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

WRITER'S DIRECT DIAL NO:
740-897-7768

February 23, 2021

Delivered Electronically

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

Dear Mr. Rockensuess:

Re: Indiana-Kentucky Electric Corporation
2021 Annual Groundwater Monitoring and Corrective Actions Report

As required by 40 CFR 257.106(h)(1), the Indiana-Kentucky Electric Corporation (IKEC) is providing notification to the Commissioner (State Director) of the Indiana Department of Environmental Management that the fifth 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 report has been placed in the facility's operating record in accordance with 40 CFR 257.105(h)(1), as well as, on the company's publically accessible internet site in accordance with 40 CFR 257.107(h)(1), which can be viewed at https://www.ovec.com/CCRCompliance.php .

If you have any questions, or require any additional information, please call me at (740) 897-7768.

Sincerely,

Tim Fulk
Engineer II

TLF:klr

Stantec Consulting Services Inc.
11687 Lebanon Road, Cincinnati OH 45241-2012

January 31, 2022

File: 175531033, 100

Ohio Valley Electric Corporation
Indiana-Kentucky Electric Corporation
Attention: Mr. Tim Fulk
3932 U.S. Route 23
P.O. Box 468
Piketon, Ohio 45661

Reference: 2021 Annual Groundwater Monitoring and Corrective Action Report
EPA Final Coal Combustion Residuals (CCR) Rule
Clifty Creek Generating Station
Madison, Indiana

Dear Mr. Fulk,

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

Reference: 2021 Annual Groundwater Monitoring and Corrective Action Report
EPA Final Coal Combustion Residuals (CCR) Rule
Clifty Creek Generating Station
Madison, Indiana

addition to identifying the constituent(s) detected at a statistically significant increase over background level); and

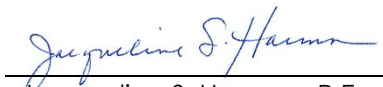
5. Other information required to be included in the annual report as specified in §§257.90 through 257.98.

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 CCR Regulation 2021 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 (2022), 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, P.E.
Principal
Phone: (513) 842-8200 ext 8220
Jacqueline.Harmon@stantec.com

Attachment: AGES (2022). Coal Combustion Residuals Regulation, 2021 Groundwater Monitoring and Corrective Action Report, Indiana-Kentucky Electric Corporation. Clifty Creek Station, Madison, Indiana, January.

c. John Griggs

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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
2021 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT

INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

JANUARY 2022

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
2021 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

JANUARY 2022

Prepared for:

INDIANA-KENTUCKY ELECTRIC CORPORATION (IKEC)

Prepared By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

Bethany Flaherty
Project Scientist

Robert W. King, P.G.
President/Chief Hydrogeologist

COAL COMBUSTION RESIDUALS REGULATION
2021 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

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

COAL COMBUSTION RESIDUALS REGULATION
2021 GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA

T A B L E O F C O N T E N T S
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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
2021 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, 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 2021 reporting period, the Type I Landfill was operating under the Detection Monitoring program in accordance with §257.94 of the CCR Rule. The sixth and seventh rounds of Detection Monitoring were conducted in March and September 2021, 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 2021 Detection Monitoring event and for Boron in well CF-15-08 during the September 2021 Detection Monitoring event. For both 2021 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 2021 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.

In 2021, the sixth and seventh 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 the March 2021 Assessment Monitoring event and for Boron in well CF-15-08 during the September 2021 Assessment Monitoring event. 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 2021. 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 2022 annual reporting period.

WBSP

At the start of this 2021 reporting period, the WBSP was operating under the Detection Monitoring program in accordance with §257.94 of the CCR Rule. The seventh and eighth rounds of Detection Monitoring were conducted in March and September 2021, respectively. Based on the sampling results, it was determined that there were no Appendix III constituent SSIs over background for either Detection Monitoring events. Therefore, the WBSP will remain operating under the Detection Monitoring program in accordance with §257.94 of the CCR Rule.

COAL COMBUSTION RESIDUALS REGULATION
2021 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 2021, 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] 2018a), 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 2021 are included in Table A-1 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2021 are included in Appendix B. As shown on the figures, groundwater generally flows to the southwest toward the Ohio River. However, in March 2021, the area around well CF-19-15 at the southwest end of the property was flooded, indicating a slight flow reversal in this area. The elevation of the Ohio River was 443.0 feet mean sea level (ft msl). During the September 2021 sampling event, the elevation of the Ohio River (423.2 ft msl) was only slightly higher than the groundwater elevation at well CF-19-15 (422.32 ft msl).

3.2 Groundwater Sampling

In accordance with §257.94 of the CCR Rule, the sixth round of Detection Monitoring was conducted in March 2021 and the seventh round of Detection Monitoring samples were collected in September 2021.

All groundwater samples were collected in accordance with the Groundwater Monitoring Program Plan (GMPP) (AGES 2018b). 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 background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection or the Assessment 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.

3.3 Analytical Results

Upon receipt of the March and September 2021 analytical results, 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). Appendix D summarizes the analytical results for groundwater samples collected in 2021. 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 2021 Detection Monitoring Event and Boron in well CF-15-08 for the September 2021 Detection Monitoring Event (Table 3-4). In accordance with the StAP, resampling for Boron was conducted in wells CF-15-08 and CF-15-09 (June 2021) and well CF-15-08 (December 2021). Based on the resampling results, SSIs were confirmed for Boron in wells CF-15-08 and CF-15-09 for the March 2021 Detection Monitoring Event and in well CF-15-08 for the September 2021 Detection Monitoring Event (Table 3-4).

3.4 Alternate Source Demonstration

For both 2021 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 remains in Detection Monitoring. The ASDs for March 2021 and September 2021 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.

In 2019, IKEC conducted additional groundwater sampling to characterize the nature and extent of the release and an Assessment of Corrective Measures (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).

4.1 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (AGES 2018a) 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 2021 are included in Table A-2 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2021 are included in Appendix B. As shown on the figures, groundwater generally flows to the southwest toward the Ohio River. However, in March 2021, the area around well CF-19-15 at the southwest end of the property was flooded, indicating a slight flow reversal in this area. The elevation of the Ohio River was 443.0 ft msl. During the September 2021 sampling event, the elevation of the Ohio River (423.2 ft msl) was only slightly higher than the groundwater elevation at well CF-19-15 (422.32 ft msl).

4.2 Groundwater Sampling

In accordance with §257.95 of the CCR Rule, the sixth round of Assessment Monitoring was conducted in March 2021 and the seventh round of Assessment Monitoring samples were collected in September 2021.

All groundwater samples were collected in accordance with the GMPP (AGES 2018b). 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 background and downgradient well, the dates the samples were collected, and whether the sample was required by the Detection or 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.

4.3 Analytical Results

4.3.1 Analytical Results-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 StAP (Stantec 2021). Appendix D summarizes the analytical results for groundwater samples collected in 2021.

The statistical evaluation of the data identified potential SSIs Boron in wells CF-15-08 and CF-15-09 for the March 2021 Assessment Monitoring Event and Boron in well CF-15-08 for the September 2021 Assessment Monitoring Event (Table 4-4). In accordance with the StAP, resampling for Boron was conducted in wells CF-15-08 and CF-15-09 (June 2021) and well CF-15-08 (December 2021). Based on the resampling results, SSIs were confirmed for Boron in wells CF-15-08 and CF-15-09 for the March 2021 Assessment Monitoring Event and in well CF-15-08 for the September 2021 Assessment Monitoring Event (Table 4-4).

4.3.2 Analytical Results-Appendix IV Constituents

Based on previous detections of Appendix IV constituents in groundwater at the LRCP, IKEC established a Groundwater Protection Standard (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.

During the sixth (March 2021) and seventh (September 2021) Assessment Monitoring Events, it was confirmed that Molybdenum in well CF-15-08 exceeded the GWPS of 100 micrograms per liter (ug/L) (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 currently serves as a settling facility for sluiced boiler slag produced at the plant. 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 Groundwater Monitoring Network

As detailed in the Monitoring Well Installation Report (AGES 2018a), 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-15-04 (Downgradient);
- WBSP-15-05 (Downgradient);
- WBSP-15-06 (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. The wells listed in the above groundwater monitoring network were sampled during the March 2021 Detection Monitoring Event.

To allow for closure of the WBSP to proceed, IKEC submitted to IDEM a CCR Partial Closure/Post Closure Plan for the unit; in May 2021, IDEM approved the CCR Partial Closure/Post Closure Plan. Based on the approved plan, downgradient wells WBSP-15-04, WBSP-15-05 and WBSP-15-06, which were located within the active Phase I construction area, needed to be abandoned and replacement wells installed in revised locations (Figure 1). To ensure that the CCR requirements were still met, a total of three (3) replacement wells (WBSP-15-04a, WBSP-15-05a and WBSP-15-06a) were installed; each well was screened at the same general elevation as its counterpart well. The replacement wells were located just outside of the active Phase I construction area, approximately 300 to 400 feet east of the original well locations. Per the CCR regulation, these revised locations are as close as practicable to the waste boundary. The locations of these replacement wells, which will accurately represent the quality of groundwater passing the waste boundary of the CCR unit in this area, were approved by the Qualified Professional Engineer (QPE) for this CCR program.

The well abandonment and replacement program was completed before the September 2021 Detection Monitoring Event. The revised groundwater monitoring network meets the requirements of Section §257.91 of the CCR regulation as it includes a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit and, accurately represent the quality of groundwater passing the waste boundary of the CCR unit. Therefore, the wells listed in the following revised network were sampled during September 2021 Detection Monitoring Event:

- 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).

Groundwater monitoring of the WBSP, with this revised network, will continue to be conducted in accordance with the Groundwater Monitoring Program Plan (AGES 2018b).

Groundwater levels measured in 2021 are included in Table A-3 of Appendix A. Groundwater flow maps for the two (2) monitoring events completed in 2021 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 southwest toward the Ohio River. However, in March 2021, the elevation of the Ohio River (443.0 ft msl) was higher than the groundwater elevation at wells WBSP-15-04 through WBSP-15-10 indicating a slight flow reversal in this area. Conditions returned to the typical southwest groundwater flow direction and the discharge of groundwater to the Ohio River during the September 2021 sampling event.

5.2 Groundwater Sampling

In accordance with §257.94 of the CCR Rule, IKEC completed two (2) rounds of Detection Monitoring at the WBSP. Table 5-2 presents a sampling summary, which includes 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 5-3 summarizes the measurements of field parameters collected at the completion of purging, immediately prior to collection of each sample. All samples were collected in accordance with the GMPP (AGES 2018b) and shipped to an analytical laboratory to be analyzed for all of the parameters listed in Appendix III of the CCR Rule (Appendix C).

5.3 Analytical Results

Upon receipt of the March and September 2021 analytical results, the groundwater monitoring data were statistically evaluated in accordance with §257.93(f) of the CCR Rule and the Clifty Creek Station CCR StAP (Stantec 2021). Appendix D summarizes the analytical results for groundwater samples collected in 2021. The statistical evaluation identified a potential SSI for

Fluoride in monitoring well WBSP-15-09 in the March and September 2021 Detection Monitoring Events (Table 5-4). In accordance with the StAP, the wells were resampled for Fluoride during the resampling events in June and December 2021 (Table 5-4). Based on the results, the potential SSIs for Fluoride were not confirmed; therefore, the WBSP will remain in Detection Monitoring.

6.0 PROBLEMS ENCOUNTERED

There were no problems encountered during the 2021 groundwater morning program at Clifty Creek Station.

7.0 PROJECTED ACTIVITIES FOR 2022

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 and the process of the selection of remedy for the LRCP will continue in 2022.

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

8.0 REFERENCES

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) 2018a. Coal Combustion Residuals Regulation Monitoring Well Installation Report, Indiana-Kentucky Electric Corporation, Clifty Creek Station, Madison, Jefferson County, Indiana. Revision 1.0. November 2018.

Applied Geology and Environmental Science, Inc. (AGES) 2018b. Coal Combustion Residuals Regulation Groundwater Monitoring Program Plan, 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 2021
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Designation	Mar-21	Jun-21	Sep-21	Dec-21
CF-15-04	Background	DM	NS	DM	NS
CF-15-05	Background	DM	NS	DM	NS
CF-15-06	Background	DM	NS	Well Dry	NS
CF-15-07	Downgradient	DM	NS	DM	NS
CF-15-08	Downgradient	DM	DM	DM	DM
CF-15-09	Downgradient	DM	DM	Well Dry	NS
WBSP-15-01	Background	DM	NS	Well Dry	NS
WBSP-15-02	Background	DM	NS	DM	NS

Notes:
1. DM: Detection Monitoring.
2. NS: Not Sampled.

TABLE 3-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2021
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-21	9.24	871	7.85	90	15.56	3.91
CF-15-05	Mar-21	10.15	863	7.59	94	3.12	2.86
CF-15-06	Mar-21	8.71	868	7.56	96	2.42	4.46
CF-15-07	Mar-21	9.87	957	7.46	-42.0	3.31	2.36
CF-15-08	Mar-21	17.87	923	7.62	217	8.48	3.4
CF-15-09	Mar-21	9.23	937	7.41	89	15.41	9.68
WBSP-15-01	Mar-21	10.12	1178	6.89	123	3.65	22.4
WBSP-15-02	Mar-21	9.25	1730	6.67	191	5.14	2.83
CF-15-08	Jun-21	18.36	829	6.2	395	3.1	19.60
CF-15-09	Jun-21	17.40	922	7.65	197	2.52	2.42
CF-15-04	Sep-21	16.21	769	7.57	315	2.01	1.36
CF-15-05	Sep-21	17.45	892	6.58	-2	2.59	3.96
CF-15-06	WELL DRY						
CF-15-07	Sep-21	22.38	1170	6.78	176	2.25	2.12
CF-15-08	Sep-21	17.55	790	6.84	177	2.49	4.31
CF-15-09	WELL DRY						
WBSP-15-01	WELL DRY						
WBSP-15-02	Sep-21	15.31	1540	7.37	223	12.91	46.5
CF-15-08	Dec-21	16.13	974	6.95	339	1.26	1.98

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.

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)	6th Detection Monitoring Sampling Event March 2021		6th Detection Monitoring Resampling Event June 2021		7th Detection Monitoring Sampling Event September 2021		7th Detection Monitoring Resampling Event December 2021	
		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)	11	5.02	10	**Yes**	13	5.02	12	**Yes**
CF-15-09	Boron (mg/L)	6	5.02	6.2	**Yes**	NA	NA	NA	NA

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 2021
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Designation	Mar-21	Jun-21	Sep-21	Dec-21
CF-15-04	Background	AM	NS	AM	NS
CF-15-05	Background	AM	NS	AM	NS
CF-15-06	Background	AM	NS	Well Dry	NS
CF-15-07	Downgradient	AM	NS	AM	NS
CF-15-08	Downgradient	AM	AM	AM	AM
CF-15-09	Downgradient	AM	AM	Well Dry	NS
WBSP-15-01	Background	AM	NS	Well Dry	NS
WBSP-15-02	Background	AM	NS	AM	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.

TABLE 4-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2021
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-21	9.24	871	7.85	90	15.56	3.91
CF-15-05	Mar-21	10.15	863	7.59	94	3.12	2.86
CF-15-06	Mar-21	8.71	868	7.56	96	2.42	4.46
CF-15-07	Mar-21	9.87	957	7.46	-42.0	3.31	2.36
CF-15-08	Mar-21	17.87	923	7.62	217	8.48	3.4
CF-15-09	Mar-21	9.23	937	7.41	89	15.41	9.68
WBSP-15-01	Mar-21	10.12	1178	6.89	123	3.65	22.4
WBSP-15-02	Mar-21	9.25	1730	6.67	191	5.14	2.83
CF-19-14	Mar-21	15.64	744	4.92	260	8.4	3.76
CF-19-15	Mar-21	9.87	1280	7.17	13	3.43	3.62
CF-15-08	Jun-21	18.36	829	6.2	395	3.1	19.60
CF-15-09	Jun-21	17.40	922	7.65	197	2.52	2.42
CF-15-04	Sep-21	16.21	769	7.57	315	2.01	1.36
CF-15-05	Sep-21	17.45	892	6.58	-2	2.59	3.96
CF-15-06	WELL DRY						
CF-15-07	Sep-21	22.38	1170	6.78	176	2.25	2.12
CF-15-08	Sep-21	17.55	790	6.84	177	2.49	4.31
CF-15-09	WELL DRY						
WBSP-15-01	WELL DRY						
WBSP-15-02	Sep-21	15.31	1540	7.37	223	12.91	46.5
CF-19-14	Sep-21	20.08	906	6.92	310	1.71	3.87
CF-19-15	Sep-21	20.35	1460	7.26	467	1.76	0.89
CF-15-08	Dec-21	16.13	974	6.95	339	1.26	1.98

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.

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)	6th Assessment Monitoring Sampling Event March 2021		6th Assessment Monitoring Resampling Event June 2021		7th Assessment Monitoring Sampling Event September 2021		7th Assessment Monitoring Resampling Event December 2021	
		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)	11	5.02	10	**Yes**	13	5.02	12	**Yes**
CF-15-09	Boron (mg/L)	6	5.02	6.2	**Yes**	NA	NA	NA	NA

Notes:

1. SSI: Statistically Significant Increase.
2. UTL: Upper Tolerance Limit (Pooled Interwell UTL).
3. mg/L: Milligrams per liter.

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)	102	2000	2000
Beryllium, Be (µg/L)	1.1	4	4
Cadmium, Cd (µg/L)	1	5	5
Chromium, Cr (µg/L)	5	100	100
Cobalt, Co (µg/L)	1.4	6*	6
Fluoride, F (mg/L)	0.5421	4	4
Lithium, Li (µg/L)	0.1	40*	40
Lead, Pb (µg/L)	1.7	15*	15
Mercury, Hg (µg/L)	1.2	2	2
Molybdenum, Mo (µg/L)	6	100*	100
Radium 226 & 228 (combined) (pCi/L)	5	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)	6th Assessment Monitoring Sampling Event March 2021		6th Assessment Monitoring Resampling Event June 2021		7th Assessment Monitoring Sampling Event September 2021		7th Assessment Monitoring Resampling Event December 2021	
		Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)	Potential Exceedance Result	GWPS	Potential Exceedance Result	Confirmed Exceedance (Yes/No)
CF-15-08	Molybdenum (ug/L)	340	100	480	**Yes**	880	100	500	**Yes**

Notes:

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

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-15-04*	Downgradient	11/12/2015	450610.07	568637.65	471.17	473.71	416.17	406.17	67.54
WBSP-15-04a	Downgradient	7/28/2021	450669.20	568855.3	472.03	474.47	418.47	408.47	68.44
WBSP-15-05*	Downgradient	11/17/2015	450051.40	568495.72	471.90	474.42	410.90	400.90	73.52
WBSP-15-05a	Downgradient	8/4/2021	450072.00	568895.20	473.66	476.20	413.20	402.20	76.54
WBSP-15-06*	Downgradient	11/19/2015	449470.57	568402.50	471.28	473.51	395.78	385.78	87.73
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.
3. * = Well abandoned in 2021.

TABLE 5-2
SUMMARY OF SAMPLES COLLECTED DURING 2021
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Designation	Mar-21	Jun-21	Sep-21	Dec-21
CF-15-04	Background	DM	NS	DM	NS
CF-15-05	Background	DM	NS	DM	NS
CF-15-06	Background	DM	NS	DM	NS
WBSP-15-01	Upgradient	DM	NS	DM	NS
WBSP-15-02	Upgradient	DM	NS	DM	NS
WBSP-15-03	Upgradient	DM	NS	DM	NS
WBSP-15-04	Downgradient	DM	NS	Well Abandoned	
WBSP-15-04a	Downgradient	Not Installed		DM	NS
WBSP-15-05	Downgradient	DM	NS	Well Abandoned	
WBSP-15-05a	Downgradient	Not Installed		DM	NS
WBSP-15-06	Downgradient	DM	NS	Well Abandoned	
WBSP-15-06a	Downgradient	Not Installed		DM	NS
WBSP-15-07	Downgradient	DM	NS	DM	NS
WBSP-15-08	Downgradient	DM	NS	DM	NS
WBSP-15-09	Downgradient	DM	DM	DM	DM
WBSP-15-10	Downgradient	DM	NS	DM	NS

Notes:
1. DM: Detection Monitoring.
2. NS: Not Sampled.

TABLE 5-3
SUMMARY OF MEASURED FIELD PARAMETERS DURING 2021
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-21	9.24	871	7.85	90	15.56	3.91
CF-15-05	Mar-21	10.15	863	7.59	94	3.12	2.86
CF-15-06	Mar-21	8.71	868	7.56	96	2.42	4.46
WBSP-15-01	Mar-21	10.12	1178	6.89	123	3.65	22.4
WBSP-15-02	Mar-21	9.25	1730	6.67	191	5.14	2.83
WBSP-15-03	Mar-21	8.87	1090	7.57	319	9.13	4.87
WBSP-15-04	Mar-21	14.58	905	8.12	-26	3.61	0.98
WBSP-15-05	Mar-21	17.96	980	7.29	-131	2.98	2.81
WBSP-15-06	Mar-21	15.07	896	7.32	281	4.57	2.63
WBSP-15-07	Mar-21	10.1	1510	6.23	-111	1.77	2.89
WBSP-15-08	Mar-21	10.12	806	6.92	-102	2.64	3.93
WBSP-15-09	Mar-21	14.48	573	6.62	-139	2.87	1.36
WBSP-15-10	Mar-21	11.3	710	6.23	4	2.82	1.42
WBSP-15-09	Jun-21	17.48	556	7.37	23	2.27	3.3
CF-15-04	Sep-21	16.21	769	7.57	315	2.01	1.36
CF-15-05	Sep-21	17.45	892	6.58	-2	2.59	3.96
CF-15-06	WELL DRY						
WBSP-15-01	WELL DRY						
WBSP-15-02	Sep-21	15.31	1540	7.37	223	12.91	46.5
WBSP-15-03	Sep-21	23.81	1200	7.35	393	1.45	1.63
WBSP-15-04	Sep-21	17.27	1040	6.61	280	1.93	3.65
WBSP-15-05	Sep-21	20.18	798	7.58	90	4.89	4.56
WBSP-15-06	Sep-21	21.32	829	7.54	-85	2.69	31.6
WBSP-15-07	Sep-21	20.28	1370	6.88	-116	9.2	64.9
WBSP-15-08	Sep-21	19.48	820	6.56	-43	11.73	>999
WBSP-15-09	Sep-21	22.3	552	6.83	-119	4.6	4.44
WBSP-15-10	Sep-21	22.91	601	7.31	7	12.6	28.4
WBSP-15-09	Dec-21	16.87	576	7.46	376	2.08	4.35

Notes:

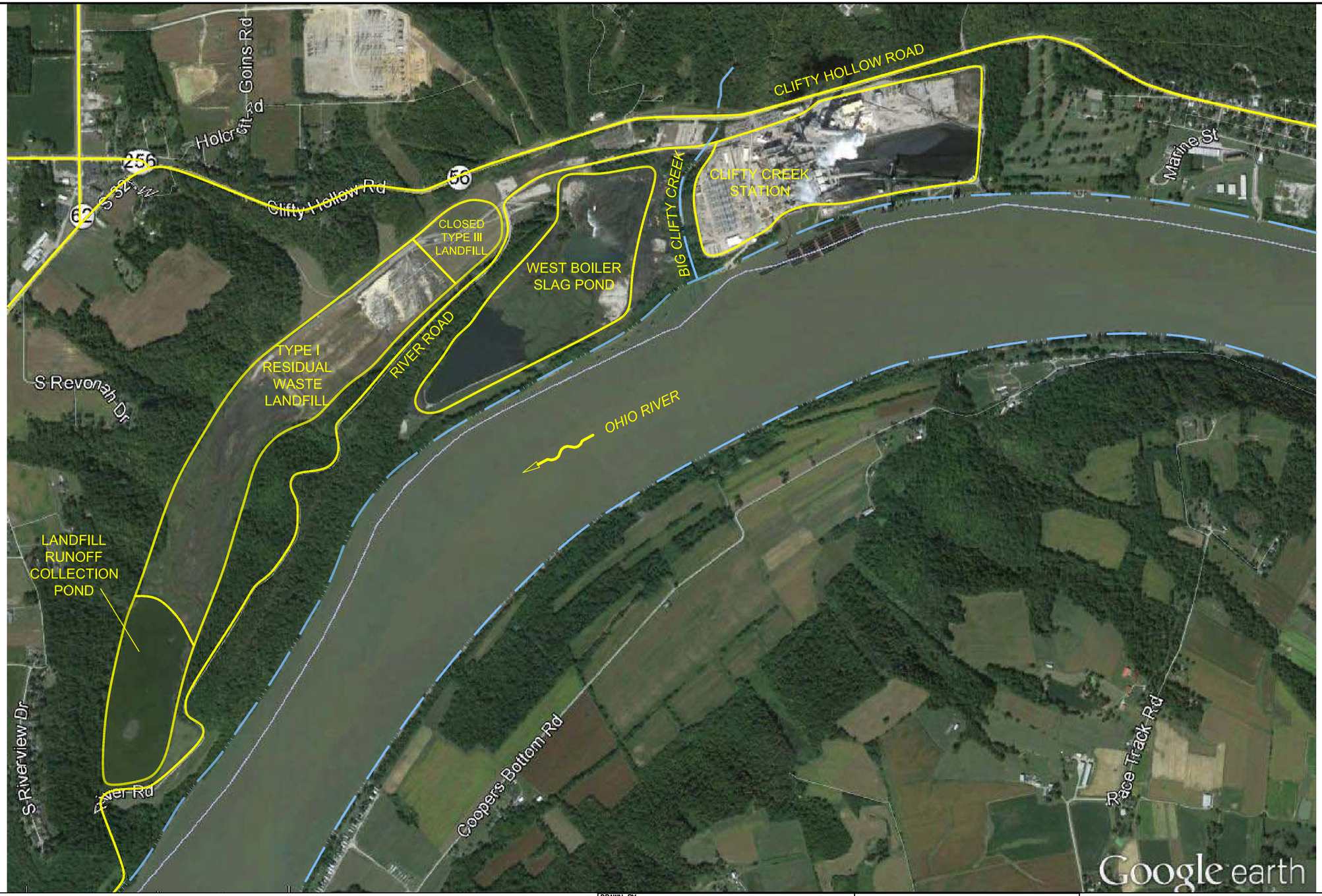
1. °C: Degrees Celsius.
2. µohms/cm: Micro-ohms per centimeter.
3. S.U.: Standard Units.
4. mV: Millivolts.
5. mg/L: Milligrams per liter.
6. NTUs: Nephelometric Turbidity Units.

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)	7th Detection Monitoring Sampling Event March 2021		7th Detection Monitoring Resampling Event June 2021		8th Detection Monitoring Sampling Event September 2021		8th Detection Monitoring Resampling Event December 2021	
		Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)	Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)
WBSP-15-09	Fluoride (mg/L)	0.63	0.56	0.55	No	0.6	0.56	0.55	No

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

FIGURES



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1200' 0' 1200' 2400'

SCALE: 1"= 1200'

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

AGES
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412.264.6453

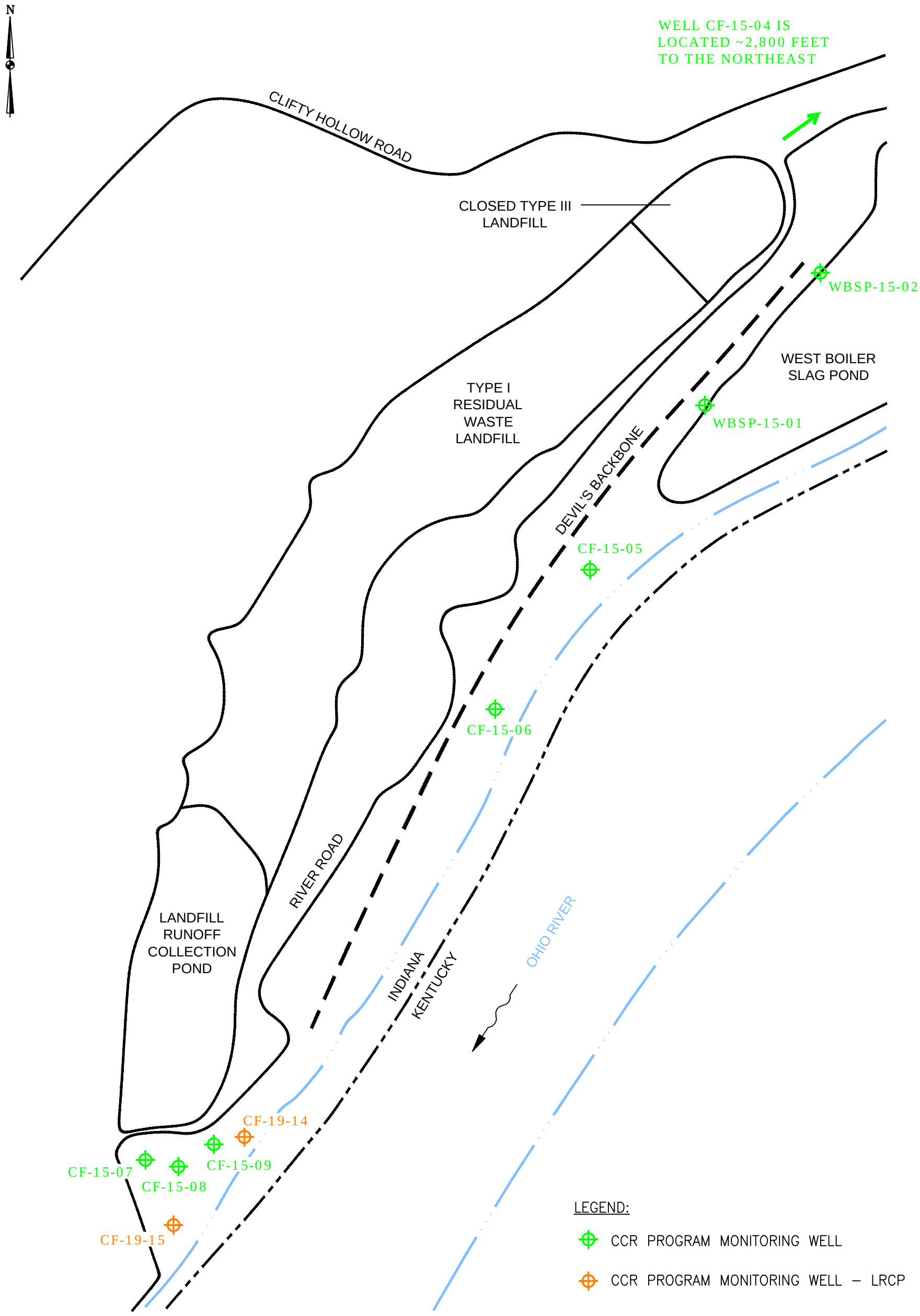
INDIANA-KENTUCKY ELECTRIC CORPORATION

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



DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2020010-CLIFTY
DWG FILE	2_2020_IKEC_Clifty_GW MW LOCs_LANDFILL b01.dwg
DRAWING SCALE	NOT TO SCALE

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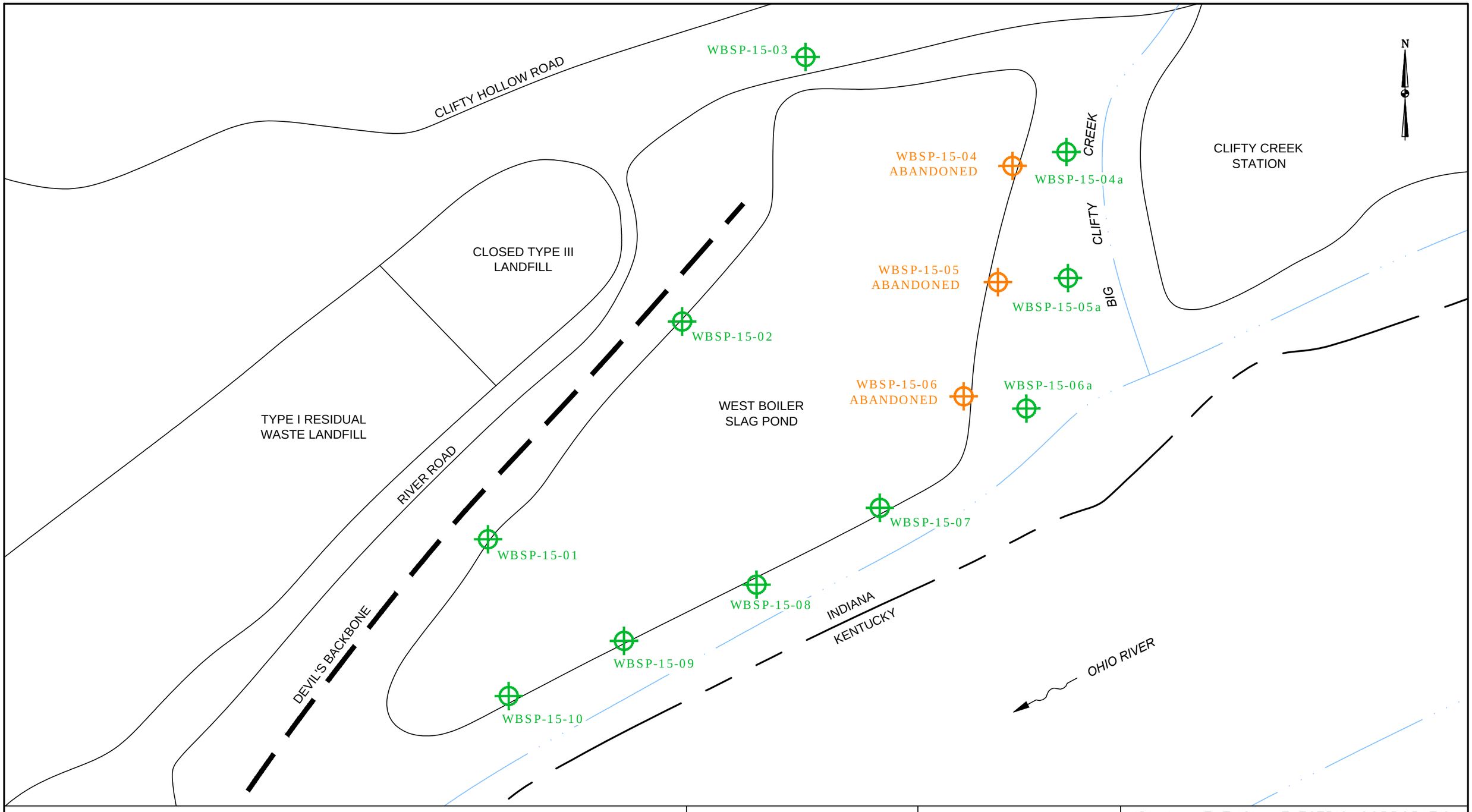
INDIANA–KENTUCKY ELECTRIC CORPORATION

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
- CCR PROGRAM MONITORING WELL – ABANDONED 2021

400' 0' 400' 800'

SCALE: 1"= 400'

DATE	
CHECKED BY	
JOB NO.	2021177-5-CLI
DWG FILE	3_2021_IKEC-IDEM_WBSP_Semi-Annual Rpt_Sept 2021_MWs.dwg
DRAWING SCALE	AS SHOWN

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INDIANA-KENTUCKY ELECTRIC CORPORATION

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

DRAWING NAME: FIGURE 3

REV.: 0

Plot: 01/18/2022 11:09 _PROGRAMS-IKEC\IKEC-IDEM\CAD\WBSP Semi-Annual Rpt Sept 2021\3_2021_IKEC-IDEM_WBSP_Semi-Annual Rpt_Sept 2021_MWs\well loc

APPENDIX A

GROUNDWATER ELEVATIONS

TABLE A-1
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2021
TYPE I RESIDUAL WASTE LANDFILL
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Mar-21	Jun-21	Sep-21	Dec-21
	Groundwater Elevation (feet)			
CF-15-04	443.93	NM	440.46	NM
CF-15-05	425.48	NM	430.12	NM
CF-15-06	430.22	NM	DRY	NM
CF-15-07	FLOODED	NM	431.56	NM
CF-15-08	440.67	440.34	439.41	438.02
CF-15-09	453.32	444.20	DRY	NM
WBSP-15-01	456.26	NM	449.74	NM
WBSP-15-02	472.68	NM	464.55	NM

Notes:
1. NM: Not Measured

TABLE A-2
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2021
LANDFILL RUNOFF COLLECTION POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Mar-21	Jun-21	Sep-21	Dec-21
	Groundwater Elevation (feet)			
CF-15-04	443.93	NM	440.46	NM
CF-15-05	425.48	NM	430.12	NM
CF-15-06	430.22	NM	DRY	NM
CF-15-07	FLOODED	NM	431.56	NM
CF-15-08	440.67	440.34	439.41	438.02
CF-15-09	453.32	444.20	DRY	NM
WBSP-15-01	456.26	NM	449.74	NM
WBSP-15-02	472.68	NM	464.55	NM
CF-19-14	449.68	NM	439.20	NM
CF-19-15	FLOODED	NM	422.32	NM

Notes:
1. NM: Not Measured

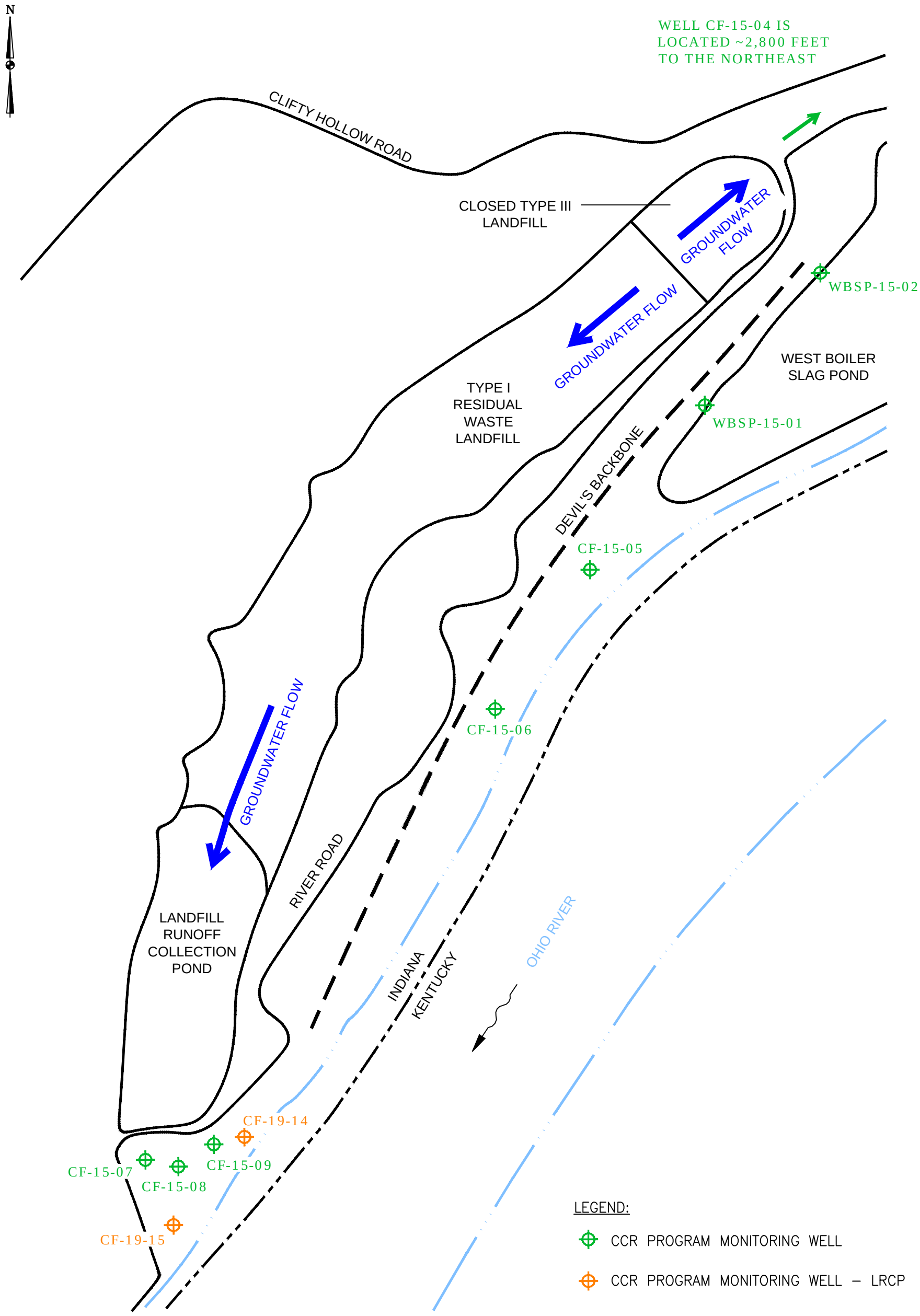
TABLE A-3
SUMMARY OF GROUNDWATER ELEVATION DATA DURING 2021
WEST BOILER SLAG POND
CCR GROUNDWATER MONITORING PROGRAM
CLIFTY CREEK STATION
MADISON, INDIANA

Well ID	Mar-21	Jun-21	Sep-21	Dec-21
	Groundwater Elevation (feet)			
CF-15-04	443.93	NM	440.46	NM
CF-15-05	425.48	NM	430.12	NM
CF-15-06	430.22	NM	DRY	NM
WBSP-15-01*	Blocked/ Inaccessible	NM	449.74	NM
WBSP-15-02*	Blocked/ Inaccessible	NM	464.55	NM
WBSP-15-03*	Blocked/ Inaccessible	NM	478.25	NM
WBSP-15-04/ WBSP-15-04a	439.56	NM	419.58	NM
WBSP-15-05/ WBSP-15-05a	436.52	NM	421.85	NM
WBSP-15-06/ WBSP-15-06a	439.33	NM	422.27	NM
WBSP-15-07	429.52	NM	434.18	NM
WBSP-15-08	428.36	NM	433.45	NM
WBSP-15-09	430.57	432.93	434.82	431.67
WBSP-15-10	429.06	NM	434.76	NM

Notes:
1. NM: Not Measured
2. *Due to ongoing construction work, the well could not be safely accessed during the collection of site-wide groundwater elevation data.

APPENDIX B

GROUNDWATER FLOW MAPS



DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021039–CLIFTY
DWG FILE	B–1_IKEC_Clifty_GW Flow_Appx B_LANDFILL_MAR–SEPT 2021.dwg
DRAWING SCALE	NOT TO SCALE

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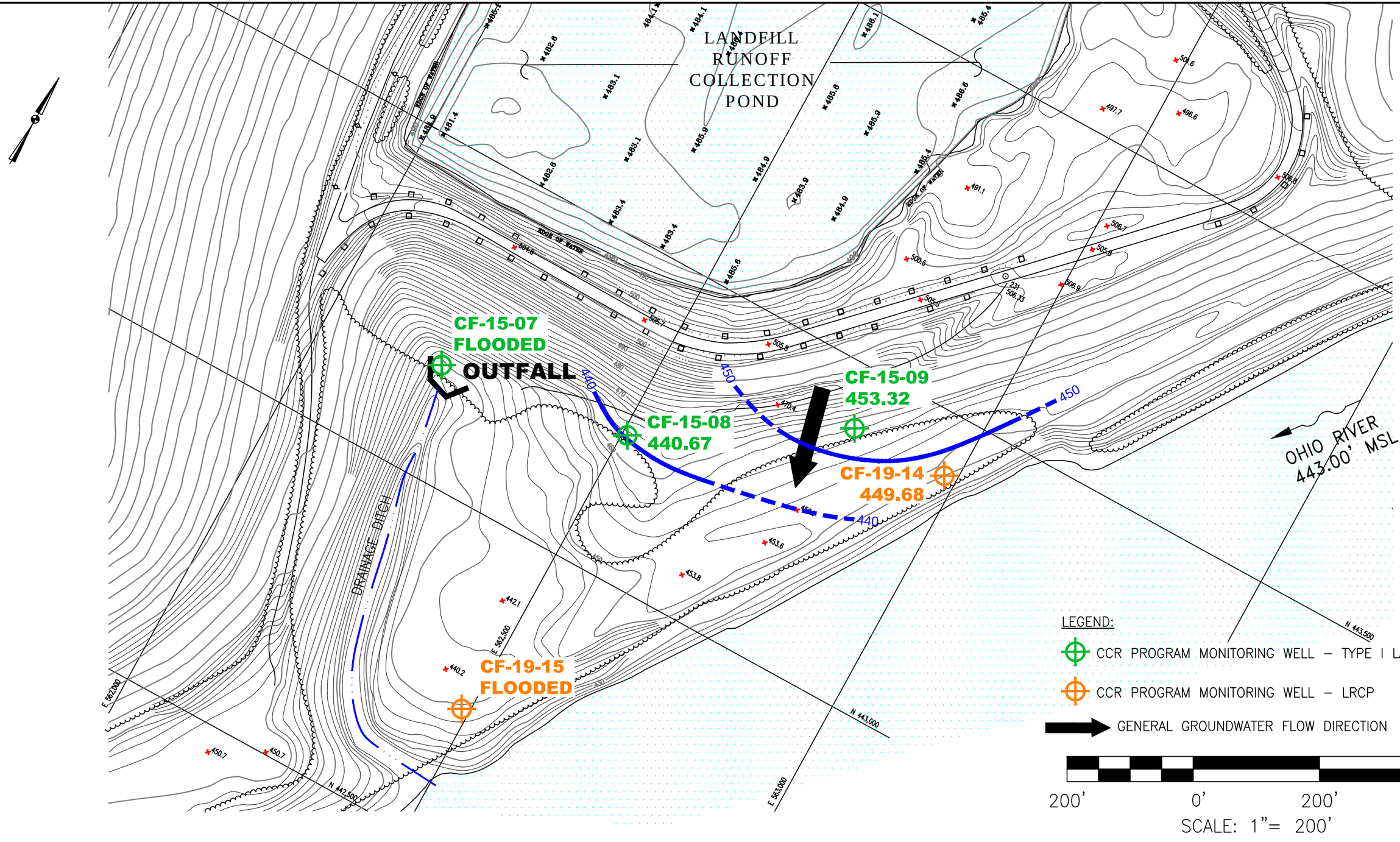
INDIANA–KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GENERALIZED GROUNDWATER FLOW
UPPERMOST AQUIFER – MARCH 2021/SEPTEMBER 2021

DRAWING NAME	REV.
FIGURE B–1	0



LEGEND:

- CCR PROGRAM MONITORING WELL – TYPE I LANDFILL
- CCR PROGRAM MONITORING WELL – LRCP
- GENERAL GROUNDWATER FLOW DIRECTION

200' 0' 200' 400'

SCALE: 1"= 200'

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

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021039-CLIFTY
DWG FILE	B-2_IKEC_Clifty_GW Flow_Appx B_LANDFILL_MAR 2021.dwg
DRAWING SCALE	AS SHOWN

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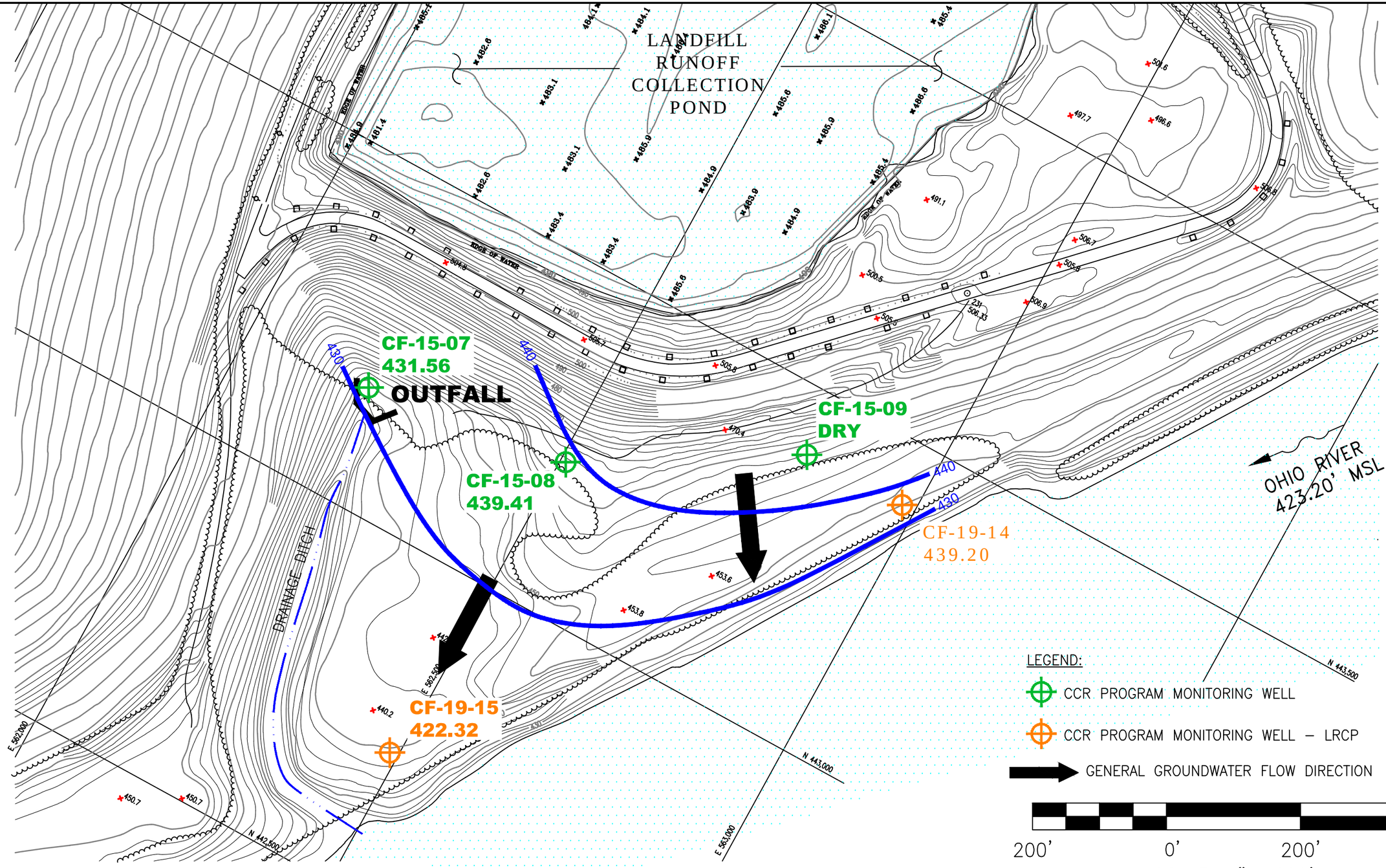
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
MARCH 2021

DRAWING NAME: FIGURE B-2 REV. 0

Plot: 09/13/2021 14:41 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\2021 GW Monitoring-Corrective Action Rpt\B-2_IKEC_Clifty_GW Flow_Appx B_LANDFILL_MAR 2021.dwg



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

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021039–CLIFTY
DWG FILE	B-3_IKEC_Clifty_GW Flow_Appx B_LRCP_SEPT 2021.dwg
DRAWING SCALE	AS SHOWN

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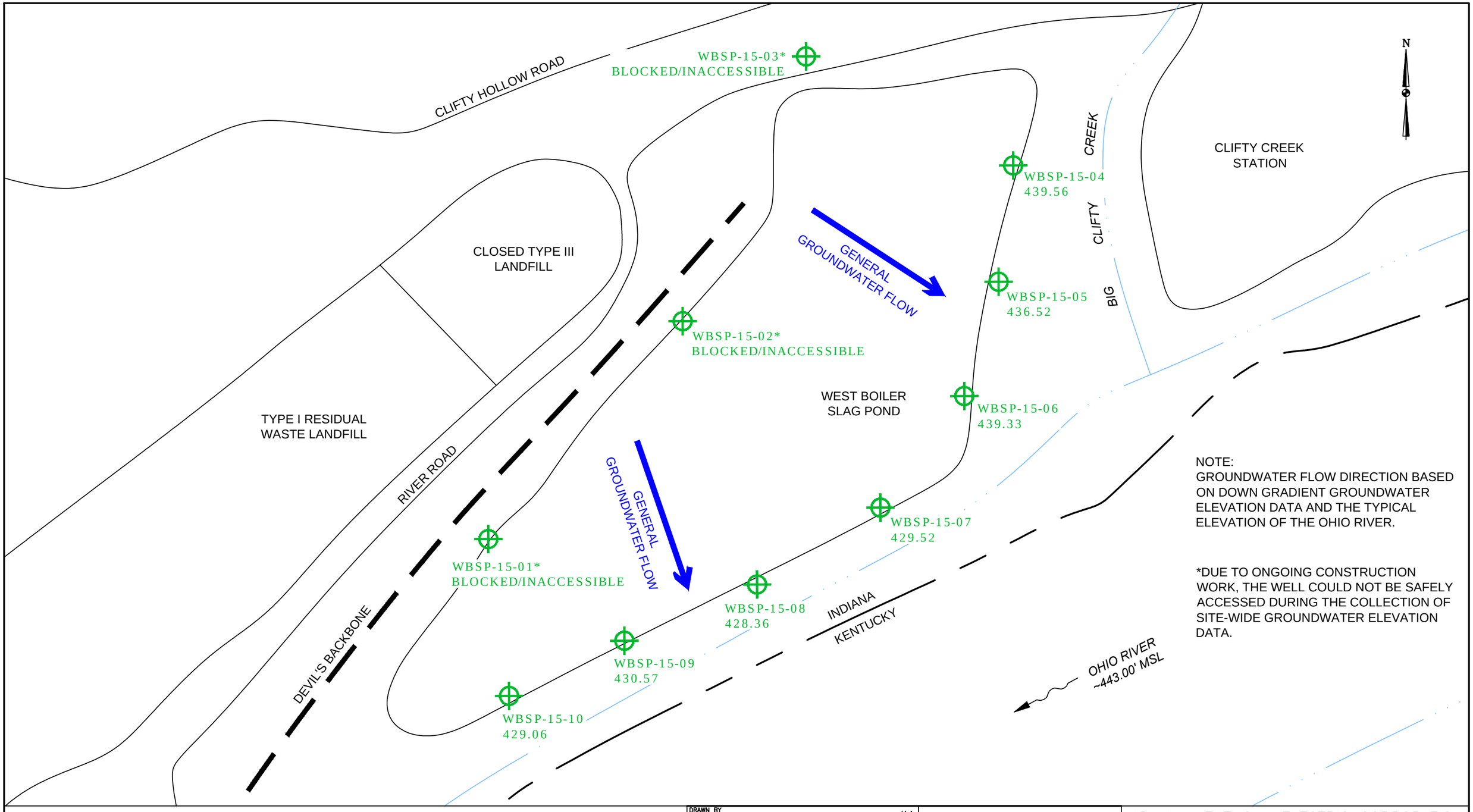
INDIANA–KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
SEPTEMBER 2021

DRAWING NAME	REV.
FIGURE B–3	0

Plot: 01/18/2022 11:17 _PROGRAMS–IKEC\Clifty Creek–CCR Program\CAD\2021 GW Monitoring–Corrective Action Rpt\B–3_IKEC_Clifty_GW Flow_Appx B_LRCP_SEPT 2021.dwg



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

*DUE TO ONGOING CONSTRUCTION WORK, THE WELL COULD NOT BE SAFELY ACCESSED DURING THE COLLECTION OF SITE-WIDE GROUNDWATER ELEVATION DATA.

LEGEND:
- MONITORING WELL LOCATION
- GROUNDWATER FLOW DIRECTION

400' 0' 400' 800'
SCALE: 1"= 400'

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021039-CLI
DWG FILE	B-4_IKEC_Clifty_GW Flow_Appx B_Annual GW Rpt_MAR21_WBSP.dwg
DRAWING SCALE	AS SHOWN

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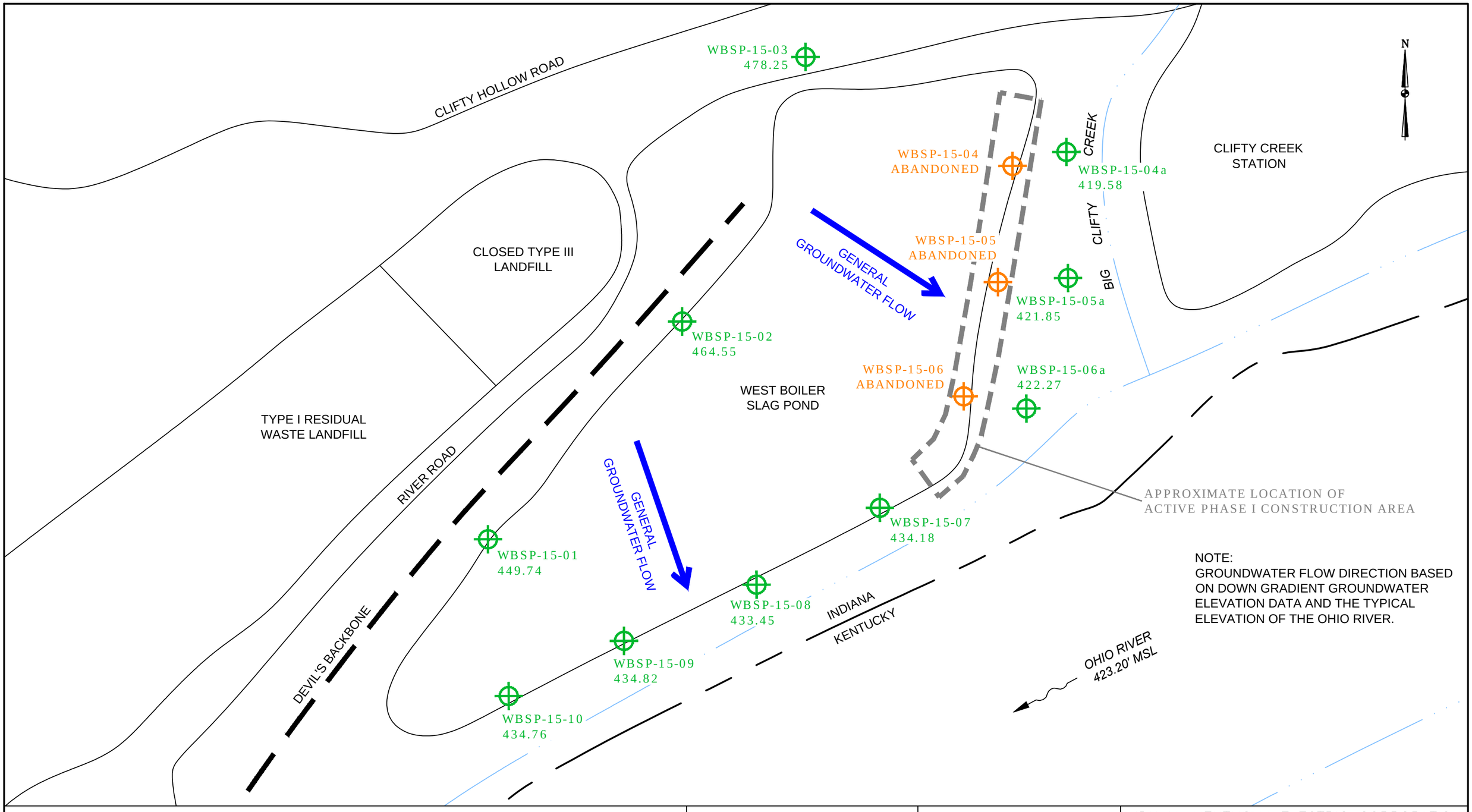
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
WEST BOILER SLAG POND
GROUNDWATER LEVELS AND FLOW DIRECTION
MARCH 2021

DRAWING NAME: FIGURE B-4
REV.: 0

Plot: 01/18/2022 11:31 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\2021 GW Monitoring-Corrective Action Rpt\B-4_IKEC_Clifty_GW Flow_Appx B_Annual GW Rpt_MAR21_WBSP.dwg\MAR21



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

LEGEND:

- CCR PROGRAM MONITORING WELL
- CCR PROGRAM MONITORING WELL – ABANDONED 2021
- GROUNDWATER FLOW DIRECTION

400' 0' 400' 800'
SCALE: 1"= 400'

DATE	
CHECKED BY	
JOB NO.	2021039–CLI
DWG FILE	B-5_IKEC-Clifty_GW Flow_Appx B_Annual GW Rpt_MAR21_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 2021

DRAWING NAME: FIGURE B–5
REV.: 0

Plot: 10/20/2021 14:31 _PROGRAMS–IKEC\IKEC–CCR Program\CAD\2021 GW Monitoring–Corrective Action Rpt\B–5_IKEC–Clifty_GW Flow_Appx B_Annual GW Rpt_SEPT21_WBSP\well loc

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 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.028 J	0.71
Calcium, Ca	mg/L	87	76
Chloride, Cl	mg/L	100	66
Fluoride, F	mg/L	0.11	0.14
pH	s.u.	7.85	7.57
Sulfate, SO4	mg/L	38	46
Total Dissolved Solids (TDS)	mg/L	420	420
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	5 U	5 U
Barium, Ba	ug/L	56	59
Beryllium, Be	ug/L	0.68 J	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	5 U
Cobalt, Co	ug/L	0.3 J	1 U
Fluoride, F	mg/L	0.11	0.14
Lithium, Li	mg/L	0.008 U	8 U
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	1.3 J
Radium 226 & 228 (combined)	pCi/L	5 U	5 U
Selenium, Se	ug/L	1.1 J	5 U
Thallium, Tl	ug/L	0.61 J	1 U

CF-15-05
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.061 J	0.12
Calcium, Ca	mg/L	56	100
Chloride, Cl	mg/L	24	32
Fluoride, F	mg/L	0.18	0.54
pH	s.u.	7.59	6.58
Sulfate, SO4	mg/L	39	49
Total Dissolved Solids (TDS)	mg/L	300	510
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	1.5 J	5 U
Barium, Ba	ug/L	66	47
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	3.9	5 U
Cobalt, Co	ug/L	2	0.64 J
Fluoride, F	mg/L	0.18 F1	0.54
Lithium, Li	mg/L	0.0063 J	16
Lead, Pb	ug/L	2.5	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5 U	5 U
Radium 226 & 228 (combined)	pCi/L	5 U	0.708
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

CF-15-06
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.096 J	WELL DRY
Calcium, Ca	mg/L	120	
Chloride, Cl	mg/L	4.1	
Fluoride, F	mg/L	0.21	
pH	s.u.	7.56	
Sulfate, SO4	mg/L	84	
Total Dissolved Solids (TDS)	mg/L	550	
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	WELL DRY
Arsenic, As	ug/L	5 U	
Barium, Ba	ug/L	32	
Beryllium, Be	ug/L	1 U	
Cadmium, Cd	ug/L	1 U	
Chromium, Cr	ug/L	1.6 J	
Cobalt, Co	ug/L	0.71 J	
Fluoride, F	mg/L	0.21	
Lithium, Li	mg/L	0.011	
Lead, Pb	ug/L	0.66 J	
Mercury, Hg	ug/L	0.2 U	
Molybdenum, Mo	ug/L	5 U	
Radium 226 & 228 (combined)	pCi/L	5 U	
Selenium, Se	ug/L	5 U	
Thallium, Tl	ug/L	1 U	

CF-15-07
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.36	0.061 J
Calcium, Ca	mg/L	110	160
Chloride, Cl	mg/L	19	6.2
Fluoride, F	mg/L	0.19	0.29
pH	s.u.	7.46	6.78
Sulfate, SO4	mg/L	49	6.3
Total Dissolved Solids (TDS)	mg/L	480	580
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	5 U	7.3
Barium, Ba	ug/L	61	87
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	5 U
Cobalt, Co	ug/L	0.33 J	2.8
Fluoride, F	mg/L	0.19	0.29
Lithium, Li	mg/L	0.008 U	1.8 J
Lead, Pb	ug/L	1 U	1 U
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	34	8.2
Radium 226 & 228 (combined)	pCi/L	5 U	1.19
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

CF-15-08
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Jun-21	Sep-21	Dec-21
Appendix III Constituents					
Boron, B	mg/L	11	10	13	12
Calcium, Ca	mg/L	130	NA	120	NA
Chloride, Cl	mg/L	17	NA	13	NA
Fluoride, F	mg/L	0.39	NA	0.42	NA
pH	s.u.	7.62	NA	6.84	NA
Sulfate, SO4	mg/L	280	NA	200	NA
Total Dissolved Solids (TDS)	mg/L	690	NA	570	NA
Appendix IV Constituents					
Antimony, Sb	ug/L	2 U	NA	2 U	NA
Arsenic, As	ug/L	5 U	NA	0.84 J	NA
Barium, Ba	ug/L	48	NA	32	NA
Beryllium, Be	ug/L	0.68 J	NA	1 U	NA
Cadmium, Cd	ug/L	0.32 J	NA	0.5 J	NA
Chromium, Cr	ug/L	2 U	NA	5 U	NA
Cobalt, Co	ug/L	0.33 J	NA	0.9 J	NA
Fluoride, F	mg/L	0.39	NA	0.42	NA
Lithium, Li	mg/L	0.019	NA	21	NA
Lead, Pb	ug/L	1 U	NA	0.7 J	NA
Mercury, Hg	ug/L	0.2 U	NA	0.2 U	NA
Molybdenum, Mo	ug/L	340	480	880	500
Radium 226 & 228 (combined)	pCi/L	5 U	NA	0.73	NA
Selenium, Se	ug/L	5 U	NA	5 U	NA
Thallium, Tl	ug/L	0.65 J	NA	1	NA

Notes:
NA: Sampling not required for this parameter.

CF-15-09
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Jun-21	Sep-21
Appendix III Constituents				
Boron, B	mg/L	6	6.2	WELL DRY
Calcium, Ca	mg/L	170	NA	
Chloride, Cl	mg/L	2.3	NA	
Fluoride, F	mg/L	0.32	NA	
pH	s.u.	7.41	NA	
Sulfate, SO4	mg/L	210	NA	
Total Dissolved Solids (TDS)	mg/L	630	NA	
Appendix IV Constituents				
Antimony, Sb	ug/L	2 U	NA	WELL DRY
Arsenic, As	ug/L	5 U	NA	
Barium, Ba	ug/L	26	NA	
Beryllium, Be	ug/L	1 U	NA	
Cadmium, Cd	ug/L	1 U	NA	
Chromium, Cr	ug/L	8.9	NA	
Cobalt, Co	ug/L	1.4	NA	
Fluoride, F	mg/L	0.32	NA	
Lithium, Li	mg/L	0.0065 J	NA	
Lead, Pb	ug/L	1.3	NA	
Mercury, Hg	ug/L	0.2 U	NA	
Molybdenum, Mo	ug/L	100	NA	
Radium 226 & 228 (combined)	pCi/L	5 U	NA	
Selenium, Se	ug/L	5 U	NA	
Thallium, Tl	ug/L	1 U	NA	

Notes:
NA: Sampling not required for this parameter.

CF-19-14
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix IV Constituents			
Molybdenum, Mo	ug/L	28	69

CF-19-15
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix IV Constituents			
Molybdenum, Mo	ug/L	1.5 J	5 U

WBSP-15-01
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.075 J	WELL DRY
Calcium, Ca	mg/L	160	
Chloride, Cl	mg/L	8.7	
Fluoride, F	mg/L	0.27	
pH	s.u.	6.89	
Sulfate, SO4	mg/L	120	
Total Dissolved Solids (TDS)	mg/L	630	
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	WELL DRY
Arsenic, As	ug/L	5 U	
Barium, Ba	ug/L	13	
Beryllium, Be	ug/L	1 U	
Cadmium, Cd	ug/L	1 U	
Chromium, Cr	ug/L	1 J	
Cobalt, Co	ug/L	0.36 J	
Fluoride, F	mg/L	0.27	
Lithium, Li	mg/L	0.013	
Lead, Pb	ug/L	1 U	
Mercury, Hg	ug/L	0.2 U	
Molybdenum, Mo	ug/L	5 U	
Radium 226 & 228 (combined)	pCi/L	5 U	
Selenium, Se	ug/L	5 U	
Thallium, Tl	ug/L	1 U	

WBSP-15-02
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	4.3	3.5
Calcium, Ca	mg/L	260	220
Chloride, Cl	mg/L	9.1	10
Fluoride, F	mg/L	0.35	0.4
pH	s.u.	6.67	7.37
Sulfate, SO4	mg/L	570	560
Total Dissolved Solids (TDS)	mg/L	1300	1100
Appendix IV Constituents			
Antimony, Sb	ug/L	2 U	2 U
Arsenic, As	ug/L	5 U	1.2 J
Barium, Ba	ug/L	25	33
Beryllium, Be	ug/L	1 U	1 U
Cadmium, Cd	ug/L	1 U	1 U
Chromium, Cr	ug/L	2 U	4.7 J
Cobalt, Co	ug/L	0.26 J	1.6
Fluoride, F	mg/L	0.35	0.4
Lithium, Li	mg/L	0.078	76
Lead, Pb	ug/L	1 U	1.7
Mercury, Hg	ug/L	0.2 U	0.2 U
Molybdenum, Mo	ug/L	5	2.9 J
Radium 226 & 228 (combined)	pCi/L	0.931	0.568
Selenium, Se	ug/L	5 U	5 U
Thallium, Tl	ug/L	1 U	1 U

WBSP-15-03
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.1	0.16
Calcium, Ca	mg/L	150	170
Chloride, Cl	mg/L	65	45
Fluoride, F	mg/L	0.2	0.24
pH	s.u.	7.57	7.35
Sulfate, SO4	mg/L	300	240
Total Dissolved Solids (TDS)	mg/L	760	780

WBSP-15-04/WBSP-15-04a
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	4.9	0.48
Calcium, Ca	mg/L	110	140
Chloride, Cl	mg/L	120	25
Fluoride, F	mg/L	0.17	0.14
pH	s.u.	8.12	6.61
Sulfate, SO4	mg/L	210	110
Total Dissolved Solids (TDS)	mg/L	580	590

WBSP-15-05/WBSP-15-05a
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	3.5	2
Calcium, Ca	mg/L	130	130
Chloride, Cl	mg/L	72	32
Fluoride, F	mg/L	0.13	0.49
pH	s.u.	7.29	7.58
Sulfate, SO4	mg/L	250	330
Total Dissolved Solids (TDS)	mg/L	620	550

WBSP-15-06/WBSP-15-06a
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	4.3	2.1
Calcium, Ca	mg/L	140	92
Chloride, Cl	mg/L	94	83
Fluoride, F	mg/L	0.18	0.54
pH	s.u.	7.32	7.54
Sulfate, SO4	mg/L	230	190
Total Dissolved Solids (TDS)	mg/L	650	540

WBSP-15-07
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.034 J	0.1
Calcium, Ca	mg/L	190	170
Chloride, Cl	mg/L	11	12
Fluoride, F	mg/L	0.37	0.28
pH	s.u.	6.23	6.88
Sulfate, SO4	mg/L	13	14
Total Dissolved Solids (TDS)	mg/L	730	740

WBSP-15-08
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.049 J	0.1 U
Calcium, Ca	mg/L	80	72
Chloride, Cl	mg/L	17	17
Fluoride, F	mg/L	0.2	0.18
pH	s.u.	6.92	6.56
Sulfate, SO4	mg/L	3.8	2.4
Total Dissolved Solids (TDS)	mg/L	350	330

WBSP-15-09
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Jun-21	Sep-21	Dec-21
Appendix III Constituents					
Boron, B	mg/L	0.1 U	NA	0.1 U	NA
Calcium, Ca	mg/L	60	NA	53	NA
Chloride, Cl	mg/L	3	NA	3	NA
Fluoride, F	mg/L	0.63	0.55	0.6	0.55
pH	s.u.	6.62	NA	6.83	NA
Sulfate, SO4	mg/L	2.9	NA	1.0 U	NA
Total Dissolved Solids (TDS)	mg/L	250	NA	250	NA

Notes:
NA: Sampling not required for this parameter.

WBSP-15-10
SUMMARY OF 2021 ANALYTICAL RESULTS
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Madison, Indiana

Parameter	Units	Mar-21	Sep-21
Appendix III Constituents			
Boron, B	mg/L	0.1 U	0.1 U
Calcium, Ca	mg/L	93	71
Chloride, Cl	mg/L	23	23
Fluoride, F	mg/L	0.28	0.31
pH	s.u.	6.23	7.31
Sulfate, SO4	mg/L	70	52
Total Dissolved Solids (TDS)	mg/L	360	330

APPENDIX E

ALTERNATE SOURCE DEMONSTRATION MARCH 2021

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COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
MARCH 2021 DETECTION MONITORING EVENT

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

AUGUST 2021

Prepared for:

INDIANA KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
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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).

Statistically Significant Increases (SSIs) were not identified at the WBSP during the March 2021 Detection Monitoring event. Therefore, the WBSP is not discussed further in this report.

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 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, and September 2020 Detection Monitoring sampling events, SSIs for Boron were again confirmed in wells located downgradient of the unit. Based on successful ASDs for these four (4) Detection Monitoring events (AGES 2019b, AGES 2020a, AGES 2020b, and AGES 2021), 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 2021 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 sixth round of Detection Monitoring groundwater samples was collected between March 3 and 16, 2021 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 15, 2021. 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 exceedances result 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 disposal ponds 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 ponds. 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 liner and a compacted 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 liner and a compacted clay liner to prevent water from the Type I Landfill from entering the underlying layers. Water in the Type I Landfill is collected by an underground 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 2021 (Detection Monitoring Event) and June 2021 (Resampling Event) are included in Appendix A (Figures A-1 and A-2). Groundwater generally flows to the southwest toward the Ohio River; however, in March 2021, the elevation of the Ohio River (443.00 feet mean sea level [ft msl]) was higher than typical conditions at the site and flooding was present in the area of wells CF-15-07 and CF-19-15, indicating a flow reversal in this area. As shown in Figure A-2, conditions returned to the typical southwest groundwater flow direction and the discharge of groundwater to the Ohio River during the June 2021 Resampling Event. Similar conditions were noted during the March 2020 Detection Monitoring Event and the June 2020 Resampling Event.

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 well CF-15-08 is estimated at 120 years. As the Type I Landfill has only been in operation for nine (9) 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 a CCR unit and 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 C) 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 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 11.9 mg/L in well CF-15-08, and from 5.7 mg/L to 7.59 mg/L in 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 B), 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. 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. Therefore, it is recommended that the Type I Landfill remain in Detection Monitoring.

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United States Environmental Protection Agency (U.S. EPA) 1993. Solid Waste Disposal Criteria Technical Manual, EPA 530-R-93-017. November 1993.

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)	6th Detection Monitoring Sampling Event March 2021		6th Detection Monitoring Resampling Event June 2021	
		Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)
CF-15-08	Boron (mg/L)	11	5.02	10	**Yes**
CF-15-09	Boron (mg/L)	6	5.02	6.2	**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 2021)				
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

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	
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 AND COMPACTED CLAY LINERS

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.	2017116-CLI
DWG FILE	Clifty_ASD_Cross Sec b02.dwg
DRAWING SCALE	NOT TO SCALE

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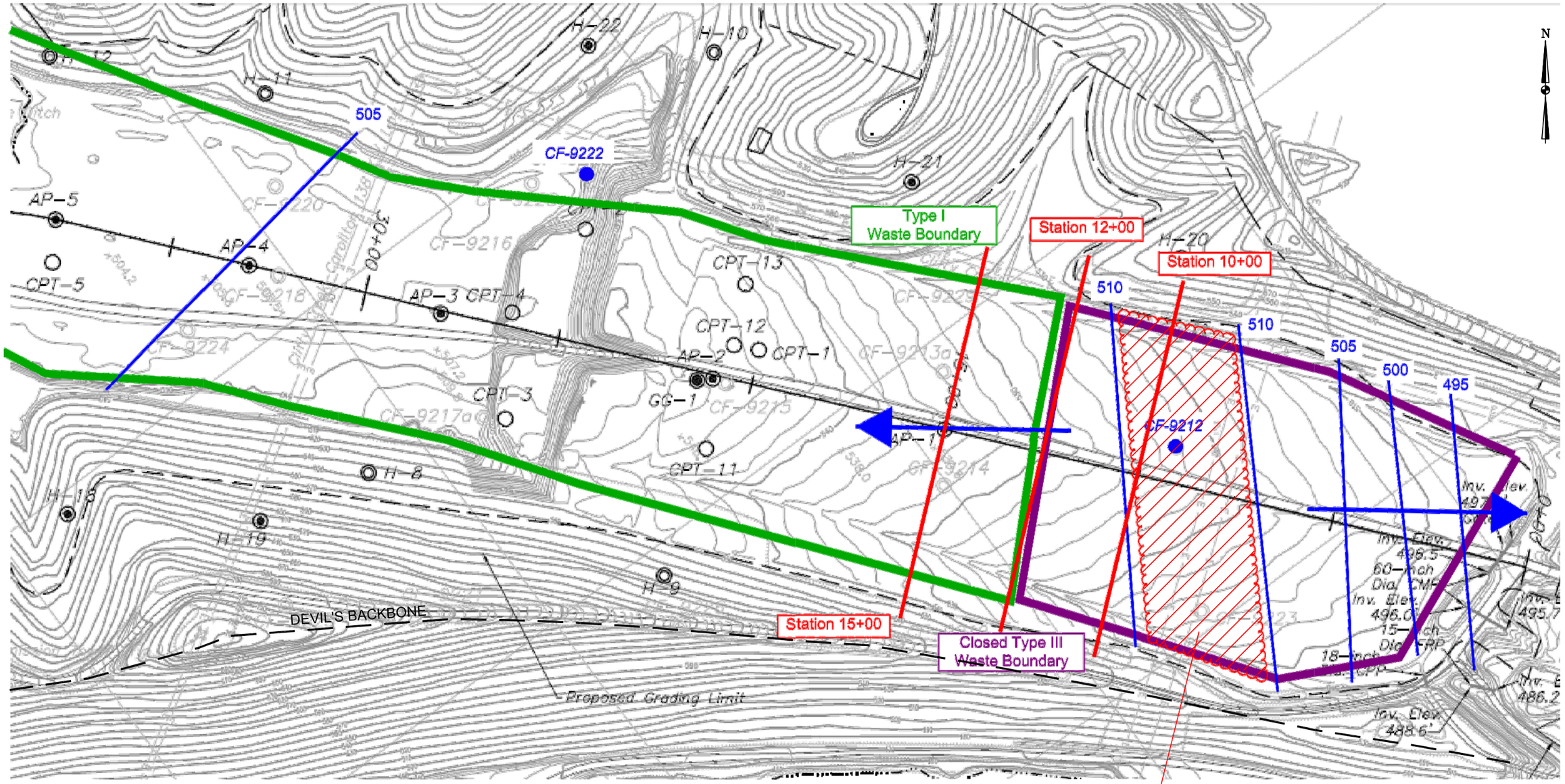
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL
GENERALIZED GEOLOGIC CROSS-SECTION
A-A' (SOUTHWEST-NORTHEAST)

DRAWING NAME: FIGURE 3

REV.: 0

Plot: 12/12/2018 11:18 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_ASD_Cross Sec b02.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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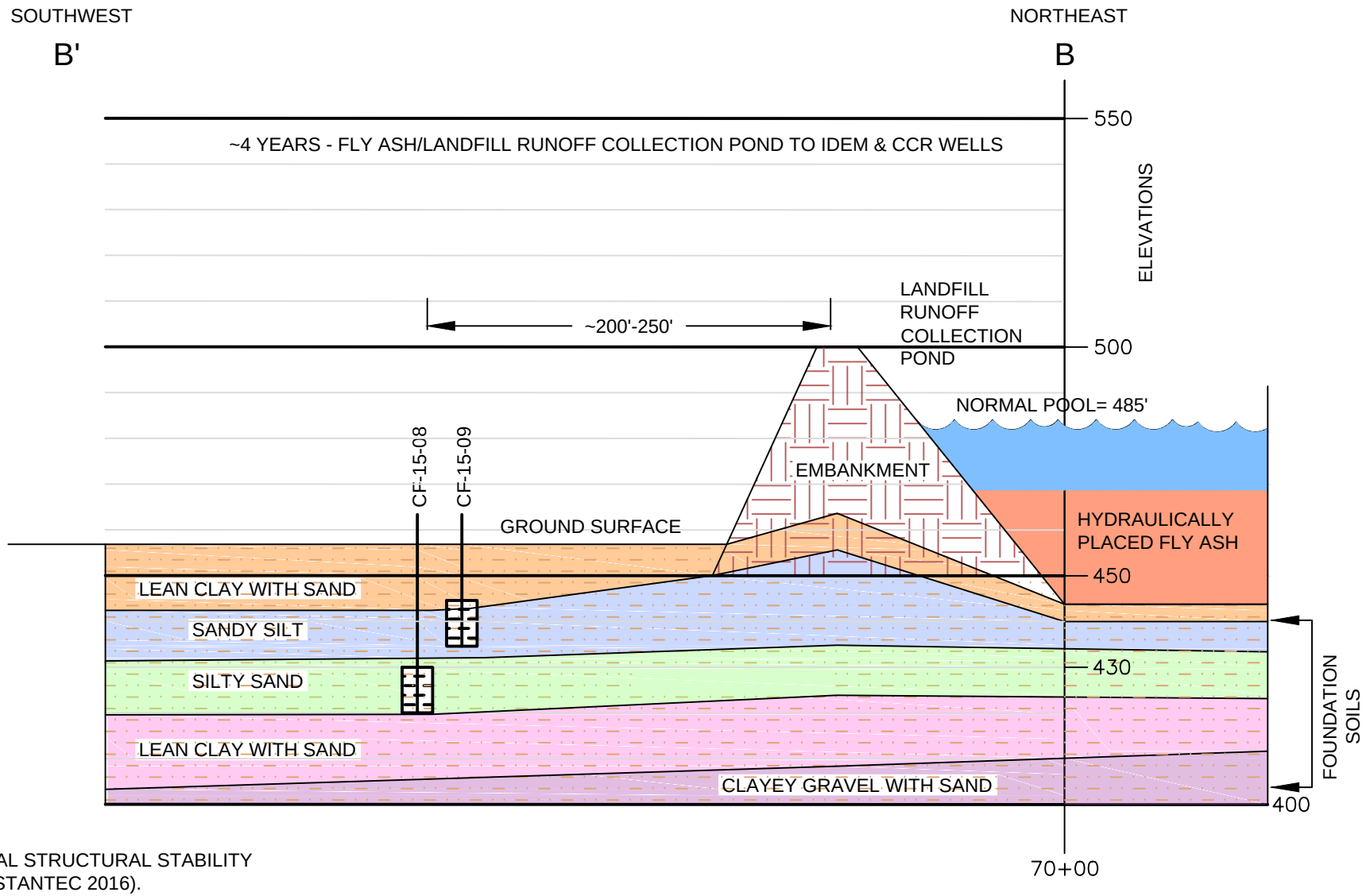
INDIANA-KENTUCKY ELECTRIC CORPORATION

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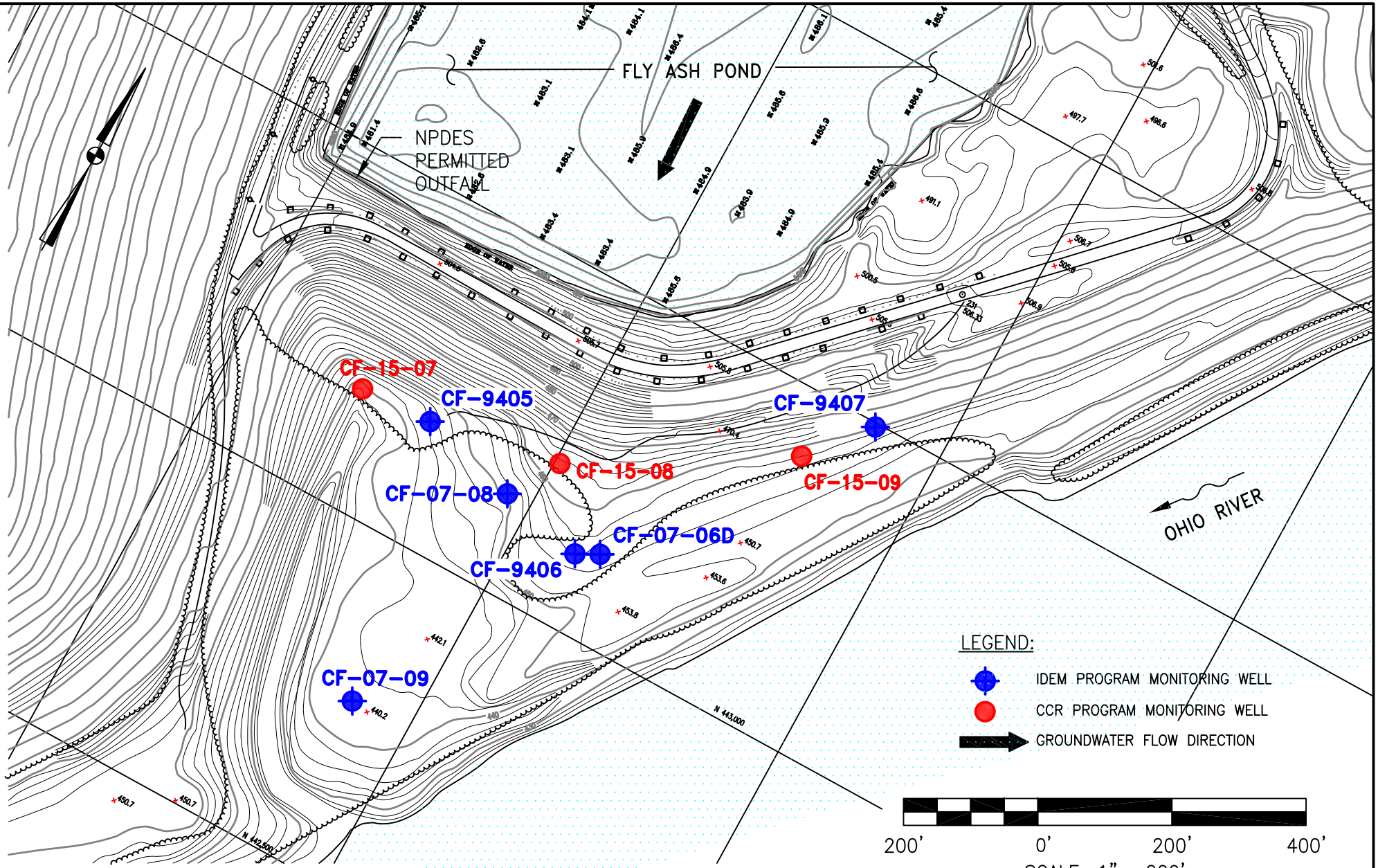
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
GENERALIZED CROSS-SECTION
LANDFILL RUNOFF COLLECTION POND TO
CCR MONITORING WELLS

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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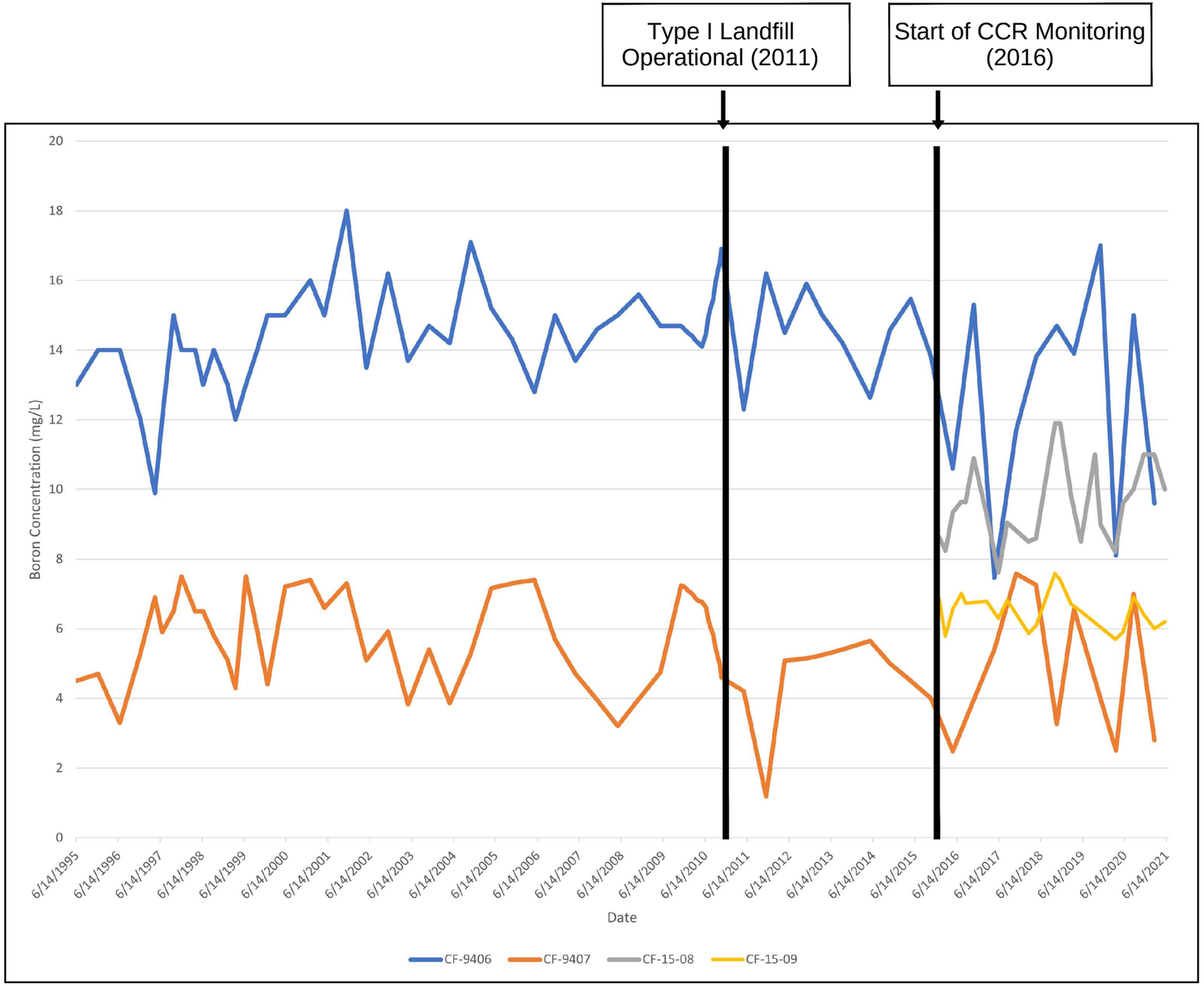
INDIANA-KENTUCKY ELECTRIC CORPORATION

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	JM
DATE	
CHECKED BY	
JOB NO.	2021034–CLIFTY
DWG FILE	7_IKEC_Clifty_ASD 6 LF_Boron–Time Graph_MAR2021.dwg
DRAWING SCALE	NOT TO SCALE

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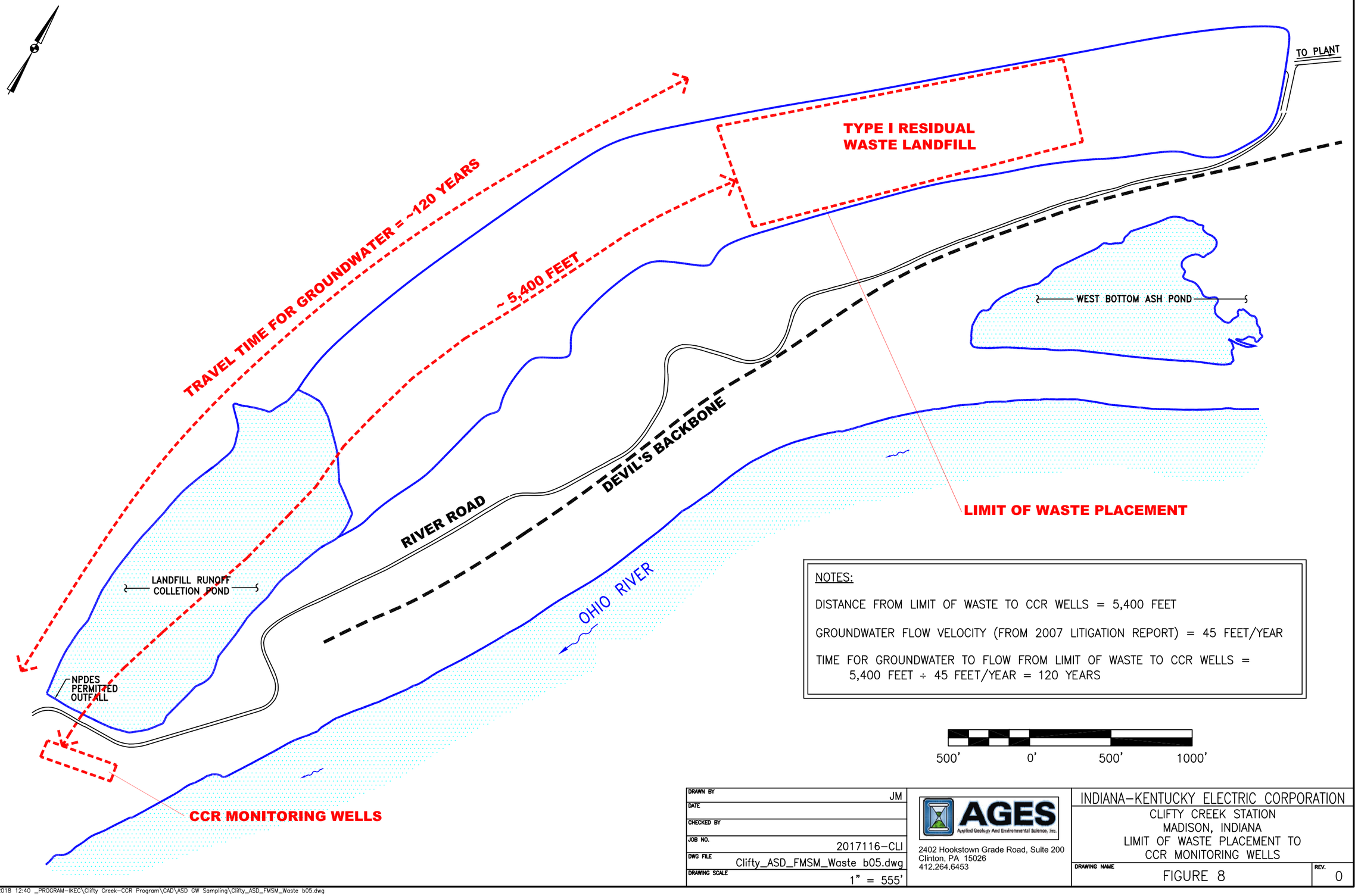
INDIANA–KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
TIME SERIES DATA FOR BORON (mg/L)
CF–9406, CF–9407, CF–15–08 AND CF–15–09
MARCH 2021

DRAWING NAME	REV.
FIGURE 7	0

Plot: 08/03/2021 10:37 _PROGRAMS–IKEC\Clifty Creek–CCR Program\CAD\ASD 6_LF_MARCH 2021\7_IKEC_Clifty_ASD 6 LF_Boron–Time Graph_MAR2021.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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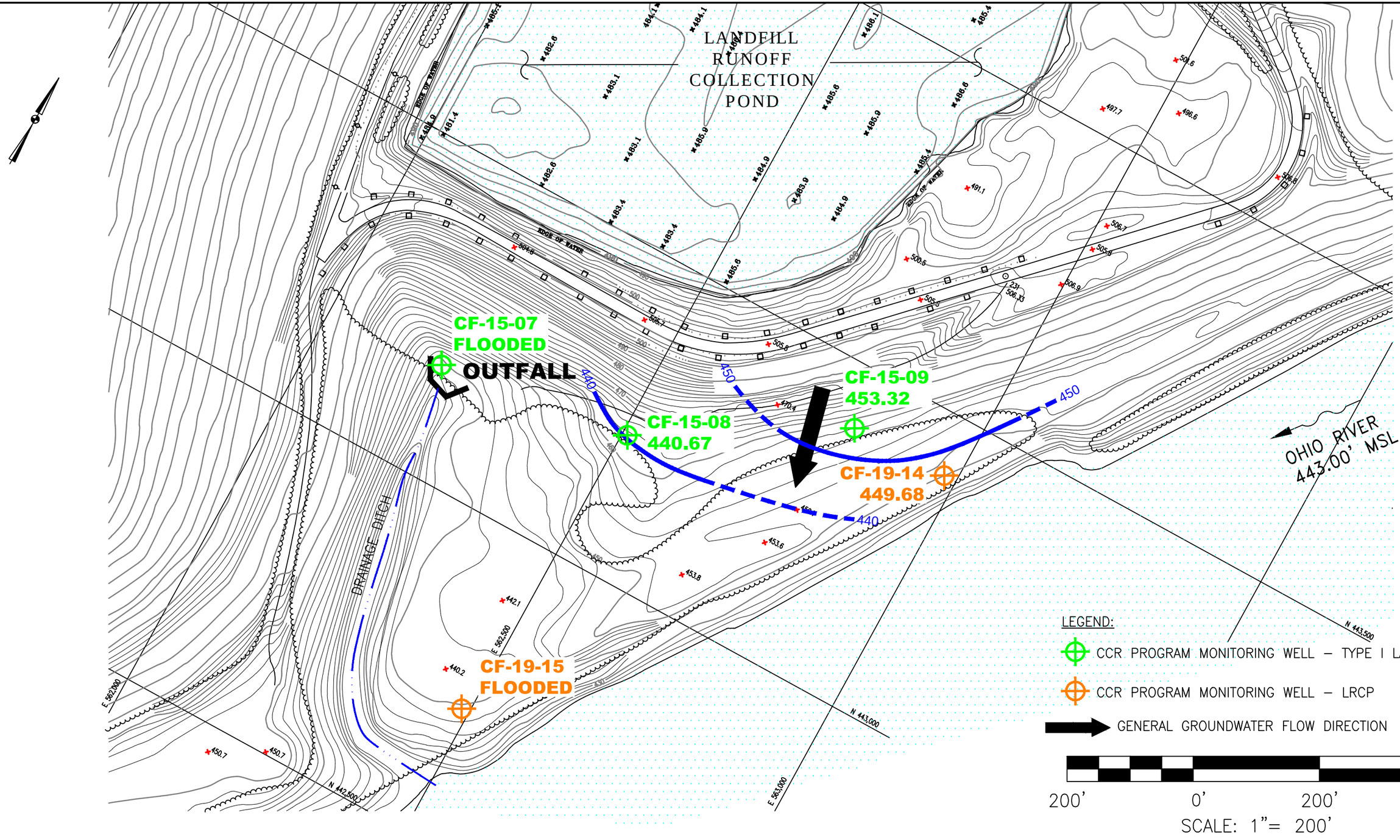
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
LIMIT OF WASTE PLACEMENT TO
CCR MONITORING WELLS

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 2021 and June 2021)



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

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021034–CLIFTY
DWG FILE	A–1_IKEC_Clifty_ASD 6 LF_GW Flow_MAR2021.dwg
DRAWING SCALE	AS SHOWN

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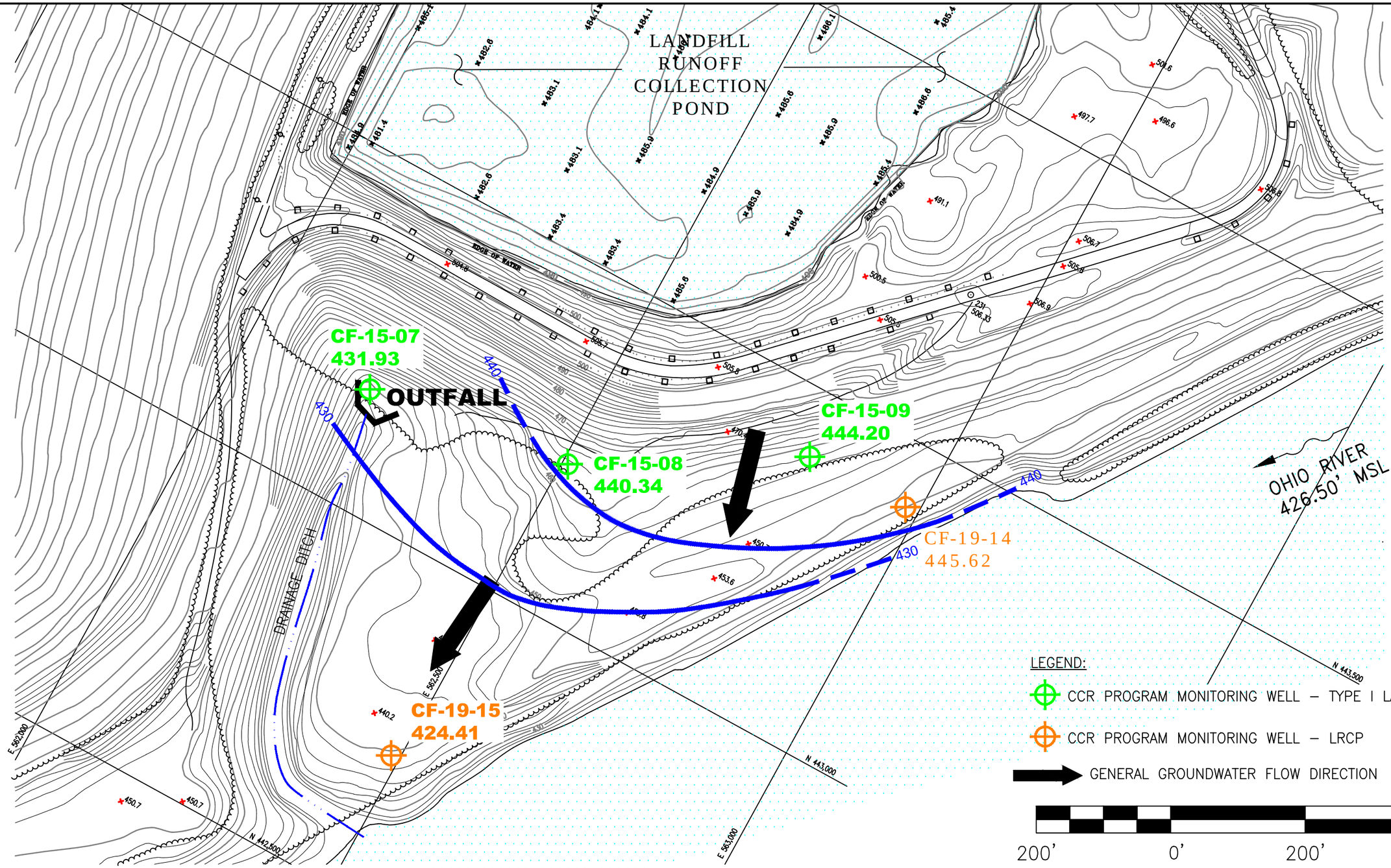
INDIANA–KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND
LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
MARCH 2021

DRAWING NAME: FIGURE A–1
REV.: 0

Plot: 08/03/2021 14:35 _PROGRAMS–IKEC\Clifty Creek–CCR Program\CAD\ASD 6_LF_MARCH 2021\A–1_IKEC_Clifty_ASD 6 LF_GW Flow_MAR2021.dwg



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

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021034–CLIFTY
DWG FILE	A–2_IKEC_Clifty_ASD 6 LF_GW Flow_JUN2021.dwg
DRAWING SCALE	AS SHOWN

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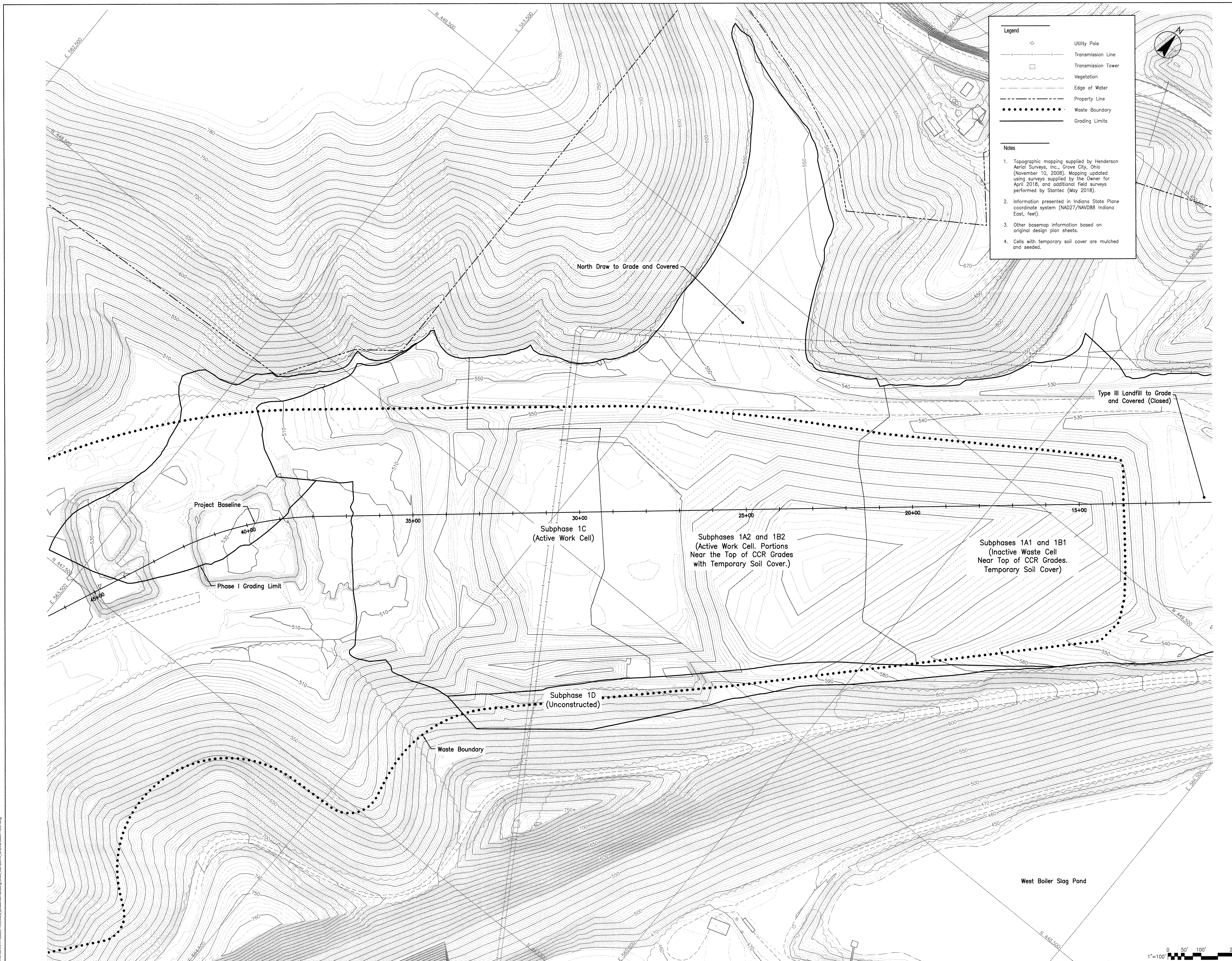
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
JUNE 2021

DRAWING NAME: FIGURE A–2
REV.: 0

APPENDIX B

PHASE I EXISTING CONDITIONS TOPOGRAPHIC MAP (Stantec 2018)



Stantec

11687 Lebanon Road
Cincinnati, Ohio 45241-2012
www.stantec.com

Client/Project
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK COAL ASH LANDFILL MODIFICATION
JEEFERSON COUNTY, MADISON TOWNSHIP, INDIANA

Title
PHASE 1 EXISTING CONDITIONS (JUNE 2018)

Permit-Seal

JACQUELINE S. HARMON REGISTERED No. 10911138 STATE OF INDIANA PROFESSIONAL ENGINEER
7/13/2018

Project Number: 175538039

File Name: 38036-18-01.dwg | MJ Dwn. | JSH Chkd. | JSH Dsgn. | 18.07.16 YY.MM.DD

Drawing No. 1

Revision -

Sheet 1 of 8

APPENDIX C

FIGURE FROM LRCP DAM STABILITY ASSESSMENT REPORT (Stantec 2016)

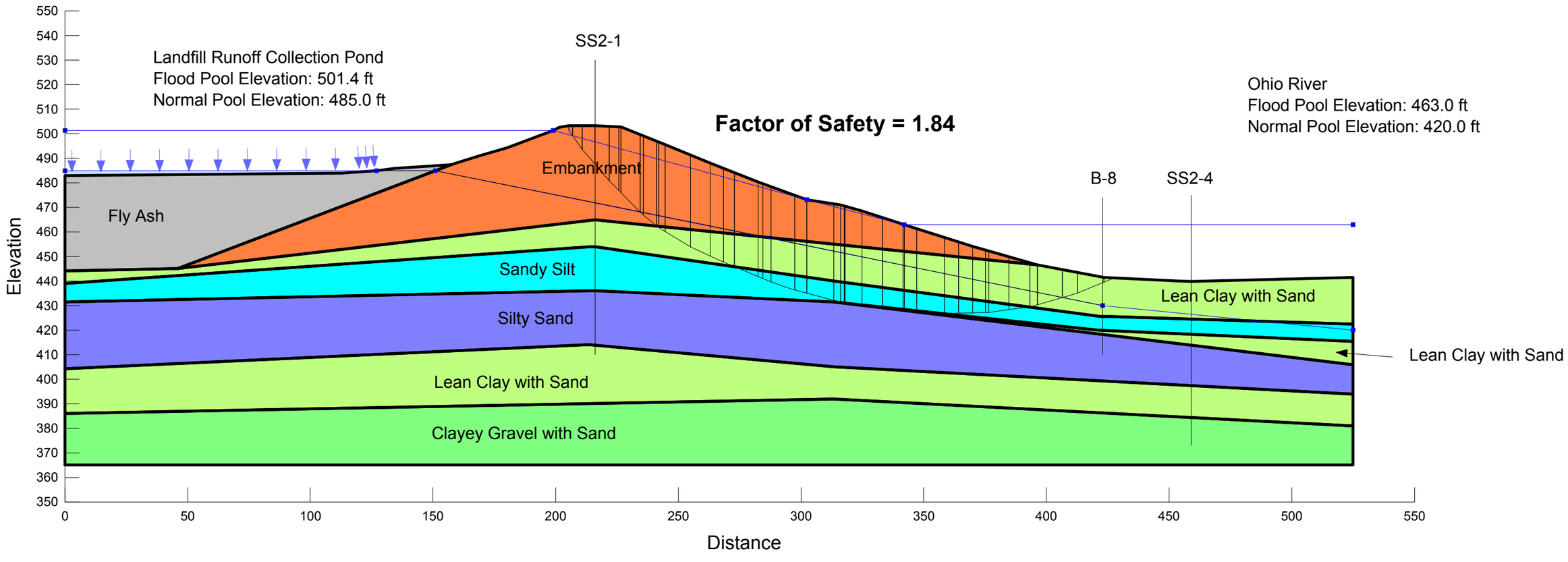
Indiana-Kentucky Electric Corporation
Clifty Creek Station
Landfill Runoff Collection Pond Dam
Madison, Indiana
Section D-D'

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 F

ALTERNATE SOURCE DEMONSTRATION SEPTEMBER 2021

AGES
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F 412. 264. 6567

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2021 DETECTION MONITORING EVENT

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

JANUARY 2022

Prepared for:

INDIANA KENTUCKY ELECTRIC CORPORATION (IKEC)

By:

APPLIED GEOLOGY AND ENVIRONMENTAL SCIENCE, INC.

COAL COMBUSTION RESIDUALS REGULATION
ALTERNATE SOURCE DEMONSTRATION REPORT
SEPTEMBER 2021 DETECTION MONITORING EVENT
TYPE I RESIDUAL WASTE LANDFILL
INDIANA KENTUCKY ELECTRIC CORPORATION
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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).

Statistically Significant Increases (SSIs) were not identified at the WBSP during the September 2021 Detection Monitoring event. Therefore, the WBSP is not discussed further in this report.

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 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, and March 2021 Detection Monitoring sampling events, SSIs for Boron were again confirmed in wells located downgradient of the unit. Based on successful ASDs for these four (4) Detection Monitoring events (AGES 2019b, AGES 2020a, AGES 2020b, AGES 2021a, and AGES 2021b), 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 2021 Detection Monitoring event, a Boron SSI was confirmed in one (1) well 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 seventh round of Detection Monitoring groundwater samples was collected between September 10 and 14, 2021 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 a potential SSI for Boron in monitoring well CF-15-08 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 December 2, 2021. Based on the result of the resampling event, the SSI for Boron was confirmed in monitoring well CF-15-08 (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 Boron in well CF-15-08 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 exceedances result 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 disposal ponds 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 ponds. 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 liner and a compacted 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 liner and a compacted clay liner to prevent water from the Type I Landfill from entering the underlying layers. Water in the Type I Landfill is collected by an underground 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 September 2021 (Detection Monitoring Event) and December 2021 (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 well CF-15-08 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 well CF-15-08 is estimated at 120 years. As the Type I Landfill has only been in operation for nine (9) 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 well CF-15-08 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 a CCR unit and 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 well CF-15-08.

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 C) 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 5.7 mg/L to 7.59 mg/L in 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 well CF-15-08 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 B), 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. 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. 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)	7th Detection Monitoring Sampling Event September 2021		7th Detection Monitoring Resampling Event December 2021	
		Potential SSI Result	UPL	Potential SSI Result	Confirmed SSI (Yes/No)
CF-15-08	Boron (mg/L)	13	5.02	12	**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 2021)				
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

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	
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 AND COMPACTED CLAY LINERS

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.	2017116-CLI
DWG FILE	Clifty_ASD_Cross Sec b02.dwg
DRAWING SCALE	NOT TO SCALE

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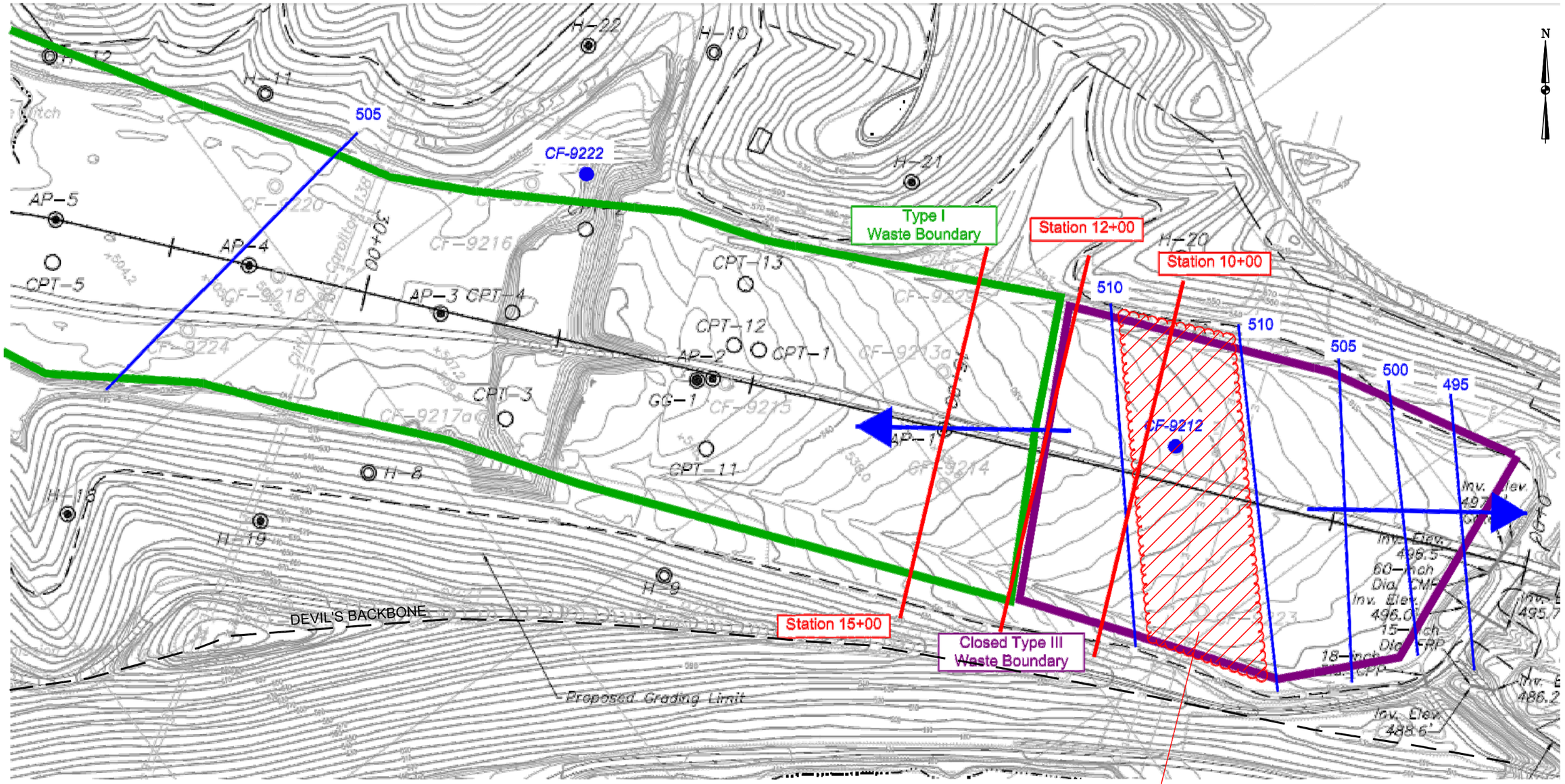
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
TYPE I RESIDUAL WASTE LANDFILL
GENERALIZED GEOLOGIC CROSS-SECTION
A-A' (SOUTHWEST-NORTHEAST)

DRAWING NAME: FIGURE 3

REV.: 0

Plot: 12/12/2018 11:18 _PROGRAM-IKEC\Clifty Creek-CCR Program\CAD\ASD GW Sampling\Clifty_ASD_Cross Sec b02.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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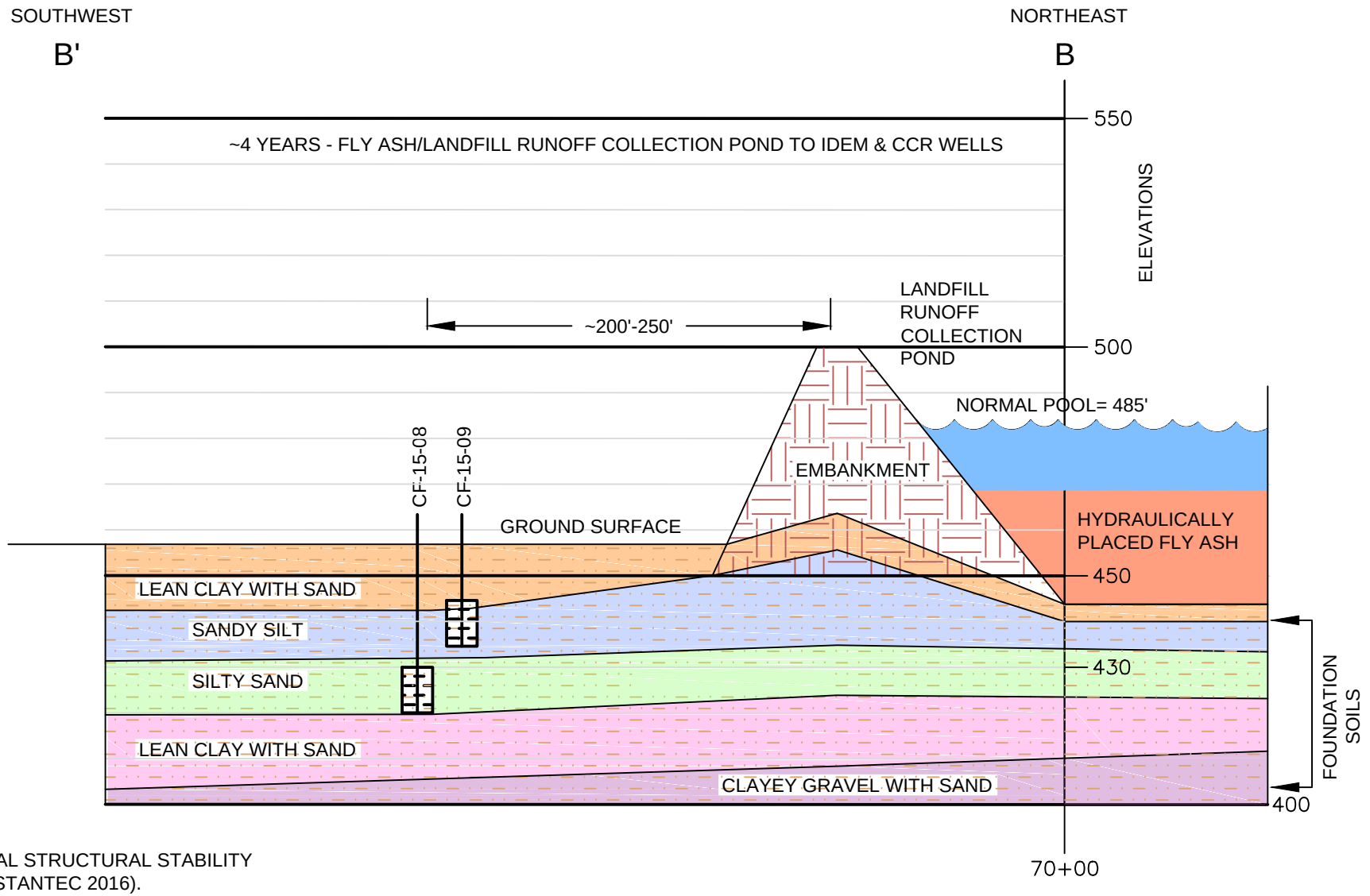
INDIANA-KENTUCKY ELECTRIC CORPORATION

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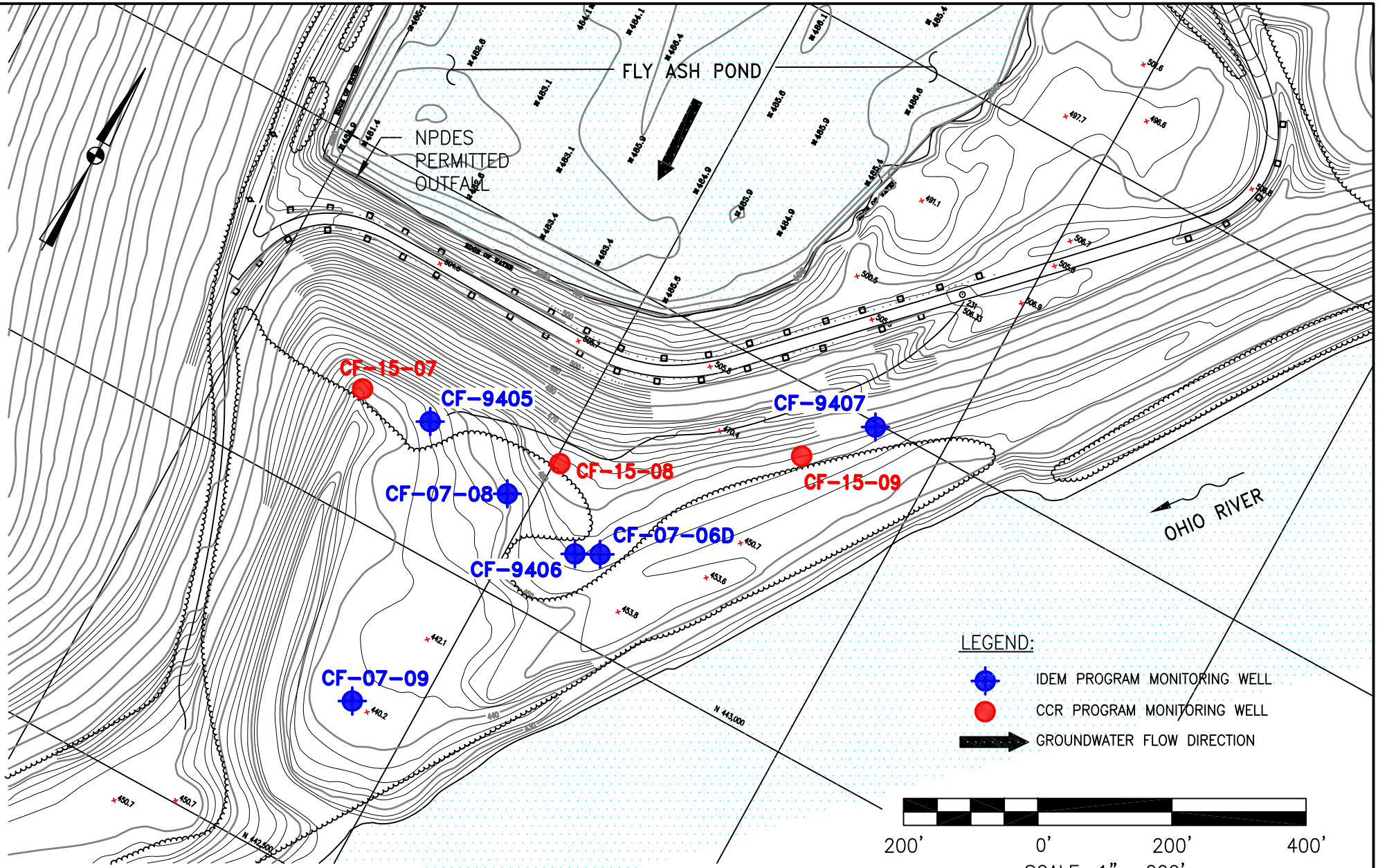
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
GENERALIZED CROSS-SECTION
LANDFILL RUNOFF COLLECTION POND TO
CCR MONITORING WELLS

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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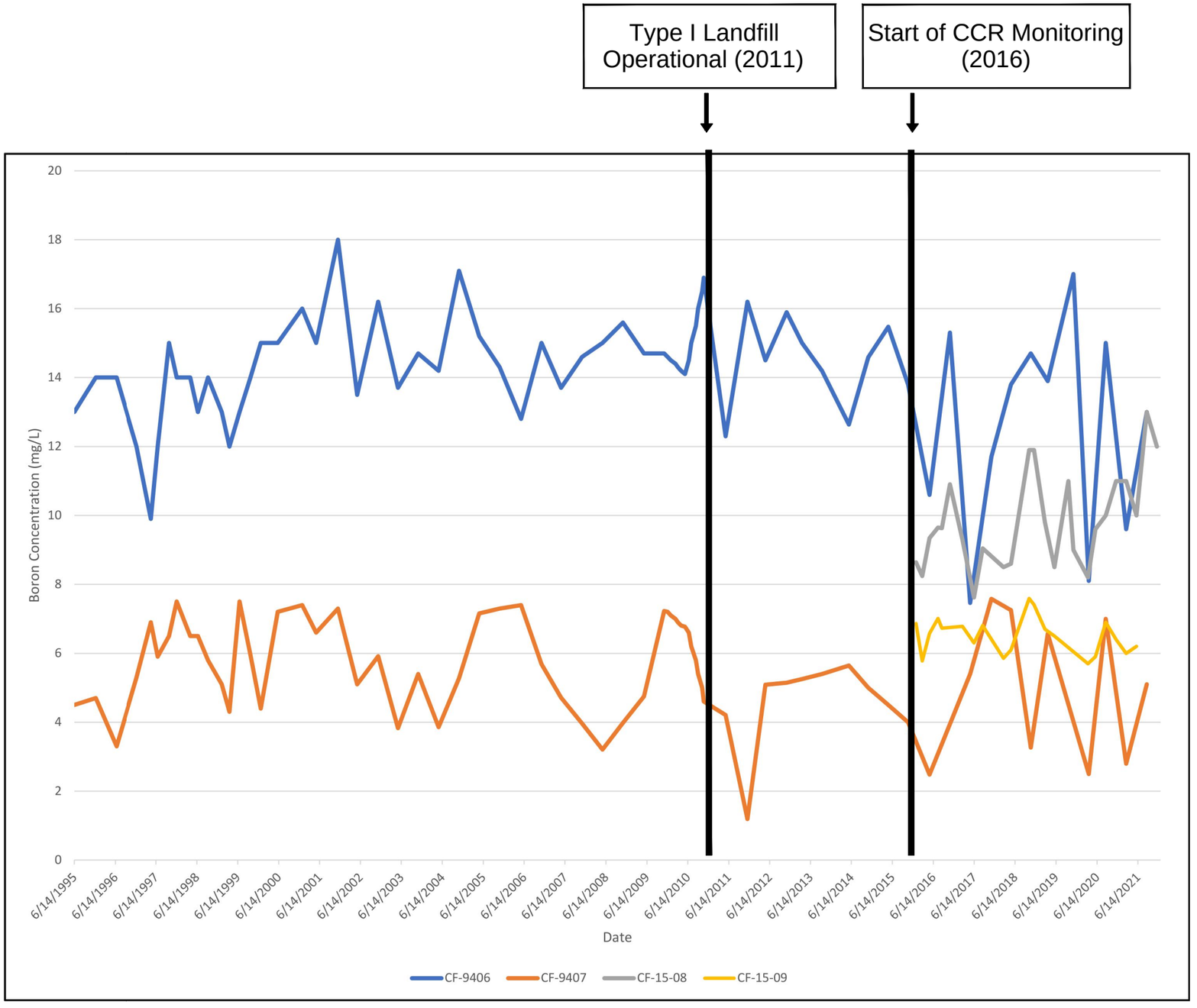
INDIANA-KENTUCKY ELECTRIC CORPORATION

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	JM
DATE	
CHECKED BY	
JOB NO.	2021037–CLIFTY
DWG. FILE	7_IKEC_Clifty_ASD 7 LF_Boron-Time Graph_SEPT 2021.dwg
DRAWING SCALE	NOT TO SCALE

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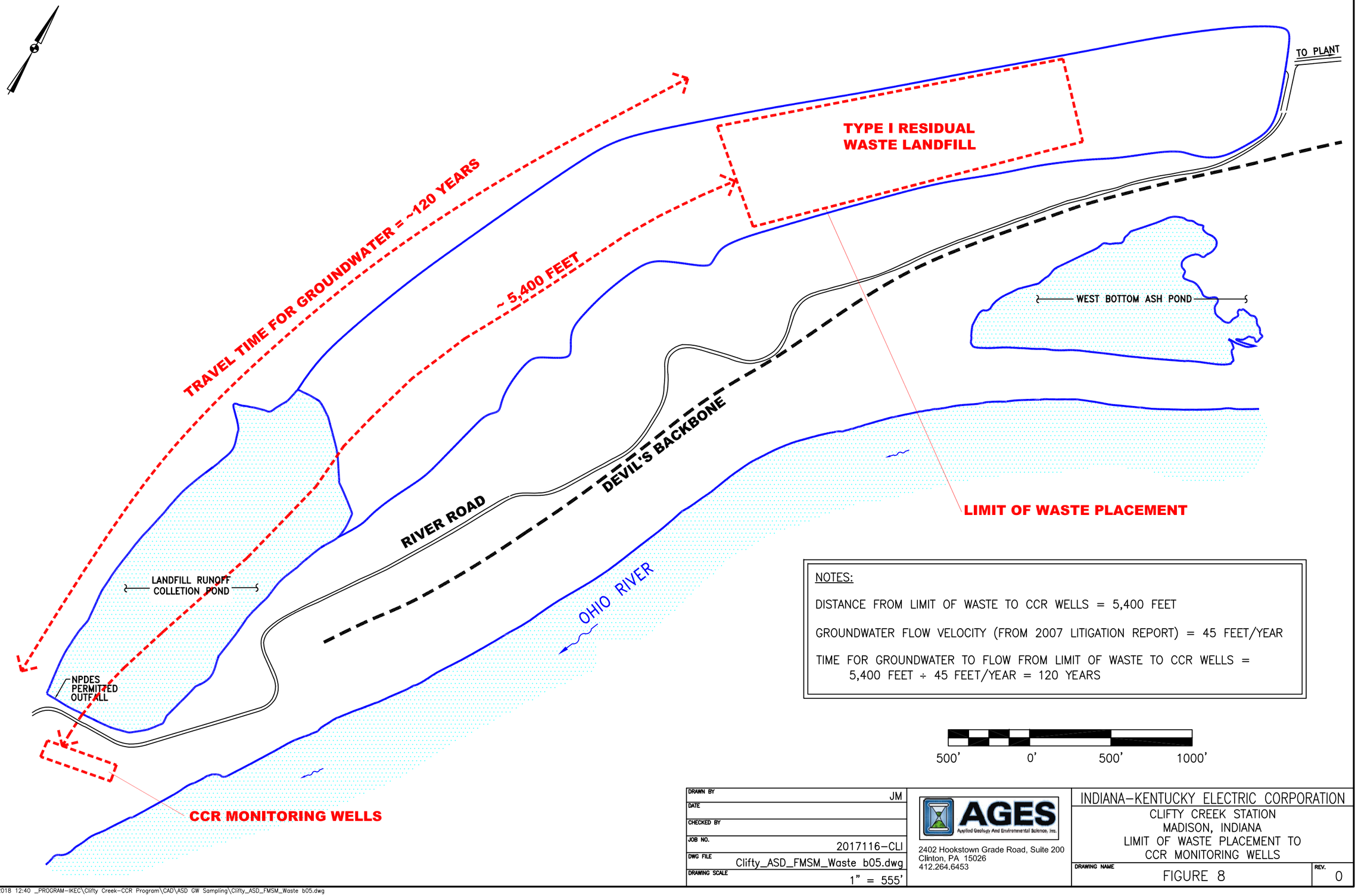
INDIANA–KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK STATION
MADISON, INDIANA
TIME SERIES DATA FOR BORON (mg/L)
CF–9406, CF–9407, CF–15–08 AND CF–15–09
SEPTEMBER 2021

DRAWING NAME	REV.
FIGURE 7	0

Plot: 01/11/2022 14:35 _PROGRAMS–IKEC\Clifty Creek–CCR Program\CAD\ASD 7_LF_SEPT 2021\7_IKEC_Clifty_ASD 7 LF_Boron–Time Graph_SEPT 2021.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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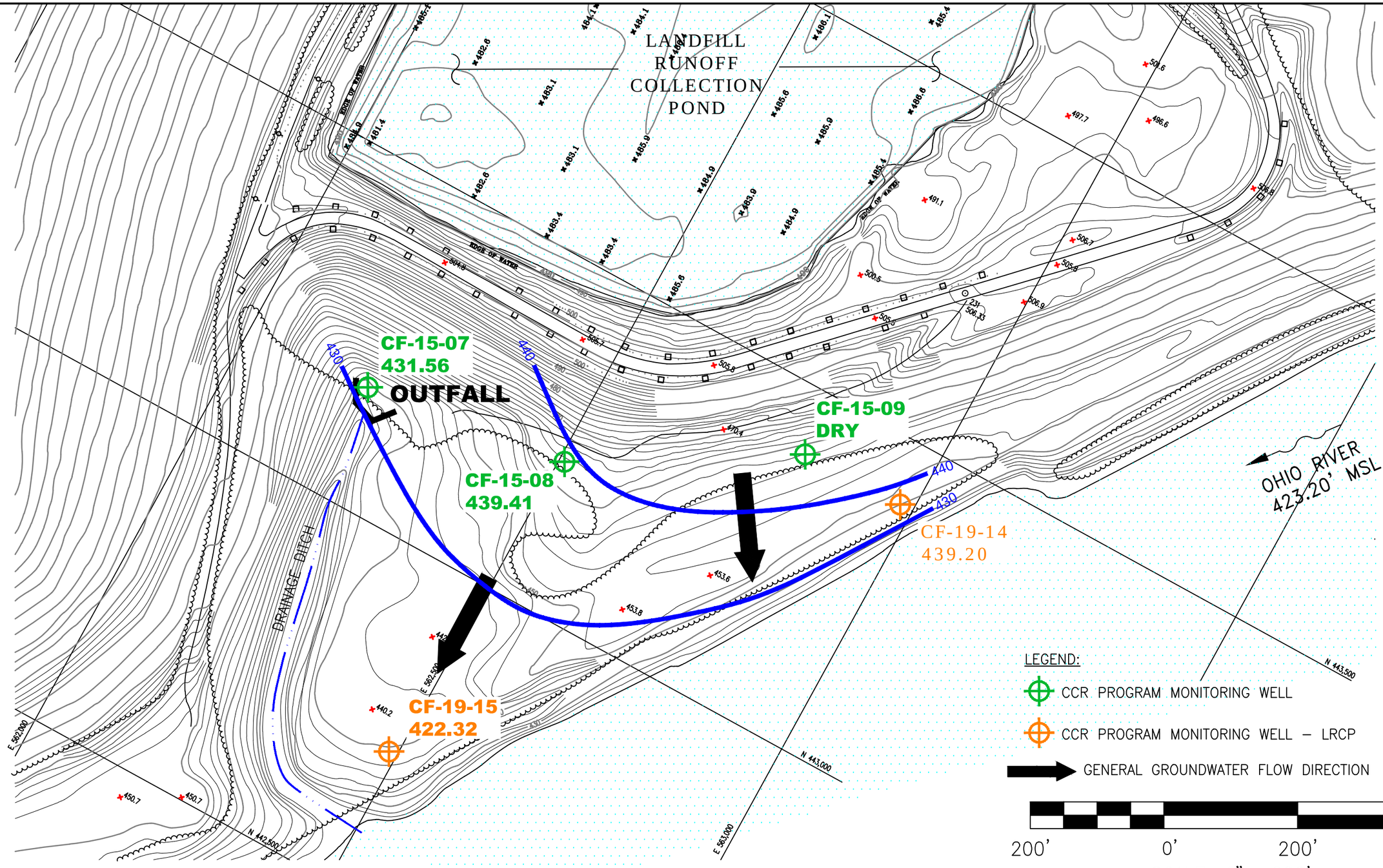
INDIANA-KENTUCKY ELECTRIC CORPORATION
CLIFTY CREEK STATION
MADISON, INDIANA
LIMIT OF WASTE PLACEMENT TO
CCR MONITORING WELLS

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
(September 2021 and December 2021)



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

DRAWN BY	JM
DATE	
CHECKED BY	
JOB NO.	2021037–CLIFTY
DWG FILE	A–1_IKEC_Clifty_ASD 7 LF_GW Flow_SEPT 2021.dwg
DRAWING SCALE	AS SHOWN

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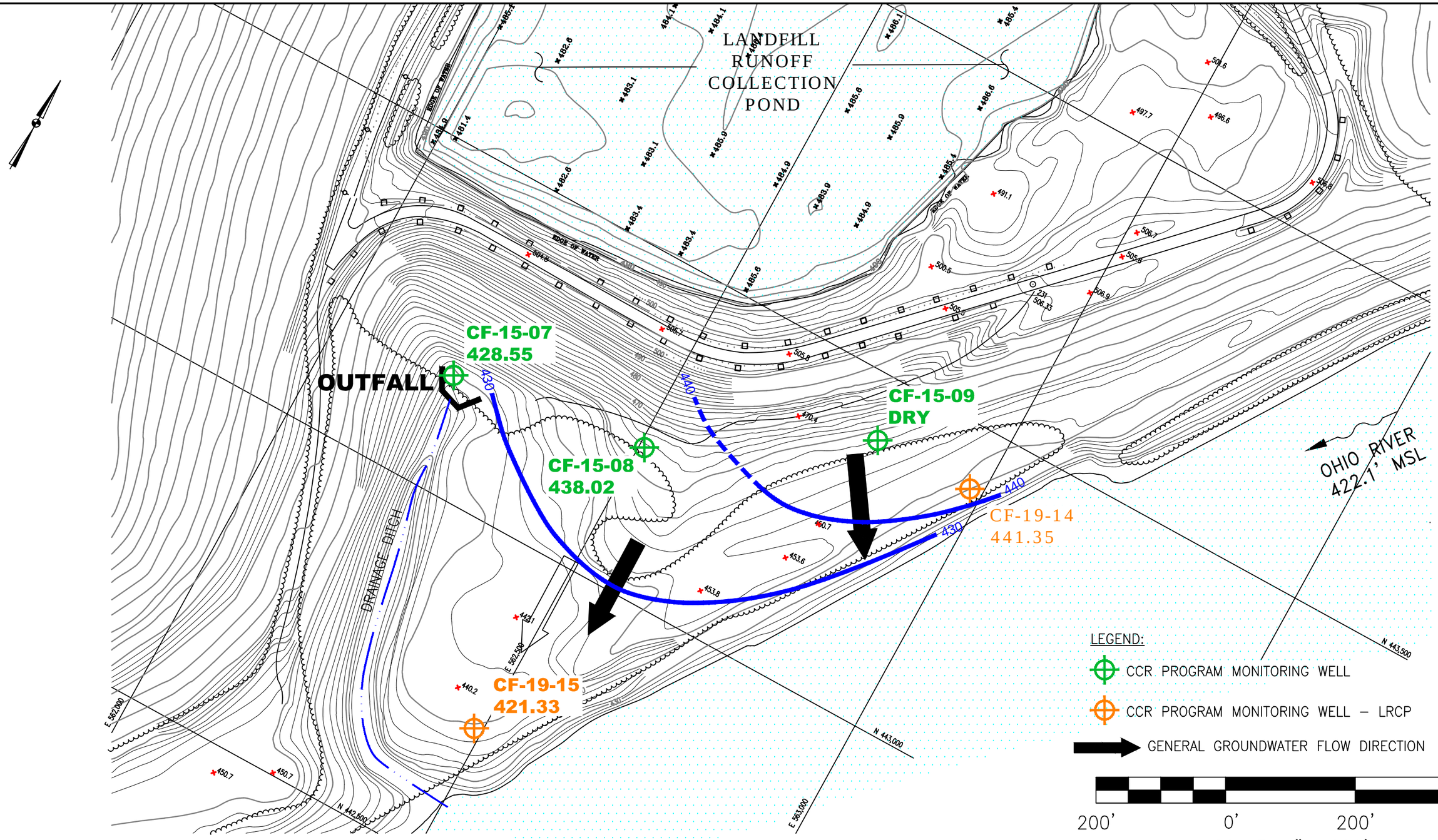
CLIFTY CREEK STATION
MADISON, INDIANA
CCR PROGRAM
TYPE I RESIDUAL WASTE LANDFILL AND LANDFILL RUNOFF COLLECTION POND
GROUNDWATER FLOW – UPPERMOST AQUIFER
SEPTEMBER 2021

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	JM
DATE	
CHECKED BY	
JOB NO.	2021037-CLIFTY
DWG FILE	A-2_IKEC_Clifty_ASD 7 LF_GW Flow_DEC 2021.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
DECEMBER 2021

DRAWING NAME	REV.
FIGURE A-2	0

Plot: 01/11/2022 14:11 _PROGRAMS-IKEC\Clifty Creek-CCR Program\CAD\ASD 7_LF_SEPT 2021\A-2_IKEC_Clifty_ASD 7 LF_GW Flow_DEC 2021.dwg

APPENDIX B

PHASE I EXISTING CONDITIONS TOPOGRAPHIC MAP (Stantec 2018)

Stantec
11687 Lebanon Road
Cincinnati, Ohio 45241-2012
www.stantec.com

Client/Project
INDIANA-KENTUCKY ELECTRIC CORPORATION

CLIFTY CREEK COAL ASH LANDFILL MODIFICATION
JEEFERSON COUNTY, MADISON TOWNSHIP, INDIANA

Title
PHASE 1 EXISTING CONDITIONS (JUNE 2018)

Permit-Seal
JACQUELINE S. HARMON REGISTERED No. 10911138 STATE OF INDIANA PROFESSIONAL ENGINEER
7/13/2018

Project Number: 175538039

File Name: 38036-18-01.dwg | MJ Dwn. | JSH Chkd. | JSH Dsgn. | 18.07.16 YY.MM.DD

Drawing No. 1
Revision - Sheet 1 of 8

APPENDIX C

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 °