Sep-23	19.39	901	8.01	152	0.96	4.01
WBSP-15-09	Sep-23	18.3	527	7.13	-134	1.78	52
WBSP-15-10	Sep-23	20.42	695	7.16	319	1.48	2.51
WBSP-15-04a	Nov-23	11.21	996	7.04	258	0.93	3.98
WBSP-15-05a	Nov-23	13.35	1010	7.32	225	1.08	4.49
WBSP-15-06a	Nov-23	8.01	856	6.88	342	1.48	4.11
WBSP-15-07	Nov-23	14	1480	7.71	-195	0.9	4.75
WBSP-15-08	Nov-23	13.72	867	7.68	-139	10.38	>100
WBSP-15-09	Nov-23	14.22	641	7.44	-147	5.26	4.8
WBSP-15-10	Nov-23	1243	751	7.94	-83	9.03	>100

TABLE 5-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2023
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Notes:

1. °C: Degrees Celsius.
2. µohms/cm: Micro-ohms per centimeter.
3. S.U.: Standard Units.
4. mV: Millivolts.
5. mg/L: Milligrams per liter.
6. NTUs: Nephelometric Turbidity Units.

3. Wells WBSP-15-04a, WBSP-15-05a and WBSP-15-06a were sampled and are being evaluating to determine if they are representative of the original wells.

TABLE 5-4
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential SSI Parameter (Units)	2nd Assessment Monitoring Sampling Event March 2023		2nd Assessment Monitoring Resampling Event June 2023		3rd Assessment Monitoring Sampling Event September 2023		3rd Assessment Monitoring Resampling Event November 2023	
		Potential SSI Result	UTL	Potential SSI Result	Confirmed SSI (Yes/No)	Potential SSI Result	UTL	Potential SSI Result	Confirmed SSI (Yes/No)
WBSP-15-08	pH (s.u.)	NA	NA	NA	NA	8.01	7.89	7.68	No
WBSP-15-09	Fluoride (mg/L)	NA	NA	NA	NA	0.63	0.56	0.57	**Yes**

Notes:
1. SSI: Statistically Significant Increase.
2. UTL: Upper Tolerance Limit (Pooled Interwell UTL).
3. s.u.: Standard units.
4. mg/L: Milligrams per liter.
5. NA: Not Applicable—no SSI.

TABLE 5-5
GROUNDWATER PROTECTION STANDARDS
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Appendix IV Constituents			
Constituent (Units)	**Background**	**MCL/SMCL**	**GWPS**
Antimony, Sb (µg/L)	0.02	6	6
Arsenic, As (µg/L)	5.1	10	10
Barium, Ba (µg/L)	112	2000	2000
Beryllium, Be (µg/L)	0.1	4	4
Cadmium, Cd (µg/L)	0.1	5	5
Chromium, Cr (µg/L)	2	100	100
Cobalt, Co (µg/L)	1.1	6*	6
Fluoride, F (mg/L)	0.51	4	4
Lead, Pb (µg/L)	1.0	15*	15
Lithium, Li (µg/L)	0.05	40*	40
Mercury, Hg (µg/L)	1.2	2	2
Molybdenum, Mo (µg/L)	6	100*	100
Radium 226 & 228 (combined) (pCi/L)	2	5	5
Selenium, Se (µg/L)	0.5	50	50
Thallium, Tl (µg/L)	0.2	2	2

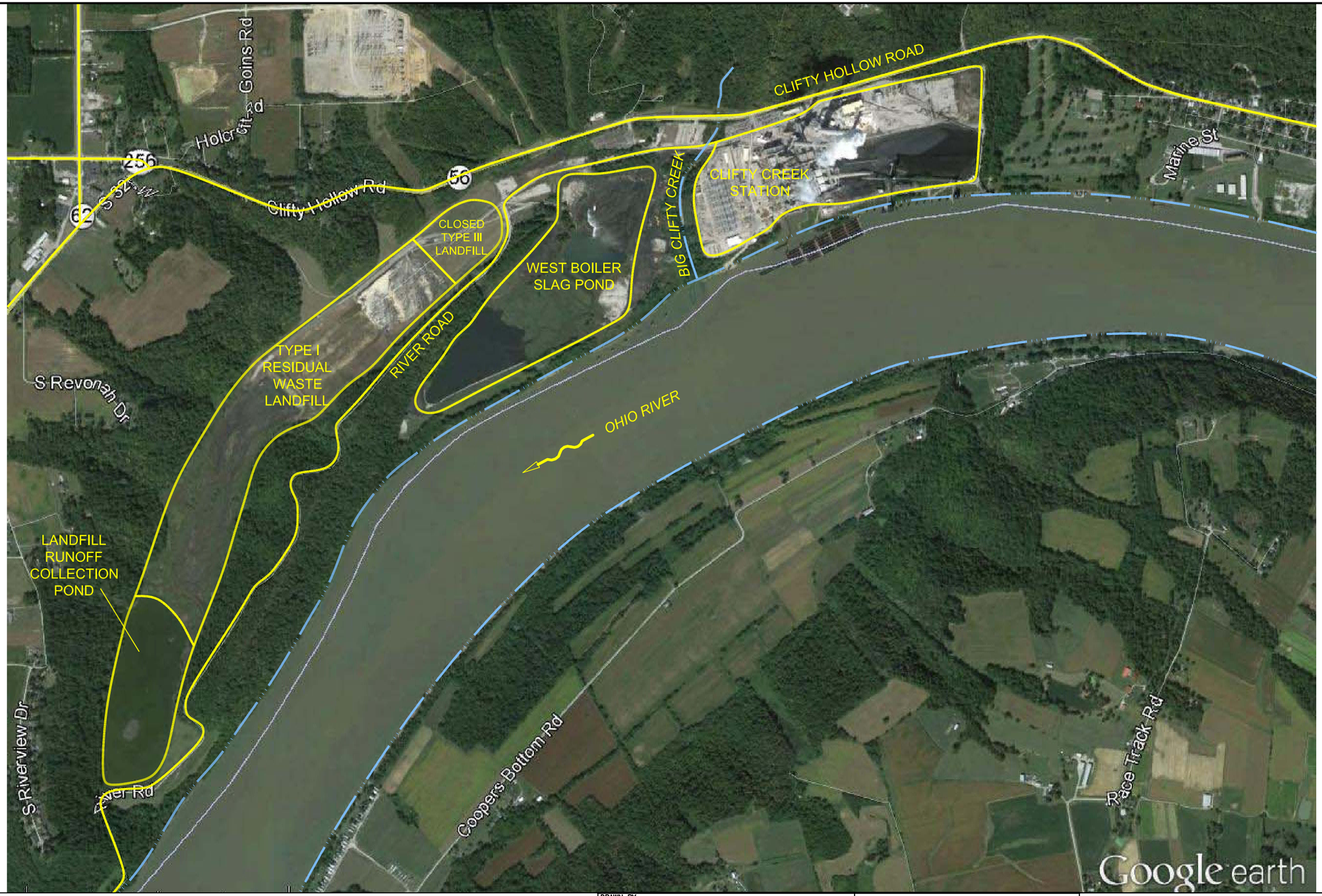
Notes:
1. MCL: Maximum Contaminant Level.
2. SMCL: Secondary Maximum Contaminant Level.
3. *: Established by U.S. EPA as part of 2018 decision.
4. GWPS: Groundwater Protection Standard.
5. µg/L: Micrograms per liter.
6. mg/L: Milligrams per liter.
7. pCi/L: Picocuries per liter.

TABLE 5-6
SUMMARY OF GWPS EXCEEDANCES
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential Exceedance Parameter (Units)	2nd Assessment Monitoring Sampling Event March 2023		2nd Assessment Monitoring Resampling Event June 2023		3rd Assessment Monitoring Sampling Event September 2023		3rd Assessment Monitoring Resampling Event November 2023	
		Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)	Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)
WBSP-15-07	Arsenic (ug/L)	87	10	25	**Yes**	42	10	51	**Yes**
WBSP-15-08	Arsenic (ug/L)	100	10	70	**Yes**	70	10	68	**Yes**
WBSP-15-09	Arsenic (ug/L)	25	10	26	**Yes**	23	10	20	**Yes**
WBSP-15-10	Arsenic (ug/L)	12	10	2.5	No	NA	NA	NA	NA
	Cobalt (ug/L)	9.1	6	2.4	No	NA	NA	NA	NA
	Radium 226 & 228 (combined) (pCi/L)	NA	NA	NA	NA	5.43	5	Non-Detect	No

Notes:
1. GWPS: Groundwater Protection Standard.
2. µg/L: Micrograms per liter.
3. pCi/L: Picocuries per liter.
4. NA: Not Applicable—no SSI.

FIGURES



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1200' 0' 1200' 2400'

SCALE: 1"= 1200'

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JOB NO.	2019008-CLI
DWG FILE	2019_IKEC_Clifty_Corrective Action_Site Loc_FIG 1.dwg
DRAWING SCALE	AS SHOWN

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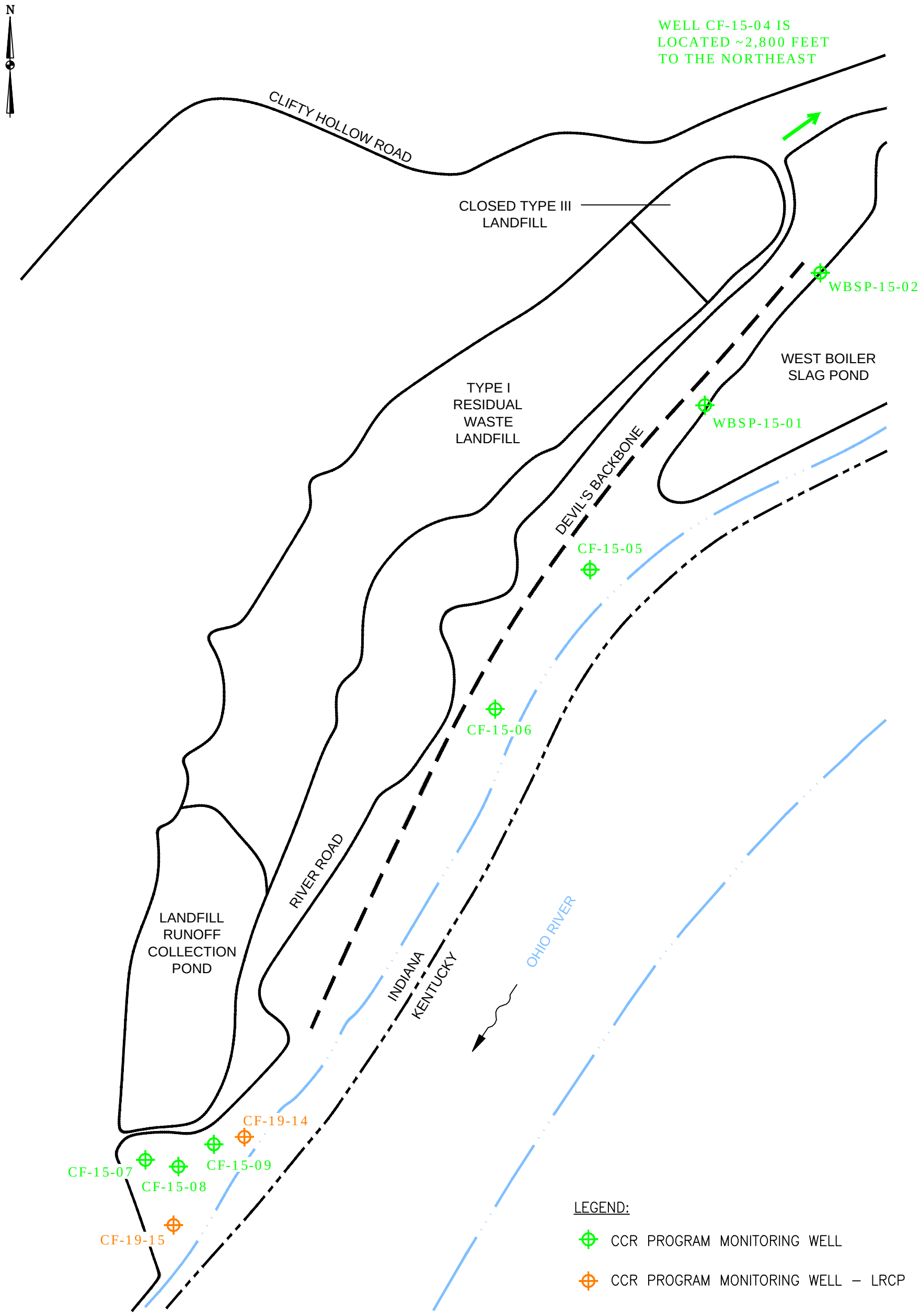
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
SITE LOCATION MAP

DRAWING NAME: FIGURE 1

REV.: 0

Plot: 12/23/2019 14:40 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\2019 GW Monitoring-Corrective Action Rpt\2019_IKEC_Clifty_Corrective Action_Site Loc_FIG 1.dwg



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JOB NO.	2020010-CLIFTY
DWG FILE	2_2020_IKEC_Clifty_GW MW LOCs_LANDFILL b01.dwg
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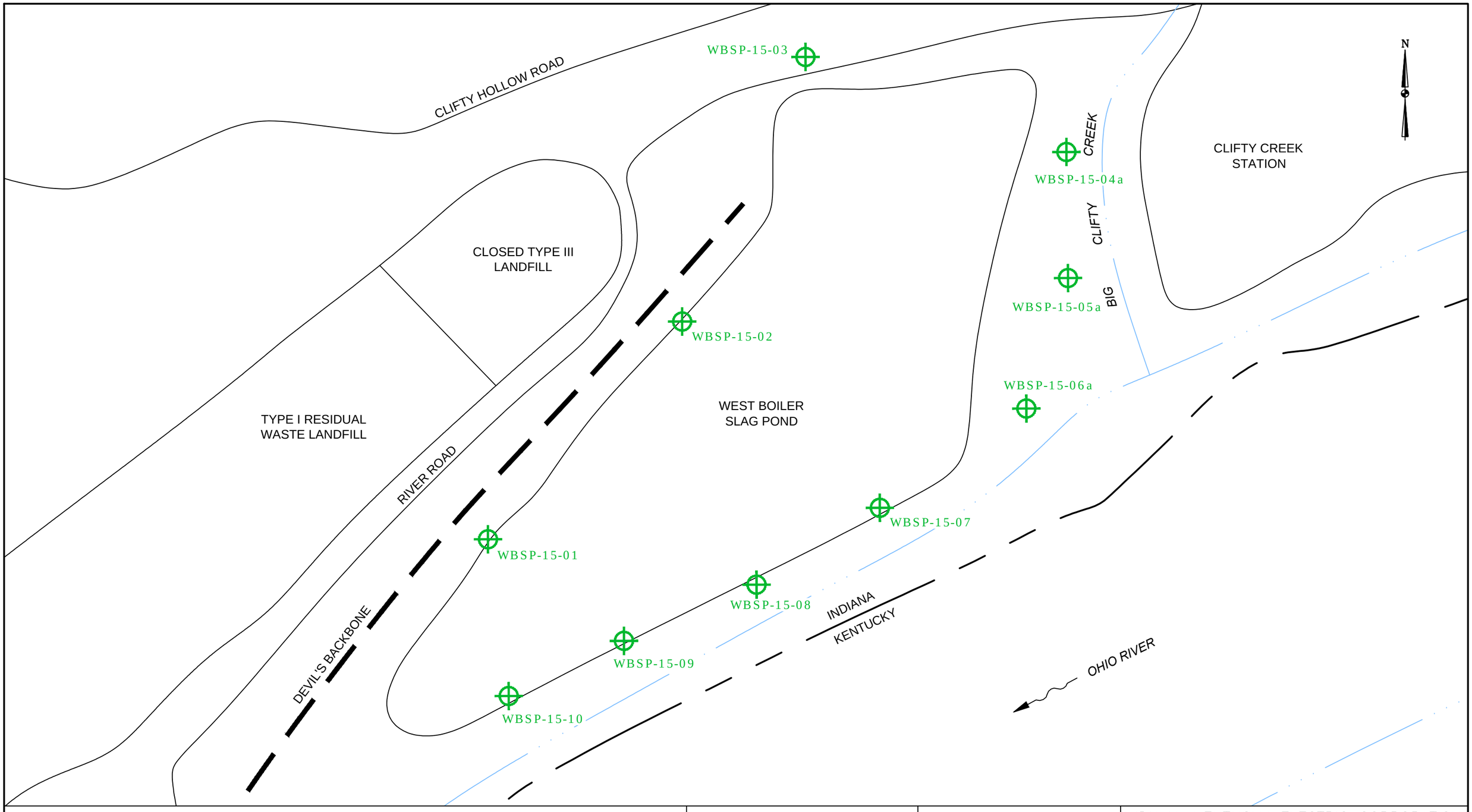
CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
MONITORING WELL LOCATION MAP

DRAWING NAME	REV.
FIGURE 2	0



LEGEND:

CCR PROGRAM MONITORING WELL

400' 0' 400' 800'

SCALE: 1"= 400'

DATE	
CHECKED BY	
JOB NO.	2022013-CLI
DWG FILE	3_2022_IKEC-IDEM_WBSP_2022 GW+CA rpt_MWs.dwg
DRAWING SCALE	AS SHOWN

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CLIFTY CREEK STATION
MADISON, INDIANA
WEST BOILER SLAG POND
MONITORING WELL LOCATION MAP

DRAWING NAME: FIGURE 3

REV.: 0

Plot: 12/21/2022 14:19 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\2022 GW Monitoring-Corrective Action Rpt\3_2022_IKEC-IDEM_WBSP_2022 GW+CA rpt_MWs\well loc

APPENDIX A

GROUNDWATER ELEVATIONS

TABLE A-1
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2023
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Mar-23	Jun-23	Sep-23	Nov-23
	Groundwater Elevation (feet)			
CF-15-04	442.67	NM	437.68	NM
CF-15-05	437.83	NM	428.80	NM
CF-15-06	428.62	NM	DRY	NM
CF-15-07	432.34	NM	426.50	NM
CF-15-08	439.09	440.34	435.62	436.50
CF-15-09	440.84	444.20	444.14	444.07
WBSP-15-01	453.73	NM	DRY	NM
WBSP-15-02	464.68	NM	DRY	NM

Notes:
1. NM: Not Measured
2. Well WBSP-15-01 was accessible for water level collection but not safely accessible for sample collection during the March 2023 sampling event.

TABLE A-2
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2023
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Mar-23	Jun-23	Sep-23	Nov-23
	Groundwater Elevation (feet)			
CF-15-04	442.67	NM	437.68	NM
CF-15-05	437.83	NM	428.80	NM
CF-15-06	428.62	NM	DRY	NM
CF-15-07	432.34	NM	426.50	NM
CF-15-08	439.09	440.34	435.62	436.50
CF-15-09	440.84	444.20	444.14	444.07
WBSP-15-01	453.73	NM	DRY	NM
WBSP-15-02	464.68	NM	DRY	NM
CF-19-14	444.17	NM	436.62	NM
CF-19-15	424.46	NM	420.27	NM

Notes:
1. NM: Not Measured
2. Well WBSP-15-01 was accessible for water level collection but not safely accessible for sample collection during the March 2023 sampling event.

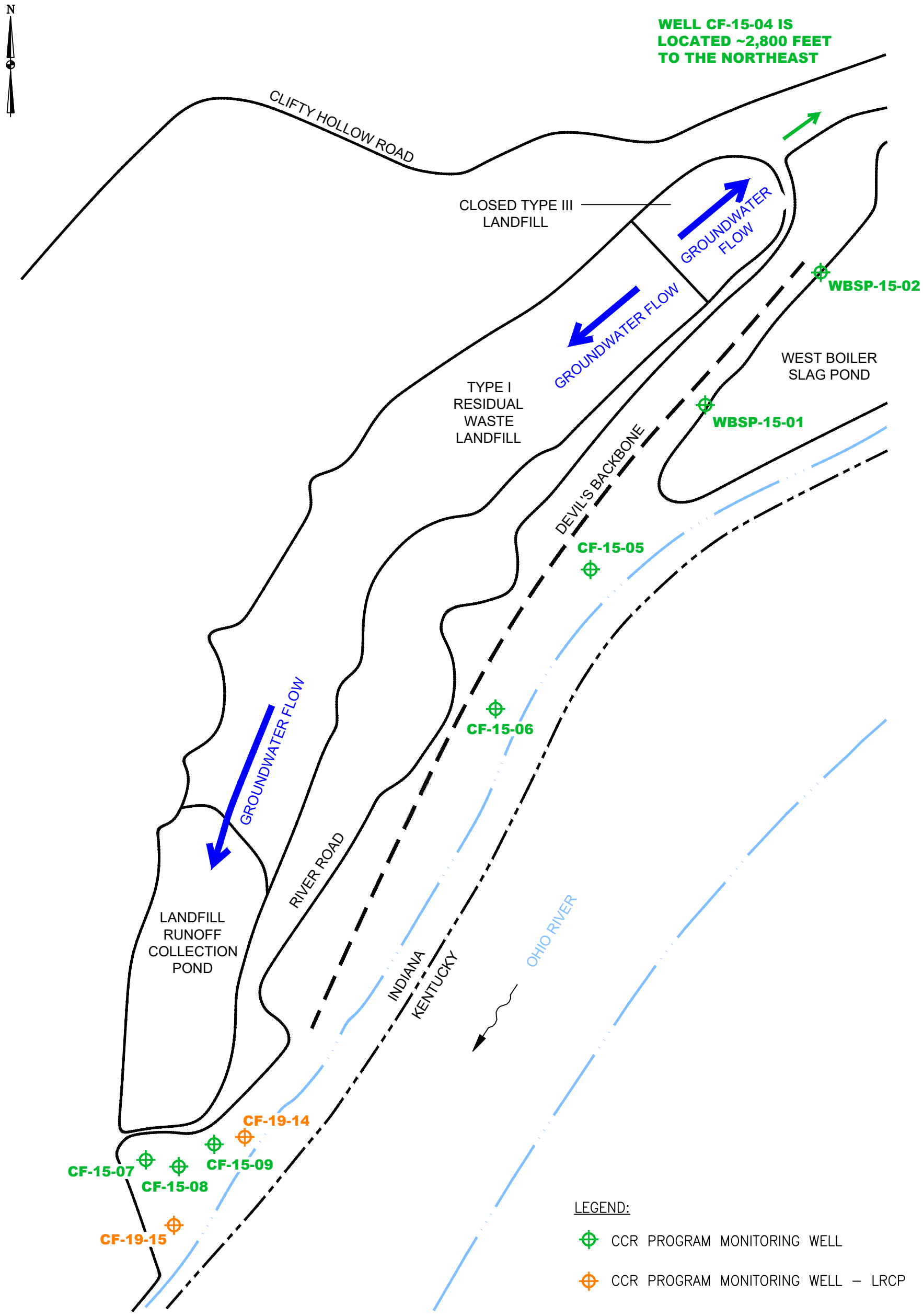
TABLE A-3
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2023
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Mar-23	Jun-23	Sep-23	Nov-23
	Groundwater Elevation (feet)			
CF-15-04	442.67	NM	437.68	NM
CF-15-05	437.83	NM	428.80	NM
CF-15-06	428.62	NM	DRY	NM
WBSP-15-01	453.73	NM	DRY	NM
WBSP-15-02	464.68	NM	DRY	NM
WBSP-15-03	480.74	NM	476.28	NM
WBSP-15-04a	422.25	420.55	416.06	418.47
WBSP-15-05a	424.07	424.03	417.90	421.18
WBSP-15-06a	424.96	421.29	418.74	422.17
WBSP-15-07	432.97	432.02	428.46	428.11
WBSP-15-08	432.27	434.10	427.79	431.20
WBSP-15-09	433.61	432.93	427.41	428.85
WBSP-15-10	433.55	432.87	429.12	429.07

Notes:
1. NM: Not Measured
2. Well WBSP-15-01 was accessible for water level collection but not safely accessible for sample collection during the March 2023 sampling event.

APPENDIX B

GROUNDWATER FLOW MAPS



DRAWN BY	JM
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CHECKED BY	
JOB NO.	2022013-CLIFTY
DWG FILE	B-1_IKEC_Clifty_GW Flow_Appx B_LANDFILL_MAR-SEPT 2022.dwg
DRAWING SCALE	NOT TO SCALE

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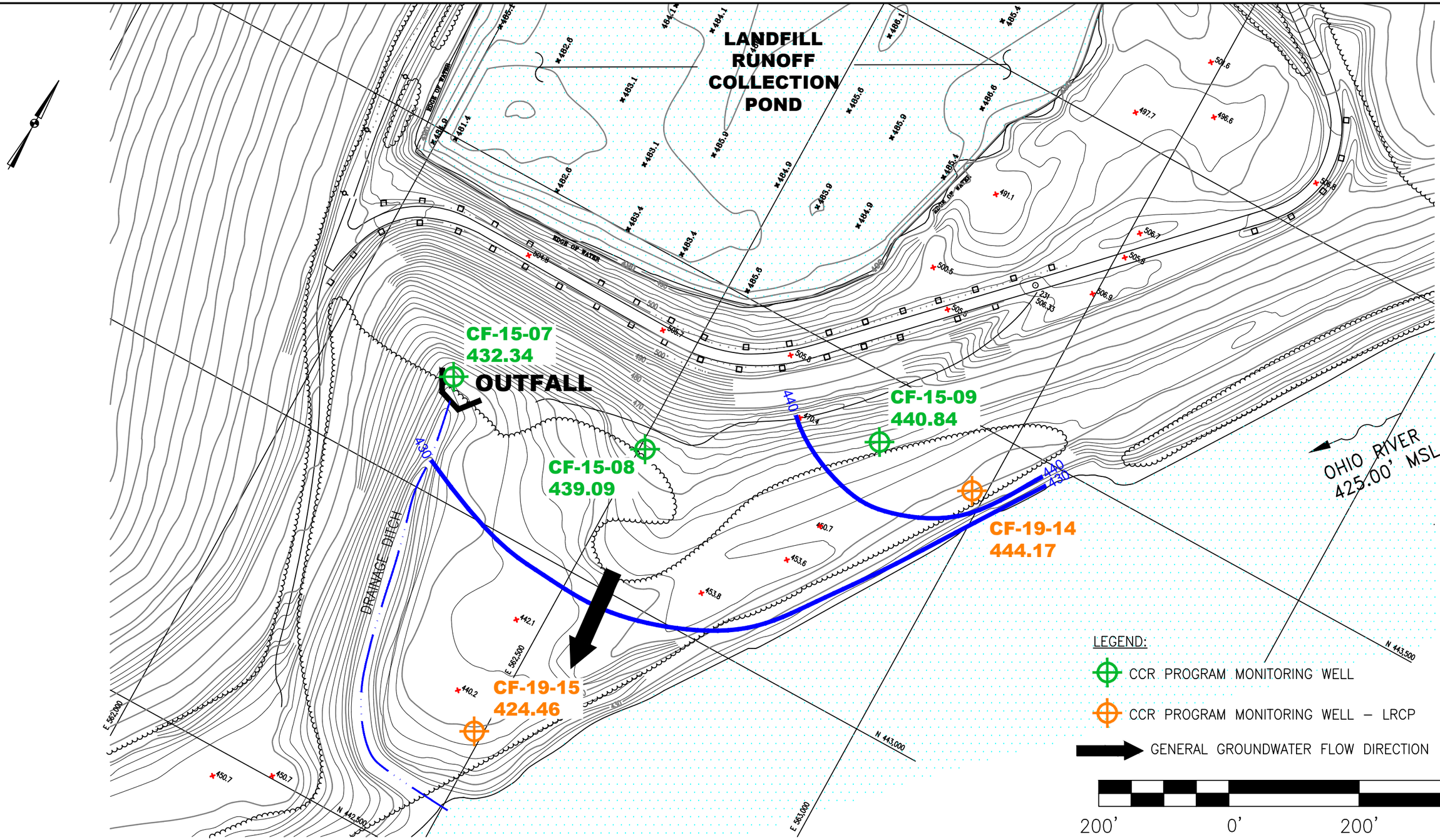
CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL AND LANDFILL RUNOFF COLLECTION POND
GENERALIZED GROUNDWATER FLOW
UPPERMOST AQUIFER – MARCH 2023/SEPTEMBER 2023

DRAWING NAME	REV.
FIGURE B-1	0

Plot: 12/21/2022 14:24 \Clifty Creek-CCR Program\CAD\2022 GW Monitoring & Corrective Action Rpt\B-1_IKEC_Clifty GW Flow_Appx B_LANDFILL_MAR-SEPT 2022.dwg



NOTE:
WELLS CF-19-14 AND CF-19-15 WERE INSTALLED IN MARCH 2019 DURING THE CHARACTERIZATION OF THE LRCP.

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DATE	
CHECKED BY	
JOB NO.	2023008-CLI
DWG FILE	A-1_IKEC_Clifty_ASD_LRCP_GL Flow_MAR 2023.dwg
DRAWING SCALE	AS SHOWN

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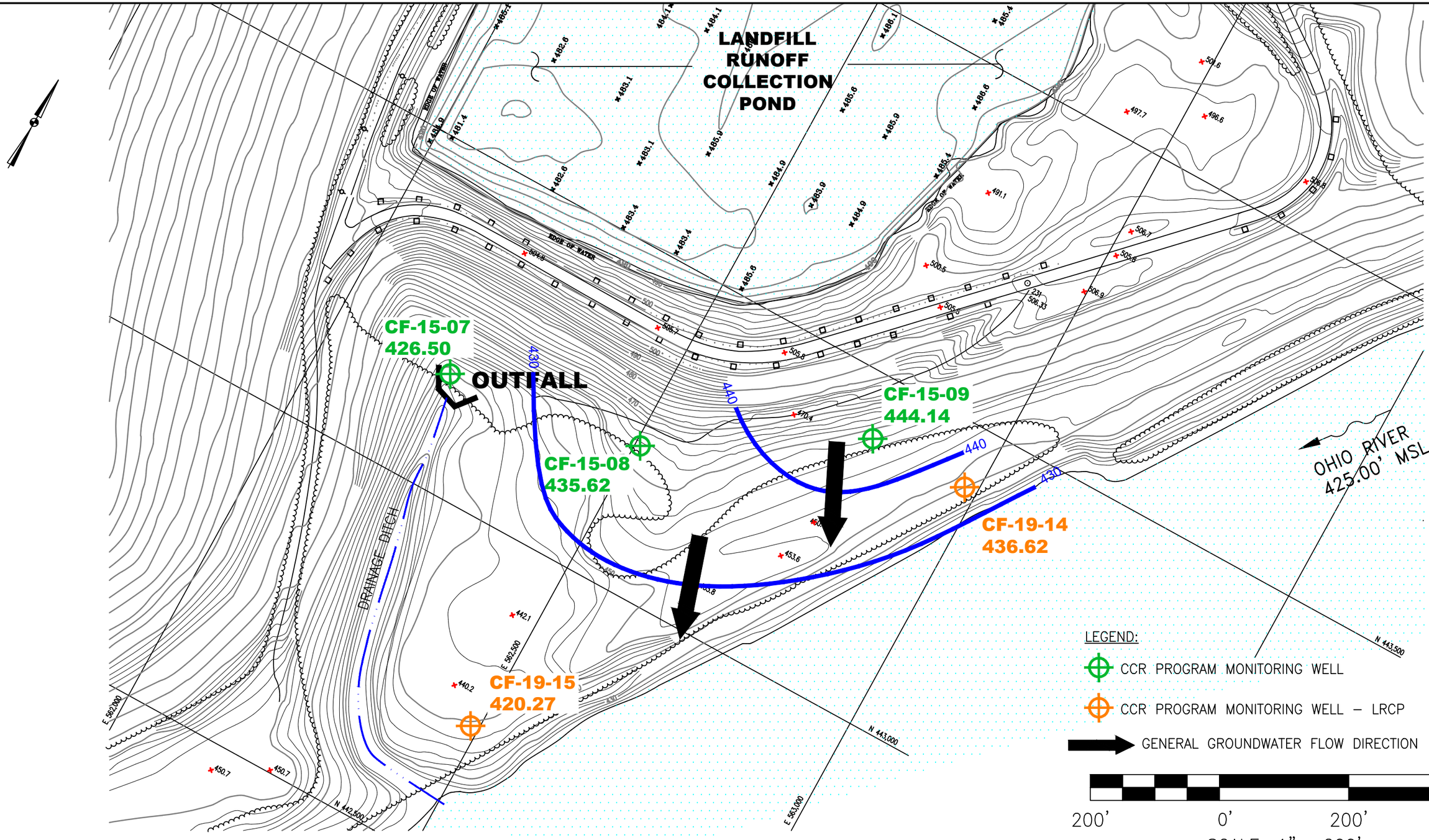
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
MARCH 2023

DRAWING NAME: FIGURE B-2 REV. 0



NOTE:
WELLS CF-19-14 AND CF-19-15 WERE INSTALLED IN MARCH 2019 DURING THE CHARACTERIZATION OF THE LRCP.

DRAWN BY	AB
DATE	
CHECKED BY	
JOB NO.	2023012-CLI
DWG FILE	A-1_IKEC_Clifty_ASD_LRCP_GL Flow_SEPT 2023.dwg
DRAWING SCALE	AS SHOWN

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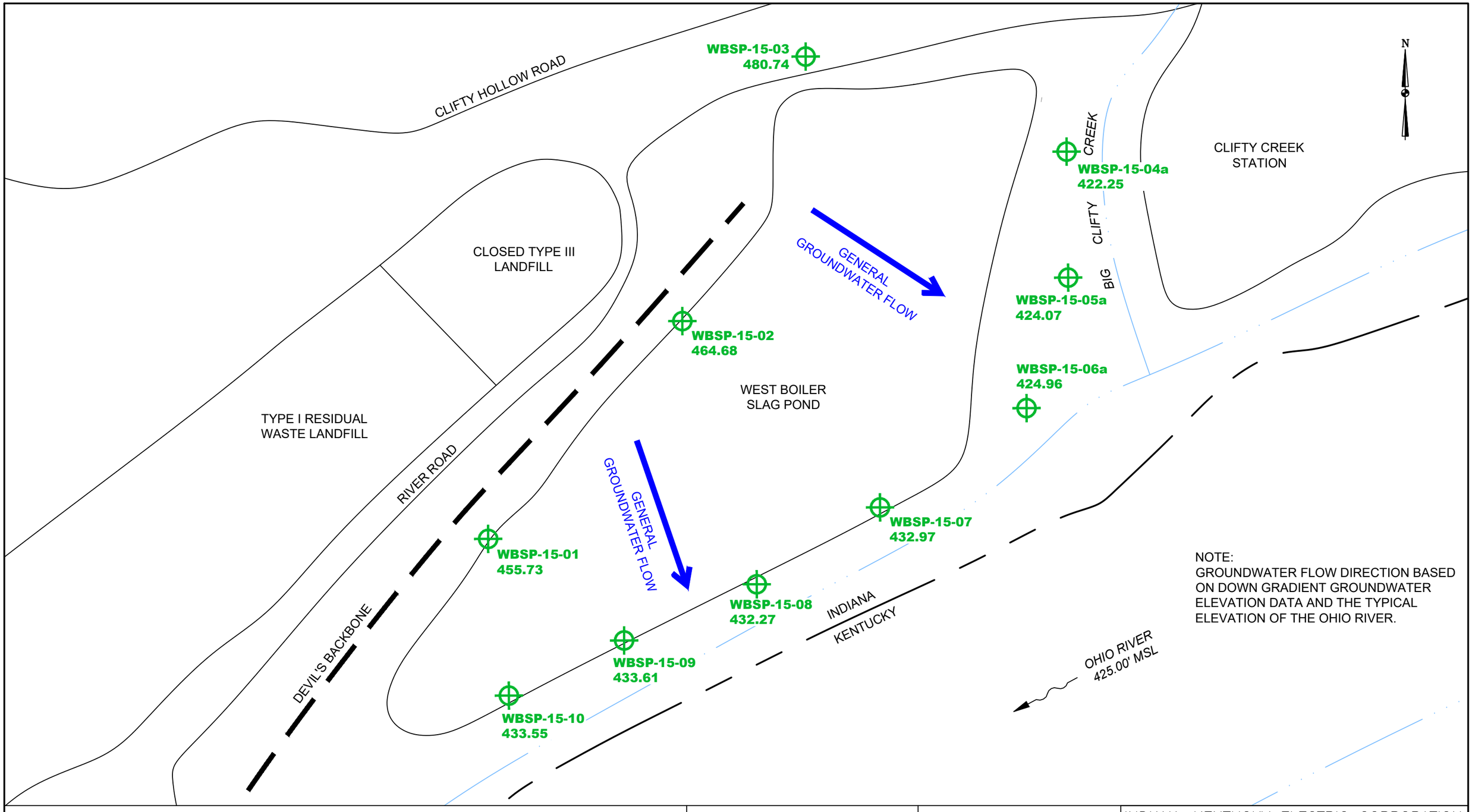
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
SEPTEMBER 2023

DRAWING NAME	REV.
FIGURE B-3	0



NOTE:
GROUNDWATER FLOW DIRECTION BASED ON DOWN GRADIENT GROUNDWATER ELEVATION DATA AND THE TYPICAL ELEVATION OF THE OHIO RIVER.

LEGEND:

CCR PROGRAM MONITORING WELL

GROUNDWATER FLOW DIRECTION

400' 0' 400' 800'

SCALE: 1"= 400'

DATE	
CHECKED BY	
JOB NO.	2022013-CLI
DWG FILE	B-4_IKEC-Clifty_GW Flow_Appx B_Annual GW Rpt_MAR22_WBSP.dwg
DRAWING SCALE	AS SHOWN

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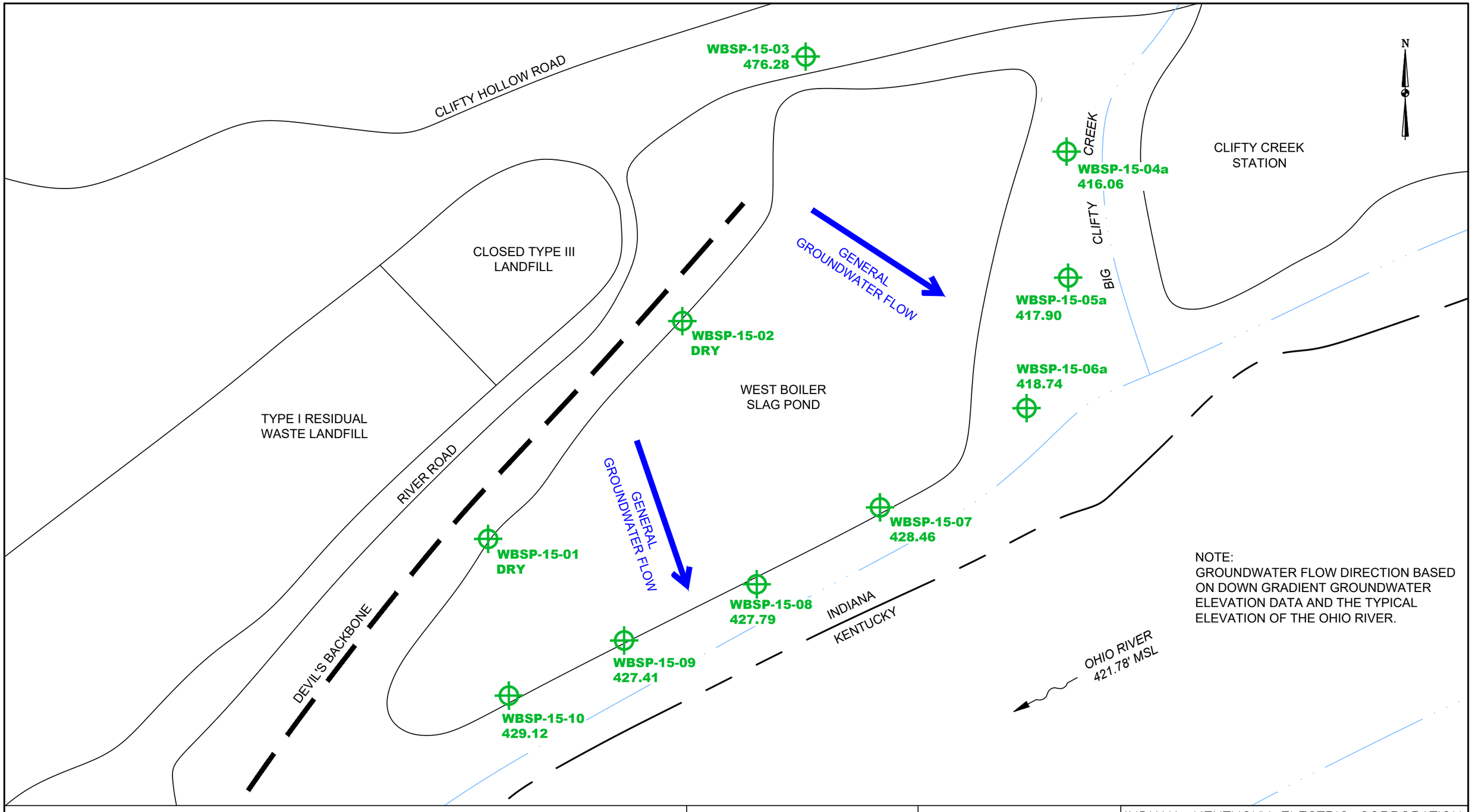
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
WEST BOILER SLAG POND
GROUNDWATER LEVELS AND FLOW DIRECTION
MARCH 2023

DRAWING NAME: FIGURE B-4

REV.: 0

Plot: 01/09/2024 14:47 _PROGRAMS-IKEC\IKEC-CCR Program\CAD\2023 GW Monitoring-Corrective Action Rpt\B-4_IKEC-Clifty_GW Flow_Appx B_Annual GW Rpt_MAR23_WBSP\well loc



NOTE:
GROUNDWATER FLOW DIRECTION BASED ON DOWN GRADIENT GROUNDWATER ELEVATION DATA AND THE TYPICAL ELEVATION OF THE OHIO RIVER.

LEGEND:

CCR PROGRAM MONITORING WELL

GROUNDWATER FLOW DIRECTION

400' 0' 400' 800'

SCALE: 1"= 400'

DATE	
CHECKED BY	
JOB NO.	2022013-CLI
DWG FILE	B-5_IKEC-Clifty_GW Flow_Appx B_Annual GW Rpt_SEPT22_WBSP.dwg
DRAWING SCALE	AS SHOWN

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INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
WEST BOILER SLAG POND
GROUNDWATER LEVELS AND FLOW DIRECTION
SEPTEMBER 2023

DRAWING NAME: FIGURE B-5

REV.: 0

Plot: 01/09/2024 14:51 _PROGRAMS-IKEC\IKEC-CCR Program\CAD\2023 GW Monitoring-Corrective Action Rpt\B-5_IKEC-Clifty_GW Flow_Appx B_Annual GW Rpt_SEPT23_WBSP

APPENDIX C

APPENDIX III AND APPENDIX IV CONSTITUENTS

APPENDIX III AND APPENDIX IV CONSTITUENTS
TYPE I RESIDUAL WASTE LANDFILL AND LANDFILL RUNOFF COLLECTION POND
AND WEST BOILER SLAG POND
CLIFTY CREEK STATION
MADISON, INDIANA

Appendix III Constituents
Boron, B
Calcium, Ca
Chloride, Cl
Fluoride, F
pH (units=SU)
Sulfate, SO4
Total Dissolved Solids (TDS)
Appendix IV Constituents
Antimony, Sb
Arsenic, As
Barium, Ba
Beryllium, Be
Cadmium, Cd
Chromium, Cr
Cobalt, Co
Fluoride, F
Lithium, Li
Lead, Pb
Mercury, Hg
Molybdenum, Mo
Radium 226 & 228 (combined)(units=pCi/L)
Selenium, Se
Thallium, Tl

APPENDIX D

ANALYTICAL RESULTS

CF-15-04
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix III Constituents			
Boron, B	mg/L	0.038	0.059
Calcium, Ca	mg/L	76	82
Chloride, Cl	mg/L	30	36
Fluoride, F	mg/L	0.1	0.17
pH	s.u.	7.89	7.98
Sulfate, SO4	mg/L	32	35
Total Dissolved Solids (TDS)	mg/L	420	280
Appendix IV Constituents			
Antimony, Sb	ug/L	1 U	1 U
Arsenic, As	ug/L	0.39	0.37
Barium, Ba	ug/L	44	42
Beryllium, Be	ug/L	0.7 U	0.7 U
Cadmium, Cd	ug/L	0.5 U	0.5 U
Chromium, Cr	ug/L	1	0.85
Cobalt, Co	ug/L	0.17	0.14
Fluoride, F	mg/L	0.1	0.17
Lead, Pb	ug/L	1 U	1 U
Lithium, Li	mg/L	0.0014	0.004 U
Mercury, Hg	ug/L	0.0002 U	0.078
Molybdenum, Mo	ug/L	0.91	1.2
Radium 226 & 228 (combined)	pCi/L	5 U	2.13
Selenium, Se	ug/L	1 U	1 U
Thallium, Tl	ug/L	0.2 U	0.2 U

CF-15-05
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix III Constituents			
Boron, B	mg/L	0.13	0.12
Calcium, Ca	mg/L	110	100
Chloride, Cl	mg/L	34	31
Fluoride, F	mg/L	0.44	0.56
pH	s.u.	7.64	7.56
Sulfate, SO4	mg/L	49	47
Total Dissolved Solids (TDS)	mg/L	500	560
Appendix IV Constituents			
Antimony, Sb	ug/L	1 U	1 U
Arsenic, As	ug/L	0.35	0.88
Barium, Ba	ug/L	49	49
Beryllium, Be	ug/L	0.7 U	0.7 U
Cadmium, Cd	ug/L	0.5 U	0.5 U
Chromium, Cr	ug/L	0.67	0.79
Cobalt, Co	ug/L	0.41	0.44
Fluoride, F	mg/L	0.44	0.56
Lead, Pb	ug/L	1 U	1 U
Lithium, Li	mg/L	0.016	0.016
Mercury, Hg	ug/L	0.0002 U	0.2 U
Molybdenum, Mo	ug/L	1 U	1.4
Radium 226 & 228 (combined)	pCi/L	5 U	5 U
Selenium, Se	ug/L	1 U	1 U
Thallium, Tl	ug/L	0.2 U	0.019

Notes:
NS: Well not sampled.

CF-15-06
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix III Constituents			
Boron, B	mg/L	0.11	NS
Calcium, Ca	mg/L	150	NS
Chloride, Cl	mg/L	5.3	NS
Fluoride, F	mg/L	0.2	NS
pH	s.u.	7.53	NS
Sulfate, SO4	mg/L	85	NS
Total Dissolved Solids (TDS)	mg/L	550	NS
Appendix IV Constituents			
Antimony, Sb	ug/L	1 U	NS
Arsenic, As	ug/L	4.8	NS
Barium, Ba	ug/L	82	NS
Beryllium, Be	ug/L	0.36	NS
Cadmium, Cd	ug/L	0.11	NS
Chromium, Cr	ug/L	9.4	NS
Cobalt, Co	ug/L	9.5	NS
Fluoride, F	mg/L	0.2	NS
Lead, Pb	ug/L	6.7	NS
Lithium, Li	mg/L	0.016	NS
Mercury, Hg	ug/L	0.000047	NS
Molybdenum, Mo	ug/L	0.64	NS
Radium 226 & 228 (combined)	pCi/L	3.29	NS
Selenium, Se	ug/L	1 U	NS
Thallium, Tl	ug/L	0.08	NS

Notes:
NS: Well not sampled.

CF-15-07
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Nov-23	Jan-24
Appendix III Constituents				
Boron, B	mg/L	0.043	0.047	NA
Calcium, Ca	mg/L	170	170	NA
Chloride, Cl	mg/L	5.9	5.2	NA
Fluoride, F	mg/L	0.22	0.22	NA
pH	s.u.	7.59	6.83	NA
Sulfate, SO4	mg/L	3.9	3.5	NA
Total Dissolved Solids (TDS)	mg/L	500	610	NA
Appendix IV Constituents				
Antimony, Sb	ug/L	1 U	1 U	NA
Arsenic, As	ug/L	8.6	15	9.9
Barium, Ba	ug/L	78	85	NA
Beryllium, Be	ug/L	0.7 U	0.7 U	NA
Cadmium, Cd	ug/L	0.5 U	0.5 U	NA
Chromium, Cr	ug/L	0.81	1.5 U	NA
Cobalt, Co	ug/L	2.6	2.5	NA
Fluoride, F	mg/L	0.22	0.22	NA
Lead, Pb	ug/L	1 U	1 U	NA
Lithium, Li	mg/L	0.0014	0.004 U	NA
Mercury, Hg	ug/L	0.0002 U	0.2 U	NA
Molybdenum, Mo	ug/L	4.5	5.6	NA
Radium 226 & 228 (combined)	pCi/L	5 U	5 U	NA
Selenium, Se	ug/L	1 U	1 U	NA
Thallium, Tl	ug/L	0.2 U	0.028	NA

Notes:
NA: Sampling not required for this parameter.
Due to access restrictions (construction) in September, well CF-15-07 was sampled in November and resampling occurred in January 2024.

CF-15-08
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	12	11	11	12
Calcium, Ca	mg/L	140	NA	130	NA
Chloride, Cl	mg/L	15	NA	17	NA
Fluoride, F	mg/L	0.39	NA	0.45	NA
pH	s.u.	7.95	NA	7.72	NA
Sulfate, SO4	mg/L	240	NA	260	NA
Total Dissolved Solids (TDS)	mg/L	240	NA	730	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	1 U	NA	1 U	NA
Arsenic, As	ug/L	0.58	NA	0.51	NA
Barium, Ba	ug/L	39	NA	42	NA
Beryllium, Be	ug/L	0.7 U	NA	0.7 U	NA
Cadmium, Cd	ug/L	0.2	NA	0.22	NA
Chromium, Cr	ug/L	0.71	NA	0.84	NA
Cobalt, Co	ug/L	0.29	NA	0.38	NA
Fluoride, F	mg/L	0.39	NA	0.45	NA
Lead, Pb	ug/L	1 U	NA	1 U	NA
Lithium, Li	mg/L	0.017	NA	0.018	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	590	570	650	730
Radium 226 & 228 (combined)	pCi/L	5 U	NA	5 U	NA
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.2 U	NA	0.021	NA

Notes:
NA: Sampling not required for this parameter.

CF-15-09
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	5.1	5.5	5.4	7.0
Calcium, Ca	mg/L	290	0.18	270	NA
Chloride, Cl	mg/L	2.8	NA	3.9	NA
Fluoride, F	mg/L	0.25	NA	0.31	NA
pH	s.u.	7.71	NA	NS	NA
Sulfate, SO4	mg/L	170	NA	220	NA
Total Dissolved Solids (TDS)	mg/L	610	NA	670	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	1 U	NA	1 U	NA
Arsenic, As	ug/L	9.1	NA	6.4	NA
Barium, Ba	ug/L	50	NA	39	NA
Beryllium, Be	ug/L	0.43	NA	0.27	NA
Cadmium, Cd	ug/L	0.092	NA	0.077	NA
Chromium, Cr	ug/L	17	NA	8.8	NA
Cobalt, Co	ug/L	14	0.4	9.5	1.8
Fluoride, F	mg/L	0.25	NA	0.31	NA
Lead, Pb	ug/L	11	NA	9.3	NA
Lithium, Li	mg/L	0.022	NA	0.018	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	88	NA	59	NA
Radium 226 & 228 (combined)	pCi/L	5 U	NA	1.44	NA
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.087	NA	0.062	NA

Notes:
NA: Sampling not required for this parameter.

CF-19-14
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix IV Constituents			
Molybdenum, Mo	ug/L	14	48

CF-19-15
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix IV Constituents			
Molybdenum, Mo	ug/L	1.2	0.53

WBSP-15-01
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix III Constituents			
Boron, B	mg/L	NS	NS
Calcium, Ca	mg/L	NS	NS
Chloride, Cl	mg/L	NS	NS
Fluoride, F	mg/L	NS	NS
pH	s.u.	NS	NS
Sulfate, SO4	mg/L	NS	NS
Total Dissolved Solids (TDS)	mg/L	NS	NS
Appendix IV Constituents			
Antimony, Sb	ug/L	NS	NS
Arsenic, As	ug/L	NS	NS
Barium, Ba	ug/L	NS	NS
Beryllium, Be	ug/L	NS	NS
Cadmium, Cd	ug/L	NS	NS
Chromium, Cr	ug/L	NS	NS
Cobalt, Co	ug/L	NS	NS
Fluoride, F	mg/L	NS	NS
Lead, Pb	ug/L	NS	NS
Lithium, Li	mg/L	NS	NS
Mercury, Hg	ug/L	NS	NS
Molybdenum, Mo	ug/L	NS	NS
Radium 226 & 228 (combined)	pCi/L	NS	NS
Selenium, Se	ug/L	NS	NS
Thallium, Tl	ug/L	NS	NS

Notes:
NS: Well not sampled.

WBSP-15-02
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix III Constituents			
Boron, B	mg/L	4.1	NS
Calcium, Ca	mg/L	280	NS
Chloride, Cl	mg/L	8.9	NS
Fluoride, F	mg/L	0.28	NS
pH	s.u.	7.27	NS
Sulfate, SO4	mg/L	550	NS
Total Dissolved Solids (TDS)	mg/L	1100	NS
Appendix IV Constituents			
Antimony, Sb	ug/L	1 U	NS
Arsenic, As	ug/L	0.54	NS
Barium, Ba	ug/L	24	NS
Beryllium, Be	ug/L	0.7 U	NS
Cadmium, Cd	ug/L	0.5 U	NS
Chromium, Cr	ug/L	1.2	NS
Cobalt, Co	ug/L	0.43	NS
Fluoride, F	mg/L	0.28	NS
Lead, Pb	ug/L	0.2	NS
Lithium, Li	mg/L	0.069	NS
Mercury, Hg	ug/L	0.0002 U	NS
Molybdenum, Mo	ug/L	3.8	NS
Radium 226 & 228 (combined)	pCi/L	5 U	NS
Selenium, Se	ug/L	1 U	NS
Thallium, Tl	ug/L	0.2 U	NS

WBSP-15-03
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Sep-23
Appendix III Constituents			
Boron, B	mg/L	0.085	0.066
Calcium, Ca	mg/L	150	38
Chloride, Cl	mg/L	79	15
Fluoride, F	mg/L	0.19	0.053
pH	s.u.	7.01	7.31
Sulfate, SO4	mg/L	140	49
Total Dissolved Solids (TDS)	mg/L	550	160
Appendix IV Constituents			
Antimony, Sb	ug/L	1 U	1 U
Arsenic, As	ug/L	1 U	0.29
Barium, Ba	ug/L	12	6.4
Beryllium, Be	ug/L	0.7 U	0.7 U
Cadmium, Cd	ug/L	0.5 U	0.5 U
Chromium, Cr	ug/L	0.82	1.2
Cobalt, Co	ug/L	0.22	0.3
Fluoride, F	mg/L	0.19	0.053
Lead, Pb	ug/L	1 U	0.34
Lithium, Li	mg/L	0.011	0.0037
Mercury, Hg	ug/L	0.0002 U	0.2 U
Molybdenum, Mo	ug/L	1.2	0.14
Radium 226 & 228 (combined)	pCi/L	5 U	5 U
Selenium, Se	ug/L	1 U	1 U
Thallium, Tl	ug/L	0.2 U	0.2 U

Notes:
NA: Sampling not required for this parameter.

WBSP-15-04a
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	0.51	0.51	0.48	0.49
Calcium, Ca	mg/L	150	NA	140	NA
Chloride, Cl	mg/L	24	NA	23	NA
Fluoride, F	mg/L	0.25 U	NA	0.11	NA
pH	s.u.	7.95	7.95	7.62	NA
Sulfate, SO4	mg/L	98	NA	100	NA
Total Dissolved Solids (TDS)	mg/L	550	NA	630	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	1 U	NA	1 U	NA
Arsenic, As	ug/L	0.3	NA	0.28	NA
Barium, Ba	ug/L	73	NA	79	NA
Beryllium, Be	ug/L	0.7 U	NA	0.7 U	NA
Cadmium, Cd	ug/L	0.18	NA	0.17	NA
Chromium, Cr	ug/L	0.79	NA	0.97	NA
Cobalt, Co	ug/L	9.5	12	11	14
Fluoride, F	mg/L	0.25 U	NA	0.11	NA
Lead, Pb	ug/L	0.21	NA	0.21	NA
Lithium, Li	mg/L	0.0014	NA	0.0018	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	0.28	NA	0.25	NA
Radium 226 & 228 (combined)	pCi/L	5 U	NA	5 U	NA
Selenium, Se	ug/L	0.46	NA	1 U	NA
Thallium, Tl	ug/L	0.025	NA	0.047	NA

Notes:
NA: Sampling not required for this parameter.
The facility is evaluating whether the sampling results provided above are the result of an error in accordance with 40 C.F.R. § 257.95(g)(3)(ii).

WBSP-15-05a
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	2.4	2.2	2	2.5
Calcium, Ca	mg/L	140	NA	110	NA
Chloride, Cl	mg/L	24	NA	25	NA
Fluoride, F	mg/L	0.17	NA	0.24	NA
pH	s.u.	7.07	NA	7.83	NA
Sulfate, SO4	mg/L	310	NA	290	NA
Total Dissolved Solids (TDS)	mg/L	690	NA	590	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	0.6	NA	1.1	NA
Arsenic, As	ug/L	1.2	NA	1.5	NA
Barium, Ba	ug/L	140	NA	240	NA
Beryllium, Be	ug/L	0.037	NA	0.063	NA
Cadmium, Cd	ug/L	0.5 U	NA	0.16	NA
Chromium, Cr	ug/L	2.4	NA	5.2	NA
Cobalt, Co	ug/L	1.8	NA	4.7	NA
Fluoride, F	mg/L	0.17	NA	0.24	NA
Lead, Pb	ug/L	0.43	NA	1.1	NA
Lithium, Li	mg/L	0.039	NA	0.1	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	34	NA	43	NA
Radium 226 & 228 (combined)	pCi/L	5 U	NA	3	NA
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.037	NA	0.068	NA

Notes:
NA: Sampling not required for this parameter.
The facility is evaluating whether the sampling results provided above are the result of an error in accordance with 40 C.F.R. § 257.95(g)(3)(ii).

WBSP-15-06a
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	1.5	1.4	1.3	1.1
Calcium, Ca	mg/L	99	NA	86	NA
Chloride, Cl	mg/L	45	NA	40	NA
Fluoride, F	mg/L	0.22	NA	0.27	NA
pH	s.u.	7.34	NA	7.99	NA
Sulfate, SO4	mg/L	85	NA	58	NA
Total Dissolved Solids (TDS)	mg/L	500	NA	430	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	1 U	NA	1 U	NA
Arsenic, As	ug/L	9.1	NA	9.5	NA
Barium, Ba	ug/L	210	NA	210	NA
Beryllium, Be	ug/L	0.7 U	NA	0.034	NA
Cadmium, Cd	ug/L	0.5 U	NA	0.5 U	NA
Chromium, Cr	ug/L	0.98	NA	1	NA
Cobalt, Co	ug/L	0.6	NA	1.1	NA
Fluoride, F	mg/L	0.22	NA	0.27	NA
Lead, Pb	ug/L	1 U	NA	0.55	NA
Lithium, Li	mg/L	0.0039	NA	0.0039	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	50	NA	39	NA
Radium 226 & 228 (combined)	pCi/L	1.05	NA	2.49	NA
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.2 U	NA	0.2 U	NA

Notes:
NA: Sampling not required for this parameter.
The facility is evaluating whether the sampling results provided above are the result of an error in accordance with 40 C.F.R. § 257.95(g)(3)(ii).

WBSP-15-07
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	0.017	NA	0.02	NA
Calcium, Ca	mg/L	200	NA	180	NA
Chloride, Cl	mg/L	11	NA	12	NA
Fluoride, F	mg/L	0.23	NA	0.42	NA
pH	s.u.	6.94	NA	7.49	NA
Sulfate, SO4	mg/L	6.2	NA	16	NA
Total Dissolved Solids (TDS)	mg/L	270	NA	710	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	1 U	NA	1 U	NA
Arsenic, As	ug/L	87	25	42	51
Barium, Ba	ug/L	650	NA	370	NA
Beryllium, Be	ug/L	0.047	NA	0.7 U	NA
Cadmium, Cd	ug/L	0.5 U	NA	0.5 U	NA
Chromium, Cr	ug/L	2.2	NA	1.1	NA
Cobalt, Co	ug/L	3.3	NA	3	NA
Fluoride, F	mg/L	0.23	NA	0.42	NA
Lead, Pb	ug/L	0.43	NA	1 U	NA
Lithium, Li	mg/L	0.0016	NA	0.0017	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	4.7	NA	3.8	NA
Radium 226 & 228 (combined)	pCi/L	1.11	NA	1.39	NA
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.2 U	NA	0.2 U	NA

Notes:
NA: Sampling not required for this parameter.

WBSP-15-08
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	0.028	NA	0.048	NA
Calcium, Ca	mg/L	85	NA	76	NA
Chloride, Cl	mg/L	17	NA	17	NA
Fluoride, F	mg/L	0.15	NA	0.2	NA
pH	s.u.	6.95	NA	8.01	7.68
Sulfate, SO4	mg/L	4 U	NA	4 U	NA
Total Dissolved Solids (TDS)	mg/L	330	NA	400	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	1 U	NA	1 U	NA
Arsenic, As	ug/L	100	70	70	68
Barium, Ba	ug/L	490	NA	340	NA
Beryllium, Be	ug/L	0.15	NA	0.18	NA
Cadmium, Cd	ug/L	0.5 U	NA	0.5 U	NA
Chromium, Cr	ug/L	3.5	NA	5	NA
Cobalt, Co	ug/L	2.3	NA	3	NA
Fluoride, F	mg/L	0.15	NA	0.2	NA
Lead, Pb	ug/L	2.3	NA	2.8	NA
Lithium, Li	mg/L	0.0025	NA	0.0028	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	0.79	NA	1.3	NA
Radium 226 & 228 (combined)	pCi/L	5 U	NA	5 U	NA
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.019	NA	0.037	NA

Notes:
NA: Sampling not required for this parameter.

WBSP-15-09
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	0.014	NA	0.025	NA
Calcium, Ca	mg/L	63	NA	57	NA
Chloride, Cl	mg/L	3.5	NA	3.5	NA
Fluoride, F	mg/L	0.55	NA	0.63	0.57
pH	s.u.	7.25	NA	7.13	NA
Sulfate, SO4	mg/L	4 U	NA	2 U	NA
Total Dissolved Solids (TDS)	mg/L	96	NA	260	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	1.1	NA	1 U	NA
Arsenic, As	ug/L	25	26	23	20
Barium, Ba	ug/L	170	NA	180	NA
Beryllium, Be	ug/L	0.036	NA	0.7 U	NA
Cadmium, Cd	ug/L	0.5 U	NA	0.5 U	NA
Chromium, Cr	ug/L	1.2	NA	0.86	NA
Cobalt, Co	ug/L	0.36	NA	0.2	NA
Fluoride, F	mg/L	0.55	NA	0.63	NA
Lead, Pb	ug/L	0.49	NA	0.42	NA
Lithium, Li	mg/L	0.004 U	NA	0.004 U	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	6.2	NA	43	NA
Radium 226 & 228 (combined)	pCi/L	0.749	NA	0.91	NA
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.2 U	NA	0.2 U	NA

Notes:
NA: Sampling not required for this parameter.

WBSP-15-10
SUMMARY OF 2023 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-23	Jun-23	Sep-23	Nov-23
Appendix III Constituents					
Boron, B	mg/L	0.039	NA	0.056	NA
Calcium, Ca	mg/L	97	NA	110	NA
Chloride, Cl	mg/L	24	NA	11	NA
Fluoride, F	mg/L	0.21	NA	0.063	NA
pH	s.u.	7.01	NA	7.16	NA
Sulfate, SO4	mg/L	65	NA	24	NA
Total Dissolved Solids (TDS)	mg/L	10 U	NA	180	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	0.53	NA	1 U	NA
Arsenic, As	ug/L	12	2.5	6.2	NA
Barium, Ba	ug/L	290	NA	200	NA
Beryllium, Be	ug/L	0.55	NA	0.033	NA
Cadmium, Cd	ug/L	0.16	NA	0.5 U	NA
Chromium, Cr	ug/L	12	NA	1.1	NA
Cobalt, Co	ug/L	9.1	2.4	3.9	NA
Fluoride, F	mg/L	0.21	NA	0.063	NA
Lead, Pb	ug/L	6.1	NA	0.29	NA
Lithium, Li	mg/L	0.011	NA	0.0021	NA
Mercury, Hg	ug/L	0.0002 U	NA	0.055	NA
Molybdenum, Mo	ug/L	3	NA	3	NA
Radium 226 & 228 (combined)	pCi/L	5 U	NA	5.43	5 U
Selenium, Se	ug/L	1 U	NA	1 U	NA
Thallium, Tl	ug/L	0.14	NA	0.022	NA

Notes:
NA: Sampling not required for this parameter.

APPENDIX E

ALTERNATE SOURCE DEMONSTRATION MARCH 2023
TYPE I LANDFILL

AGES
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COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
MARCH 2023 DETECTION MONITORING EVENT

TYPE I RESIDUAL WASTE LANDFILL
INDIANA KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK PLANT
MADISON, JEFFERSON COUNTY, INDIANA

OCTOBER 2023

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

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Applied Geology and Environmental Science, Inc.

Bethany Flaherty
Senior Scientist II

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COAL COMBUSTION RESIDUALS REGULATION
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1.0 INTRODUCTION

On December 19, 2014, the United States Environmental Protection Agency (U.S. EPA) issued their final Coal Combustion Residuals (CCR) regulation which regulates CCR as a non-hazardous waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) and became effective six (6) months from the date of its publication (April 2015) in the Federal Register, referred to as the "CCR Rule."

The Indiana-Kentucky Electric Corporation (IKEC) contracted with Applied Geology and Environmental Science, Inc. (AGES) to administer the CCR Rule groundwater monitoring program at the Clifty Creek Station located in Madison, Jefferson County, Indiana. There are three (3) CCR units at the Clifty Creek Station (Figure 1):

- Type I Residual Waste Landfill (Type I Landfill);
- Landfill Runoff Collection Pond (LRCP); and,
- West Boiler Slag Pond (WBSP).

Under the CCR program, the Type I Landfill and LRCP are being monitored under one (1) multi-unit groundwater monitoring system. During the March 2018 Detection Monitoring event, Boron Statistically Significant Increases (SSIs) were confirmed in two (2) wells located downgradient of the Type I Landfill and LRCP and these CCR units entered into Assessment Monitoring in September 2018. Based on a successful Alternate Source Demonstration (ASD) (AGES 2019a), IKEC determined that the Type I Landfill was not the source of the Boron. Therefore, the Type I Landfill returned to Detection Monitoring in January 2019. During the March 2019, October 2019, March 2020, September 2020, March 2021, September 2021, March 2022 and September 2022 Detection Monitoring sampling events, SSIs for Boron were again confirmed in wells located downgradient of the unit. Based on successful ASDs for these eight (8) Detection Monitoring events (AGES 2019b, AGES 2020a, AGES 2020b, AGES 2021a, AGES 2021b, AGES 2022a, AGES 2022b and AGES 2023), the Type I Landfill has remained in Detection Monitoring. As an alternate source for Boron at the LRCP could not be established, the LRCP remains in Assessment Monitoring.

During the March 2023 Detection Monitoring event, Boron SSIs were confirmed in two (2) wells located downgradient of the Type I Landfill. Therefore, IKEC has prepared this ASD to show that

the Type I Landfill is not the source of the Boron. Details regarding this evaluation are presented in this report.

1.1 Background

In accordance with §257.91(d) of the CCR Rule, as detailed in the Well Installation Report (AGES 2018a), because the LRCP is directly adjacent to the southwest (downgradient) of the Type I Landfill, and because of the hydrogeologic conditions of the site, IKEC installed a multi-unit groundwater monitoring system to monitor groundwater quality directly downgradient of the Type I Landfill and LRCP. As described above, the Type I Landfill has remained in Detection Monitoring based on previous successful ASDs; the LRCP remains in Assessment Monitoring. In accordance with §257.94 of the CCR Rule, IKEC completed the groundwater monitoring requirements of the Detection Monitoring Program at the Type I Landfill as described below.

The tenth round of Detection Monitoring groundwater samples was collected between March 14 and 22, 2023 from monitoring wells at the Type I Landfill (Figure 1). All samples were collected in accordance with the Groundwater Monitoring Program Plan (GMPP) (AGES 2018b) and analyzed for all Appendix III constituents.

Upon receipt, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Clifty Creek Station CCR Statistical Analysis Plan (StAP) (Stantec 2021). The initial statistical evaluation identified potential SSIs for Boron in monitoring wells CF-15-08 and CF-15-09 at the Type I Landfill. The results of the statistical evaluation are summarized in Table 1.

In accordance with the StAP, IKEC resampled the well for Boron on June 14, 2023. Based on the result of the resampling event, the SSIs for Boron were confirmed in monitoring wells CF-15-08 and CF-15-09 (Table 1).

1.2 Purpose of This Report

The purpose of this report is to present an ASD and provide sufficient evidence that the SSIs identified for Boron in wells CF-15-08 and CF-15-09 resulted from a source other than the Type I Landfill.

The CCR Rule does not contain specific requirements for an ASD beyond what is stated, as follows, in §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 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 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."

In addition to the above requirements of the CCR Rule, this ASD has been conducted and presented using guidance and documentation recommendations included in the U.S. EPA document Solid Waste Disposal Facility Criteria Technical Manual EPA 530-R-93-017 (U.S. EPA 1993).

A detailed discussion of the confirmed SSIs and a technical justification that the exceedance results are from a source other than the Type I Landfill are presented in the following sections of this report.

2.0 DESCRIPTION OF THE TYPE I LANDFILL

2.1 Unit Description

The Type I Landfill and LRCP occupy an approximately 200-acre area situated within an eroded bedrock channel. The Type I Landfill consists of approximately 109 acres that were approved as a Type I residual waste landfill by the Indiana Department of Environmental Management (IDEM) in 2007. The remaining 91 acres consist of the LRCP located at the southwest end of the Type I Landfill (57 acres) and 34 acres closed under the IDEM landfill permit requirements (Figures 1 and 2).

Beginning in 1955, ash products were sluiced to a disposal pond located in the bedrock channel at the plant site. To allow for more disposal capacity, an on-site fly ash pond was developed into a Type III residual landfill in 1988. All required permits for the Type III Residual Waste Landfill (Type III Landfill) were obtained from IDEM. The Type III Landfill was permitted to be constructed and to serve as closure for the historic fly ash pond. The Type III Landfill is located at the northeast end of the bedrock channel and went operational in 1991.

After IDEM approval, IKEC upgraded the Type III Landfill to a Type I residual waste landfill (Type I Landfill). As a result, the Type III Landfill was closed and the Type I Landfill was designed and constructed to serve as the cap for the closed Type III Landfill. The Type I Landfill, which went operational in 2011, is completely separated from the closed Type III Landfill by a geosynthetic clay liner.

2.2 Hydrogeology

Based on information in the Hydrogeologic Study Report (AGES 2007), bedrock beneath the Type I Landfill and the closed Type III Landfill consists of impermeable limestone and shale of the Ordovician Dillsboro formation which is overlain by approximately 20 to 35 feet of gray clay. The gray clay is directly overlain by fly ash that had been historically hydraulically placed in the area. A generalized cross section showing the proposed final limits of the Type I Landfill & LRCP, the location and limits of the closed Type III Landfill, and the extent of the historic, hydraulically placed fly ash is presented in Figure 3. A limestone ridge known as the Devil's Backbone runs northeast to southwest along the length of the Type I Landfill & LRCP and the closed Type III Landfill. The Devil's Backbone acts as an impermeable barrier that forces groundwater passing beneath both of the landfills to flow either toward the northeast or toward the southwest. A detailed hydrogeologic study determined that a groundwater flow divide is present near the northeast end of the bedrock channel and that all groundwater beneath the active Type I Landfill flows toward the southwest (AGES 2007) (Figure 4). As detailed in the Monitoring Well Installation Report (AGES 2018a), an aquifer does not exist beneath either of the landfills. Therefore, alluvial deposits located southwest of the LRCP are designated as the uppermost aquifer for the Type I Landfill & LRCP.

The Type I Landfill was constructed using a geosynthetic clay liner to prevent water from the Type I Landfill from entering the underlying layers. Water in the Type I Landfill is collected by a leachate system and is currently discharged into the WBSP where it mixes with surface water runoff from the surrounding 510-acre drainage area.

In November and December 2015, groundwater monitoring wells were installed for the CCR groundwater monitoring network at the site. The CCR groundwater monitoring network for the Type I Landfill consists of eight (8) monitoring wells (Figure 1). Three (3) monitoring wells (CF-15-07, CF-15-08 and CF-15-09) were installed in the alluvial deposits (uppermost aquifer) located southwest of the LRCP. Based on exploratory soil borings and historical data, there were no suitable upgradient locations for the Type I Landfill. Well CF-15-04 was installed northeast of and outside the hydrologic influence of the Type I Landfill and the closed Type III Landfill to serve as a background monitoring well. Wells CF-15-05 and CF-15-06 were also installed in alluvial deposits along the Ohio River to serve as background monitoring wells. Wells WBSP-15-01 and WBSP-15-02 are located southeast of the impermeable Devil's Backbone and are hydraulically separated from groundwater flowing beneath the Type I Landfill. Because these wells are outside the hydraulic influence of the Type I Landfill, these wells were designated as background wells. Table 2 presents construction details for the monitoring wells in the groundwater monitoring network for the Type I Landfill. Two (2) additional wells (CF-19-14 and CF-19-15) were installed southwest of the Type I Landfill during the characterization of the LRCP. Although these wells are not part of the monitoring system for the Type I Landfill, groundwater elevation data from the wells has been used to support the development of flow maps for the area.

Based on groundwater levels collected at the site since 1994, groundwater in the uppermost aquifer southwest (downgradient) of the Type I Landfill typically flows to the southwest toward the Ohio River. Historic groundwater data also indicates that groundwater flow at the southwest end of the property is affected by the elevation of the adjacent Ohio River. Evidence of routine, brief flow reversals (i.e., groundwater flows from the Ohio River back toward the southwest end of the property) and periodic flooding of the southwest end of the property have also been observed.

Groundwater contour maps for the uppermost aquifer southwest of the Type I Landfill in March 2023 (Detection Monitoring Event) and June 2023 (Resampling Event) are included in Appendix A (Figures A-1 and A-2). Groundwater generally flows to the southwest toward the Ohio River.

3.0 ALTERNATE SOURCE DEMONSTRATION

As noted above, Boron was identified as a confirmed SSI in wells CF-15-08 and CF-15-09 downgradient of the Type I Landfill. Based on a review of the current and historic data, AGES/IKEC have determined that the active Type I Landfill is not the source of the Boron SSIs reported in the CCR monitoring wells and that historic fly ash that had been sluiced into the valley beginning in 1955 is the alternate source for the Boron SSIs. As discussed in detail below, this conclusion is based on the following lines of evidence:

- Ash that was historically sluiced into the bedrock valley in the 1950s is a known source of Boron and is hydraulically connected to groundwater downgradient of the Type I Landfill;

- Boron has been detected in groundwater downgradient from the hydraulically-placed ash (and the Type I Landfill) in IDEM program wells CF-9405, CF-9406 and CF-9407 (located near wells CF-15-08 and CF-15-09) since 1994, which is 17 years prior to operation of the Type I Landfill; and

- Given the extremely low groundwater flow velocity at the landfill, the travel time for a release of Boron from the Type I Landfill to reach wells CF-15-08 and CF-15-09 is estimated at 120 years. As the Type I Landfill has only been in operation for 12 years, the landfill cannot be the source of the Boron.

Details to support these conclusions are presented below.

3.1 Alternate Source Demonstration Method

The evaluation of the alternate source for Boron in wells CF-15-08 and CF-15-09 was assessed in general accordance with guidelines presented in the Solid Waste Disposal Facility Criteria Technical Manual (U.S. EPA 1993) using the following methods:

- Identify a potential alternate source;

- Establish that a hydraulic connection exists between the alternate source and the wells with the confirmed SSIs;
- Establish that constituents of concern are present at the alternate source; and
- Establish that the concentrations observed in the compliance wells could not have resulted from the CCR unit given the hydrogeologic conditions at the site.

3.2 Alternate Source Identification

The initial groundwater investigation conducted for the former Type III Landfill (beginning in 1994) focused on the fly ash that had been hydraulically placed in the bedrock channel beginning in 1955. The Type III Landfill was permitted to serve as the closure for the hydraulically placed fly ash.

After IDEM approval, IKEC upgraded the Type III Landfill to a Type I Landfill and the Type I Landfill was permitted as the closure for the Type III Landfill. The active Type I Landfill was constructed with a geosynthetic liner and an engineered clay liner on top of the Type III Landfill to serve as a cap. The two (2) liners prevent migration of groundwater from the active Type I Landfill to the closed Type III Landfill. The closed Type III Landfill is not subject to regulation under the CCR Rule.

Both landfills were constructed on top of the historic, hydraulically placed fly ash which extends the length of the bedrock channel (Figure 3) beneath the LRCP to the embankment at the southwestern end of the LRCP (Figure 5). Although the base of the LRCP contains historic, hydraulically placed fly ash, the LRCP does not receive CCR and the existing historic CCR is not actively managed. Therefore, the LRCP is considered an inactive CCR unit.

Due to the age and extent of the historic, hydraulically placed ash, this material was identified as the alternate source for the Boron detected in wells CF-15-08 and CF-15-09.

3.3 Establish a Hydraulic Connection

A review of the permit drawings, construction drawings, and a figure from the Initial Structural Stability Assessment Landfill Runoff Collection Pond Report (Stantec 2016) (Appendix B) indicated that material from the closed Type III Landfill and the historic, hydraulically placed fly ash are located entirely beneath the active Type I Landfill & LRCP (Figure 3). The base of the layer of “hydraulically placed fly ash” is located between elevations 445 feet mean sea level (ft msl) and 500 ft msl.

When the fly ash was originally emplaced in the bedrock channel, there were no impermeable liners constructed to separate the fly ash from the underlying “foundation soils.” The CCR and IDEM groundwater monitoring wells are screened in these “foundation soils,” which consist of alluvial deposits of silt, sand and gravel. These alluvial deposits extend from beneath the LRCP

and the hydraulically placed fly ash southwest to the Ohio River and provide a direct hydraulic connection between the historic, hydraulically placed fly ash and the groundwater monitoring wells (Figure 5).

3.4 Constituents Are Present at the Alternate Source

Both the closed Type III Landfill and the Type I Landfill are currently being monitored under an IDEM groundwater monitoring program. In 1994, three (3) monitoring wells (CF-9405, CF-9406 and CF-9407) were installed south of the LRCP as a condition of a pH variance for the former Type III Landfill granted by IDEM. From June 1994 through February 1995, 17 biweekly background events were conducted. Since June 1995, routine quarterly and semi-annual monitoring of these wells has been conducted.

In 2009, three (3) additional wells (CF-07-06D, CF-07-08 and CF-07-09) were installed per IDEM to monitor groundwater quality during the year prior to the start of operations of the Type I Landfill in 2011. Wells in the IDEM groundwater monitoring network are located south of the LRCP and screened in the same "foundation soils" as the wells in the CCR monitoring network (Figure 6).

During quarterly and semi-annual sampling events from June 1995 through 2011, Boron was detected in well CF-9406 (adjacent to well CF-15-08) at concentrations ranging from 9.9 milligrams per liter (mg/L) to 18 mg/L and in well CF-9407 (adjacent to well CF-15-09) at concentrations ranging from 1.19 mg/L to 7.5 mg/L (Table 3 and Figure 7). This demonstrates that Boron was present in groundwater downgradient of the eventual location of the Type I Landfill 17 years prior to its operation. Boron concentrations in downgradient CCR wells have ranged from 7.62 mg/L to 13 mg/L in well CF-15-08, and from 3.8 mg/L to 7.59 mg/L in well CF-15-09 (Table 3 and Figure 7). These concentrations are similar to historic Boron concentrations observed in wells CF-9406 and CF-9407 from June 1995 through 2011.

Because Boron concentrations similar to those observed in CCR wells CF-15-08 and CF-15-09 were detected in IDEM wells CF-9406 and CF-9407 prior to construction of the Type I Landfill, the historic, hydraulically placed ash is the source of the detected Boron.

3.5 Hydrogeologic Conditions and Groundwater Flow Velocity

As presented in the Evaluation of Potential Risk to Supply Well Fields Report (AGES 2006), a groundwater flow velocity of 45 feet per year (ft/yr) was calculated for alluvial deposits, which are designated as the uppermost aquifer for these CCR units. Based on the most recent topographical survey conducted of the Type I Landfill (Appendix C), the current limit of waste for the active Type I Landfill is located approximately 5,400 feet (more than one [1] mile) northeast of the three (3) CCR groundwater monitoring wells (CF-15-07, CF-15-08 and CF-15-09) (Figure 8). Based on this data, it was calculated that it will take 120 years for groundwater to flow from the current limit of waste in the Type I Landfill to the CCR monitoring wells. Waste placement in

the Type I Landfill began in early 2011. Given the two (2) constructed liners, the distance and the flow rate, water from the Type I Landfill is not able to enter the groundwater, and groundwater has not had enough time to reach the CCR monitoring wells.

Based on the calculations presented above, the active Type I Landfill cannot be the source of Boron detected in the CCR monitoring wells.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The ASD has been completed in general accordance with guidelines presented in the Solid Waste Disposal Facility Criteria Technical Manual (U.S. EPA 1993).

Based on a review of the current and historic data, AGES/IKEC have determined that the Type I Landfill is not the source of Boron detected in the CCR monitoring wells CF-15-08 and CF-15-09. This conclusion is supported by the following evidence:

- "Foundation soils" that extend from beneath the LRCP and the hydraulically placed fly ash southwest to the Ohio River provide a direct hydraulic connection between the historic, hydraulically placed fly ash and the CCR groundwater monitoring wells CF-15-08 and CF-15-09.

- Historic data from the IDEM groundwater monitoring program indicate that Boron concentrations similar to those observed in CCR wells CF-15-08 and CF-15-09 were detected in IDEM wells CF-9406 and CF-9407 for 17 years prior to operation of the Type I Landfill, indicating that the Boron is associated with the historic, hydraulically placed fly ash.

- Using the previously calculated groundwater flow velocity of 45 ft/yr, it is estimated that it would take 120 years for groundwater flowing beneath the Type I Landfill to reach the CCR monitoring wells.

Based on the demonstration presented above, the Type I Landfill is not the source of the Boron detected in CCR monitoring wells CF-15-08 and CF-15-09. Therefore, it is recommended that the Type I Landfill remain in Detection Monitoring.

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TABLES

TABLE 1
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential SSI Parameter (Units)	10th Detection Monitoring Sampling Event March 2023		10th Detection Monitoring Resampling Event June 2023	
		Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)
CF-15-08	Boron (mg/L)	12	4.91	11	**Yes**
CF-15-09	Boron (mg/L)	5.1	4.91	5.5	**Yes**

Notes:
1. SSI: Statistically Significant Increase.
2. UPL: Upper Prediction Limit (Maximum Interwell UPL).
3. mg/L: Milligrams per liter.

TABLE 2
GROUNDWATER MONITORING NETWORK
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)[2]	Top of Casing Elevation (ft)[2]	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
CF-15-04	Background	12/3/2015	451482.81	569307.19	465.55	468.03	439.55	429.55	38.48
CF-15-05	Background	12/1/2015	447491.91	565533.64	439.85	442.58	422.85	412.85	29.73
CF-15-06	Background	11/30/2015	447026.92	565190.31	437.49	440.40	431.49	421.49	18.91
CF-15-07	Downgradient	11/23/2015	443135.08	562259.25	438.61	441.11	432.61	422.61	18.50
CF-15-08	Downgradient	11/19/2015	443219.57	562537.29	460.33	462.79	430.33	420.33	42.46
CF-15-09	Downgradient	11/25/2015	443445.96	562871.69	456.73	459.45	447.73	442.73	16.72
WBSP-15-01	Background	11/30/2015	449072.27	566322.12	466.93	469.36	458.93	448.93	20.43
WBSP-15-02	Background	11/11/2015	449803.91	566987.30	473.83	476.76	457.83	452.83	23.93

Notes:
1. The Well locations are referenced to the North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 3
HISTORIC BORON CONCENTRATIONS: IDEM WELLS CF-9406 & CF-9407 AND CCR WELLS CF-15-08 & CF-15-09
CLIFTY CREEK STATION
MADISON, INDIANA

Boron Concentrations in IDEM Wells (1994 through 2015)					
Date	**CF-9406**	**CF-9407**	**Date**	**CF-9406**	**CF-9407**
6/8/1994	10	2.9	**11/19/2002**	16.2	5.92
6/22/1994	9.8	4.7	**5/14/2003**	13.7	3.83
7/6/1994	11	6.3	**11/12/2003**	14.7	5.4
7/20/1994	12	8.4	**5/11/2004**	14.2	3.86
8/3/1994	10	6.3	**11/9/2004**	17.1	5.28
8/17/1994	9	6.4	**5/9/2005**	15.2	7.16
8/31/1994	12	7.7	**11/8/2005**	14.3	DRY
9/14/1994	9.8	6.9	**5/17/2006**	12.8	7.4
9/28/1994	9.7	5.9	**11/15/2006**	15	5.69
10/12/1994	12	7.3	**5/9/2007**	13.7	4.71
10/26/1994	12	6.8	**11/14/2007**	14.6	DRY
11/9/1994	11	6.7	**5/13/2008**	15	3.21
11/30/1994	11	5	**11/12/2008**	15.6	DRY
12/7/1994	10	3.6	**5/19/2009**	14.7	4.75
12/21/1994	11	2.5	**11/16/2009**	14.7	7.23
1/18/1995	11	3	**12/16/2009**	NM	NM
2/22/1995	13	3.6	**01/14/2010**	NM	NM
6/14/1995	13	4.5	**02/23/2010**	NM	NM
12/21/1995	14	4.7	**03/16/2010**	NM	NM
6/26/1996	14	3.3	**04/15/2010**	NM	NM
12/23/1996	12	5.3	**5/19/2010**	14.1	6.77
4/30/1997	**9.9**	6.9	**06/23/2010**	NM	NM
6/30/1997	12	5.9	**07/15/2010**	NM	NM
10/7/1997	15	DRY	**08/24/2010**	NM	NM
12/16/1997	14	**7.5**	**09/14/2010**	NM	NM
4/16/1998	14	6.5	**10/19/2010**	NM	NM
6/24/1998	13	6.5	**11/3/2010**	16.9	DRY
9/23/1998	14	DRY	**Type I Landfill Operational**		
1/21/1999	13	5.1	**5/17/2011**	12.3	4.21
3/31/1999	12	4.3	**11/28/2011**	16.2	**1.19**
6/30/1999	13	7.5	**5/7/2012**	14.5	5.09
10/7/1999	DRY	DRY	**11/13/2012**	15.9	DRY
1/6/2000	15	4.4	**3/30/2013**	15	5.25
6/6/2000	15	7.2	**9/23/2013**	14.2	DRY
1/10/2001	16	7.4	**5/21/2014**	12.63	5.646
5/15/2001	15	6.6	**11/11/2014**	14.58	DRY
11/26/2001	**18**	7.3	**5/9/2015**	15.47	DRY
5/15/2002	13.5	5.1	**11/3/2015**	13.8	DRY

TABLE 3
HISTORIC BORON CONCENTRATIONS: IDEM WELLS CF-9406 & CF-9407 AND CCR WELLS CF-15-08 & CF-15-09
CLIFTY CREEK STATION
MADISON, INDIANA

Boron Concentrations in IDEM and CCR Wells (2016 through 2023)				
Date	**CF-9406**	**CF-9407**	**CF-15-08**	**CF-15-09**
January 2016	NM	NM	8.64	6.86
March 2016	NM	NM	8.24	5.78
May 2016	10.6	2.48	9.34	6.58
July 2016	NM	NM	9.65	7.01
August 2016	NM	NM	9.63	6.73
November 2016	15.3	DRY	10.9	DRY
March 2017	NM	NM	9.29	6.78
May 2017	7.46	5.4	NM	NM
June 2017	NM	NM	**7.62**	6.3
August 2017	NM	NM	9.04	6.81
November 2017	11.7	7.58	NM	NM
March 2018	NM	NM	8.5	5.86
May 2018	13.8	7.25	8.6	6.1
October 2018	NM	NM	11.9	**7.59**
November 2018	14.7	3.27	NM	NM
December 2018	NM	NM	11.9	7.41
March 2019	NM	NM	9.8	6.7
May 2019	13.9	6.56	NM	NM
June 2019	NM	NM	8.5	6.5
October 2019	NM	NM	11.0	DRY
November 2019	17	DRY	9.0	NM
March 2020	NM	NM	8.2	5.7
April 2020	8.1	2.5	NM	NM
June 2020	NM	NM	9.6	5.9
September 2020	15	7	10	6.9
December 2020	NM	NM	11	6.4
March 2021	9.6	2.8	11	6.0
June 2021	NM	NM	10	6.2
September 2021	13	5.1	**13**	DRY
December 2021	NM	NM	12	NM
March 2022	9.3	6.9	12	6.2
June 2022	NM	NM	11	5.9
September 2022	14	4.2	10	**3.8**
December 2022	NM	NM	**13**	NM
March 2023	12	4.8	12	5.1
June 2023	NM	NM	11	5.5

TABLE 3
HISTORIC BORON CONCENTRATIONS: IDEM WELLS CF-9406 & CF-9407 AND CCR WELLS CF-15-08 & CF-15-09
CLIFTY CREEK STATION
MADISON, INDIANA

Notes: 1. All concentrations are mg/L. 2. NM = Well was not monitored on this date.
3. DRY = Well was dry and not able to be sampled.
4. Maximum and minimum Boron results for IDEM wells (June 1995 through 2011 only) and CCR wells are shown in **Bold.**

FIGURES

N

CLIFTY HOLLOW ROAD

CF-15-04

CLIFTY CREEK STATION

BIG CLIFTY CREEK

LIMIT OF WASTE PLACEMENT

TYPE I RESIDUAL WASTE LANDFILL

WBSP-15-02

WEST BOILER SLAG POND

DEVIL'S BACKBONE

WBSP-15-01

INDIANA

KENTUCKY

CF-15-05

CF-15-06

OHIO RIVER

RIVER ROAD

LANDFILL RUNOFF COLLECTION POND

B'

B

CF-15-08

CF-15-07

CF-9407

CF-15-09

CF-07-06D

CF-9406

CF-07-08

CF-9405

CF-07-09

LEGEND:

BACKGROUND CCR PROGRAM MONITORING WELL LOCATION

DOWNGRADIENT CCR PROGRAM MONITORING WELL LOCATION

IDEM PROGRAM MONITORING WELL LOCATION

800' 0' 800' 1600'

SCALE: 1"= 800'

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017114-CLI
DWG FILE	IKEC_Clifty_ASD_MW Locs_b03.dwg
DRAWING SCALE	NOT TO SCALE

AGES
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2402 Hookstown Grade Road, Suite 200
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INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL
MONITORING WELL LOCATIONS

DRAWING NAME: FIGURE 1

REV.: 0

Plot: 01/10/2019 13:32 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\IKEC_Clifty_ASD_MW Locs_b03.dwg\FIG 1

DWG. NO.: 16-30500-01-A

TYPE I RESIDUAL WASTE LANDFILL

LRCP

WEST BOILER SLAG POND

A

A'

Proposed Grading Limit

Ohio River

LEGEND:

A-A' CROSS SECTION TRANSECT

SOURCE: CLIFTY CREEK PERMIT DRAWINGS (FMSM, NOVEMBER 2006)

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017116-CLI
DWG FILE	Clifty_ASD_Boring Plan b04.dwg
DRAWING SCALE	NOT TO SCALE

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INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
OVERVIEW OF TYPE I LANDFILL AND LRCP

DRAWING NAME: FIGURE 2

REV.: 0

Plot: 12/12/2018 10:47 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_ASD_Boring Plan b04.dwg

A
SOUTHWEST

A'
NORTHEAST

600

550

500

450

400

ELEVATIONS IN FEET ABVOVE MSL

TYPE I LANDFILL

APPROXIMATE AREA OF
GROUNDWATER DIVIDE

GEOSYNTHETIC
CLAY LINER

STRUCTURAL FILL (SUBGRADE)

TYPE III LANDFILL (ASH)

STRUCTURAL FILL (BOILER SLAG)

EXISTING BOILER SLAG

HYDRAULICALLY PLACED FLY ASH

ORIGINAL GROUND LINE

FOUNDATION SOILS

BEDROCK

70+00 60+00 50+00 40+00 30+00 20+00 10+00 0+00

STATION

APPROXIMATE PHREATIC SURFACE

GROUNDWATER FLOW DIRECTION

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2022008-CLI
DWG FILE	3_Clifty_ASD_Cross Sec b02_RVSD 9-8-22.dwg
DRAWING SCALE	NOT TO SCALE

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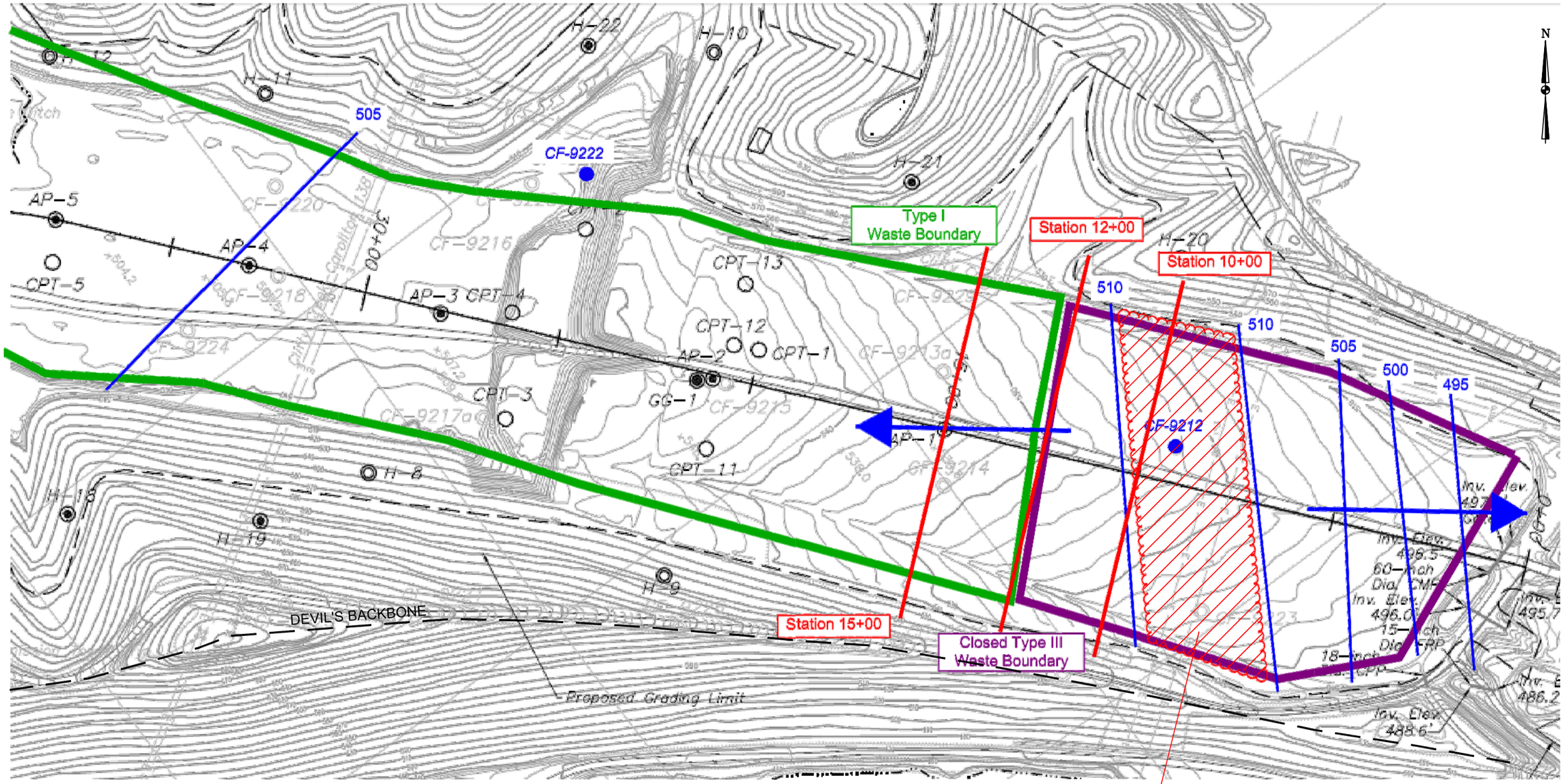
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL
GENERALIZED GEOLOGIC CROSS-SECTION
A-A' (SOUTHWEST-NORTHEAST)

DRAWING NAME: FIGURE 3

REV.: 0

Plot: 09/08/2022 14:19 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD 8_LF_MAR 2022\3_Clifty_ASD_Cross Sec b02_RVSD 9-8-22.dwg



505 — January 2006 Groundwater Contour

Groundwater Flow Direction

APPROXIMATE LOCATION OF GROUNDWATER DIVIDE.
BETWEEN STATIONS 7+00 AND 10+00.

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017116-CLI
DWG FILE	Clifty_GW Divide b01.dwg
DRAWING SCALE	NOT TO SCALE

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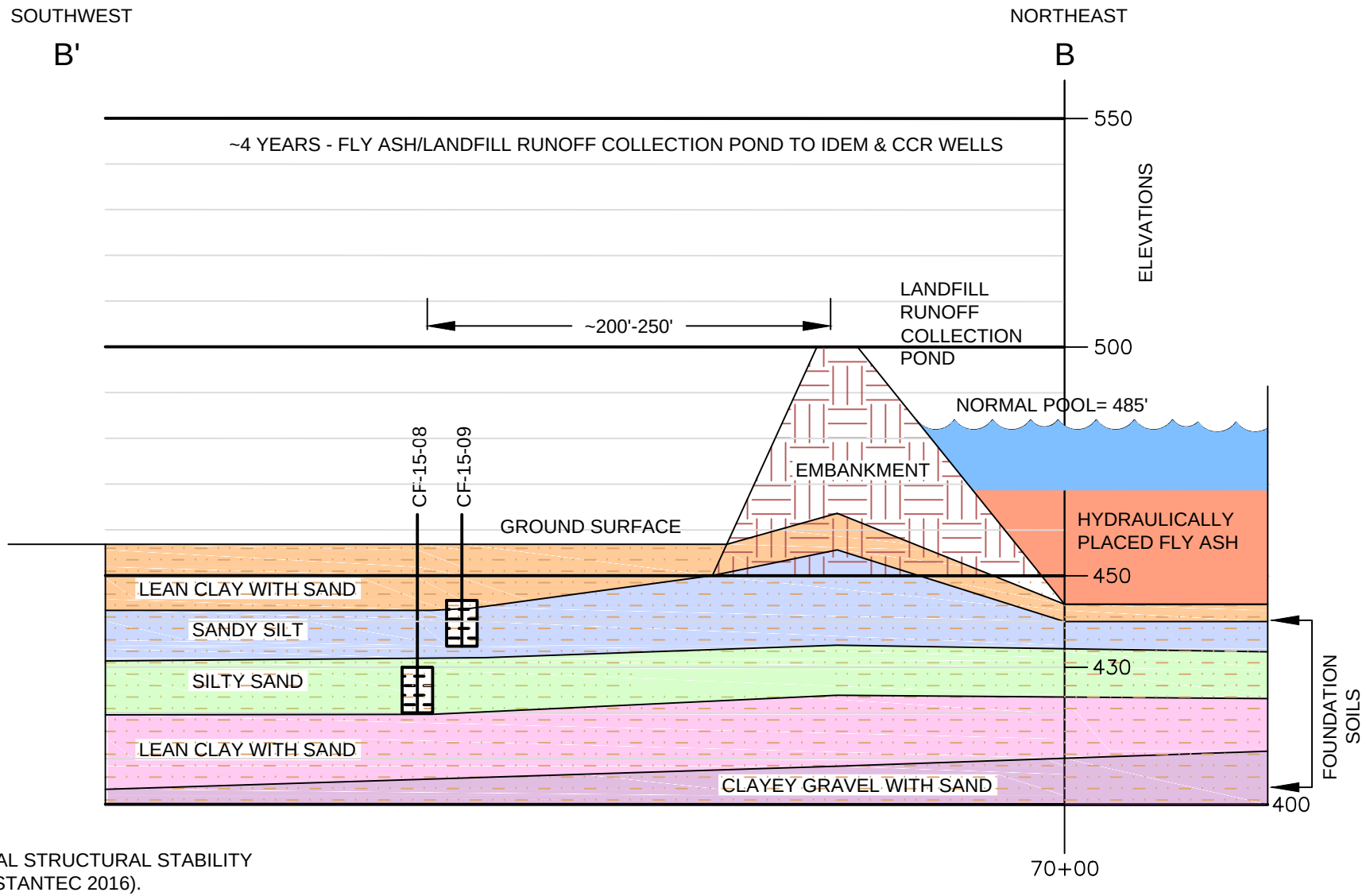
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
GROUNDWATER FLOW AT
NORTHEAST END OF BEDROCK CHANNEL

DRAWING NAME: FIGURE 4

REV.: 0

Plot: 12/12/2018 11:46 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_GW Divide b01.dwg



NOTES:
BASED ON INITIAL STRUCTURAL STABILITY ASSESSMENT (STANTEC 2016).

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021037-CLI
DWG FILE	5_Clifty_ASD_X-Sec Pond-Wells a06_revised 1-25-22.dwg
DRAWING SCALE	NOT TO SCALE

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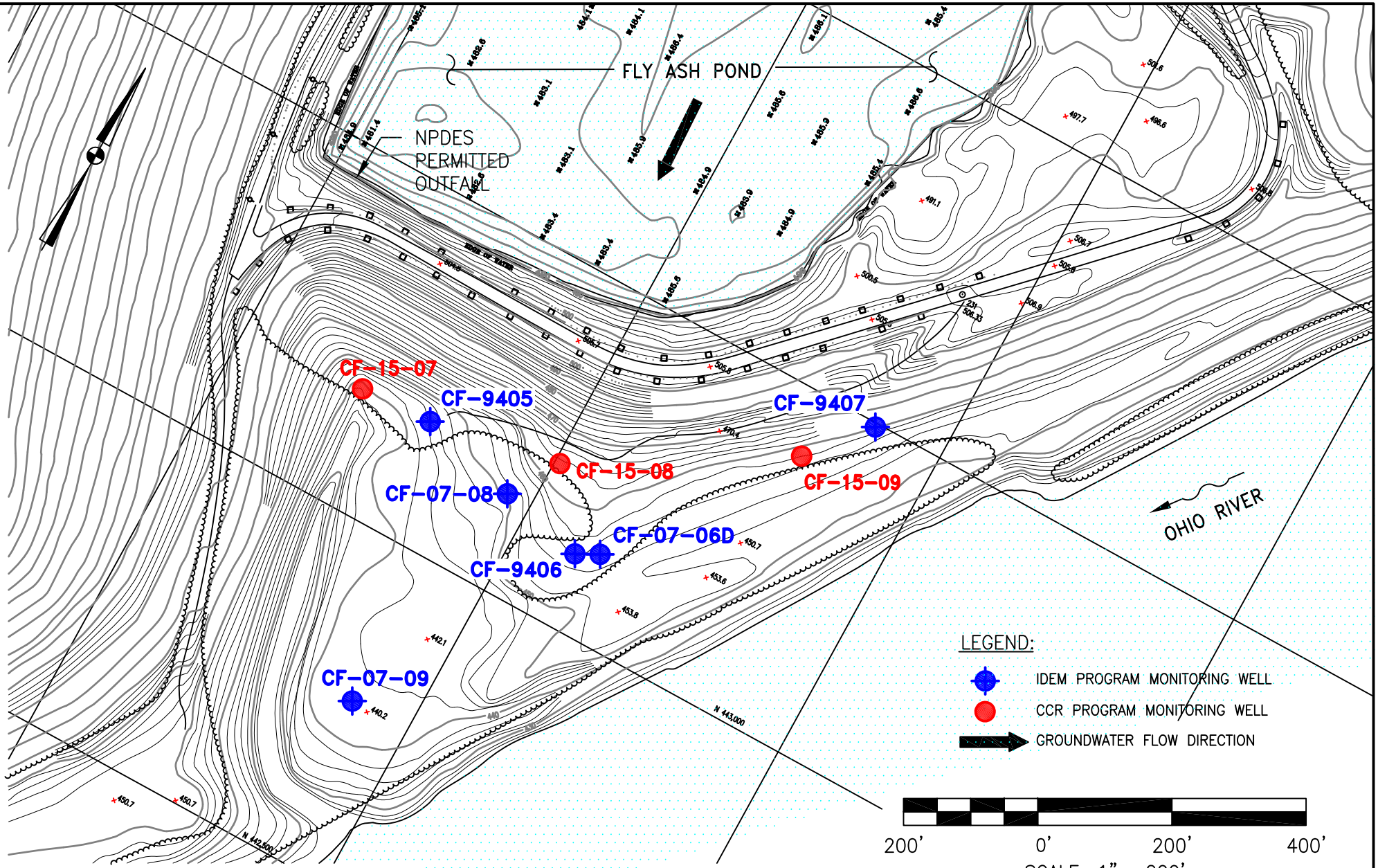
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
GENERALIZED CROSS-SECTION
LANDFILL RUNOFF COLLECTION POND TO
CCR MONITORING WELLS

DRAWING NAME: FIGURE 5
REV.: 0

Plot: 01/25/2022 12:15 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD 7_LF_SEPT 2021\5_Clifty_ASD_X-Sec Pond-Wells a06_revised 1-25-22.dwg



DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017116-CLI
DWG FILE	CLIFTY Well Locations a03 R2.dwg
DRAWING SCALE	AS SHOWN

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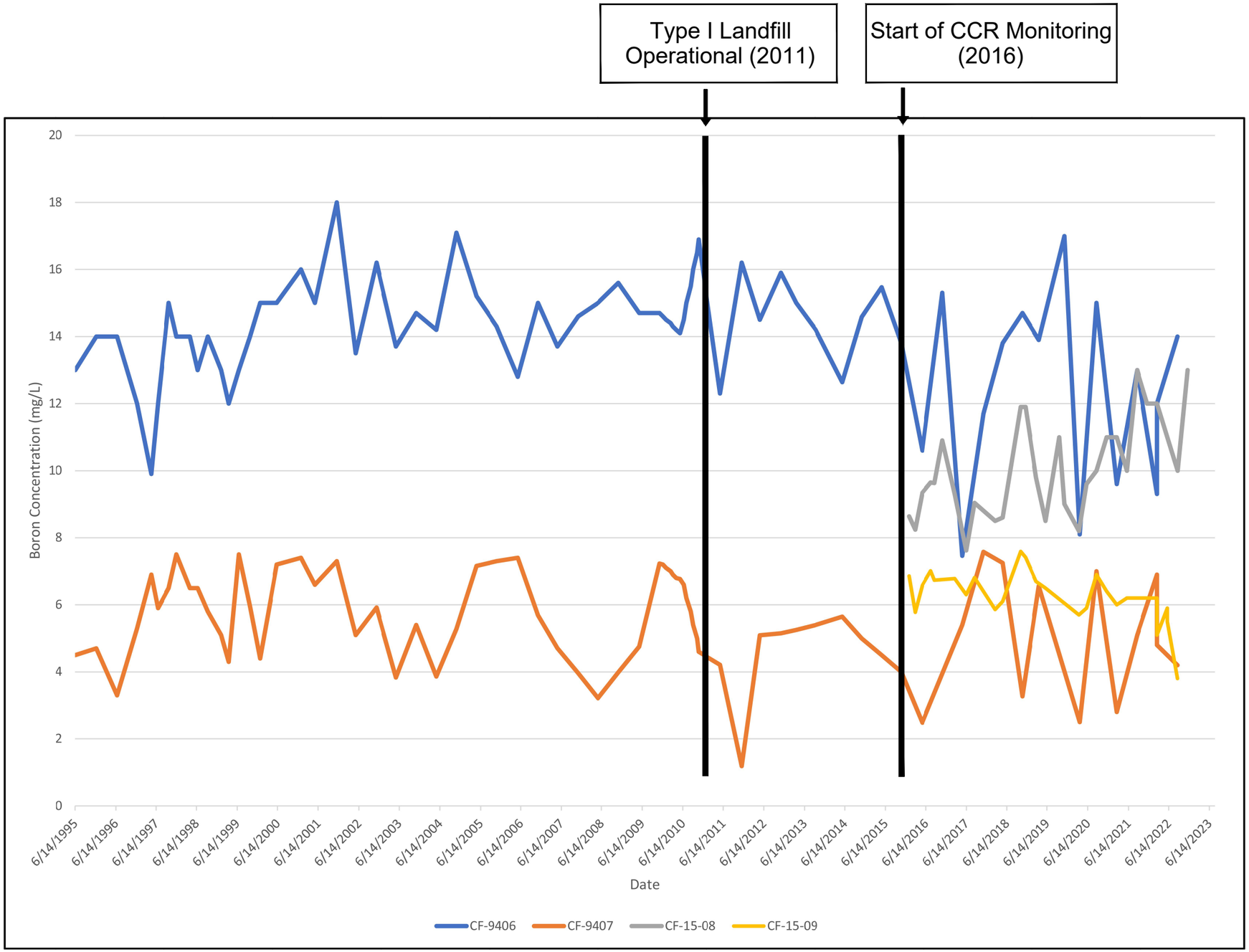
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK PLANT
MADISON, INDIANA
CCR PROGRAM AND IDEM PROGRAM
MONITORING WELL LOCATION MAP

DRAWING NAME	REV.
FIGURE 6	0

Plot: 12/12/2018 12:18 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\CLIFTY Well Locations a03 R2.dwg



DRAWN BY	AB
DATE	
CHECKED BY	
JOB NO.	2023008-CLI
DWG-FILE	7_IKEC_Clifty_ASD LRCP_Boron-Time Graph_MAR 2023.dwg
DRAWING SCALE	NOT TO SCALE

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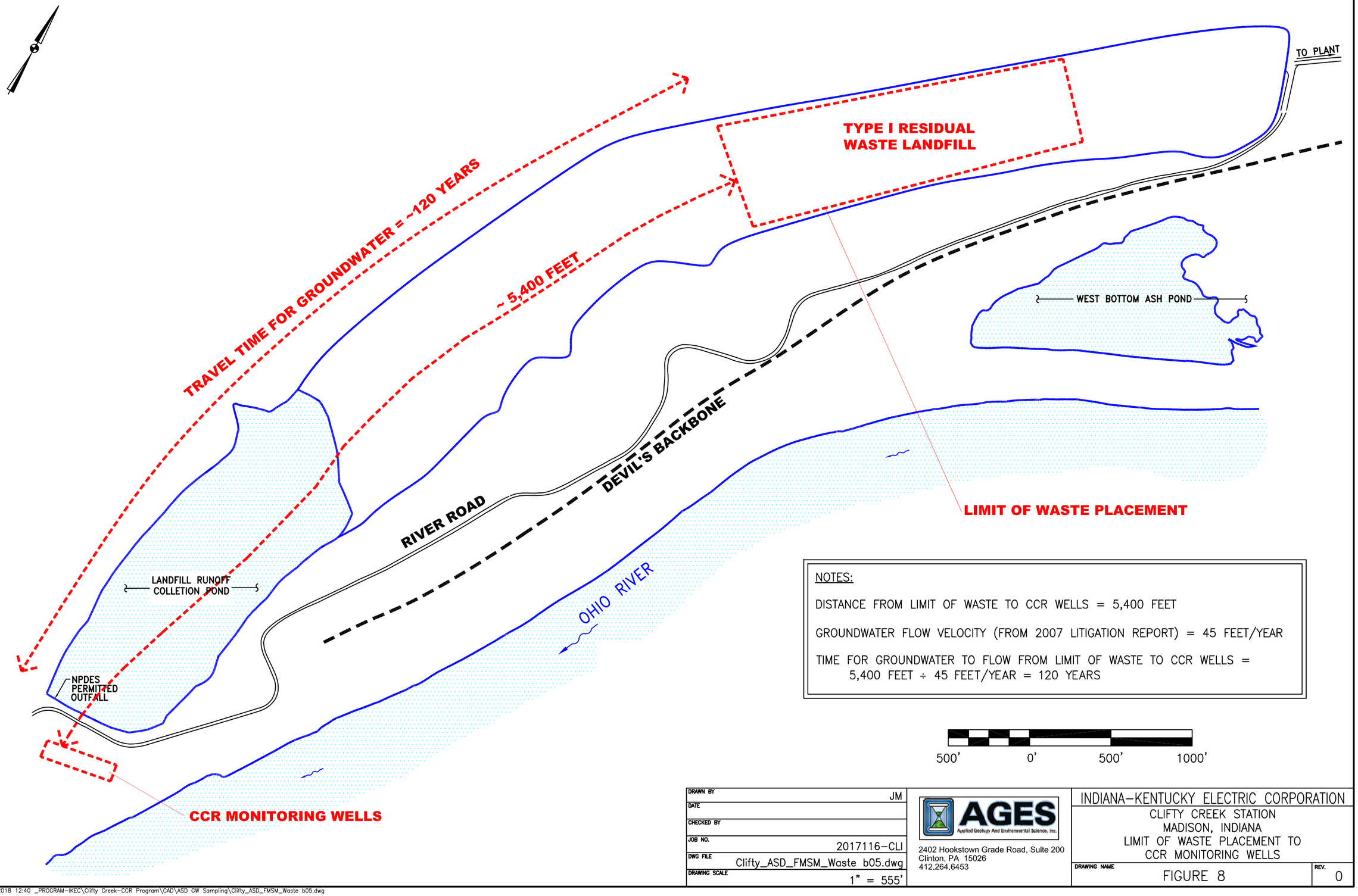
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
TIME SERIES DATA FOR BORON (mg/L)
CF-9406, CF-9407, CF-15-08 AND CF-15-09
MARCH 2023

DRAWING NAME	REV.
FIGURE 7	0

Plot: 08/30/2023 08:17 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD _LRCP_MAR 2023\7_IKEC_Clifty_ASD LRCP_Boron-Time Graph_MAR 2023.dwg



NOTES:

DISTANCE FROM LIMIT OF WASTE TO CCR WELLS = 5,400 FEET

GROUNDWATER FLOW VELOCITY (FROM 2007 LITIGATION REPORT) = 45 FEET/YEAR

TIME FOR GROUNDWATER TO FLOW FROM LIMIT OF WASTE TO CCR WELLS =
5,400 FEET ÷ 45 FEET/YEAR = 120 YEARS

500' 0' 500' 1000'

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017116-CLI
DWG FILE	Clifty_ASD_FMSM_Waste b05.dwg
DRAWING SCALE	1" = 555'

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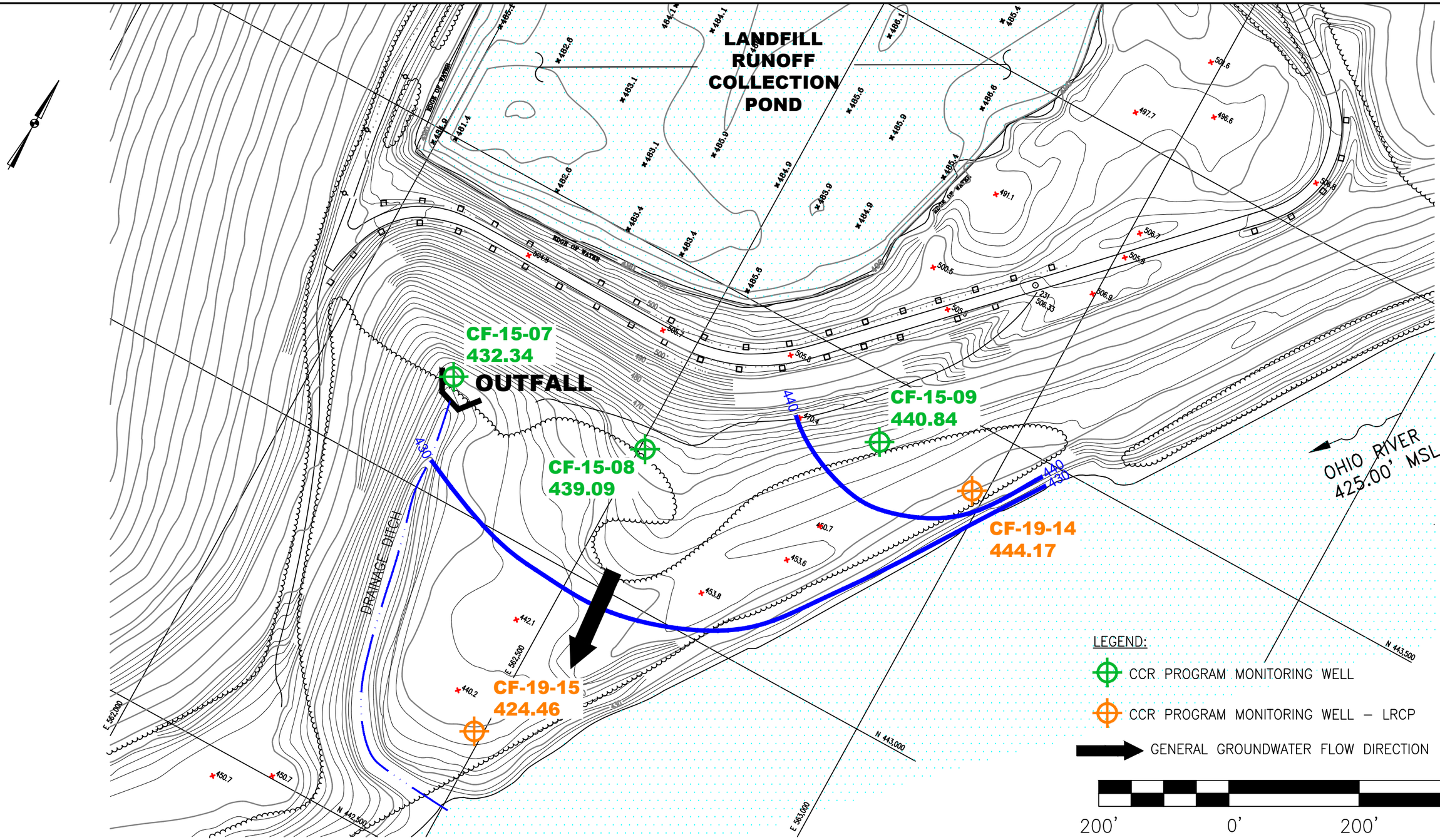
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
LIMIT OF WASTE PLACEMENT TO
CCR MONITORING WELLS

DRAWING NAME: FIGURE 8 REV. 0

Plot: 12/12/2018 12:40 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_ASD_FMSM_Waste b05.dwg

APPENDIX A

Groundwater Flow Maps
(March 2023 and June 2023)



NOTE:
WELLS CF-19-14 AND CF-19-15 WERE INSTALLED IN MARCH 2019 DURING THE CHARACTERIZATION OF THE LRCP.

DRAWN BY	AB
DATE	
CHECKED BY	
JOB NO.	2023008-CLI
DWG FILE	A-1_IKEC_Clifty_ASD_LRCP_GL Flow_MAR 2023.dwg
DRAWING SCALE	AS SHOWN

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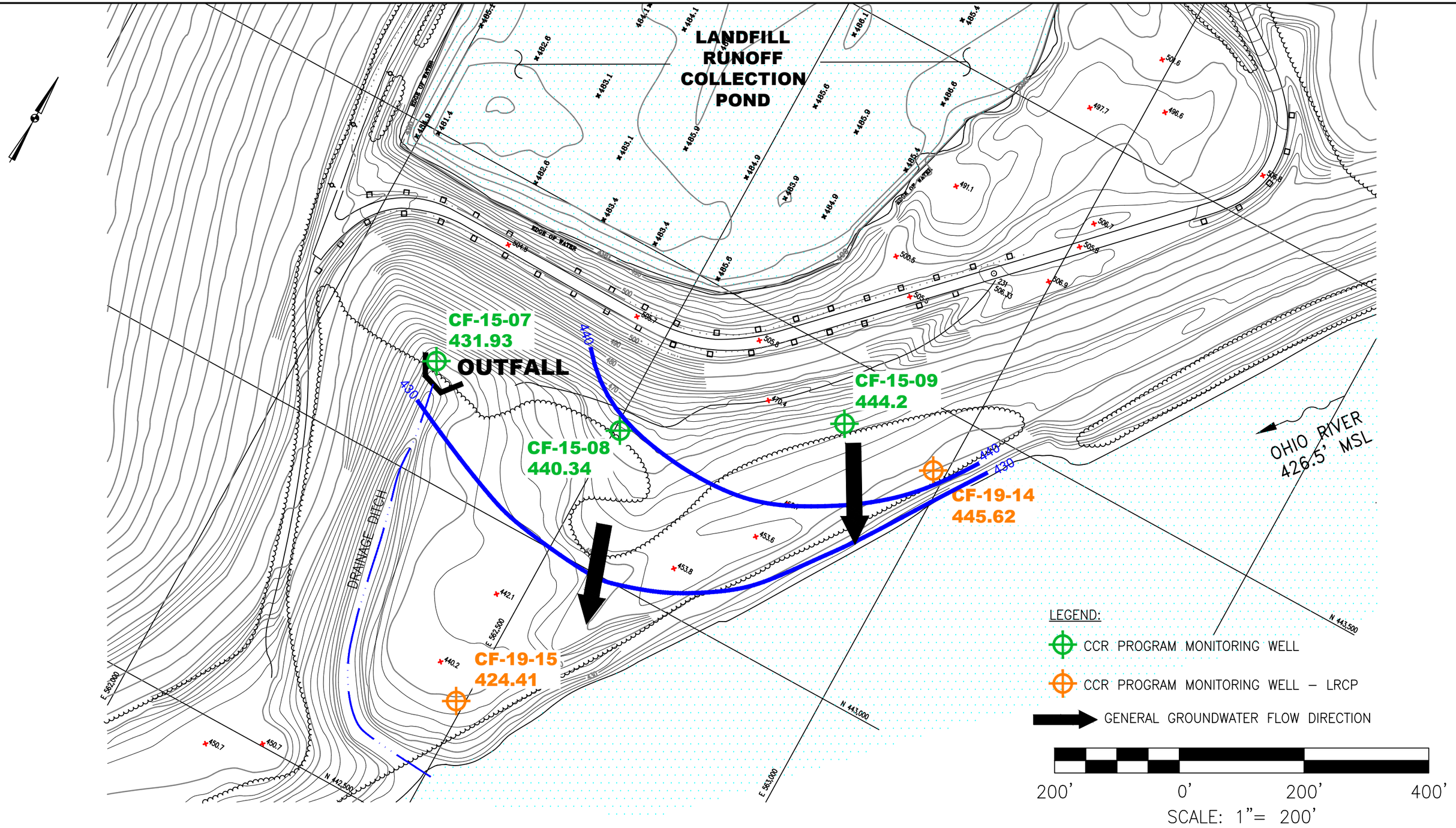
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
MARCH 2023

DRAWING NAME	REV.
FIGURE A-1	0



NOTE:
WELLS CF–19–14 AND CF–19–15 WERE INSTALLED IN MARCH 2019 DURING THE CHARACTERIZATION OF THE LRCP.

DRAWN BY	AB
DATE	
CHECKED BY	
JOB NO.	2023008–CLI
DWG FILE	A–2_IKEC_Clifty_ASD_LRCP_June 2023.dwg
DRAWING SCALE	AS SHOWN

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INDIANA–KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
JUNE 2023

DRAWING NAME	REV.
FIGURE A–2	0

APPENDIX B

FIGURE FROM LRCP DAM STABILITY ASSESSMENT REPORT (Stantec 2016)

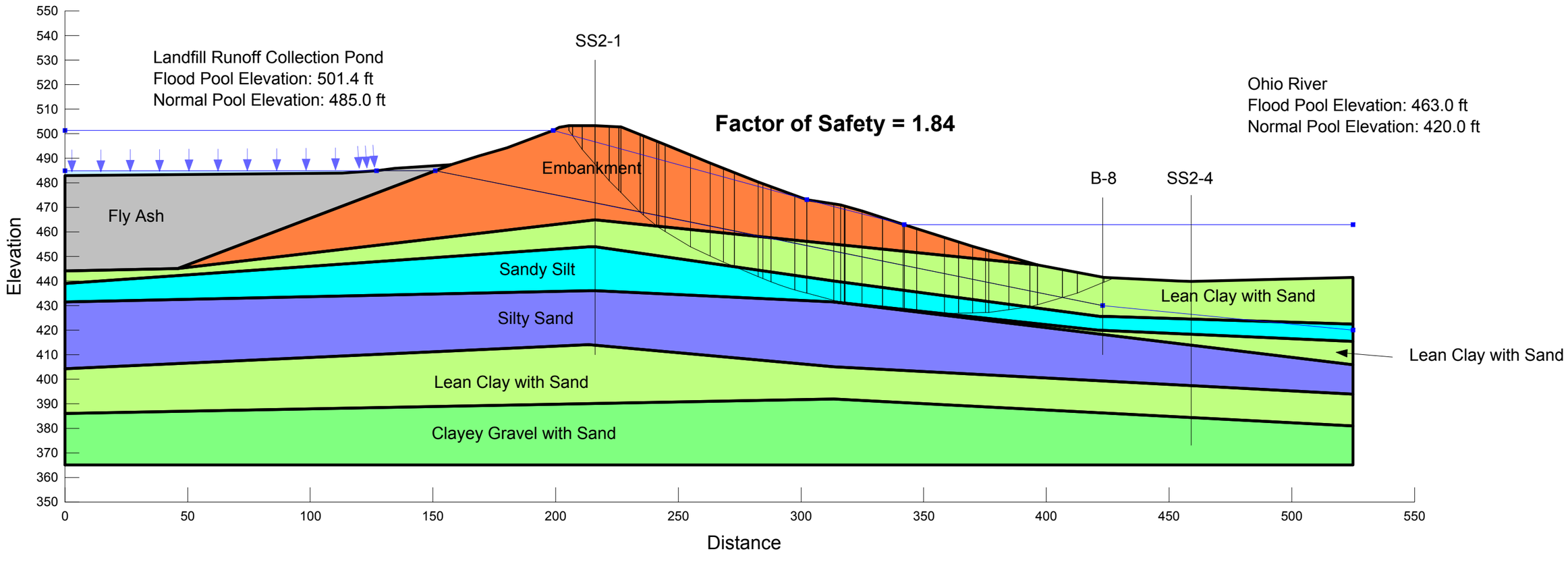
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Landfill Runoff Collection Pond Dam
Madison, Indiana
Section D-D'

Existing Geometry
Sudden Drawdown
Undrained, Sudden Drawdown Strengths

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

Sudden Drawdown

Material Type	Unit Weight	Effective - c'	Effective - phi	Total - c	Total - phi
Embankment (SDD)	129 pcf	198 psf	27.5 °	1400 psf	21 °
Lean Clay with Sand (SDD)	127 pcf	206 psf	28 °	1200 psf	17 °
Sandy Silt (SDD)	125 pcf	0 psf	30 °	0 psf	30 °
Silty Sand (SDD)	94 pcf	0 psf	30 °	0 psf	30 °
Clayey Gravel with Sand (SDD)	130 pcf	0 psf	35 °	0 psf	35 °
Fly Ash (SDD)	115 pcf	0 psf	25 °	0 psf	25 °



APPENDIX C

PHASE 1, 2 AND 3 EXISTING CONDITIONS TOPOGRAPHIC MAP (Stantec 2023)

LEGEND

- UTILITY POLE
- TRANSMISSION LINE
- TRANSMISSION TOWER
- VEGETATION
- EDGE OF WATER
- PROPERTY LINE
- WASTE BOUNDARY
- GRADING LIMITS

MAPPING SOURCE NOTE:

TOPOGRAPHIC, BATHYMETRIC, AND PLANIMETRIC SURVEY INFORMATION FOR THE PLANS WERE OBTAINED FROM MAPPING PROVIDED BY INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC) AND AMERICAN ELECTRIC POWER (AEP). AN AERIAL SURVEY OF THE SOUTHWEST LANDFILL AREA PERFORMED MAY 2022 WAS PROVIDED BY R. B. JERGENS. THE APRIL 2023 QUARTERLY LANDFILL SURVEY WAS PROVIDED BY IKEC AND RIVERSIDE CONTRACTING & EXCAVATING, LLC. HORIZONTAL DATUM IS NAD27 AND VERTICAL DATUM IS NAVD88.

NOTES:

1. OTHER BASEMAP INFORMATION BASED ON ORIGINAL DESIGN PLAN SHEETS.
2. ANY REMAINING PHASE 1 CONSTRUCTION WILL BE PERFORMED DURING FUTURE CONSTRUCTION SEASONS. PHASES 2 AND 3 SUBGRADE CURRENTLY UNDER CONSTRUCTION.
3. CELLS WITH TEMPORARY SOIL COVER ARE MULCHED AND SEEDED.
4. MINOR LANDFILL PERMIT MODIFICATION TO THE LEACHATE AND STORMWATER MANAGEMENT ARE SHOWN IN THE PHASE 3 RWS TYPE 1 FOOTPRINT AND THE RWS TYPE III FOOTPRINT.

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Client/Project
INDIANA-KENTUCKY ELECTRIC CORPORATION

ANNUAL CONTOUR UPDATE AS REQUIRED BY 329 IAC 10-20-24
CLIFTY CREEK COAL ASH LANDFILL (ID 39-04)
MADISON, JEFFERSON COUNTY, INDIANA

Title
PHASES 1, 2, AND 3 EXISTING CONDITIONS
(JUNE 2023)

Permit-Seal
JACQUELINE S. HARMON REGISTERED No. 10911138 STATE OF INDIANA PROFESSIONAL ENGINEER
6/8/2023

Project Number: 175532014

File Name: 32010c-01-econ-2023.dwg | RRP Dwn. | PSS Chkd. | JSH Dsgn. | 23.06.08 YY.MM.DD

Drawing No. 1
Revision -
Sheet 1 of 3

APPENDIX F

ALTERNATE SOURCE DEMONSTRATION SEPTEMBER 2023
TYPE I LANDFILL

AGES
Applied Geology And Environmental Science, Inc.

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www.appliedgeology.net
412. 264. 6453
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COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2023 DETECTION MONITORING EVENT

TYPE I RESIDUAL WASTE LANDFILL
INDIANA KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK PLANT
MADISON, JEFFERSON COUNTY, INDIANA

JANUARY 2024

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2023 DETECTION MONITORING EVENT
TYPE I RESIDUAL WASTE LANDFILL
INDIANA KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK PLANT
MADISON, JEFFERSON COUNTY, INDIANA

JANUARY 2024

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

Applied Geology and Environmental Science, Inc.

Bethany Flaherty
Senior Scientist II

Robert W. King, L.P.G. #1237
President/Chief Hydrogeologist

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2023 DETECTION MONITORING EVENT
TYPE I RESIDUAL WASTE LANDFILL
INDIANA KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK PLANT
MADISON, JEFFERSON COUNTY, INDIANA

T A B L E O F C O N T E N T S

SECTION **PAGE**

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2023 DETECTION MONITORING EVENT
TYPE I RESIDUAL WASTE LANDFILL
INDIANA KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK PLANT
MADISON, JEFFERSON COUNTY, INDIANA

T A B L E O F C O N T E N T S

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LIST OF FIGURES

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COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2023 DETECTION MONITORING EVENT
TYPE I RESIDUAL WASTE LANDFILL
INDIANA KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK PLANT
MADISON, JEFFERSON COUNTY, INDIANA

1.0 INTRODUCTION

On December 19, 2014, the United States Environmental Protection Agency (U.S. EPA) issued their final Coal Combustion Residuals (CCR) regulation which regulates CCR as a non-hazardous waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) and became effective six (6) months from the date of its publication (April 2015) in the Federal Register, referred to as the "CCR Rule."

The Indiana-Kentucky Electric Corporation (IKEC) contracted with Applied Geology and Environmental Science, Inc. (AGES) to administer the CCR Rule groundwater monitoring program at the Clifty Creek Station located in Madison, Jefferson County, Indiana. There are three (3) CCR units at the Clifty Creek Station (Figure 1):

- Type I Residual Waste Landfill (Type I Landfill);
- Landfill Runoff Collection Pond (LRCP); and,
- West Boiler Slag Pond (WBSP).

Under the CCR program, the Type I Landfill and LRCP are being monitored under one (1) multi-unit groundwater monitoring system. During the March 2018 Detection Monitoring event, Boron Statistically Significant Increases (SSIs) were confirmed in two (2) wells located downgradient of the Type I Landfill and LRCP and these CCR units entered into Assessment Monitoring in September 2018. Based on a successful Alternate Source Demonstration (ASD) (AGES 2019a), IKEC determined that the Type I Landfill was not the source of the Boron. Therefore, the Type I Landfill returned to Detection Monitoring in January 2019. During the March 2019, October 2019, March 2020, September 2020, March 2021, September 2021, March 2022, September 2022 and March 2023 Detection Monitoring sampling events, SSIs for Boron were again confirmed in wells located downgradient of the unit. Based on successful ASDs for these nine (9) Detection Monitoring events (AGES 2019b, AGES 2020a, AGES 2020b, AGES 2021a, AGES 2021b, AGES 2022a, AGES 2022b, AGES 2023b and AGES 2023a), the Type I Landfill has remained in Detection Monitoring. As an alternate source for Boron at the LRCP could not be established, the LRCP remains in Assessment Monitoring.

During the September 2023 Detection Monitoring event, Boron SSIs were confirmed in two (2) wells located downgradient of the Type I Landfill. Therefore, IKEC has prepared this ASD to

show that the Type I Landfill is not the source of the Boron. Details regarding this evaluation are presented in this report.

1.1 Background

In accordance with §257.91(d) of the CCR Rule, as detailed in the Well Installation Report (AGES 2018a), because the LRCP is directly adjacent to the southwest (downgradient) of the Type I Landfill, and because of the hydrogeologic conditions of the site, IKEC installed a multi-unit groundwater monitoring system to monitor groundwater quality directly downgradient of the Type I Landfill and LRCP. As described above, the Type I Landfill has remained in Detection Monitoring based on previous successful ASDs; the LRCP remains in Assessment Monitoring. In accordance with §257.94 of the CCR Rule, IKEC completed the groundwater monitoring requirements of the Detection Monitoring Program at the Type I Landfill as described below.

The 11th round of Detection Monitoring groundwater samples was collected between September 13 and 18, 2023 from monitoring wells at the Type I Landfill (Figure 1). All samples were collected in accordance with the Groundwater Monitoring Program Plan (GMPP) (AGES 2018b) and analyzed for all Appendix III constituents.

Upon receipt, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Clifty Creek Station CCR Statistical Analysis Plan (StAP) (Stantec 2021). The initial statistical evaluation identified potential SSIs for Boron in monitoring wells CF-15-08 and CF-15-09 at the Type I Landfill. The results of the statistical evaluation are summarized in Table 1.

In accordance with the StAP, IKEC resampled the well for Boron on November 29, 2023. Based on the result of the resampling event, the SSIs for Boron were confirmed in monitoring wells CF-15-08 and CF-15-09 (Table 1).

1.2 Purpose of This Report

The purpose of this report is to present an ASD and provide sufficient evidence that the SSIs identified for Boron in wells CF-15-08 and CF-15-09 resulted from a source other than the Type I Landfill.

The CCR Rule does not contain specific requirements for an ASD beyond what is stated, as follows, in §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 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 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."

In addition to the above requirements of the CCR Rule, this ASD has been conducted and presented using guidance and documentation recommendations included in the U.S. EPA document Solid Waste Disposal Facility Criteria Technical Manual EPA 530-R-93-017 (U.S. EPA 1993).

A detailed discussion of the confirmed SSIs and a technical justification that the exceedance results are from a source other than the Type I Landfill are presented in the following sections of this report.

2.0 DESCRIPTION OF THE TYPE I LANDFILL

2.1 Unit Description

The Type I Landfill and LRCP occupy an approximately 200-acre area situated within an eroded bedrock channel. The Type I Landfill consists of approximately 109 acres that were approved as a Type I residual waste landfill by the Indiana Department of Environmental Management (IDEM) in 2007. The remaining 91 acres consist of the LRCP located at the southwest end of the Type I Landfill (57 acres) and 34 acres closed under the IDEM landfill permit requirements (Figures 1 and 2).

Beginning in 1955, ash products were sluiced to a disposal pond located in the bedrock channel at the plant site. To allow for more disposal capacity, an on-site fly ash pond was developed into a Type III residual landfill in 1988. All required permits for the Type III Residual Waste Landfill (Type III Landfill) were obtained from IDEM. The Type III Landfill was permitted to be constructed and to serve as closure for the historic fly ash pond. The Type III Landfill is located at the northeast end of the bedrock channel and went operational in 1991.

After IDEM approval, IKEC upgraded the Type III Landfill to a Type I residual waste landfill (Type I Landfill). As a result, the Type III Landfill was closed and the Type I Landfill was designed and constructed to serve as the cap for the closed Type III Landfill. The Type I Landfill, which went operational in 2011, is completely separated from the closed Type III Landfill by a geosynthetic clay liner and an engineered clay liner on top of the Type III Landfill to serve as a cap.

2.2 Hydrogeology

Based on information in the Hydrogeologic Study Report (AGES 2007), bedrock beneath the Type I Landfill and the closed Type III Landfill consists of impermeable limestone and shale of the Ordovician Dillsboro formation which is overlain by approximately 20 to 35 feet of gray clay. The gray clay is directly overlain by fly ash that had been historically hydraulically placed in the area. A generalized cross section showing the proposed final limits of the Type I Landfill & LRCP, the location and limits of the closed Type III Landfill, and the extent of the historic, hydraulically placed fly ash is presented in Figure 3. A limestone ridge known as the Devil's Backbone runs northeast to southwest along the length of the Type I Landfill & LRCP and the closed Type III Landfill. The Devil's Backbone acts as an impermeable barrier that forces groundwater passing beneath both of the landfills to flow either toward the northeast or toward the southwest. A detailed hydrogeologic study determined that a groundwater flow divide is present near the northeast end of the bedrock channel and that all groundwater beneath the active Type I Landfill flows toward the southwest (AGES 2007) (Figure 4). As detailed in the Monitoring Well Installation Report (AGES 2018a), an aquifer does not exist beneath either of the landfills. Therefore, alluvial deposits located southwest of the LRCP are designated as the uppermost aquifer for the Type I Landfill & LRCP.

The Type I Landfill was constructed using a geosynthetic clay liner to prevent water from the Type I Landfill from entering the underlying layers. Water in the Type I Landfill is collected by a leachate system and discharged into the low volume waste treatment system.

In November and December 2015, groundwater monitoring wells were installed for the CCR groundwater monitoring network at the site. The CCR groundwater monitoring network for the Type I Landfill consists of eight (8) monitoring wells (Figure 1). Three (3) monitoring wells (CF-15-07, CF-15-08 and CF-15-09) were installed in the alluvial deposits (uppermost aquifer) located southwest of the LRCP. Based on exploratory soil borings and historical data, there were no suitable upgradient locations for the Type I Landfill. Well CF-15-04 was installed northeast of and outside the hydrologic influence of the Type I Landfill and the closed Type III Landfill to serve as a background monitoring well. Wells CF-15-05 and CF-15-06 were also installed in alluvial deposits along the Ohio River to serve as background monitoring wells. Wells WBSP-15-01 and WBSP-15-02 are located southeast of the impermeable Devil's Backbone and are hydraulically separated from groundwater flowing beneath the Type I Landfill. Because these wells are outside the hydraulic influence of the Type I Landfill, these wells were designated as background wells. Table 2 presents construction details for the monitoring wells in the groundwater monitoring network for the Type I Landfill. Two (2) additional wells (CF-19-14 and CF-19-15) were installed southwest of the Type I Landfill during the characterization of the LRCP. Although these wells are not part of the monitoring system for the Type I Landfill, groundwater elevation data from the wells has been used to support the development of flow maps for the area.

Based on groundwater levels collected at the site since 1994, groundwater in the uppermost aquifer southwest (downgradient) of the Type I Landfill typically flows to the southwest toward the Ohio River. Historic groundwater data also indicates that groundwater flow at the southwest end of the property is affected by the elevation of the adjacent Ohio River. Evidence of routine, brief flow reversals (i.e., groundwater flows from the Ohio River back toward the southwest end of the property) and periodic flooding of the southwest end of the property have also been observed.

Groundwater contour maps for the uppermost aquifer southwest of the Type I Landfill in September 2023 (Detection Monitoring Event) and November 2023 (Resampling Event) are included in Appendix A (Figures A-1 and A-2). Groundwater generally flows to the southwest toward the Ohio River.

3.0 ALTERNATE SOURCE DEMONSTRATION

As noted above, Boron was identified as a confirmed SSI in wells CF-15-08 and CF-15-09 downgradient of the Type I Landfill. Based on a review of the current and historic data, AGES/IKEC have determined that the active Type I Landfill is not the source of the Boron SSIs reported in the CCR monitoring wells and that historic fly ash that had been sluiced into the valley beginning in 1955 is the alternate source for the Boron SSIs. As discussed in detail below, this conclusion is based on the following lines of evidence:

- Ash that was historically sluiced into the bedrock valley in the 1950s is a known source of Boron and is hydraulically connected to groundwater downgradient of the Type I Landfill;

- Boron has been detected in groundwater downgradient from the hydraulically-placed ash (and the Type I Landfill) in IDEM program wells CF-9405, CF-9406 and CF-9407 (located near wells CF-15-08 and CF-15-09) since 1994, which is 17 years prior to operation of the Type I Landfill; and

- Given the extremely low groundwater flow velocity at the landfill, the travel time for a release of Boron from the Type I Landfill to reach wells CF-15-08 and CF-15-09 is estimated at 120 years. As the Type I Landfill has only been in operation for 12 years, the landfill cannot be the source of the Boron.

Details to support these conclusions are presented below.

3.1 Alternate Source Demonstration Method

The evaluation of the alternate source for Boron in wells CF-15-08 and CF-15-09 was assessed in general accordance with guidelines presented in the Solid Waste Disposal Facility Criteria Technical Manual (U.S. EPA 1993) using the following methods:

- Identify a potential alternate source;
- Establish that a hydraulic connection exists between the alternate source and the wells with the confirmed SSIs;
- Establish that constituents of concern are present at the alternate source; and
- Establish that the concentrations observed in the compliance wells could not have resulted from the CCR unit given the hydrogeologic conditions at the site.

3.2 Alternate Source Identification

The initial groundwater investigation conducted for the former Type III Landfill (beginning in 1994) focused on the fly ash that had been hydraulically placed in the bedrock channel beginning in 1955. The Type III Landfill was permitted to serve as the closure for the hydraulically placed fly ash.

After IDEM approval, IKEC upgraded the Type III Landfill to a Type I Landfill and the Type I Landfill was permitted as the closure for the Type III Landfill. The active Type I Landfill was constructed with a geosynthetic liner and an engineered clay liner on top of the Type III Landfill to serve as a cap. The two (2) liners prevent migration of groundwater from the active Type I Landfill to the closed Type III Landfill. The closed Type III Landfill is not subject to regulation under the CCR Rule.

Both landfills were constructed on top of the historic, hydraulically placed fly ash which extends the length of the bedrock channel (Figure 3) beneath the LRCP to the embankment at the southwestern end of the LRCP (Figure 5). Although the base of the LRCP contains historic, hydraulically placed fly ash, the LRCP does not receive CCR and the existing historic CCR is not actively managed. Therefore, the LRCP is considered an inactive CCR unit.

Due to the age and extent of the historic, hydraulically placed ash, this material was identified as the alternate source for the Boron detected in wells CF-15-08 and CF-15-09.

3.3 Establish a Hydraulic Connection

A review of the permit drawings, construction drawings, and a figure from the Initial Structural Stability Assessment Landfill Runoff Collection Pond Report (Stantec 2016) (Appendix B) indicated that material from the closed Type III Landfill and the historic, hydraulically placed fly ash are located beneath the active Type I Landfill & LRCP (Figure 3). The base of the layer of "hydraulically placed fly ash" is located between elevations 445 feet mean sea level (ft msl) and 500 ft msl.

When the fly ash was originally emplaced in the bedrock channel, there were no impermeable liners constructed to separate the fly ash from the underlying "foundation soils." The CCR and IDEM groundwater monitoring wells are screened in these "foundation soils," which consist of

alluvial deposits of silt, sand and gravel. These alluvial deposits extend from beneath the LRCP and the hydraulically placed fly ash southwest to the Ohio River and provide a direct hydraulic connection between the historic, hydraulically placed fly ash and the groundwater monitoring wells (Figure 5).

3.4 Constituents Are Present at the Alternate Source

Both the closed Type III Landfill and the Type I Landfill are currently being monitored under an IDEM groundwater monitoring program. In 1994, three (3) monitoring wells (CF-9405, CF-9406 and CF-9407) were installed south of the LRCP as a condition of a pH variance for the former Type III Landfill granted by IDEM. From June 1994 through February 1995, 17 biweekly background events were conducted. Since June 1995, routine quarterly and semi-annual monitoring of these wells has been conducted.

In 2009, three (3) additional wells (CF-07-06D, CF-07-08 and CF-07-09) were installed per IDEM to monitor groundwater quality during the year prior to the start of operations of the Type I Landfill in 2011. Wells in the IDEM groundwater monitoring network are located south of the LRCP and screened in the same "foundation soils" as the wells in the CCR monitoring network (Figure 6).

During quarterly and semi-annual sampling events from June 1995 through 2011, Boron was detected in well CF-9406 (adjacent to well CF-15-08) at concentrations ranging from 9.9 milligrams per liter (mg/L) to 18 mg/L and in well CF-9407 (adjacent to well CF-15-09) at concentrations ranging from 1.19 mg/L to 7.5 mg/L (Table 3 and Figure 7). This demonstrates that Boron was present in groundwater downgradient of the eventual location of the Type I Landfill 17 years prior to its operation. Boron concentrations in downgradient CCR wells have ranged from 7.62 mg/L to 13 mg/L in well CF-15-08, and from 3.8 mg/L to 7.59 mg/L in well CF-15-09 (Table 3 and Figure 7). These concentrations are similar to historic Boron concentrations observed in wells CF-9406 and CF-9407 from June 1995 through 2011.

Because Boron concentrations similar to those observed in CCR wells CF-15-08 and CF-15-09 were detected in IDEM wells CF-9406 and CF-9407 prior to construction of the Type I Landfill, the historic, hydraulically placed ash is the source of the detected Boron.

3.5 Hydrogeologic Conditions and Groundwater Flow Velocity

As presented in the Evaluation of Potential Risk to Supply Well Fields Report (AGES 2006), a groundwater flow velocity of 45 feet per year (ft/yr) was calculated for alluvial deposits, which are designated as the uppermost aquifer for these CCR units. Based on the most recent topographical survey conducted of the Type I Landfill (Appendix C), the current limit of waste for the active Type I Landfill is located approximately 5,400 feet (more than one [1] mile) northeast of the three (3) CCR groundwater monitoring wells (CF-15-07, CF-15-08 and CF-15-09) (Figure 8). Based on this data, it was calculated that it will take 120 years for groundwater to flow from

the current limit of waste in the Type I Landfill to the CCR monitoring wells. Waste placement in the Type I Landfill began in early 2011. Given the two (2) constructed liners, the distance and the flow rate, water from the Type I Landfill should not be able to enter the groundwater, and groundwater has not had enough time to reach the CCR monitoring wells.

Based on the calculations presented above, the active Type I Landfill cannot be the source of Boron detected in the CCR monitoring wells.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The ASD has been completed in general accordance with guidelines presented in the Solid Waste Disposal Facility Criteria Technical Manual (U.S. EPA 1993).

Based on a review of the current and historic data, AGES/IKEC have determined that the Type I Landfill is not the source of Boron detected in the CCR monitoring wells CF-15-08 and CF-15-09. This conclusion is supported by the following evidence:

- "Foundation soils" that extend from beneath the LRCP and the hydraulically placed fly ash southwest to the Ohio River provide a direct hydraulic connection between the historic, hydraulically placed fly ash and the CCR groundwater monitoring wells CF-15-08 and CF-15-09.

- Historic data from the IDEM groundwater monitoring program indicate that Boron concentrations similar to those observed in CCR wells CF-15-08 and CF-15-09 were detected in IDEM wells CF-9406 and CF-9407 for 17 years prior to operation of the Type I Landfill, indicating that the Boron is associated with the historic, hydraulically placed fly ash.

- Using the previously calculated groundwater flow velocity of 45 ft/yr, it is estimated that it would take 120 years for groundwater flowing beneath the Type I Landfill to reach the CCR monitoring wells.

Based on the demonstration presented above, the Type I Landfill is not the source of the Boron detected in CCR monitoring wells CF-15-08 and CF-15-09. Therefore, it is recommended that the Type I Landfill remain in Detection Monitoring.

5.0 REFERENCES

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TABLES

TABLE 1
SUMMARY OF POTENTIAL AND CONFIRMED APPENDIX III SSIs
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential SSI Parameter (Units)	11th Detection Monitoring Sampling Event September 2023		11th Detection Monitoring Resampling Event November 2023	
		Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)
CF-15-08	Boron (mg/L)	11	4.91	12	**Yes**
CF-15-09	Boron (mg/L)	5.4	4.91	7	**Yes**

Notes:
1. SSI: Statistically Significant Increase.
2. UPL: Upper Prediction Limit (Maximum Interwell UPL).
3. mg/L: Milligrams per liter.

TABLE 2
GROUNDWATER MONITORING NETWORK
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)[2]	Top of Casing Elevation (ft)[2]	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
CF-15-04	Background	12/3/2015	451482.81	569307.19	465.55	468.03	439.55	429.55	38.48
CF-15-05	Background	12/1/2015	447491.91	565533.64	439.85	442.58	422.85	412.85	29.73
CF-15-06	Background	11/30/2015	447026.92	565190.31	437.49	440.40	431.49	421.49	18.91
CF-15-07	Downgradient	11/23/2015	443135.08	562259.25	438.61	441.11	432.61	422.61	18.50
CF-15-08	Downgradient	11/19/2015	443219.57	562537.29	460.33	462.79	430.33	420.33	42.46
CF-15-09	Downgradient	11/25/2015	443445.96	562871.69	456.73	459.45	447.73	442.73	16.72
WBSP-15-01	Background	11/30/2015	449072.27	566322.12	466.93	469.36	458.93	448.93	20.43
WBSP-15-02	Background	11/11/2015	449803.91	566987.30	473.83	476.76	457.83	452.83	23.93

Notes:
1. The Well locations are referenced to the North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 3
HISTORIC BORON CONCENTRATIONS: IDEM WELLS CF-9406 & CF-9407 AND CCR WELLS CF-15-08 & CF-15-09
CLIFTY CREEK STATION
MADISON, INDIANA

Boron Concentrations in IDEM Wells (1994 through 2015)					
Date	**CF-9406**	**CF-9407**	**Date**	**CF-9406**	**CF-9407**
6/8/1994	10	2.9	**11/19/2002**	16.2	5.92
6/22/1994	9.8	4.7	**5/14/2003**	13.7	3.83
7/6/1994	11	6.3	**11/12/2003**	14.7	5.4
7/20/1994	12	8.4	**5/11/2004**	14.2	3.86
8/3/1994	10	6.3	**11/9/2004**	17.1	5.28
8/17/1994	9	6.4	**5/9/2005**	15.2	7.16
8/31/1994	12	7.7	**11/8/2005**	14.3	DRY
9/14/1994	9.8	6.9	**5/17/2006**	12.8	7.4
9/28/1994	9.7	5.9	**11/15/2006**	15	5.69
10/12/1994	12	7.3	**5/9/2007**	13.7	4.71
10/26/1994	12	6.8	**11/14/2007**	14.6	DRY
11/9/1994	11	6.7	**5/13/2008**	15	3.21
11/30/1994	11	5	**11/12/2008**	15.6	DRY
12/7/1994	10	3.6	**5/19/2009**	14.7	4.75
12/21/1994	11	2.5	**11/16/2009**	14.7	7.23
1/18/1995	11	3	**12/16/2009**	NM	NM
2/22/1995	13	3.6	**01/14/2010**	NM	NM
6/14/1995	13	4.5	**02/23/2010**	NM	NM
12/21/1995	14	4.7	**03/16/2010**	NM	NM
6/26/1996	14	3.3	**04/15/2010**	NM	NM
12/23/1996	12	5.3	**5/19/2010**	14.1	6.77
4/30/1997	**9.9**	6.9	**06/23/2010**	NM	NM
6/30/1997	12	5.9	**07/15/2010**	NM	NM
10/7/1997	15	DRY	**08/24/2010**	NM	NM
12/16/1997	14	**7.5**	**09/14/2010**	NM	NM
4/16/1998	14	6.5	**10/19/2010**	NM	NM
6/24/1998	13	6.5	**11/3/2010**	16.9	DRY
9/23/1998	14	DRY	**Type I Landfill Operational**		
1/21/1999	13	5.1	**5/17/2011**	12.3	4.21
3/31/1999	12	4.3	**11/28/2011**	16.2	**1.19**
6/30/1999	13	7.5	**5/7/2012**	14.5	5.09
10/7/1999	DRY	DRY	**11/13/2012**	15.9	DRY
1/6/2000	15	4.4	**3/30/2013**	15	5.25
6/6/2000	15	7.2	**9/23/2013**	14.2	DRY
1/10/2001	16	7.4	**5/21/2014**	12.63	5.646
5/15/2001	15	6.6	**11/11/2014**	14.58	DRY
11/26/2001	**18**	7.3	**5/9/2015**	15.47	DRY
5/15/2002	13.5	5.1	**11/3/2015**	13.8	DRY

TABLE 3
HISTORIC BORON CONCENTRATIONS: IDEM WELLS CF-9406 & CF-9407 AND CCR WELLS CF-15-08 & CF-15-09
CLIFTY CREEK STATION
MADISON, INDIANA

Boron Concentrations in IDEM and CCR Wells (2016 through 2023)				
Date	**CF-9406**	**CF-9407**	**CF-15-08**	**CF-15-09**
January 2016	NM	NM	8.64	6.86
March 2016	NM	NM	8.24	5.78
May 2016	10.6	2.48	9.34	6.58
July 2016	NM	NM	9.65	7.01
August 2016	NM	NM	9.63	6.73
November 2016	15.3	DRY	10.9	DRY
March 2017	NM	NM	9.29	6.78
May 2017	7.46	5.4	NM	NM
June 2017	NM	NM	**7.62**	6.3
August 2017	NM	NM	9.04	6.81
November 2017	11.7	7.58	NM	NM
March 2018	NM	NM	8.5	5.86
May 2018	13.8	7.25	8.6	6.1
October 2018	NM	NM	11.9	**7.59**
November 2018	14.7	3.27	NM	NM
December 2018	NM	NM	11.9	7.41
March 2019	NM	NM	9.8	6.7
May 2019	13.9	6.56	NM	NM
June 2019	NM	NM	8.5	6.5
October 2019	NM	NM	11.0	DRY
November 2019	17	DRY	9.0	NM
March 2020	NM	NM	8.2	5.7
April 2020	8.1	2.5	NM	NM
June 2020	NM	NM	9.6	5.9
September 2020	15	7	10	6.9
December 2020	NM	NM	11	6.4
March 2021	9.6	2.8	11	6.0
June 2021	NM	NM	10	6.2
September 2021	13	5.1	**13**	DRY
December 2021	NM	NM	12	NM
March 2022	9.3	6.9	12	6.2
June 2022	NM	NM	11	5.9
September 2022	14	4.2	10	**3.8**
December 2022	NM	NM	**13**	NM
March 2023	12	4.8	12	5.1
June 2023	NM	NM	11	5.5

TABLE 3
HISTORIC BORON CONCENTRATIONS: IDEM WELLS CF-9406 & CF-9407 AND CCR WELLS CF-15-08 & CF-15-09
CLIFTY CREEK STATION
MADISON, INDIANA

Boron Concentrations in IDEM and CCR Wells (2016 through 2023) Continued				
Date	**CF-9406**	**CF-9407**	**CF-15-08**	**CF-15-09**
September 2023	15	1	11	5.4
November 2023	NM	NM	12	7

Notes:
1. All concentrations are mg/L.
2. NM = Well was not monitored on this date.
3. DRY = Well was dry and not able to be sampled.
4. Maximum and minimum Boron results for IDEM wells (June 1995 through 2011 only) and CCR wells are shown in **Bold.**

FIGURES

N

CLIFTY HOLLOW ROAD

CF-15-04

CLIFTY CREEK STATION

BIG CLIFTY CREEK

LIMIT OF WASTE PLACEMENT

TYPE I RESIDUAL WASTE LANDFILL

WBSP-15-02

WEST BOILER SLAG POND

DEVIL'S BACKBONE

WBSP-15-01

INDIANA

KENTUCKY

CF-15-05

CF-15-06

OHIO RIVER

RIVER ROAD

LANDFILL RUNOFF COLLECTION POND

B'

B

CF-15-08

CF-15-07

CF-9407

CF-15-09

CF-07-06D

CF-9406

CF-07-08

CF-9405

CF-07-09

LEGEND:

BACKGROUND CCR PROGRAM MONITORING WELL LOCATION

DOWNGRADIENT CCR PROGRAM MONITORING WELL LOCATION

IDEM PROGRAM MONITORING WELL LOCATION

800' 0' 800' 1600'

SCALE: 1"= 800'

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017114-CLI
DWG FILE	IKEC_Clifty_ASD_MW Locs_b03.dwg
DRAWING SCALE	NOT TO SCALE

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INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL
MONITORING WELL LOCATIONS

DRAWING NAME: FIGURE 1

REV.: 0

Plot: 01/10/2019 13:32 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\IKEC_Clifty_ASD_MW Locs_b03.dwg\FIG 1

DWG. NO.: 16-30500-01-A

TYPE I RESIDUAL WASTE LANDFILL

LRCP

WEST BOILER SLAG POND

A

A'

Proposed Grading Limit

Ohio River

LEGEND:

A-A' CROSS SECTION TRANSECT

SOURCE: CLIFTY CREEK PERMIT DRAWINGS (FMSM, NOVEMBER 2006)

DRAWN BY	JM
DATE	
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JOB NO.	2017116-CLI
DWG FILE	Clifty_ASD_Boring Plan b04.dwg
DRAWING SCALE	NOT TO SCALE

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CLIFTY CREEK STATION
MADISON, INDIANA
OVERVIEW OF TYPE I LANDFILL AND LRCP

DRAWING NAME: FIGURE 2

REV.: 0

Plot: 12/12/2018 10:47 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_ASD_Boring Plan b04.dwg

A
SOUTHWEST

A'
NORTHEAST

600

550

500

450

400

ELEVATIONS IN FEET ABVOVE MSL

TYPE I LANDFILL

APPROXIMATE AREA OF
GROUNDWATER DIVIDE

GEOSYNTHETIC
CLAY LINER

STRUCTURAL FILL (SUBGRADE)

TYPE III LANDFILL (ASH)

STRUCTURAL FILL (BOILER SLAG)

EXISTING BOILER SLAG

HYDRAULICALLY PLACED FLY ASH

ORIGINAL GROUND LINE

FOUNDATION SOILS

BEDROCK

70+00 60+00 50+00 40+00 30+00 20+00 10+00 0+00

STATION

APPROXIMATE PHREATIC SURFACE

GROUNDWATER FLOW DIRECTION

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2022008-CLI
DWG FILE	3_Clifty_ASD_Cross Sec b02_RVSD 9-8-22.dwg
DRAWING SCALE	NOT TO SCALE

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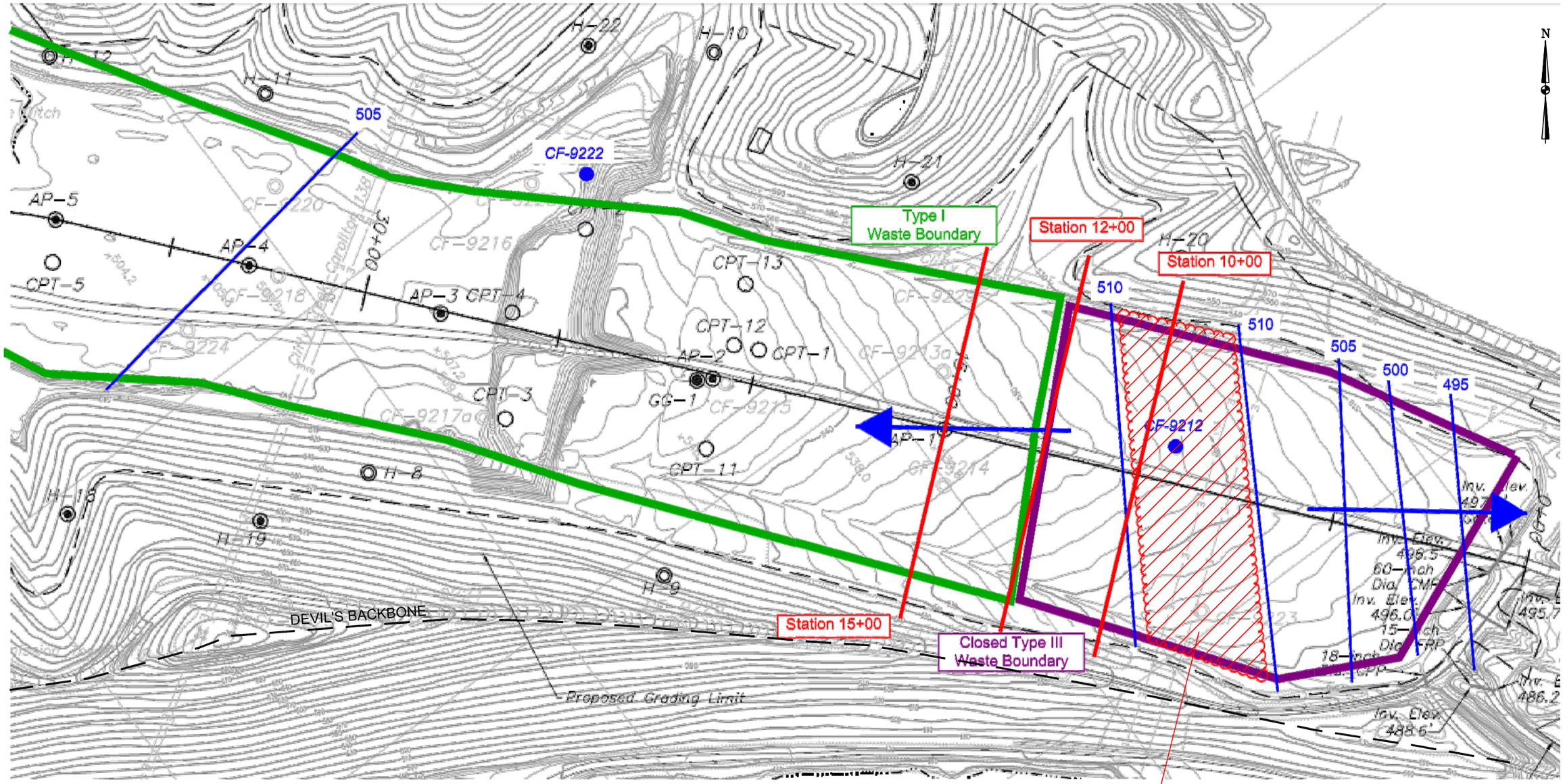
CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL
GENERALIZED GEOLOGIC CROSS-SECTION
A-A' (SOUTHWEST-NORTHEAST)

DRAWING NAME: FIGURE 3

REV.: 0

Plot: 09/08/2022 14:19 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD 8_LF_MAR 2022\3_Clifty_ASD_Cross Sec b02_RVSD 9-8-22.dwg



505 — January 2006 Groundwater Contour

Groundwater Flow Direction

APPROXIMATE LOCATION OF GROUNDWATER DIVIDE.
BETWEEN STATIONS 7+00 AND 10+00.

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017116-CLI
DWG FILE	Clifty_GW Divide b01.dwg
DRAWING SCALE	NOT TO SCALE

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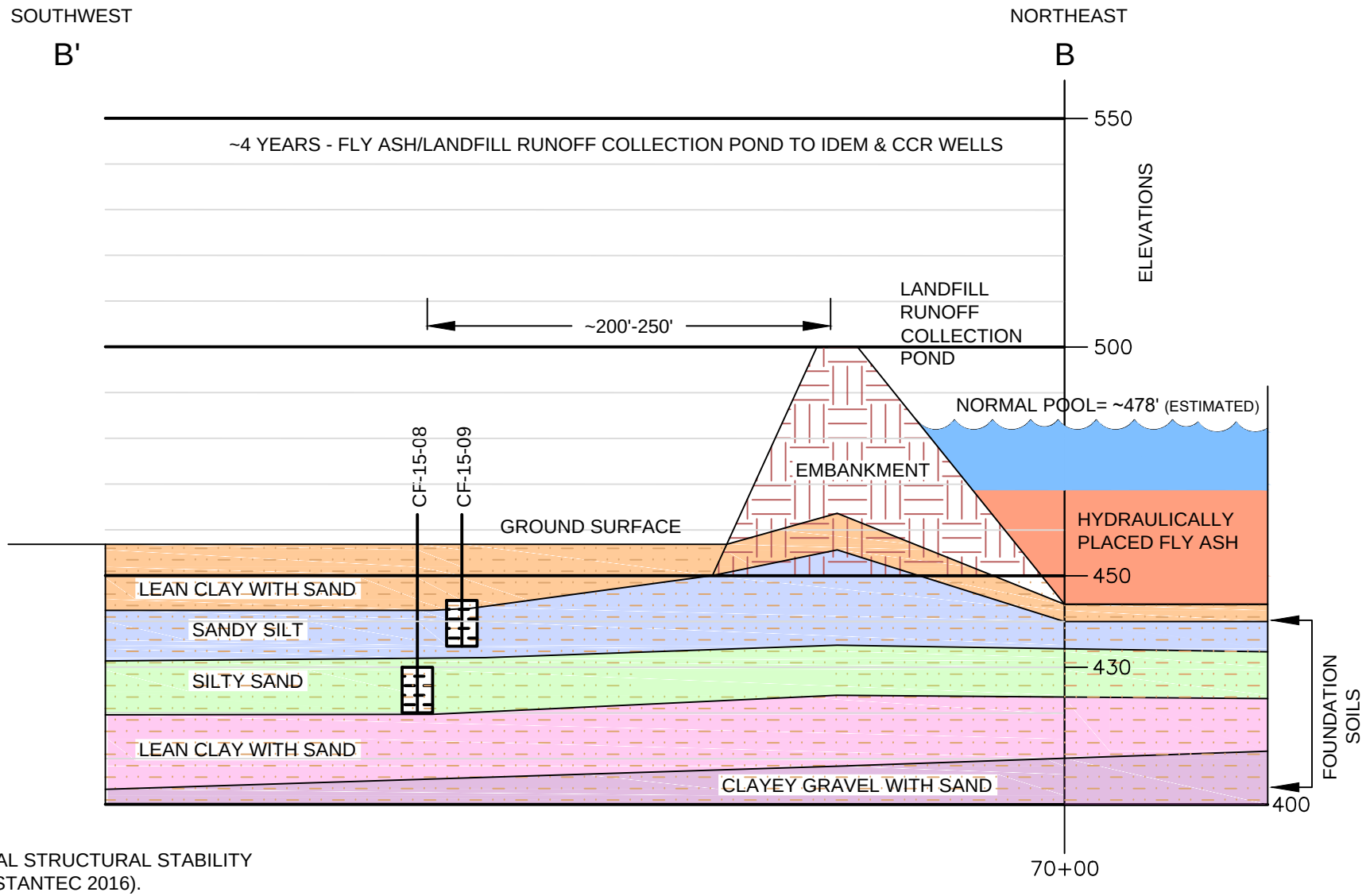
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
GROUNDWATER FLOW AT
NORTHEAST END OF BEDROCK CHANNEL

DRAWING NAME: FIGURE 4

REV.: 0

Plot: 12/12/2018 11:46 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_GW Divide b01.dwg



NOTES:
BASED ON INITIAL STRUCTURAL STABILITY ASSESSMENT (STANTEC 2016).

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021037-CLI
DWG FILE	5_Clifty_ASD_X-Sec Pond-Wells a06_revised 1-25-22.dwg
DRAWING SCALE	NOT TO SCALE

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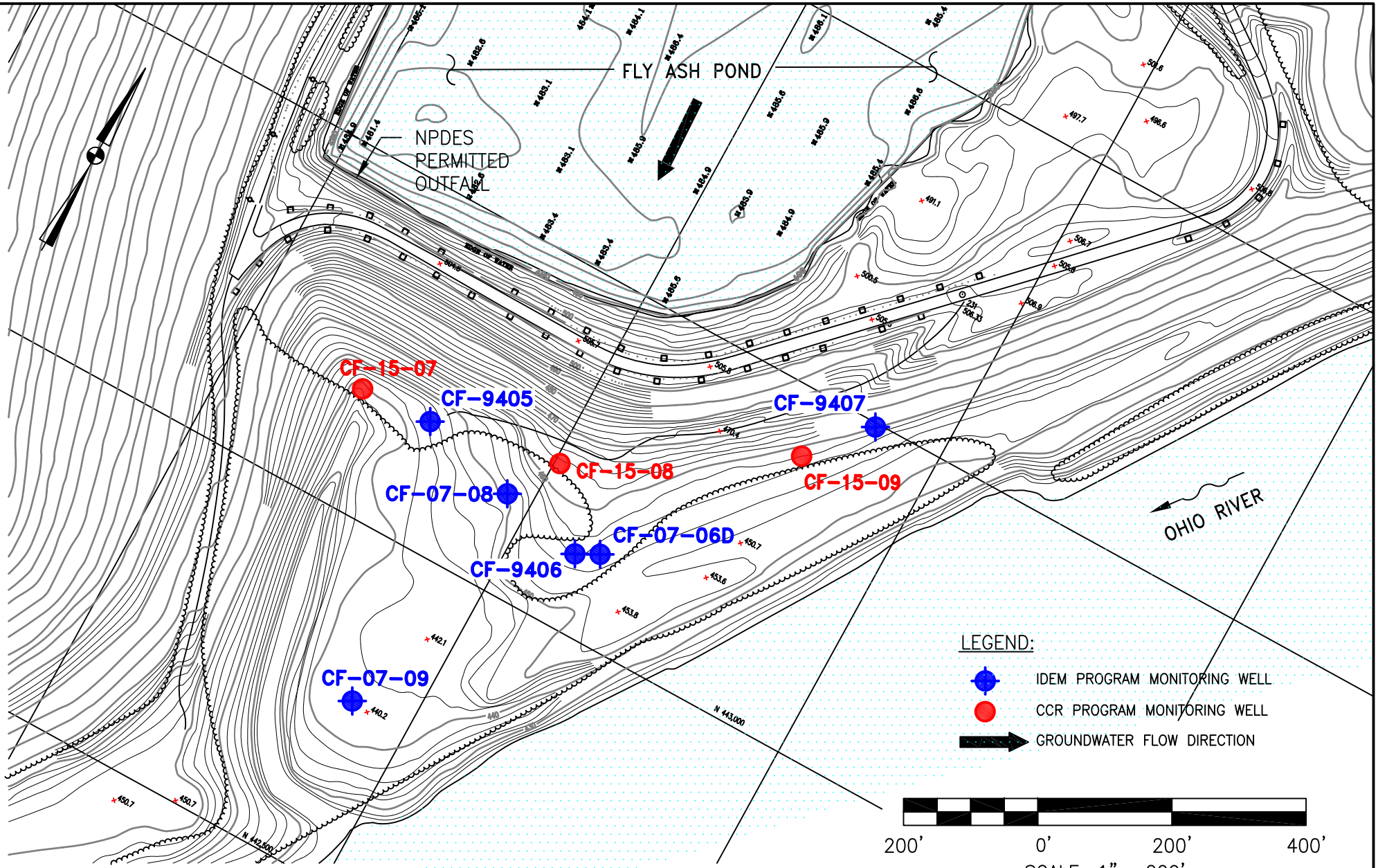
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
GENERALIZED CROSS-SECTION
LANDFILL RUNOFF COLLECTION POND TO
CCR MONITORING WELLS

DRAWING NAME	REV.
FIGURE 5	0

Plot: 01/25/2022 12:15 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD 7_LF_SEPT 2021\5_Clifty_ASD_X-Sec Pond-Wells a06_revised 1-25-22.dwg



DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2017116-CLI
DWG FILE	CLIFTY Well Locations a03 R2.dwg
DRAWING SCALE	AS SHOWN

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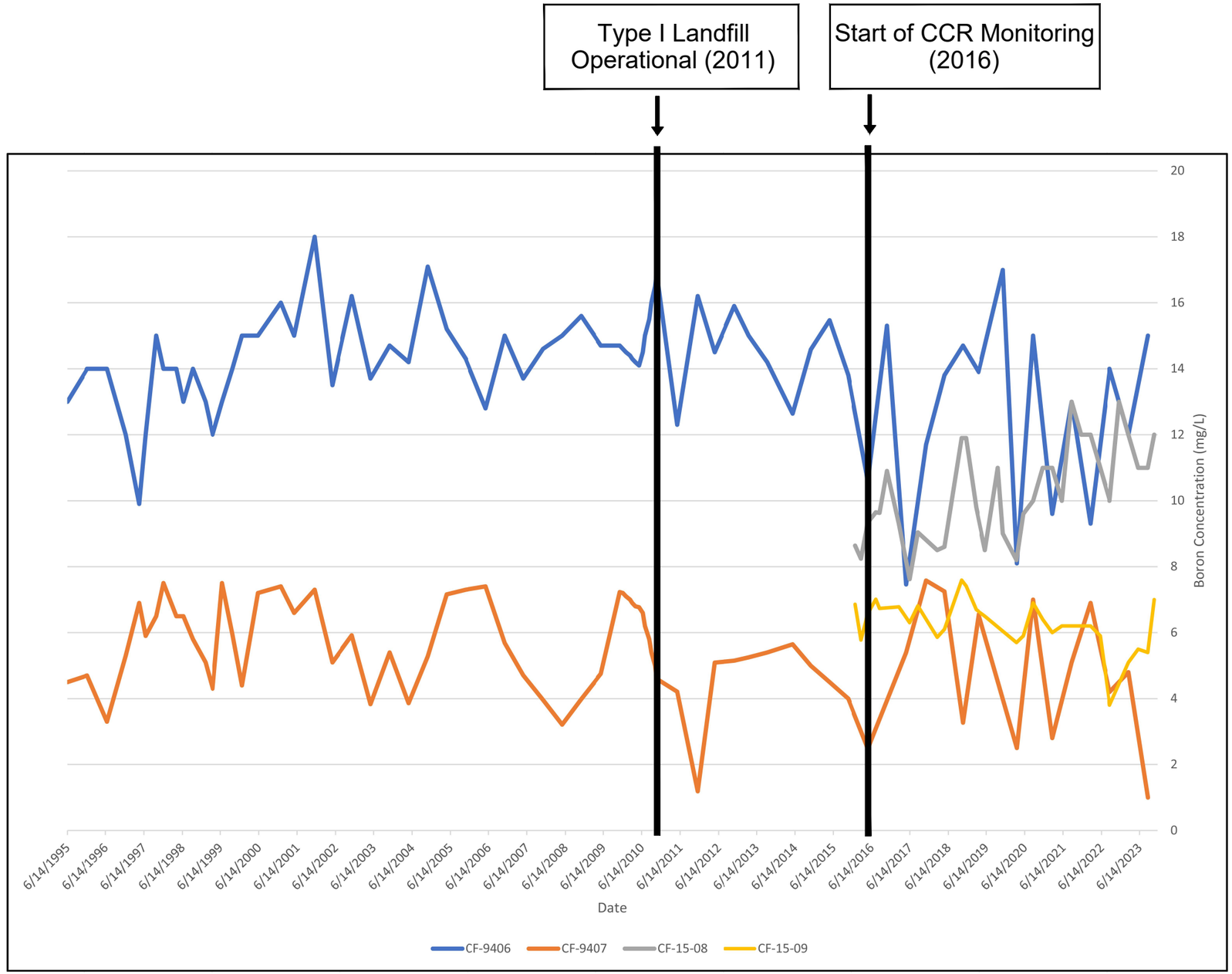
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK PLANT
MADISON, INDIANA
CCR PROGRAM AND IDEM PROGRAM
MONITORING WELL LOCATION MAP

DRAWING NAME	REV.
FIGURE 6	0

Plot: 12/12/2018 12:18 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\CLIFTY Well Locations a03 R2.dwg



DRAWN BY	AB
DATE	
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JOB NO.	2023012-CLI
DWG-FILE	7_IKEC_Clifty_ASD LRCP_Boron-Time Graph_MAR 2023.dwg
DRAWING SCALE	NOT TO SCALE

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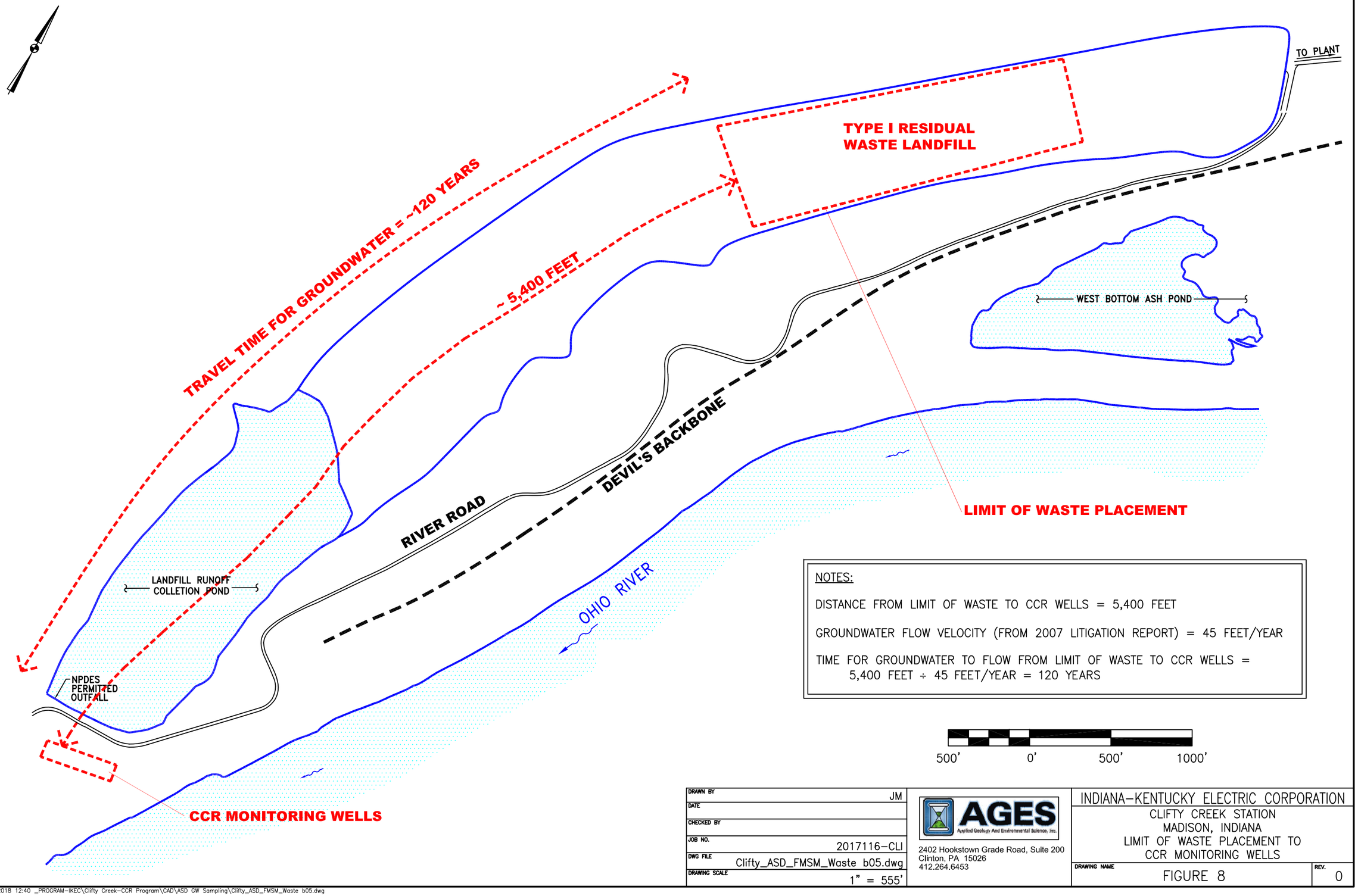
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
TIME SERIES DATA FOR BORON (mg/L)
CF-9406, CF-9407, CF-15-08 AND CF-15-09
SEPTEMBER 2023

DRAWING NAME	REV.
FIGURE 7	0



NOTES:

DISTANCE FROM LIMIT OF WASTE TO CCR WELLS = 5,400 FEET

GROUNDWATER FLOW VELOCITY (FROM 2007 LITIGATION REPORT) = 45 FEET/YEAR

TIME FOR GROUNDWATER TO FLOW FROM LIMIT OF WASTE TO CCR WELLS =
5,400 FEET ÷ 45 FEET/YEAR = 120 YEARS

500' 0' 500' 1000'

DRAWN BY	JM
DATE	
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JOB NO.	2017116-CLI
DWG FILE	Clifty_ASD_FMSM_Waste b05.dwg
DRAWING SCALE	1" = 555'

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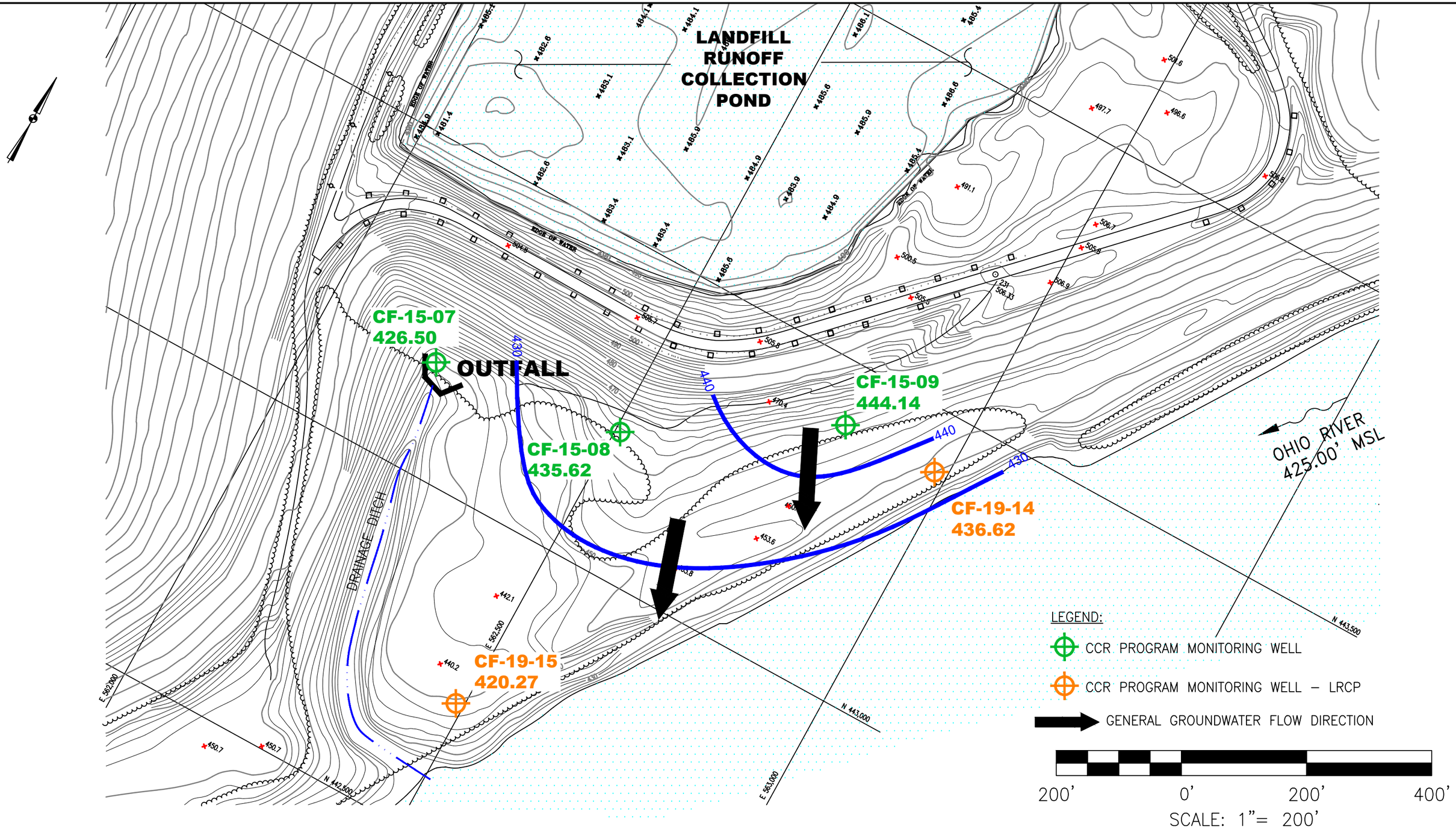
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
LIMIT OF WASTE PLACEMENT TO
CCR MONITORING WELLS

DRAWING NAME: FIGURE 8 REV. 0

Plot: 12/12/2018 12:40 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_ASD_FMSM_Waste b05.dwg

APPENDIX A

Groundwater Flow Maps
(September 2023 and November 2023)



NOTE:
WELLS CF-19-14 AND CF-19-15 WERE INSTALLED IN MARCH 2019 DURING THE CHARACTERIZATION OF THE LRCP.

DRAWN BY	AB
DATE	
CHECKED BY	
JOB NO.	2023012-CLI
DWG FILE	A-1_IKEC_Clifty_ASD_LRCP_GL Flow_SEPT 2023.dwg
DRAWING SCALE	AS SHOWN

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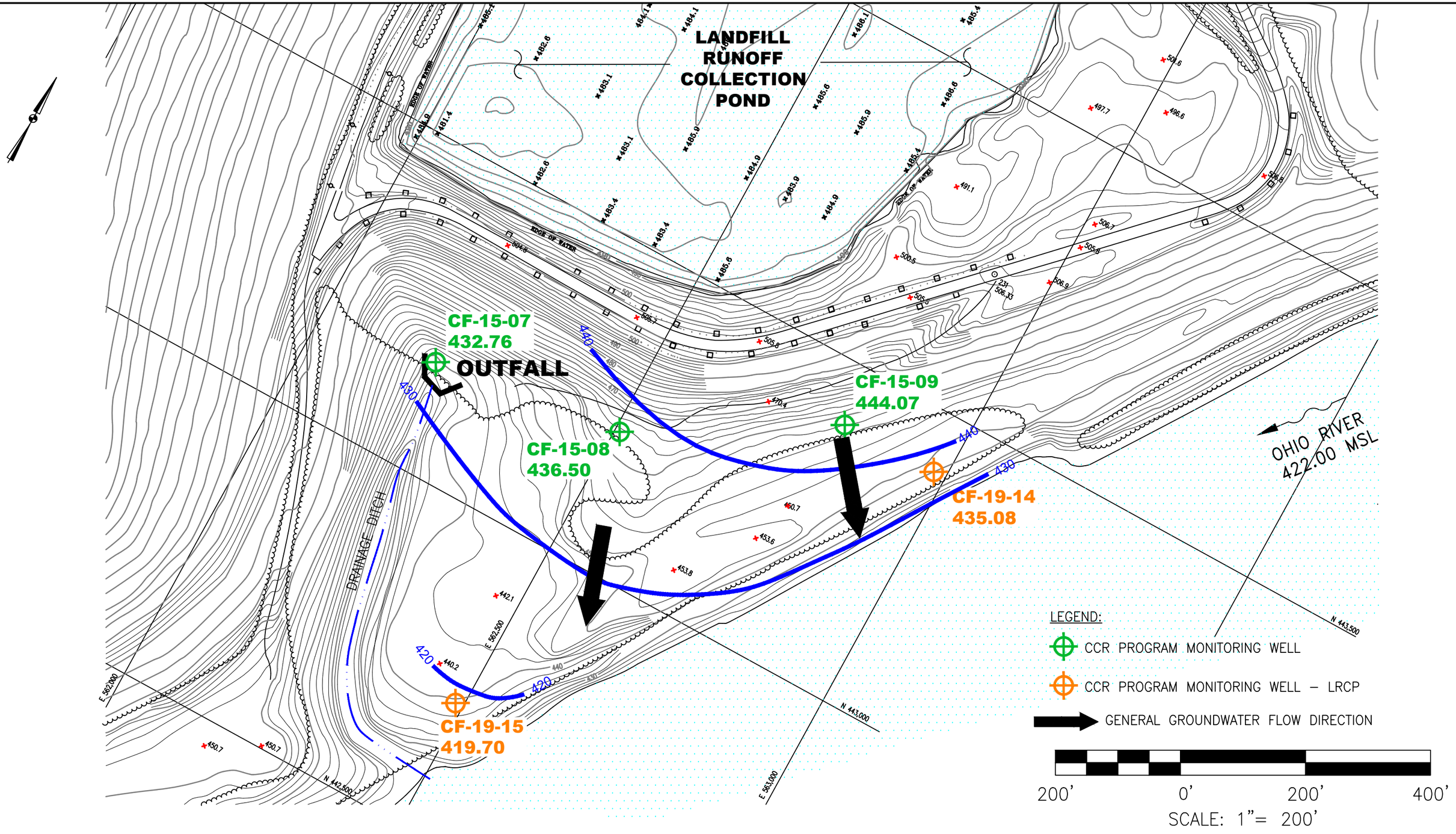
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
SEPTEMBER 2023

DRAWING NAME	REV.
FIGURE A-1	0



NOTE:
WELLS CF–19–14 AND CF–19–15 WERE INSTALLED IN MARCH 2019 DURING THE CHARACTERIZATION OF THE LRCP.

DRAWN BY	AB
DATE	
CHECKED BY	
JOB NO.	2023012–CLI
DWG FILE	A–2_IKEC_Clifty_ASD_LRCP_November 2023.dwg
DRAWING SCALE	AS SHOWN

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INDIANA–KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
NOVEMBER 2023

DRAWING NAME	REV.
FIGURE A–2	0

Plot: 01/08/2024 13:52 _PROGRAMS–IKEC\Clifty Creek–CCR Program\CAD\ASD_LRCP_NOV 2023\A–2_IKEC_Clifty_ ASD_LRCP_GW Flow_November 2023.dwg

APPENDIX B

FIGURE FROM LRCP DAM STABILITY ASSESSMENT REPORT (Stantec 2016)

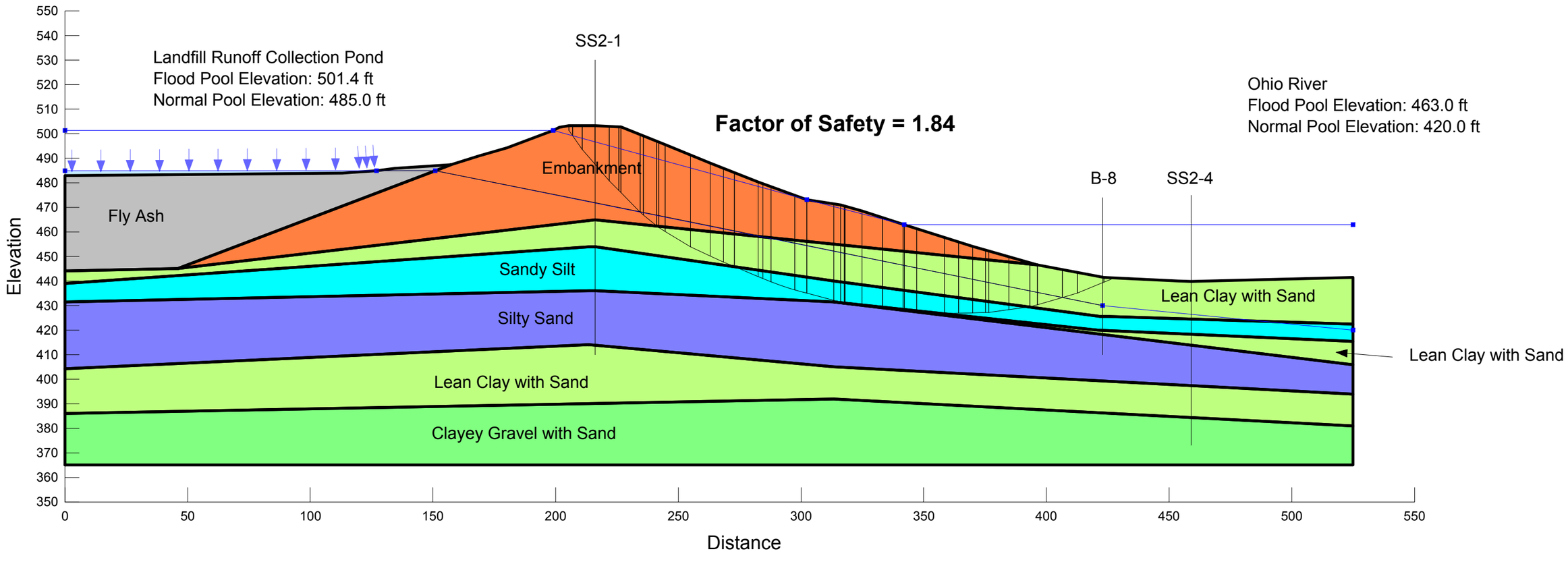
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Landfill Runoff Collection Pond Dam
Madison, Indiana
Section D-D'

Existing Geometry
Sudden Drawdown
Undrained, Sudden Drawdown Strengths

Note: The results of the analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. The drawing depicts approximate subsurface conditions based on historical drawings or specific borings at the time of drilling. No warranties can be made regarding the continuity of subsurface conditions.

Sudden Drawdown

Material Type	Unit Weight	Effective - c'	Effective - phi	Total - c	Total - phi
Embankment (SDD)	129 pcf	198 psf	27.5 °	1400 psf	21 °
Lean Clay with Sand (SDD)	127 pcf	206 psf	28 °	1200 psf	17 °
Sandy Silt (SDD)	125 pcf	0 psf	30 °	0 psf	30 °
Silty Sand (SDD)	94 pcf	0 psf	30 °	0 psf	30 °
Clayey Gravel with Sand (SDD)	130 pcf	0 psf	35 °	0 psf	35 °
Fly Ash (SDD)	115 pcf	0 psf	25 °	0 psf	25 °



APPENDIX C

PHASE 1, 2 AND 3 EXISTING CONDITIONS TOPOGRAPHIC MAP (Stantec 2023)

LEGEND

UTILITY POLE
TRANSMISSION LINE
TRANSMISSION TOWER
VEGETATION
EDGE OF WATER
PROPERTY LINE
WASTE BOUNDARY
GRADING LIMITS

MAPPING SOURCE NOTE:

TOPOGRAPHIC, BATHYMETRIC, AND PLANIMETRIC SURVEY INFORMATION FOR THE PLANS WERE OBTAINED FROM MAPPING PROVIDED BY INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC) AND AMERICAN ELECTRIC POWER (AEP). AN AERIAL SURVEY OF THE SOUTHWEST LANDFILL AREA PERFORMED MAY 2022 WAS PROVIDED BY R. B. JERGENS. THE APRIL 2023 QUARTERLY LANDFILL SURVEY WAS PROVIDED BY IKEC AND RIVERSIDE CONTRACTING & EXCAVATING, LLC. HORIZONTAL DATUM IS NAD27 AND VERTICAL DATUM IS NAVD88.

NOTES:

1. OTHER BASEMAP INFORMATION BASED ON ORIGINAL DESIGN PLAN SHEETS.
2. ANY REMAINING PHASE 1 CONSTRUCTION WILL BE PERFORMED DURING FUTURE CONSTRUCTION SEASONS. PHASES 2 AND 3 SUBGRADE CURRENTLY UNDER CONSTRUCTION.
3. CELLS WITH TEMPORARY SOIL COVER ARE MULCHED AND SEEDED.
4. MINOR LANDFILL PERMIT MODIFICATION TO THE LEACHATE AND STORMWATER MANAGEMENT ARE SHOWN IN THE PHASE 3 RWS TYPE 1 FOOTPRINT AND THE RWS TYPE III FOOTPRINT.

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Client/Project
INDIANA-KENTUCKY ELECTRIC CORPORATION

ANNUAL CONTOUR UPDATE AS REQUIRED BY 329 IAC 10-20-24
CLIFTY CREEK COAL ASH LANDFILL (ID 39-04)
MADISON, JEFFERSON COUNTY, INDIANA

Title
PHASES 1, 2, AND 3 EXISTING CONDITIONS
(JUNE 2023)

Permit-Seal

JACQUELINE S. HARMON REGISTERED No. 10911138 STATE OF INDIANA PROFESSIONAL ENGINEER

6/8/2023

Project Number: 175532014

File Name: 32010c-01-econ-2023.dwg	RRP	PSS	JSH	23.06.08
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Drawing No. 1

Revision -

Sheet 1 of 3

APPENDIX G

ALTERNATE SOURCE DEMONSTRATION SEPTEMBER 2022
LANDFILL RUNOFF COLLECTION POND

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COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2022 ASSESSMENT MONITORING EVENT
LANDFILL RUNOFF COLLECTION POND
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, JEFFERSON COUNTY, INDIANA

MAY 2023

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2022 ASSESSMENT MONITORING EVENT
LANDFILL RUNOFF COLLECTION POND
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, JEFFERSON COUNTY, INDIANA

MAY 2023

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

Bethany Flaherty

Bethany Flaherty
Senior Scientist II

Robert W. King

Robert W. King, L.P.G. #1237
President/Chief Hydrogeologist

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2022 ASSESSMENT MONITORING EVENT
LANDFILL RUNOFF COLLECTION POND
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, JEFFERSON COUNTY, INDIANA

T A B L E O F C O N T E N T S

SECTION **PAGE**

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2022 ASSESSMENT MONITORING EVENT
LANDFILL RUNOFF COLLECTION POND
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, JEFFERSON COUNTY, INDIANA

T A B L E O F C O N T E N T S

LIST OF TABLES

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COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2022 ASSESSMENT MONITORING EVENT
LANDFILL RUNOFF COLLECTION POND
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, JEFFERSON COUNTY, INDIANA

1.0 INTRODUCTION

On December 19, 2014, the United States Environmental Protection Agency (U.S. EPA) issued their final Coal Combustion Residuals (CCR) regulation which regulates CCR as a non-hazardous waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) and became effective six (6) months from the date of its publication (April 2015) in the Federal Register, referred to as the "CCR Rule."

The Indiana-Kentucky Electric Corporation (IKEC) contracted with Applied Geology and Environmental Science, Inc. (AGES) to administer the CCR Rule groundwater monitoring program at the Clifty Creek Station located in Madison, Jefferson County, Indiana. There are three (3) CCR units at the Clifty Creek Station (Figure 1):

- Type I Residual Waste Landfill (Type I Landfill);
- Landfill Runoff Collection Pond (LRCP); and,
- West Boiler Slag Pond (WBSP).

During the September 2022 Assessment Monitoring event, an Arsenic SSI was identified in one (1) well (CF-15-07) located downgradient of the LRCP; the SSI was confirmed in a resampling event in December 2022. Based on further research regarding CCR constituent concentrations in the well and resampling at the site, AGES has determined that the LRCP is not the source of the Arsenic exceedance. Therefore, AGES has prepared this Alternate Source Demonstration (ASD) Report to document these results.

Details regarding this evaluation are presented in this report.

1.1 Background

During the March 2018 Detection Monitoring event, Boron Statistically Significant Increases (SSIs) were confirmed in two (2) wells located downgradient of the LRCP and the CCR unit entered into Assessment Monitoring in September 2018. In accordance with §257.95 of the CCR Rule, IKEC completed the groundwater monitoring requirements of the Assessment Monitoring Program at the LRCP as described below.

The ninth round of Assessment Monitoring groundwater samples was collected between September 29 and October 6, 2022, from monitoring wells at the LRCP (Figure 1). All samples were collected in accordance with the Groundwater Monitoring Program Plan (GMPP) (AGES 2018b) and analyzed for all Appendix III and IV constituents.

Upon receipt, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Clifty Creek Station CCR Statistical Analysis Plan (StAP) (Stantec 2021). The initial statistical evaluation identified a potential SSI for Arsenic in monitoring well CF-15-07 at the LRCP. The results of the statistical evaluation are summarized in Table 1.

In accordance with the StAP, IKEC resampled the well for Arsenic on December 27, 2022. Based on the result of the resampling event, the SSI for Arsenic was confirmed in monitoring well CF-15-07 (Table 1).

1.2 Purpose of This Report

The purpose of this report is to present an ASD and provide sufficient evidence that the SSI identified for Arsenic in well CF-15-07 resulted from **a programmatic error in the sampling** method, which lead to an alternate source, and not from the LRCP. The CCR Rule does not contain specific requirements for an ASD beyond what is stated, as follows, in §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 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 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."*

1.3 Technical Basis for ASD

From March 2019 through March 2022, well CF-15-07 had been sampled for analysis of Arsenic during a total of eight (8) Assessment Monitoring events. All Arsenic results for well CF-15-07 during these events were less than the GWPS of 10 micrograms per liter (ug/L). During the ninth Assessment Monitoring event in September 2022, Arsenic was detected at 12 ug/L, which

exceeded the GWPS. The exceedance was confirmed in a resampling event in December 2022, with Arsenic detected at 40 ug/L.

Based on these unexpected results, IKEC conducted further research regarding the potential for suspended sediments to impact the concentrations of CCR constituents in groundwater. Concentrations of CCR constituents in total (unfiltered) groundwater samples are often highly correlated to the amount of suspended sediment present in the samples. A recent study noted that greater than 95% of Cobalt was irreversibly adsorbed to solids when exposed to groundwater (Hostetler, Rehm, Karkowski and Kron 2020). According to this paper, Total Cobalt concentrations are believed to be an artifact of stabilized turbidity and not a release of Cobalt from a source area. Due to the low level and micro-scale of the suspended sediment, it does not appear to impact the turbidity of the samples as measured in Nephelometric Turbidity units (NTUs). Based on recent experience at other CCR sites, this same type of issue is also observed for Arsenic. Additional sampling was required to fully evaluate this issue.

Presented below is a description of the LRCP followed by a technical justification for the ASD, conclusions, and a recommended revision to the purge method in the GMPP to address this issue.

2.0 DESCRIPTION OF THE LRCP

2.1 Unit Description

The Type I Landfill and LRCP occupy an approximately 200-acre area situated within an eroded bedrock channel (Figures 1 and 2). The LRCP is an unlined pond located at the southern edge of the Type I Landfill to the north, natural grade to the east and west, and by a dam to the south that runs along the bank of the Ohio River. Approximately 508 acres of both landfill contact water and stormwater runoff drain to the LRCP. The base of the LRCP consists of historic hydraulically-placed fly ash. The LRCP does not receive CCR and any CCR within the LRCP is not being actively managed. Therefore, the LRCP is identified as an inactive unit under the CCR Rule.

2.2 Hydrogeology

Based on information in the Hydrogeologic Study Report (AGES 2007), bedrock beneath the Type I Landfill and the closed Type III Landfill (northeast of the LRCP) consists of impermeable limestone and shale of the Ordovician Dillsboro formation which is overlain by approximately 20 to 35 feet of gray clay. The gray clay is directly overlain by fly ash that had been historically hydraulically placed in the area. A generalized cross section showing the Type I Landfill and the location and limits of the closed Type III Landfill, and the extent of the historic, hydraulically placed fly ash is presented in Figure 3.

A limestone ridge known as the Devil's Backbone runs northeast to southwest along the length of the Type I Landfill, LRCP and closed Type III Landfill. The Devil's Backbone acts as an impermeable barrier that forces groundwater passing beneath both of the landfills to flow either toward the northeast or toward the southwest. A detailed hydrogeologic study determined that a groundwater flow divide is present near the northeast end of the bedrock channel and that all groundwater beneath the active Type I Landfill flows toward the southwest toward the LRCP (AGES 2007) (Figure 4).

An aquifer is not present beneath the approximate 200-acre footprint of the Type I and Type III Landfills. Therefore, alluvial deposits located southwest of the LRCP are designated as the uppermost aquifer for the Type I Landfill and the LRCP. For groundwater monitoring of the LRCP, a fine to medium grained sand with gravel, silt and clay found within alluvial deposits located southwest of the LRCP, is designated as the uppermost aquifer.

In November and December 2015, eight (8) monitoring wells were installed for the CCR groundwater monitoring network at the LRCP (Figure 1). Three (3) monitoring wells (CF-15-07, CF-15-08 and CF-15-09) were installed in the alluvial deposits (uppermost aquifer) located southwest of the LRCP. Based on exploratory soil borings and historical data, there were no suitable upgradient locations for the Type I Landfill. Well CF-15-04 was installed northeast of and outside the hydrologic influence of the Type I Landfill and the closed Type III Landfill to serve as a background well for the LRCP. Wells CF-15-05 and CF-15-06 were installed in alluvial deposits along the Ohio River to serve as background monitoring wells. Wells WBSP-15-01 and WBSP-15-02 are located southeast of the impermeable Devil's Backbone and are hydraulically separated from groundwater at the Type I Landfill and LRCP. These two (2) wells were also designated as background wells for the LRCP. Two (2) additional wells (CF-19-14 and CF-19-15) were installed at the southwest end of the property during the characterization of the LRCP. Table 2 presents construction details for the monitoring wells in the groundwater monitoring network for the LRCP.

Based on groundwater levels collected at the LRCP since 1994, groundwater in the uppermost aquifer at the LRCP flows to the southwest, toward the Ohio River. Historic groundwater data also indicates that groundwater flow at the southwest end of the property is affected by the elevation of the adjacent Ohio River. Evidence of routine, brief flow reversals (i.e., groundwater flows from the Ohio River back toward the southwest end of the property) and periodic flooding of the southwest end of the property have also been observed. A groundwater contour map for the uppermost aquifer southwest of the LRCP in September 2022 is included in Figure 5.

3.0 ALTERNATE SOURCE DEMONSTRATION

Groundwater sampling under the CCR Program is conducted in general accordance with Revision 1 of the CCR GMMP, Clifty Creek Station (AGES 2018b). Per the plan, all wells are purged using the low flow method, with varied pumping rates. Each well is purged until the following field parameters stabilize:

- Temperature (±3%);
- Specific Conductivity (±3%);
- pH (±0.01);
- Oxidation-Reduction Potential (ORP) (±10 millivolts);
- Dissolved Oxygen (DO) (+10%); and
- Turbidity (±10%).

Based on the results for Arsenic for well CF-15-07, this purge method sampling may allow for extremely low levels of sediment in the samples, which is believed to be the cause of the Arsenic exceedances.

To evaluate this issue, well CF-15-07 was sampled in March 2023 using a modified purge method that included the approved low flow purge method but for a total of four (4) hours prior to sampling (rather than until stabilization of field parameters). Based on results from similar sites, the use of a longer purge time appears to reduce the volume of micro-scale sediments that are believed to be the source of the Arsenic exceedances.

Presented below is a summary of Arsenic results for well CF-15-07 and a discussion of the Arsenic result using the modified purge method for the well.

3.1 Arsenic Results for January 2016 through March 2022

Under the CCR Program, well CF-15-07 has been sampled for Arsenic a total of 17 times using the above procedure from January 2016 through March 2022. Arsenic analytical results are included in Table 3. Arsenic results have ranged from non-detect (March 2021) to 7.6 ug/L in September 2020. The total purge times and purge volumes for the well have varied based on time required for stabilization of field parameters. The final turbidity values prior to sampling are presented in Table 4. For these events, final turbidity values averaged 5.0 NTUs and ranged from 2.12 to 21.0 NTUs.

3.2 Arsenic Results for September and December 2022

During the September 2022 Assessment Monitoring event, well CF-15-07 was purged at a rate of 50 milliliters per minute for 90 minutes; a total of approximately 1.25 gallons of groundwater were purged. At this point, all field parameters had stabilized within the limits listed above. The final turbidity value was 3.62 NTUs. For this event, the Arsenic concentration (12 ug/L) exceeded the applicable GWPS of 10 ug/L.

In accordance with the StAP, well CF-15-07 was resampled for Arsenic analysis in December 2022. During this resampling event, the well was purged at a rate of 200 milliliters per minute; a total of approximately seven (7) gallons of groundwater were purged. At this point, all field

parameters had stabilized within the limits listed above. The final turbidity value was 3.97 NTUs. For this event, the Arsenic concentration (40 ug/L) also exceeded the applicable GWPS of 10 ug/L.

3.3 Arsenic Result for March 2023

During the March 2023 sampling event, well CF-15-07 was purged at a rate of 125 milliliters per minute for four (4) hours (240 minutes); a total of approximately 10 gallons of groundwater were purged. At this point, all field parameters had also stabilized within the limits listed above. The final turbidity value was 11.2 NTUs. For this event, the Arsenic concentration (8.6 ug/L) was less than the applicable GWPS of 10 ug/L.

3.4 Result of ASD

Based on the results above, the use of a modified purge time of four (4) hours reduced the volume of micro-scale sediment, which was the alternate source of Arsenic, in the samples. As a result, the Arsenic concentration at well CF-15-07 is once again less than the GWPS of 10 ug/L.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The ASD has been completed in general accordance with CCR Rule, which allows for a successful ASD in the case of an error in the sampling. In this case, the purge method allowed for the presence of micro-scale sediment in the samples, which became an alternate source of the Arsenic. Based on this demonstration presented above, the LRCP is not the source of the Arsenic detected in CCR monitoring well CF-15-07. Therefore, it is recommended that the LRCP remain in Assessment Monitoring.

To further address this issue, it is recommended that the GMPP be revised to include the potential use of a four (4) hour purge time for confirmation re-sampling of any wells that exhibit an SSI during an initial sampling round. This modification to the purge method will ensure that micro-scale sediment is not an alternate source of any CCR constituent in groundwater.

5.0 REFERENCES

Applied Geology and Environmental Science, Inc. (AGES), 2018a. Coal Combustion Residuals Regulation Monitoring Well Installation Report. Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Indiana. October 2016, Revision 1.0 November 2018a.

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Applied Geology and Environmental Science, Inc. (AGES), 2007. Hydrogeologic Study Report, Clifty Creek Coal Ash Landfill Modification, Clifty Creek Station, Madison, Indiana. November 2007.

Hostetler, C., Rehm, B. Karwoski, T., and Kron, N., 2020. Groundwater Monitoring Plan Considerations for Corrective Action Sites, SCS Engineers, Inc.: www.scsengineers.com.

Stantec Consulting Services, Inc. (Stantec), 2021. Coal Combustion Residuals Regulation Statistical Analysis Plan, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. July 2021.

TABLES

TABLE 1
SUMMARY OF ARSENIC GWPS EXCEEDANCES: WELL CF-15-07
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Potential Exceedance Parameter (Units)	9th Assessment Monitoring Sampling Event September 2022		9th Assessment Monitoring Resampling Event December 2022	
		Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)
CF-15-07	Arsenic (ug/L)	12	10	40	**Yes**

Notes:
1. GWPS: Groundwater Protection Standard.
2. µg/L: Micrograms per liter.

TABLE 2
GROUNDWATER MONITORING NETWORK
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Monitoring Well ID	Designation	Date of Installation	Coordinates		Ground Elevation (ft)[2]	Top of Casing Elevation (ft)[2]	Top of Screen Elevation (ft)	Base of Screen Elevation (ft)	Total Depth From Top of Casing (ft)
			Northing	Easting					
CF-15-04	Background	12/3/2015	451482.81	569307.19	465.55	468.03	439.55	429.55	38.48
CF-15-05	Background	12/1/2015	447491.91	565533.64	439.85	442.58	422.85	412.85	29.73
CF-15-06	Background	11/30/2015	447026.92	565190.31	437.49	440.40	431.49	421.49	18.91
CF-15-07	Downgradient	11/23/2015	443135.08	562259.25	438.61	441.11	432.61	422.61	18.50
CF-15-08	Downgradient	11/19/2015	443219.57	562537.29	460.33	462.79	430.33	420.33	42.46
CF-15-09	Downgradient	11/25/2015	443445.96	562871.69	456.73	459.45	447.73	442.73	16.72
WBSP-15-01	Background	11/30/2015	449072.27	566322.12	466.93	469.36	458.93	448.93	20.43
WBSP-15-02	Background	11/11/2015	449803.91	566987.30	473.83	476.76	457.83	452.83	23.93

Notes:
1. The Well locations are referenced to the North American Datum (NAD83), east zone coordinate system.
2. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

TABLE 3
ARSENIC ANALYTICAL RESULTS: WELL CF-15-07
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Sampling Event Date	Arsenic Result (ug/L)
Jan-16	4.08
Mar-16	2.51
May-16	4.47
Jul-16	4.83
Aug-16	5.4
Nov-16	6.12
Feb-17	6.22
Jun-17	5.07
Aug-17	5.32
Oct-18	6.81
Mar-19	4.6 J
Oct-19	7.5
Mar-20	3.7 J
Sep-20	7.6
Mar-21	5 U
Sep-21	7.3
Mar-22	6.7
Sep-22	12
Dec-22	40
Mar-23	8.6

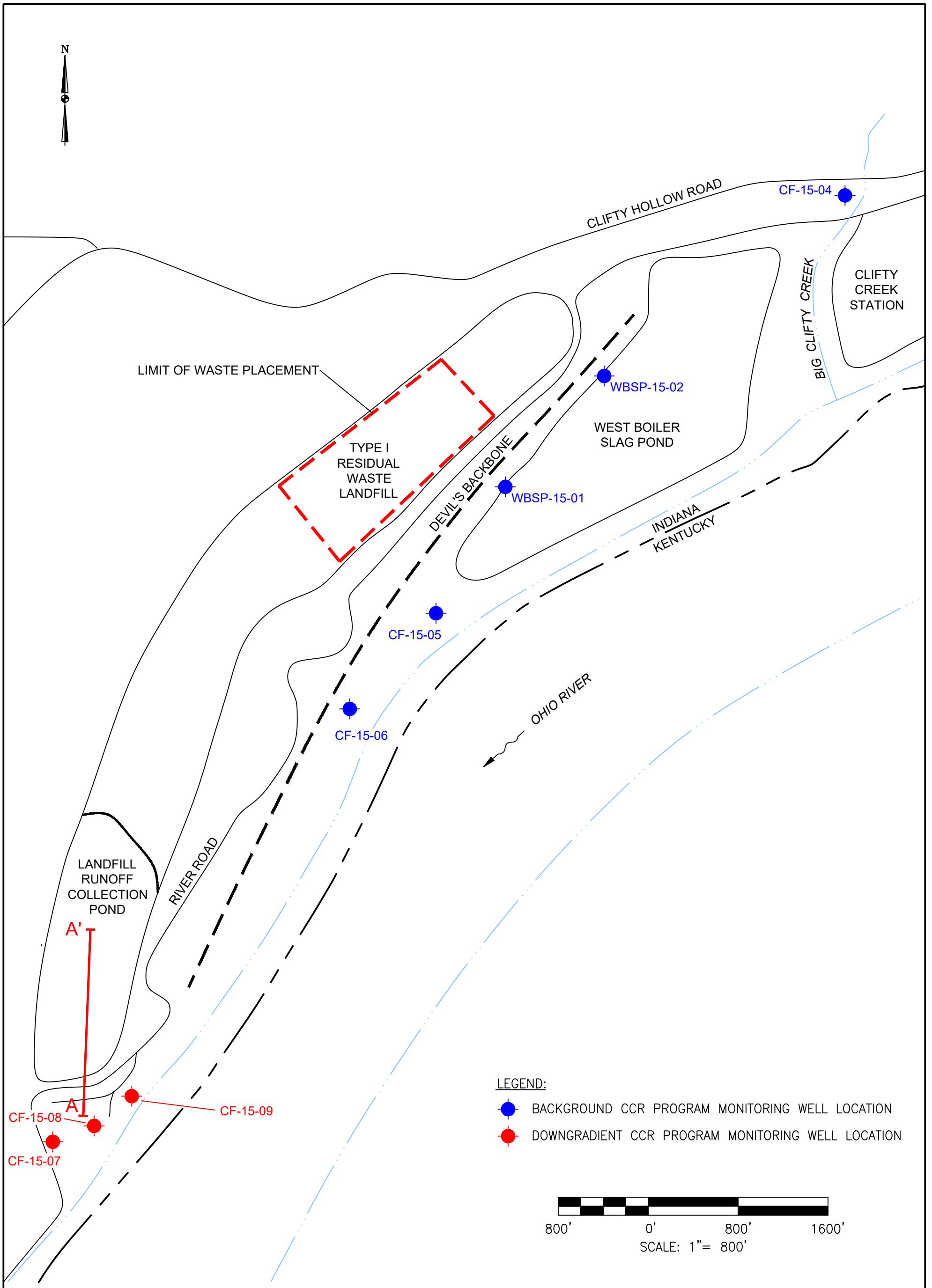
Notes:
1. µg/L: Micrograms per liter.
2. J: Estimated value.
3. U: Result non-detect.

TABLE 4
TURBIDITY FIELD PARAMETER RESULTS: WELL CF-15-07
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Sampling Event Date	Turbidity Result (NTUs)
Jan-16	4.63
Mar-16	4.63
May-16	4.11
Jul-16	4.36
Aug-16	2.87
Nov-16	3.82
Feb-17	3.02
Jun-17	3.98
Aug-17	3.92
Oct-18	4.38
Mar-19	4.89
Oct-19	4.08
Mar-20	3.01
Sep-20	4.09
Mar-21	2.36
Sep-21	2.12
Mar-22	21.0
Sep-22	3.62
Dec-22	3.97
Mar-23	11.20

Notes:
1. NTUs: Nephelometric Turbidity units.

FIGURES



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CHECKED BY	
JOB NO.	2017114-CLI
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DRAWING SCALE	NOT TO SCALE

AGES
Applied Geology And Environmental Science, Inc.
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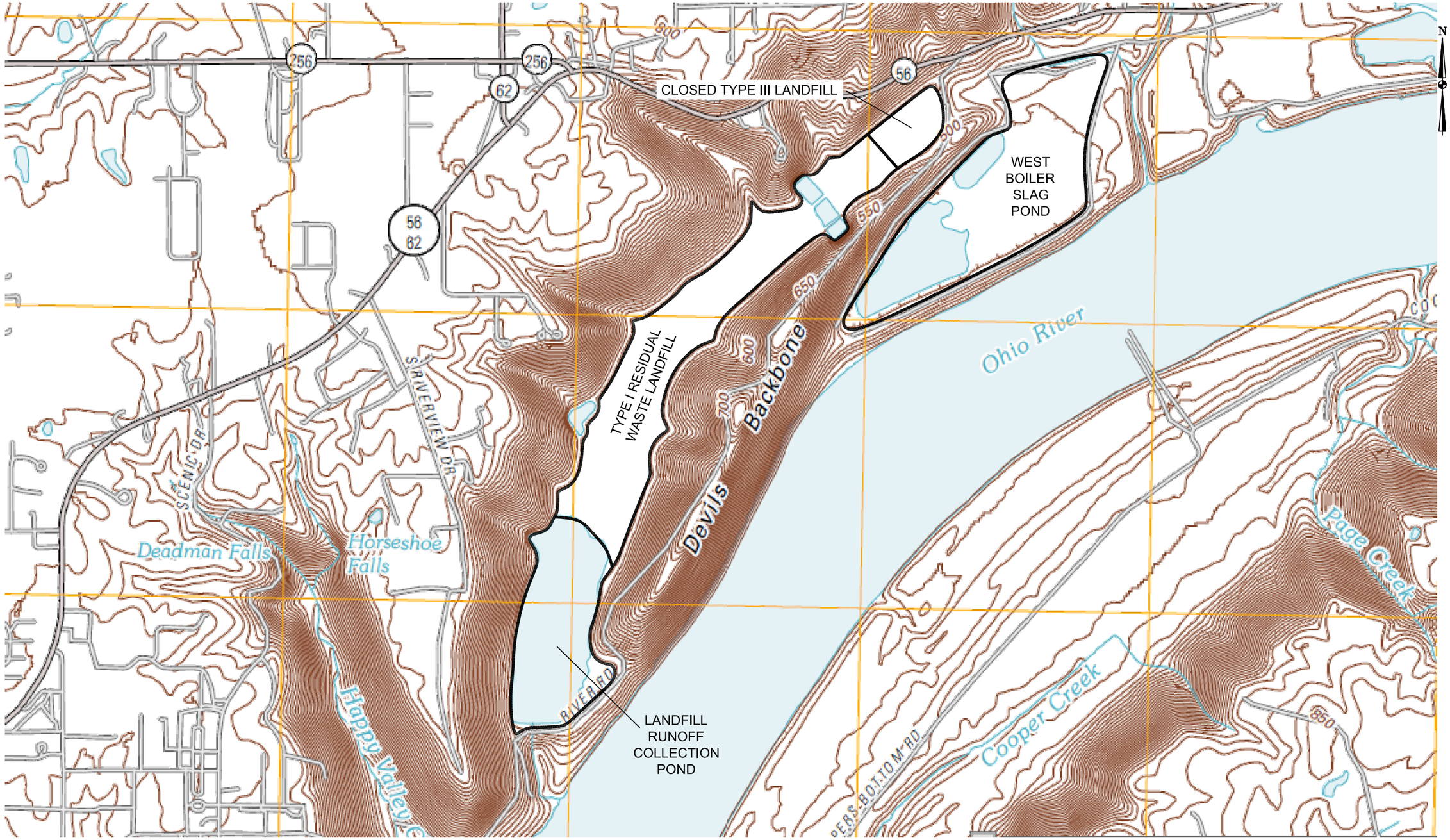
412.264.6453

INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
LANDFILL RUNOFF COLLECTION POND
MONITORING WELL LOCATIONS

DRAWING NAME	REV.
FIGURE 1	0

Plot: 01/10/2019 13:32 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\IKEC_Clifty_ASD_MW Locs_b03.dwg\FIG 1



SOURCE: USGS MADISON WEST 7.5 MINUTE TOPOGRAHIC QUADRANGLE, 2010.

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CLIFTY CREEK STATION
MADISON, INDIANA
TOPOGRAPHIC MAP

DRAWING NAME: FIGURE 2

REV.: 0

A
SOUTHWEST

A'
NORTHEAST

ELEVATIONS IN FEET ABOVE MSL

600
550
500
450
400

TYPE I LANDFILL

APPROXIMATE AREA OF
GROUNDWATER DIVIDE

GEOSYNTHETIC LINER AND
COMPACTED CLAY LINER

STRUCTURAL FILL (SUBGRADE)

TYPE III LANDFILL (ASH)

STRUCTURAL FILL (BOILER SLAG)

EXISTING BOILER SLAG

HYDRAULICALLY PLACED FLY ASH

ORIGINAL GROUND LINE

FOUNDATION SOILS

BEDROCK

70+00 60+00 50+00 40+00 30+00 20+00 10+00 0+00

STATION

APPROXIMATE PHREATIC SURFACE

GROUNDWATER FLOW DIRECTION

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2018070-2-CLI
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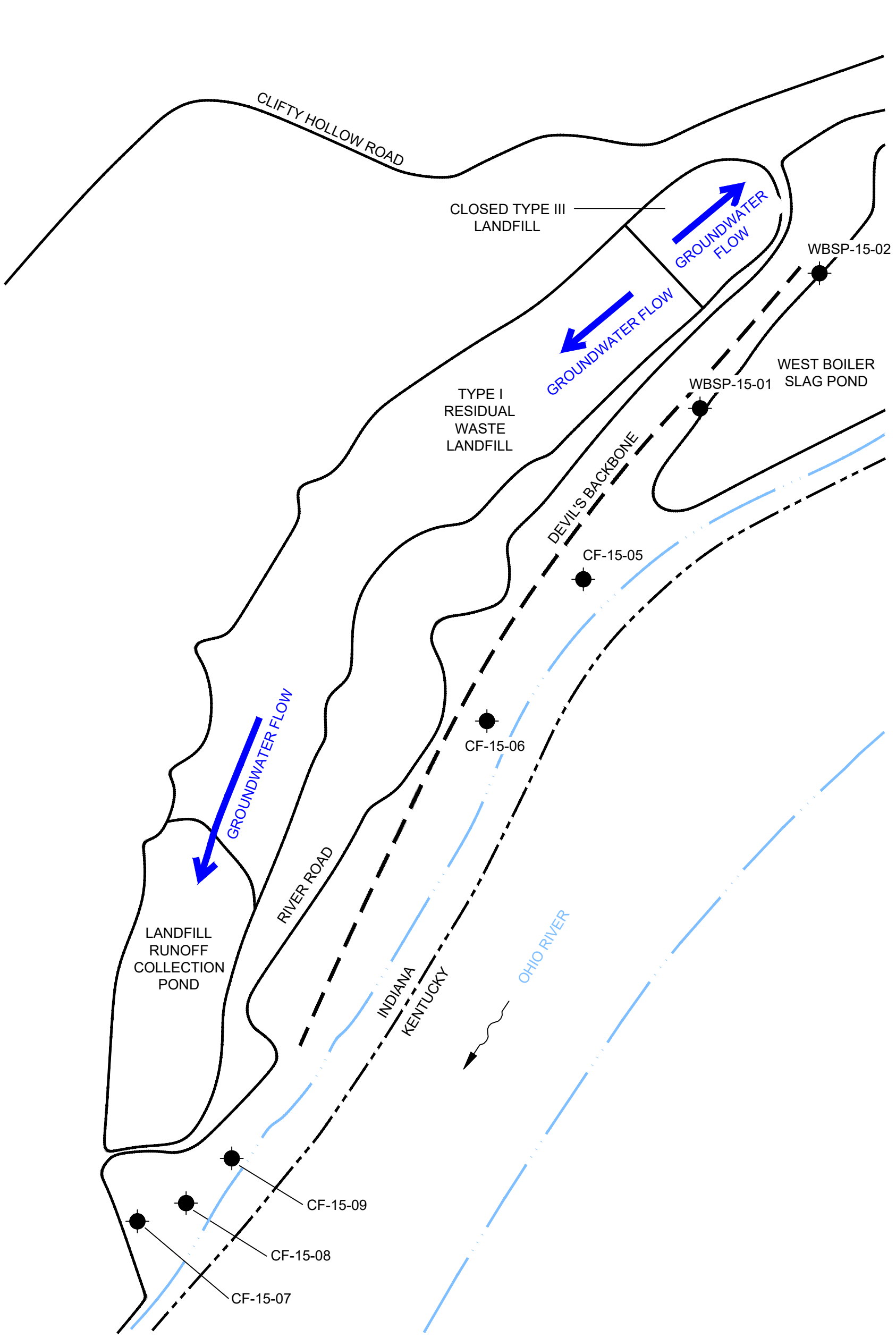
CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL
GENERALIZED GEOLOGIC CROSS-SECTION
A-A' (SOUTHWEST-NORTHEAST)

DRAWING NAME: FIGURE 3
REV.: 0

Plot: 10/08/2018 14:53 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\Clifty CCR MW Install\IKEC_Clifty MW Install_Cross Sec b08.dwg



LEGEND:

MONITORING WELL LOCATION

NOTE:
SEE FIGURE 1 FOR LOCATION OF BACKGROUND WELL CF-15-04.

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JOB NO.	2015067-CLIF
DWG FILE	IKEC_Clifty MWs_LANDFILL b01.dwg
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INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
LANDFILL RUNOFF COLLECTION POND
MONITORING WELL LOCATIONS AND
GENERALIZED GROUNDWATER FLOW

DRAWING NAME	REV.
FIGURE 4	0

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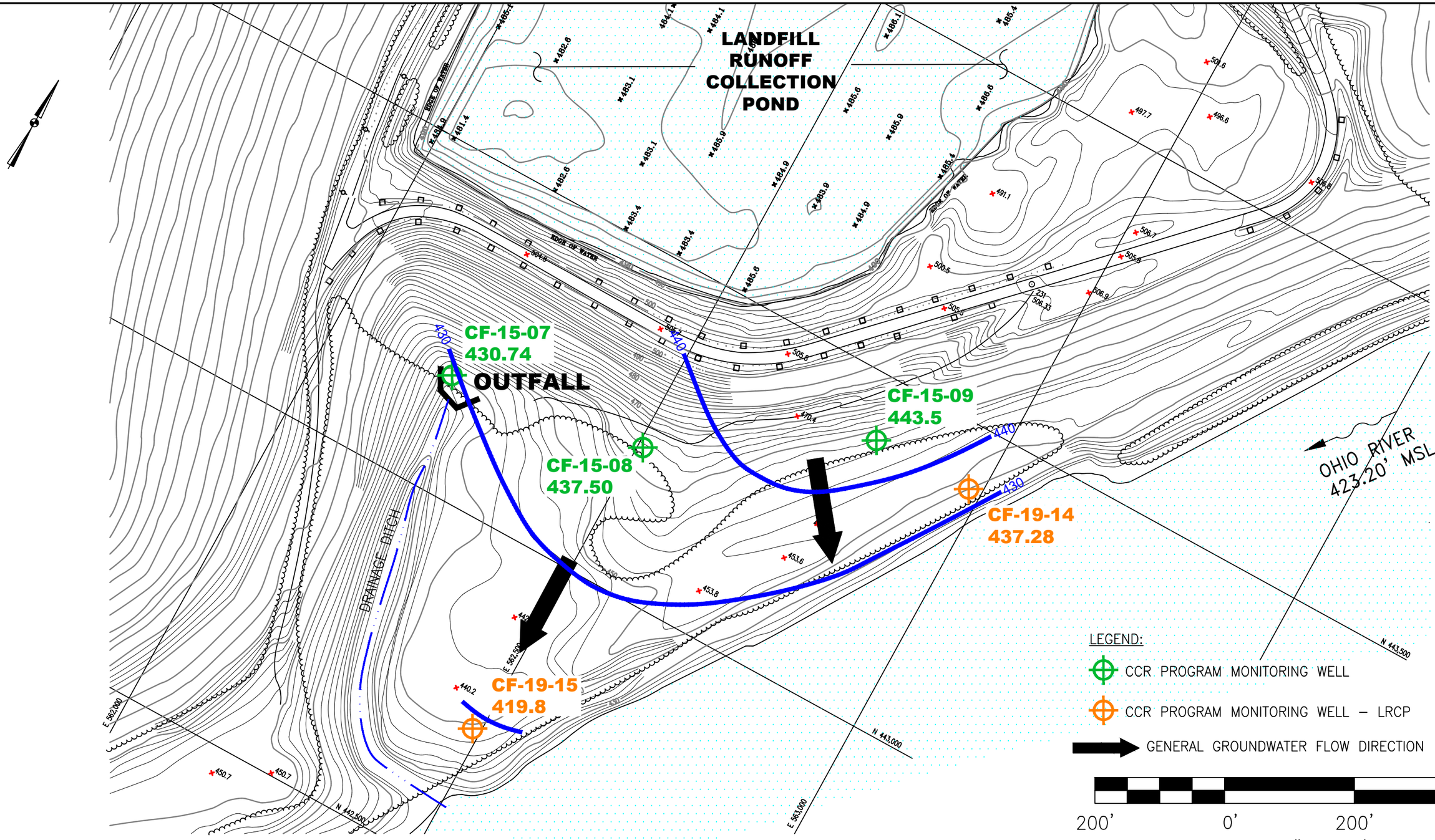

NOTE:
WELLS CF-19-14 AND CF-19-15 WERE INSTALLED IN MARCH 2019 DURING THE CHARACTERIZATION OF THE LRCP.

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CHECKED BY	
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INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
SEPTEMBER 2022

DRAWING NAME	REV.
FIGURE 5	0

Plot: 12/21/2022 14:38 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\2022 GW Monitoring-Corrective Action Rpt\B-3_IKEC_Clifty_GW Flow_Appx B_LRCP_SEPT 2022.dwg