Gavin Bottom Ash Pond

Gavin Power, LLC

2020 Annual Groundwater Monitoring and Corrective Action Report

Gavin Power Plant
Cheshire, Ohio

31 January 2021

Project No.: 0545239

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Gavin Bottom Ash Pond

2020 Annual Groundwater Monitoring and Corrective Action Report

Gavin Power Plant
Cheshire, Ohio

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Acronyms and Abbreviations

Name	Description
ASD	Alternate Source Demonstration
BAC	Bottom Ash Complex
BAP	Bottom Ash Pond
CCR	Coal combustion residual
CFR	Code of Federal Regulations
ERM	ERM Consulting & Engineering, Inc.
Gavin	Gavin Power, LLC
Plant	General James M. Gavin Power Plant
SSI	Statistically significant increase
TDS	Total dissolved solids

EXECUTIVE SUMMARY

On behalf of Gavin Power, LLC (Gavin), ERM Consulting & Engineering, Inc. (ERM) has prepared this *2020 Annual Groundwater Monitoring and Corrective Action Report* summarizing groundwater sampling activities at the Bottom Ash Pond (BAP) at the General James M. Gavin Power Plant (Plant) located in Cheshire, Ohio. The BAP is one of three regulated coal combustion residual (CCR) management units at the Plant that are subject to regulation under Title 40, Code of Federal Regulations, Part 257, Subpart D (40 CFR § 257.50 *et seq*.), also known as the CCR Rule. A review of the CCR monitoring well network is documented in the *Groundwater Monitoring Network Evaluation* for the BAP (Geosyntec 2016).

This report documents the status of the groundwater monitoring program for the BAP, which includes the following as required by 40 CFR § 257.90(e):

- A summary of key actions completed;
- A description of problems encountered and actions taken to resolve the problems; and
- Identification of key activities for the coming year.

The BAP CCR unit groundwater monitoring program began 2020 in a “detection monitoring” program status as defined by 40 CFR § 257.94 and remained in detection monitoring at the end of the 2020 reporting period. Groundwater monitoring in 2020 consisted of two semi-annual monitoring events completed in March and September 2020 that included groundwater level measurements and subsequent groundwater sampling. Groundwater level measurements were used to construct an updated groundwater potentiometric surface map.

Groundwater samples were collected for laboratory analysis of CCR Rule Appendix III constituents and the results were compared to previously calculated upgradient well prediction limits to identify statistically significant increases (SSIs) for downgradient wells. The following locations and analytes exhibited SSIs in 2020:

Well	Date Sampled	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids (TDS)
BAC-02	Mar-2020	X	X	X	X	X	X	X
	Sep-2020	X	ϕ	X	ϕ	X	X	X
BAC-03	Mar-2020	X	ϕ	X	ϕ	X	X	X
	Sep-2020	X	ϕ	X	ϕ	X	X	ϕ
BAC-04	Mar-2020	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2020	X	ϕ	X	ϕ	X	X	ϕ
BAC-05	Mar-2020	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2020	X	ϕ	X	ϕ	X	X	ϕ

Notes: ϕ = No SSI; X = SSI; SSI = statistically significant increase

Each identified SSI was evaluated in the corresponding attached Alternate Source Demonstration (ASD) Reports. The ASD reports identify regional background (total dissolved solids [TDS], calcium, chloride, fluoride, and sulfate), mixing of upgradient groundwater and Ohio River surface water (pH), and the Kyger Creek North Fly Ash Pond (boron) as the sources of these SSIs; therefore, these wells remained in detection monitoring at the conclusion of 2020. Accordingly, no remedial actions were selected, initiated or performed in 2020.

1. INTRODUCTION

The General James M. Gavin Power Plant is a coal-fired generating station located in Gallia County in Cheshire, Ohio, along the Ohio River. The Plant encompasses three regulated coal combustion residual (CCR) management units that are subject to regulation under Title 40, Code of Federal Regulations, Part 257, Subpart D (40 CFR § 257.50 *et seq.*), also known as the CCR Rule: the Residual Waste Landfill (RWL), the Fly Ash Reservoir (FAR), and the Bottom Ash Pond. The BAP is south of the main Plant area and adjacent to the Ohio River (Figure 1-1). The BAP, together with the smaller Reclaim Pond, makes up the Bottom Ash Complex (BAC), which has operated since 1974. Bottom ash slurry is pumped into the BAP where the surficial water is decanted through a reinforced concrete drop inlet structure into the Reclaim Pond. The water in the Reclaim Pond is either pumped to the Plant for reuse or discharged to the Ohio River via an overflow structure subject to the Gavin National Pollution Discharge Elimination System (NPDES) permit. The Reclaim Pond is not intended to, and does not receive any significant amount of CCR from the BAP; was not designed to retain an accumulation of CCR; and does not treat, store, or dispose of CCR. Therefore, it is not subject to the CCR Rule.

ERM Consulting & Engineering, Inc. produced this report on behalf of Gavin Power, LLC. The report documents the status of the groundwater monitoring program for the BAP, which includes the following as required by 40 CFR § 257.90(e):

- A summary of key actions completed;
- A description of problems encountered and actions taken to resolve the problems; and
- Identification of key activities for the coming year.

Consistent with the notification requirements of the CCR Rule, this annual groundwater monitoring report will be posted to the Plant operating record no later than 31 January 2021 (40 CFR § 257.105(h)(1)). Within 30 days of placing the report in the operating record, notification will be made to the Ohio Environmental Protection Agency, and the report will be placed on the Plant publicly-accessible internet site (40 CFR § 257.106(h)(1), 257.107(h)(1)). Table 1-1 cross-references the reporting requirements under the CCR Rule with the contents of this report.

Table 1-1: Regulatory Requirement Cross-References

Regulatory Citation in 40 CFR Part 257, Subpart D	Requirement (paraphrased)	Where Addressed in This Report
§ 257.90(e)	Status of the groundwater monitoring program.	Section 2
§ 257.90(e)	Summarize key actions completed.	Section 2.3
§ 257.90(e)	Describe any problems encountered and actions taken to resolve problems.	Section 2.3
§ 257.90(e)	Key activities for upcoming year.	Section 4.0
§ 257.90(e)(1)	Map, aerial image, or diagram of coal combustion residual (CCR) Unit and monitoring wells.	Figures 1-1, 2-1
§ 257.90(e)(2)	Identification of new monitoring wells installed or abandoned during the preceding year and narrative description.	Section 2.4
§ 257.90(e)(3)	Summary of groundwater data, wells sampled, date sampled, and whether sampling was required under detection or assessment monitoring.	Section 2.3, 3.2, Appendix C
§ 257.90(e)(4)	Narrative discussion of any transition between monitoring programs.	Section 4.0
§ 257.93(c) (via § 257.90(e)(5))	Rate and direction of groundwater flow each time groundwater is sampled	Section 3.1
§ 257.94(e)(2) (via § 257.90(e)(5))	Any Alternate Source Demonstration (ASD) reports and related certifications.	Appendices A–B

2. PROGRAM STATUS § 257.90(E)

2.1 Monitoring Well Network

The groundwater monitoring well network consists of three upgradient monitoring wells (BAC-01, MW-1, and MW-6) and four downgradient monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05). All of the monitoring wells are screened in the uppermost aquifer around the BAP. The uppermost aquifer is approximately 25 feet to 35 feet thick and consists of fine to coarse sand; it is located below an approximately 20-foot thick confining layer of silty clay with interbedded sand and silt, and above a shale bedrock unit. Two new monitoring wells (BAC-06 and BAC-07) were installed at the southern boundary of the Bottom Ash Pond in 2020 and are being evaluated for addition to the monitoring program.

Figure 2-1 provides the monitoring well locations on the site location map.

2.2 Previous Groundwater Monitoring Activities

The BAP monitoring wells were initially sampled eight times between August 2016 and July 2017 to establish upgradient well baseline data. Consistent with the CCR Rule and the *Groundwater Monitoring Plan Appendix G Statistical Analysis Plan* (ERM 2017), a prediction limit approach was used to identify potential future impacts to groundwater. After subsequent groundwater sampling events in July 2017, May and September 2018, and March and September 2019, the prediction limits were compared to the results from the downgradient wells to identify statistically significant increases. Alternate Source Demonstration (ASD) Reports were developed for each sampling event discussing each SSI, which concluded that SSIs resulted from alternate sources, and thus the CCR unit remained in detection monitoring (ERM 2018b; ERM 2018c; ERM 2019b; ERM 2019c; ERM 2020b). Table 2-1 summarizes the SSIs that have been identified in the *2017*, *2018*, and *2019 Annual Groundwater Monitoring and Corrective Action Reports* (ERM 2018a; ERM 2019a; ERM 2020a).

Table 2-1: Previous SSIs for Downgradient Wells

Well	Date Sampled	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids (TDS)
BAC-02	Jul-2017	X	X	X	ϕ	X	X	X
	May-2018	X	X	X	ϕ	X	X	X
	Sep-2018	X	X	X	X	X	X	X
	Mar-2019	X	X	X	ϕ	X	X	X
	Sep-2019	X	X	X	ϕ	X	X	X
BAC-03	Jul-2017	X	ϕ	X	ϕ	X	X	ϕ
	May-2018	X	ϕ	X	ϕ	X	X	X
	Sep-2018	X	ϕ	X	ϕ	X	X	ϕ
	Mar-2019	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2019	X	ϕ	X	ϕ	X	X	ϕ
BAC-04	Jul-2017	X	ϕ	X	ϕ	X	X	X
	May-2018	X	ϕ	X	ϕ	X	X	X
	Sep-2018	X	ϕ	X	ϕ	X	X	ϕ
	Mar-2019	X	ϕ	X	ϕ	X	X	X
	Sep-2019	X	ϕ	X	ϕ	X	X	ϕ
BAC-05	Jul-2017	X	ϕ	ϕ	X	X	X	ϕ
	May-2018	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2018	X	ϕ	X	ϕ	X	X	ϕ
	Mar-2019	X	ϕ	X	ϕ	X	X	ϕ
	Sep-2019	X	ϕ	X	ϕ	X	X	ϕ

Notes: ϕ = No SSI; X = SSI; SSI = statistically significant increase

2.3 2020 Sampling Summary

BAP groundwater monitoring for 2020 was performed under the detection monitoring program, and each of the seven monitoring wells was sampled in March and September 2020 for the 40 CFR Part 257, Subpart D, Appendix III analytes. Table 2-2 provides a summary of the 2020 sample dates and the well gradient designation (upgradient or downgradient) from the CCR unit.

Table 2-2: Sampling Dates for Each Well

Well	Location	Sampling Date			
		11 Mar 2020	12 Mar 2020	9 Sept 2020	10 Sept 2020
BAC-01	Upgradient	X		X	
BAC-02	Downgradient	X		X	
BAC-03	Downgradient		X		X
BAC-04	Downgradient		X		X
BAC-05	Downgradient	X			X
BAC-06	Upgradient				X
BAC-07	Upgradient			X	
MW-1	Upgradient	X			X
MW-6	Upgradient	X		X	

Notes: BAC-06 and BAC-07 were installed in June 2020 and were only sampled in Fall 2020

During the March 2020 and September 2020 sampling events, no significant field sampling issues were encountered and therefore no actions were required for resolution.

2.4 Monitoring Well Installation

As originally reported in the *2019 BAP Annual Groundwater Monitoring and Corrective Action Report* (ERM 2020a), Gavin planned to install additional monitoring wells in 2020. In June 2020, Gavin installed two monitoring wells (BAC-06 and BAC-07) along the southern boundary of the BAP to monitor deeper groundwater flowing across the upgradient property boundary. These wells were sampled in the September sampling event and are being evaluated for addition to the groundwater monitoring network under a revised *Monitoring Well Network Certification*.

2.5 Data Quality

Samples collected during 2020 were analyzed by TestAmerica of North Canton, Ohio. All resulting field and laboratory documentation was reviewed to assess the validity, reliability, and usability of the analytical results. Data quality information reviewed included field sampling forms, chain-of-custody documentation, holding times, laboratory methods, laboratory method blanks, laboratory control sample recoveries, field duplicate samples, matrix spikes/matrix spike duplicates, quantitation limits, and equipment blanks. Data qualifiers were appended to the results in the project database as appropriate based on laboratory quality measurements (e.g., control sample recoveries) and field quality measurements (e.g., agreement between normal and field duplicate samples). The data quality review found the laboratory analytical results to be valid, reliable, and usable for decision-making purposes with the listed qualifiers. No analytical results were rejected.

3. 2020 RESULTS

3.1 2020 Groundwater Flow Direction and Velocity

Gavin personnel measured the depth to groundwater in each monitoring well prior to each sampling event. Groundwater elevations, calculated by subtracting the depth to groundwater from the surveyed reference elevation for each well, were established for each sampling event. Potentiometric surface maps based on these data for March and September 2020 are presented on Figure 3-1 and Figure 3-2, respectively.

The hydraulic gradient for both the March 2020 sampling event and the September 2020 sampling event was generally northeast, with both gradients toward the Ohio River.

Measured hydraulic gradients were 0.0008 and 0.0012 in the March and September 2020 sampling events, respectively. Based on the measured hydraulic gradients, an assumed porosity of 0.3, and an estimated hydraulic conductivity of 0.5 centimeters per second based on the particle-size distribution of the sandy alluvium (Freeze and Cherry 1979), the velocity of groundwater in the alluvial aquifer beneath the BAP varied between 1,400 and 2,000 feet per year when the groundwater elevation data were collected. This value is similar to the velocity of groundwater calculated in 2019 (1,400 to 2,200 feet per year).

3.2 Comparison of Results to Prediction Limits

Consistent with the CCR Rule and the *Statistical Analysis Plan* (ERM 2017) in the operating record, a prediction limit approach was used to identify potential impacts to groundwater. Upper prediction limits were developed for the Appendix III parameters; in the case of pH, a lower prediction limit was also developed. The *2017 Annual Groundwater Monitoring and Corrective Action Report* (ERM 2018a) provides documentation of the development of the upper and lower prediction limits for the BAP.

3.2.1 March 2020 Results

Table 3-1 summarizes a comparison of the March 2020 results to the identified SSIs based on prediction limits for Appendix III analytes in the downgradient wells.

Table 3-1: SSIs from March 2020 Sampling Event

Analyte	Monitoring Well			
	BAC-02	BAC-03	BAC-04	BAC-05
Boron	X	X	X	X
Calcium	X	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	X	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
TDS	X	X	ϕ	ϕ

Notes: ϕ = No SSI; X = SSI; SSI = statistically significant increase; TDS = total dissolved solids
Results are for the downgradient wells sampled in March 2020.

March 2020 SSIs were similar to those observed in 2017, 2018 and 2019. Alternate sources were similarly identified for each of the SSIs detected in the March 2020 data and documented in the *Gavin BAP First Semiannual Sampling Event of 2020 ASD Report* (ERM 2020c). This ASD Report identified the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River. The report also identified the regional discharge of groundwater as the source of calcium, chloride, fluoride, sulfate, and total dissolved solids (TDS), and the Kyger Creek North Fly Ash Pond as the source of boron. A copy of *the Gavin BAP First Semiannual Sampling Event of 2020 ASD Report* is included in Appendix A (ERM 2020c).

3.2.2 September 2020 Results

Table 3-2 summarizes a comparison of the September 2020 results to the identified SSIs based on prediction limits for Appendix III analytes in the downgradient wells.

Table 3-2: SSIs from September 2020 Sampling Event

Analyte	Monitoring Well			
	BAC-02	**BAC-03**	**BAC-04**	**BAC-05**
Boron	X	X	X	X
Calcium	ϕ	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	ϕ	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
TDS	X	ϕ	ϕ	ϕ

Notes: ϕ = No SSI, X = SSI; SSI = statistically significant increase; TDS = total dissolved solids
Results are for the downgradient wells sampled in September 2020.

September 2020 SSIs were similar to those observed in 2017, 2018, 2019, and March 2020. Alternate sources were identified for each of the SSIs associated with the September 2020 data and documented in the *Gavin BAP Second Semiannual Sampling Event of 2020 ASD Report* (ERM 2020c). This ASD Report identified the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River. The report also identified the regional discharge of groundwater as the source of chloride, sulfate, and TDS, and the Kyger Creek North Fly Ash Pond as the source of boron. A copy of the *Gavin BAP Second Semiannual Sampling Event of 2020 ASD Report* is included in Appendix B (ERM 2020c).

Appendix C provides a summary of all historical and current analytical results obtained from the BAP groundwater monitoring program.

4. KEY FUTURE ACTIVITIES

The seven ASD Reports prepared to date concluded that sources other than the BAP were responsible for the identified SSIs. As required by 40 CFR § 257.94(e)(2), these demonstrations were completed within 90 days of detecting the SSIs and were certified by a qualified professional engineer. Because it met these requirements, the BAP remains in detection monitoring at the conclusion of 2020. Two semi-annual groundwater sampling events will be performed at the BAP in 2021, and the results will be compared to the prediction limits to identify potential SSIs.

5. REFERENCES

ERM (ERM Consulting & Engineering, Inc.). 2017. *Groundwater Monitoring Plan. Bottom Ash Complex, Fly Ash Reservoir, and Residual Waste Landfill*, *Gavin Plant, Cheshire Ohio*.

ERM. 2018a. *2017 Annual Groundwater Monitoring and Corrective Action Report. Bottom Ash Complex, Gavin Plant, Cheshire Ohio,* dated 1-31-2018.

ERM. 2018b. *Gavin Bottom Ash Complex Alternate Source Demonstration,* dated 7-3-2018.

ERM. 2018c. *First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration. Bottom Ash Complex,* dated 10-12-2018.

ERM. 2019a. *2018 Annual Groundwater Monitoring and Corrective Action Report. Bottom Ash Complex, Gavin Plant, Cheshire Ohio,* dated 1-31-2019.

ERM. 2019b. *Gavin Bottom Ash Complex Second Semiannual Sampling Event of 2018 Alternate Source Demonstration Report*, dated 1-31-2019.

ERM. 2019c. *Gavin Bottom Ash Pond First Semiannual Sampling Event of 2019 Alternate Source Demonstration Report,* dated 11-4-2019.

ERM. 2020a. *2019 Annual Groundwater Monitoring and Corrective Action Report. Bottom Ash Complex, Gavin Plant, Cheshire Ohio,* dated 1-29-2020.

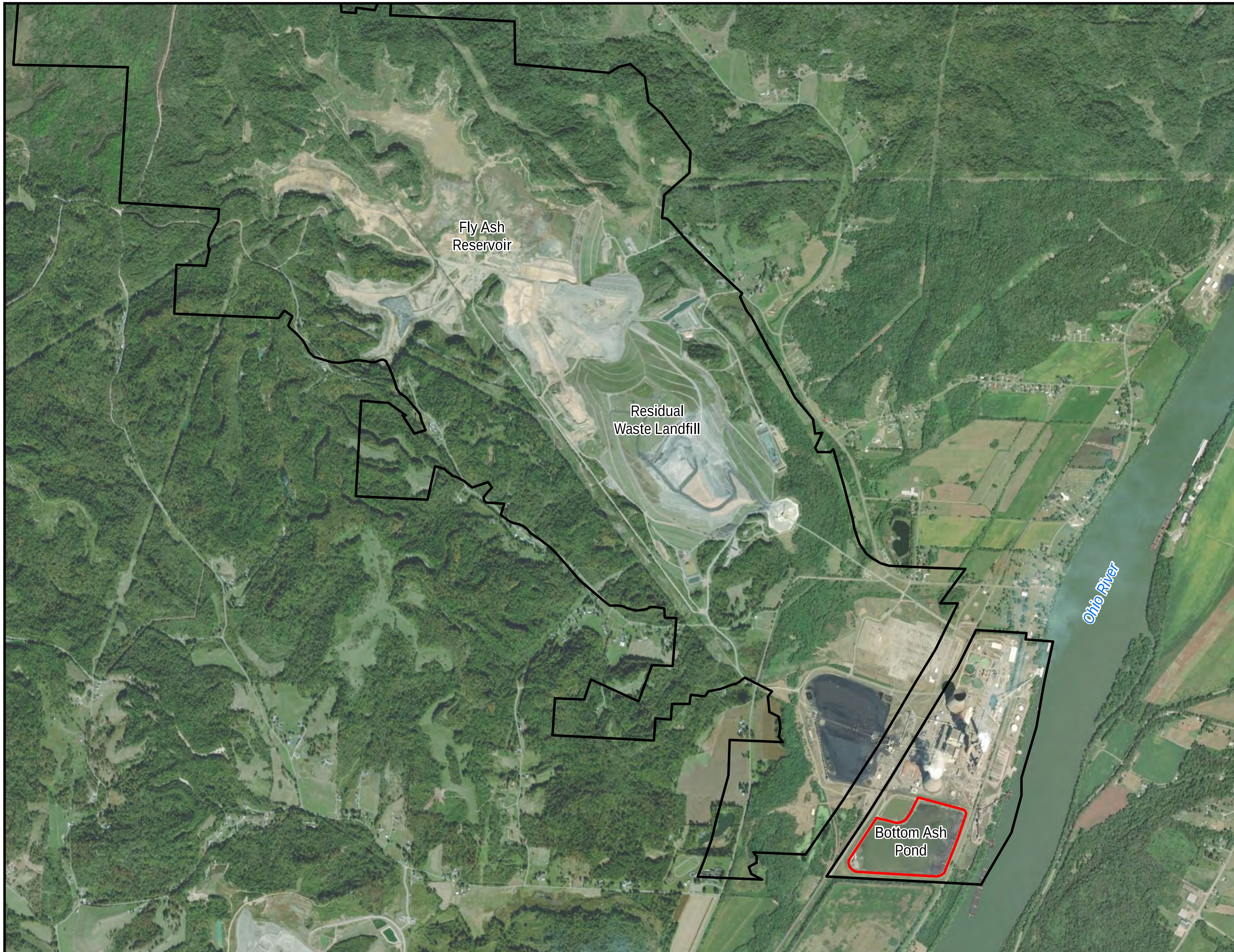
ERM. 2020b. *Gavin Bottom Ash Pond Second Semiannual Sampling Event of 2019 Alternate Source Demonstration Report,* dated 1-31-2020.

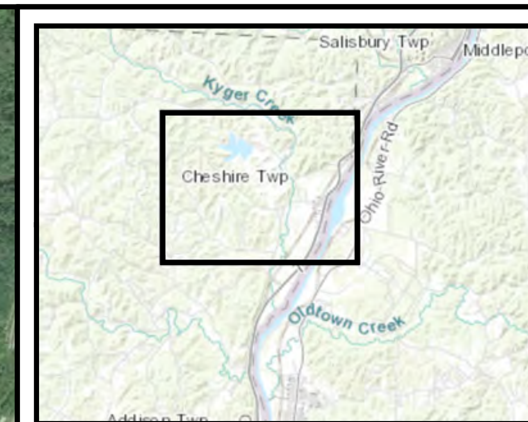
ERM. 2020c. *Gavin Bottom Ash Pond First Semiannual Sampling Event of 2020 Alternate Source Demonstration Report,* dated 8-27-2020.

Freeze, R. and J. Cherry. 1979. *Groundwater*. Upper Saddle River, NJ: Prentice Hall Inc.

Geosyntec. 2016. *Groundwater Monitoring Network Evaluation, Gavin Site—Bottom Ash Complex, Cheshire, Ohio*.

FIGURES





Legend

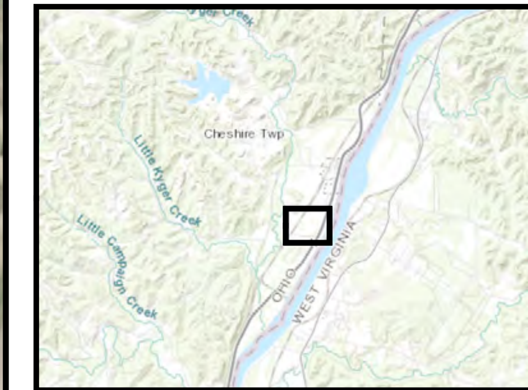
- Bottom Ash Pond
- Gavin Property Boundary

0 500 1,000 2,000 3,000 4,000
Feet

Figure 1-1: Bottom Ash Pond Location
Gavin Generating Station
Cheshire, Ohio

ERM

Figure 2-1: Monitoring Well Network
Gavin Generating Station
Cheshire, Ohio



Legend

- Federal Sampling Program Groundwater Monitoring Well
- 539.85 Groundwater Elevation (ft)
- Interpreted Groundwater Elevation Contour
- Interpreted Groundwater Flow Direction

NOTES:
1. Locations are approximate
2. Groundwater elevations based on measurements made on 3/5/2020
3. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.7

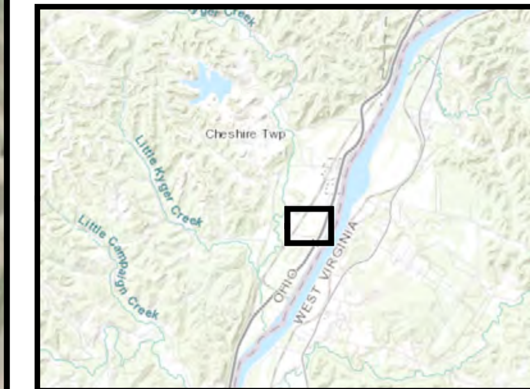
N

0 60 120 240 360 480
Feet

Figure **3-1**: March 2020 Groundwater Elevations and Flow Direction

Gavin Generating Station
Cheshire, Ohio

ERM



Legend

- Federal Sampling Program Groundwater Monitoring Well
- 539.85 Groundwater Elevation (ft)
- Interpreted Groundwater Elevation Contour
- Interpreted Groundwater Flow Direction

NOTES:
1. Locations are approximate
2. Groundwater elevations based on measurements made on 9/2/2020
3. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.7

N

0 60 120 240 360 480
Feet

Figure 3-2: September 2020 Groundwater Elevations and Flow Direction
Gavin Generating Station
Cheshire, Ohio

ERM

APPENDIX A GAVIN BOTTOM ASH POND FIRST SEMIANNUAL SAMPLING EVENT OF 2020 ALTERNATE SOURCE DEMONSTRATION REPORT

Gavin Bottom Ash Pond

Gavin Power, LLC

First Semiannual Sampling Event of 2020 Alternate Source Demonstration Report

Gavin Power Plant
Cheshire, Ohio

27 August 2020

Project No.: 0545239

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27 August 2020

Gavin Bottom Ash Pond

First Semiannual Sampling Event of 2020 Alternate Source Demonstration Report

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Acronyms and Abbreviations

Name	Description
ASD	Alternate Source Demonstration
BAC	Bottom Ash Complex
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCR Rule	Coal Combustion Residuals in Landfills and Surface Impoundments
CFR	Code of Federal Regulations
Gavin	Gavin Power, LLC
mg/L	milligrams per liter
NFAP	North Fly Ash Pond
Plant	General James M. Gavin Power Plant
SFAP	South Fly Ash Pond
SSI	Statistically significant increase
TDS	Total Dissolved Solids
USGS	United States Geological Survey

1. INTRODUCTION

1.1 Regulatory and Legal Framework

In accordance with 40 Code of Federal Regulations (CFR), Part 257, Subpart D—Standards for the Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments (CCR Rule)—Gavin Power, LLC (Gavin) has been implementing the groundwater monitoring requirements of 40 CFR § 257.90 *et seq.* for its Bottom Ash Pond (BAP) CCR Surface Impoundment at the General James M. Gavin Power Plant (Plant). Gavin calculated background levels and conducted statistical analyses for Appendix III constituents in accordance with 40 CFR § 257.93(h). Currently, Gavin is performing detection monitoring at the BAP in accordance with 40 CFR § 257.94. Statistically significant increases (SSIs) over background concentrations were detected in downgradient monitoring wells for Appendix III constituents for the first semiannual groundwater sampling event of 2020 and are explained in this Alternate Source Demonstration (ASD) Report.

An SSI for one or more Appendix III constituents is a potential indication of a release of constituents from the CCR unit to groundwater. In the event of an SSI, the CCR Rule provides that “the owner or operator may demonstrate that a source other than the CCR unit caused the SSI over background levels for a constituent or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality” (40 CFR § 257.94(e)(2)). If it is demonstrated that the SSI is due to a source other than the CCR unit, then the CCR unit may remain in the Detection Monitoring Program instead of transitioning to an Assessment Monitoring Program. An ASD must be made in writing and the accuracy of the information must be verified through certification by a qualified Professional Engineer (40 CFR § 257.94(e)(2)).

The United States Environmental Protection Agency’s guidance document, “Solid Waste Disposal Facility Criteria Technical Manual, EPA530-R-93-017, Subpart E” (USEPA 1993), specifies six lines of evidence (listed below) that must be addressed to determine whether an SSI resulted from a source other than the regulated disposal unit.

1. An alternative source exists.
2. A hydraulic connection exists between the alternative source and the well with the significant increase.
3. Constituent(s) (or precursor constituents) are present at the alternative source or along the flow path from the alternative source prior to possible release from the unit.
4. The relative concentration and distribution of constituents in the zone of contamination are more strongly linked to the alternative source than to the unit when the fate and transport characteristics of the constituents are considered.
5. The concentration observed in groundwater could not have resulted from the unit given the waste constituents and concentrations in the unit leachate and wastes, and the site hydrogeologic conditions.
6. The data supporting conclusions regarding the alternative source are historically consistent with the hydrogeologic conditions and findings of the monitoring program.

This ASD Report addresses each of these lines of evidence for the SSIs detected in groundwater beneath the BAP.

1.2 Background

The Plant is a coal-fired generating station located in Gallia County in Cheshire, Ohio, along the Ohio River (Figure 1-1). The BAP is one of three CCR units at the Plant that are subject to regulation under the CCR Rule and is located adjacent to and immediately south of the main Plant area along the Ohio River (Figure 1-2). Adjacent to the BAP is the smaller Reclaim Pond (Figure 1-3). The BAP and the smaller Reclaim Pond make up the Bottom Ash Complex (BAC), which has operated since 1974.

The groundwater monitoring well network consists of three upgradient monitoring wells (BAC-01, MW-1, and MW-6) and four downgradient monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05) positioned around the perimeter of the BAP (Figure 1-3). In addition, Monitoring Well B-0904 is located south of the BAP and is used in this ASD Report to define the baseline groundwater quality migrating from the Kyger Creek North Fly Ash Pond (NFAP) under the BAP. The uppermost alluvial aquifer (Figure 2-1) monitored by the groundwater well network exhibits the following characteristics (Geosyntec 2016):

- The alluvial aquifer consists of fine to coarse sand with some gravel that grades progressively finer with decreasing depth;
- It is approximately 25-feet to 35-feet thick in the BAP area; and
- It is located below an approximate 20-foot-thick silty clay confining layer and above a shale bedrock unit of the Conemaugh Group.

Consistent with the CCR Rule and the Groundwater Monitoring Plan developed for Gavin (ERM 2017), a prediction limit approach was used to identify potential effects to groundwater. Upper prediction limits, and a lower prediction limit specifically for pH, were established based on the upgradient groundwater data. The 2017 Annual Groundwater Monitoring and Corrective Action Report was prepared to document the status of the groundwater monitoring program for the BAP (ERM 2018a) and included results from eight sampling events performed from August 2016 to August 2017. The 2017 report compared upper and lower prediction limits to the most recent results from the downgradient wells. Additionally, ASDs (ERM 2018b-ERM 2019b, and ERM 2020c) addressed SSIs which occurred during their respective reporting periods.

The first semiannual groundwater sampling event of 2020 was performed in March 2020. The data from this sampling event were compared to the upper and lower prediction limits and SSIs for Appendix III analytes were determined. Table 1-1 summarizes occurrences of SSIs from the March 2020 sampling event.

Table 1-1: SSIs in Groundwater beneath the BAP

Analyte	Monitoring Well			
	BAC-02	**BAC-03**	**BAC-04**	**BAC-05**
Boron	X	X	X	X
Calcium	X	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	X	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
Total Dissolved Solids	X	X	ϕ	ϕ

Notes: ϕ = No SSI; X = SSI; BAP = Bottom Ash Pond; SSI = statistically significant increase.
Results are for the downgradient wells sampled in March 2020.

Consistent with previous ASD Reports, this ASD Report identifies the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River. This ASD Report also identifies the regional discharge of groundwater as the source of calcium, chloride, fluoride, sulfate, and total dissolved solids (TDS); the Kyger Creek NFAP is identified as the source of boron. Supporting information and additional discussion of each of the lines of evidence discussed in Section 1.1 are presented in subsequent sections of this ASD Report.

2. DESCRIPTION OF ALTERNATE SOURCES

The first ASD Report for the BAP (ERM 2018b) identified and described in detail three alternate sources for the Appendix III constituents: the Ohio River, the regional geology, and the neighboring Kyger Creek Generating Station. A summary of each of these alternate sources is provided below.

2.1 Ohio River

The Ohio River extends approximately 981 river miles from Pittsburgh, Pennsylvania to Cairo, Illinois and drains an area of approximately 205,000 square miles (ORSANCO 2018). The Ohio River is approximately 700 feet east of the BAP, and the alluvial aquifer beneath the BAP is hydraulically connected to the river. When the Ohio River floods, water from the river mixes with groundwater within the alluvial aquifer (ERM 2018b) beneath the BAP. The mixing of groundwater and river water is discussed in Section 3; the quality of the Ohio River water that mixes with groundwater is discussed in Section 4.

2.2 Regional Background

The regional bedrock geology near the Plant includes Pennsylvanian-age sedimentary rocks from the Monongahela and Conemaugh Formations, with the Morgantown and Cow Run Sandstone members being part of the latter. These sedimentary rocks consist primarily of shale and siltstone, with minor amounts of mudstone, sandstone, and incidental amounts of limestone and coal (USGS 2005). Overlying the Pennsylvanian-age rocks are Quaternary-age alluvium that consists primarily of sand, silt, clay, and gravel (OEPA 2018). The sedimentary rocks form the ridges and valleys west of the Ohio River, and the unconsolidated sand, silt, clay, and gravel, are located along the Ohio River and tributaries. The consolidated sedimentary rocks and the unconsolidated alluvium form the two major aquifers near the Plant (Figure 2-1). The interaction of groundwater with rocks and minerals within these aquifers can influence the concentration of Appendix III constituents, for example via dissolution (ORSANCO 1984).

Naturally occurring brine, which is known to be rich in calcium, chloride, sulfate, fluoride, and other trace elements, exists in the subsurface in the Ohio River Valley (Stout et al. 1932; ORSANCO 1984; ODNR 1995). Some of the brines also exist close to the land surface. For example, brine was discovered at the land surface approximately 10 miles southwest of the Plant in Gallipolis, Ohio and was utilized for the commercial production of salt starting in 1807 (Geological Survey of Ohio 1932). Naturally occurring brine was also identified at the land surface in Jackson, Ohio approximately 30 miles west of the Plant (ODNR 1995). The regional presence of shallow brine indicates the potential for naturally occurring brine to contribute Appendix III constituents to groundwater at the Plant.

To account for natural and anthropogenic influences on Appendix III constituents on a regional scale, background groundwater data were obtained from United States Geological Survey (USGS) databases. The background groundwater data set is discussed further in Section 4.

2.3 Kyger Creek Generating Station

The Kyger Creek Generating Station is located along the Ohio River in Gallia County, south of the Plant (Figure 2-2). The Kyger Creek Fly Ash Pond complex consists of the 110-acre NFAP and 60-acre South Fly Ash Pond (SFAP). The construction history and groundwater monitoring results of these ponds are summarized in the first ASD Report (ERM 2018b). The Kyger Creek NFAP is located less than 300 feet from the BAP and the units share an approximately 2,000-foot-long border (Figure 2-2). The Kyger Creek NFAP has a higher potential to impact groundwater than the BAP because the Kyger Creek NFAP contains fly ash, which when compared to bottom ash, has a greater tendency to leach CCR constituents due to higher concentrations of CCR constituents and increased surface area due to smaller particle size (Cox et al. 1978; Jones et al. 2012) which is described further in Section 7.

3. HYDRAULIC CONNECTIONS TO THE ALTERNATE SOURCES

Explanations of the hydraulic connections between potential alternate sources and the downgradient wells of the BAP were previously provided in the first ASD Report for the BAP (ERM 2018b). A summary of each of these connections is provided below.

3.1 Ohio River

Both the Gavin BAP and the Kyger Creek NFAP are located above the alluvial aquifer (Geosyntec 2016; AGES 2016; ERM 2018b). Groundwater in the alluvial aquifer typically flows from the vicinity of the BAP and Kyger Creek NFAP toward the Ohio River (ERM 2018b). Exceptions to this flow direction occur when the river stage (elevation of the surface water in the river) exceeds approximately 540 feet above mean sea level (ERM 2018b). When this occurs, groundwater flow reverses and generally flows westward from the Ohio River toward the BAP and Kyger Creek NFAP (ERM 2018b). The correlation of the flow reversals with Ohio River flooding is strong evidence that the alluvial aquifer is hydraulically connected to the Ohio River (ERM 2018b).

3.2 Regional Background

Regional groundwater within the fractured sedimentary bedrock flows from northwest to southeast toward the Ohio River (ORSANCO 1984). Precipitation that falls in areas of higher topographic elevation northwest of the Plant infiltrates the land surface and recharges the underlying aquifers. Groundwater then flows from areas of higher topographic elevation (which correspond to higher hydraulic pressure) to areas of lower topographic elevation (which correspond to lower hydraulic pressure). As groundwater flows from northwest to southeast, it migrates both horizontally and vertically through a network of fractures within the sedimentary bedrock. Near the Plant, groundwater in the bedrock aquifer mixes with groundwater in the alluvial aquifer, which then discharges to the Ohio River (Figure 3-1). Thus, regional groundwater is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b).

3.3 Kyger Creek Generating Station

The Ohio River stage elevation records were used to identify the frequency and duration of flow reversals and were combined with the groundwater velocity estimates to develop groundwater flow paths under the BAP (ERM 2018b). The following three key points are associated with the interpreted groundwater flow paths:

- The Kyger Creek NFAP is hydraulically upgradient of the four monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05) that are downgradient of the Gavin BAP.
- Due to the northeast flow direction, the Kyger Creek NFAP is not upgradient of the western edge of the BAP—where upgradient Monitoring Wells MW-1, BAC-01, and MW-6 are located.
- State Monitoring Well B-0904 is directly downgradient of the Kyger Creek NFAP and upgradient of the BAP.

It is evident that the Kyger Creek NFAP is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b) based on the average northeastern direction of groundwater flow and the presence of the same alluvial aquifer beneath both the Kyger Creek NFAP and the Gavin BAP.

4. CONSTITUENTS ARE PRESENT AT THE ALTERNATE SOURCES OR ALONG THE FLOW PATHWAYS

4.1 Ohio River

The pH of the Ohio River is near neutral and the pH of groundwater emanating from the Kyger Creek NFAP, as observed in well B-0904, is slightly acidic (ERM 2018b). As described in Section 3, the hydrogeologic data indicate that water from the Ohio River mixes with groundwater in the alluvial aquifer during times of river flooding. This mixing process results in an intermediate pH that is between the pH of the Ohio River and the pH of the Kyger Creek NFAP. Table 4-1 and Figure 4-1 summarize this pattern observed in the March 2020 data.

Table 4-1: Groundwater and Surface Water pH Values

Location	pH
Kyger Creek NFAP Groundwater (B-0904, March 2020)	5.26
BAP Downgradient Groundwater (BAC-02 through BAC-05, March 2020)	6.19–6.43
Ohio River (March 2020)	6.79

Notes: BAP = Bottom Ash Pond; NFAP = North Fly Ash Pond

The March 2020 results remain consistent with previous ASD Reports for the BAP (ERM 2018b-2019b, and 2020c). These results demonstrate that the pH of the Ohio River water is higher than Kyger Creek groundwater; the mixing of these waters results in the intermediate pH observed in groundwater downgradient of the BAP.

4.2 Regional Background

Regional background groundwater quality data were obtained from the USGS National Water Information System database. Groundwater results were selected for monitoring wells constructed within the alluvial, Monongahela Group, and Conemaugh Group aquifers located within 50 miles of the Plant (Figure 4-2). The USGS background data were compared to downgradient BAP data (Wells BAC-02, BAC-03, BAC-04, and BAC-05) and Ohio River data collected in March 2020. As presented in Table 4-2, the concentrations of calcium, chloride, fluoride, sulfate, and TDS in groundwater downgradient of the BAP are generally between the concentrations in USGS background data for groundwater and the Ohio River. These results are consistent with previous ASD Reports for the BAP (ERM 2018b; ERM 2018c; ERM 2019a; ERM 2019b; ERM 2020c) and, along with Figure 3-1, demonstrate that calcium, chloride, sulfate, and TDS are present along flow pathways from the sedimentary bedrock aquifers to the alluvial aquifer beneath the BAP.

Table 4-2: Comparison of USGS Regional Background to BAP and Ohio River

Analyte	Units	USGS Background (Max)	Downgradient BAP[a]	Ohio River[a]
Calcium	mg/L	520	79–140	28
Chloride	mg/L	9,900	29–82	22
Fluoride	mg/L	8.8	0.081–0.18	0.14
Sulfate	mg/L	2,700	200–340	52
TDS	mg/L	9,910	440–880	180

Notes: BAP = Bottom Ash Pond; mg/L = milligrams per liter; TDS = total dissolved solids; USGS = United States Geological Survey.
[a] Results from samples collected in March 2020.

4.3 Kyger Creek Generating Station

The concentration of boron in groundwater downgradient of the BAP (Figure 4-3) ranges from 1.6 milligrams per liter (mg/L) to 2.8 mg/L in the March 2020 samples. Figure 4-3 depicts the distribution of boron at the northern boundary of the Kyger Creek NFAP and along the flow pathways, as summarized by the following points:

- The highest boron concentrations in BAP downgradient wells were measured at wells BAC-05 and BAC-04, which are located closest to and downgradient of the Kyger Creek NFAP. Monitoring Well B-0904 is situated downgradient of the Kyger Creek NFAP and upgradient of the BAP.
- Concentrations decrease with distance downgradient from the Kyger Creek NFAP, along the northeastern flow path.

In addition to the Ohio Environmental Protection Agency correspondence that concluded that groundwater below the Kyger Creek NFAP appears to be impacted by a release from the Kyger Creek NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]), the Kyger Creek SFAP data also suggest that boron is present in groundwater below both Kyger Creek fly ash ponds. Table 4-3 summarizes boron analytical results from eight groundwater sampling events conducted between October 2015 and September 2017 at Kyger Creek SFAP downgradient monitoring wells (AGES 2018).

Table 4-3: Kyger Creek SFAP Boron Results

Analyte	Units	Maximum	Average
Boron	mg/L	17.7	6.8

Notes: mg/L = milligrams per liter; SFAP = South Fly Ash Pond.

The average concentration of boron (6.8 mg/L) in the Kyger Creek SFAP is higher than the highest concentration of boron measured in groundwater beneath the BAP (2.8 mg/L) in March 2020. The Kyger Creek SFAP and NFAP both manage fly ash generated at the Kyger Creek Generating Station; thus, it is reasonable to expect that the chemical characteristics of the landfilled fly ash are similar in both units. Given the elevated boron concentrations in groundwater downgradient of the Kyger Creek SFAP and considering that both units are unlined, elevated concentrations of boron in groundwater downgradient of the Kyger Creek NFAP are expected. Thus, this evidence supports the conclusion that boron is present at the Kyger Creek Generating Station.

5. LINKAGES OF CONSTITUENT CONCENTRATIONS AND DISTRIBUTIONS BETWEEN ALTERNATE SOURCES AND DOWNGRADIENT WELLS

5.1 Ohio River

As described in Section 3 and in detail in the first ASD Report for the BAP (ERM 2018b), the groundwater elevation and flow directions provide strong evidence of groundwater flow reversals and the mixing of Ohio River surface water and groundwater. The intermediate pH of groundwater downgradient of the BAP (i.e., the value between the pH of Kyger Creek groundwater and the pH of the Ohio River) is consistent with the mixing of surface water and groundwater. This evidence suggests there is a linkage between groundwater downgradient of the BAP and the Ohio River.

5.2 Regional Background

As described in Section 3.2 and illustrated on Figure 3-1, groundwater flowing in the sedimentary bedrock aquifers discharges to the alluvial aquifer along the Ohio River, including the portion beneath the BAP. As described in Section 4.2, regional concentrations of calcium, chloride, fluoride, sulfate, and TDS are higher than respective groundwater concentrations downgradient of the BAP. Based on these observations, it is likely that the discharge of groundwater from the sedimentary bedrock aquifers to the alluvial aquifer under the BAP (Figure 5-1 and Figure 5-2) is an alternate source for these constituents. This evidence suggests that there is a linkage between groundwater downgradient of the BAP and regional background.

5.3 Kyger Creek Generating Station

When the river stage is low (Figure 5-1), groundwater in the alluvial aquifer migrates in a northeasterly direction from the Kyger Creek NFAP, under the BAP, and eventually discharges to the Ohio River. During times of higher river stage (Figure 5-2), groundwater in the alluvial aquifer temporarily reverses direction and river water flows into the alluvial aquifer. Despite the temporary reversals of groundwater flow caused by flooding of the Ohio River, the overall, long-term flow direction is to the northeast. This indicates that the source of boron detected in the monitoring wells downgradient of the BAP is the Kyger Creek NFAP.

6. RELEASES FROM THE BAP ARE NOT SUPPORTED AS THE SOURCES

6.1 Chemical Fingerprints

The geochemical fingerprints of surface water from the BAP, groundwater from the BAP, groundwater from the Kyger Creek NFAP, and surface water from the Ohio River were determined using a piper diagram. The piper diagram is a graphical procedure commonly used to interpret sources of dissolved constituents in water and evaluate the potential for mixing of waters from different sources (Piper 1944). The samples presented on the diagram were collected from 2012 through 2020. The primary observations and conclusions based on the BAP piper diagram (Figure 6-1) are the following:

- Multiple samples collected from a single location (e.g., the Ohio River or Well B-0904) tended to be tightly clustered, indicating that the chemical signatures of individual locations were consistent over time.
- Groundwater from BAP upgradient Wells MW-1, BAC-01, and MW-6 has a unique geochemical signature dominated by calcium and bicarbonate. This groundwater flows under the west-northwest portion of the BAP and does not appear to be influenced by the Ohio River or Kyger Creek NFAP.
- Groundwater from Well B-0904, which is downgradient of the Kyger Creek NFAP and upgradient of the BAP, is dominated by calcium and sulfate and has a signature that is distinct from all other chemical signatures on the diagram.
- Surface water from the Ohio River also has a distinct signature that plots closer to the center of the piper diagram.
- Groundwater from BAP downgradient Wells BAC-02, BAC-03, BAC-04, and BAC-05 plots on the piper diagram between the Ohio River and Kyger Creek NFAP groundwater. This is an independent line of evidence that groundwater under a majority of the BAP is a mixture of groundwater from the Kyger Creek NFAP (represented by Well B-0904, which is upgradient of the BAP) and the Ohio River.

Based on the data summarized above and the chemical fingerprints of the groundwater at issue, the BAP is not the source of the SSIs.

7. ALTERNATE SOURCE DATA ARE HISTORICALLY CONSISTENT WITH HYDROGEOLOGIC CONDITIONS

7.1 Ohio River

The hydraulic connection of the Ohio River to the alluvial aquifer was established after the last deglaciation (Kozar and McCoy 2004). Seasonal flooding of the Ohio River, which has occurred regularly over the period that the Plant has existed, is the driving force behind the mixing of surface water and groundwater. Thus, source data for the Ohio River are historically consistent with the hydrogeologic conditions and findings of the monitoring program.

7.2 Regional Background

This ASD Report provides background groundwater quality data for the fractured sedimentary bedrock aquifers found within and beyond the boundary of the Plant. Flow patterns of regional groundwater through fractured bedrock near the BAP were established after the last deglaciation, which occurred approximately 14,000 years ago (Hansen 2017). Assuming a conservatively high effective porosity of 1 percent, results in an estimated groundwater velocity of 80 feet per year for the Morgantown Sandstone and 50 feet per year for the Cow Run Sandstone (ERM 2020b). This would allow ample time for groundwater to migrate from upgradient regional sources onto Plant property since the end of the last glaciation. The data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

7.3 Kyger Creek Generating Station

The Kyger Creek NFAP was constructed in 1955 with its base on native soil, without an engineered liner to contain leachate. The unit was used to manage fly ash until it was drained and closed in 1997, although dewatered ash is still present within the Kyger Creek NFAP. Groundwater flows under the Kyger Creek NFAP in a northeasterly direction toward and under the Gavin BAP. Given the six decades that this unit has contained fly ash and the alluvial aquifer groundwater velocity estimates of 1,400 to 2,200 feet per year (ERM 2020a), ample time has passed for groundwater to migrate from the Kyger Creek NFAP beneath the BAP. The following evidence supports the Kyger Creek NFAP as the alternate source of boron:

- The distribution of boron in groundwater beneath the BAP (Section 4).
- Analytical results from groundwater samples collected below the Kyger Creek SFAP suggest boron is present in Kyger Creek groundwater. Given the similarity in construction and types of CCR managed, it is reasonable to interpret Kyger Creek SFAP groundwater data as representative of Kyger Creek NFAP groundwater quality (Section 4).
- The chemical fingerprinting evidence suggests groundwater from Kyger Creek mixes with Ohio River water under the BAP (Section 6).
- The Ohio Environmental Protection Agency concluded that groundwater appears to be impacted by a release from the Kyger Creek NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]).

In addition, a comparison of the materials managed provides evidence that the BAP is not the source of boron—that the Kyger Creek NFAP is a more likely source of boron. The Kyger Creek NFAP has contained fly ash since 1955, while the BAP has been used primarily for the management of bottom ash since 1974. Bottom ash and fly ash have different physical and chemical properties; laboratory investigations have demonstrated elements (including Appendix III constituents) have a much greater potential to leach from fly ash compared to bottom ash (Cox et al. 1978; Jones et al. 2012). The higher concentrations of boron observed in Kyger Creek SFAP groundwater compared to the lower concentration of boron observed in groundwater downgradient of the BAP are consistent with the known leaching properties of fly ash and bottom ash. Boron, therefore, is more likely to leach from the Kyger Creek SFAP than the BAP based on the historical use of each unit. These observations support the conclusion that the Kyger Creek NFAP, and not the BAP, is the source of boron in groundwater under the BAP. Thus, the data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

8. CONCLUSIONS

The SSIs identified in this ASD Report are based on samples from monitoring wells downgradient of the BAP collected in March 2020. The data were reviewed for quality assurance, statistically analyzed, and reported to Gavin on 05 June 2020. In response to the SSIs, this ASD Report was prepared within the required 90-day period in accordance with 40 CFR § 257.94(e)(2).

All SSIs in the downgradient BAP monitoring wells have been determined to result from alternate sources: mixing with the Ohio River, regional groundwater discharge, and the Kyger Creek Power Plant. Table 8-1 summarizes the six lines of evidence for each of the SSIs.

Table 8-1: BAP ASD Summary

Analyte	SSI Location	Six Lines of Evidence from USEPA Guidance					
		Alternate Source	Hydraulic Connection	Constituent Present at Source or along Flow Path	Constituent Distribution More Strongly Linked to Alternate Source	Constituent Could Not Have Resulted from the BAP	Data Are Historically Consistent with Hydrogeologic Conditions
Boron	BAC-02 BAC-03 BAC-04 BAC-05	Kyger Creek NFAP	X	X	X	X	X
Calcium	BAC-02	Regional Groundwater Discharge	X	X	X	X	X
Chloride	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
Fluoride	BAC-02	Regional Groundwater Discharge	X	X	X	X	X
pH	BAC-02 BAC-03 BAC-04 BAC-05	Mixing with Ohio River	X	X	X	X	X
Sulfate	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
TDS	BAC-02BAC-03	Regional Groundwater Discharge	X	X	X	X	X

Notes: BAP = Bottom Ash Pond; NFAP = North Fly Ash Pond; SSI = statistically significant increase; TDS = total dissolved solids; USEPA = United States Environmental Protection Agency.

In conclusion, the BAP is not the source of the SSIs associated with the first semiannual sampling event groundwater results for 2020. Thus, Gavin will continue detection monitoring at the BAP in accordance with 40 CFR § 257.94(e)(2).

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I, or an agent under my review, have prepared this Alternate Source Demonstration Report for the Bottom Ash Pond and it meets the requirements of 40 CFR § 257.94(e)(2). To the best of my knowledge, the information contained in this Report is true, complete, and accurate.

James A. Hemme, P.E.
State of Ohio License No.: 72851

Date: 08/27/2020

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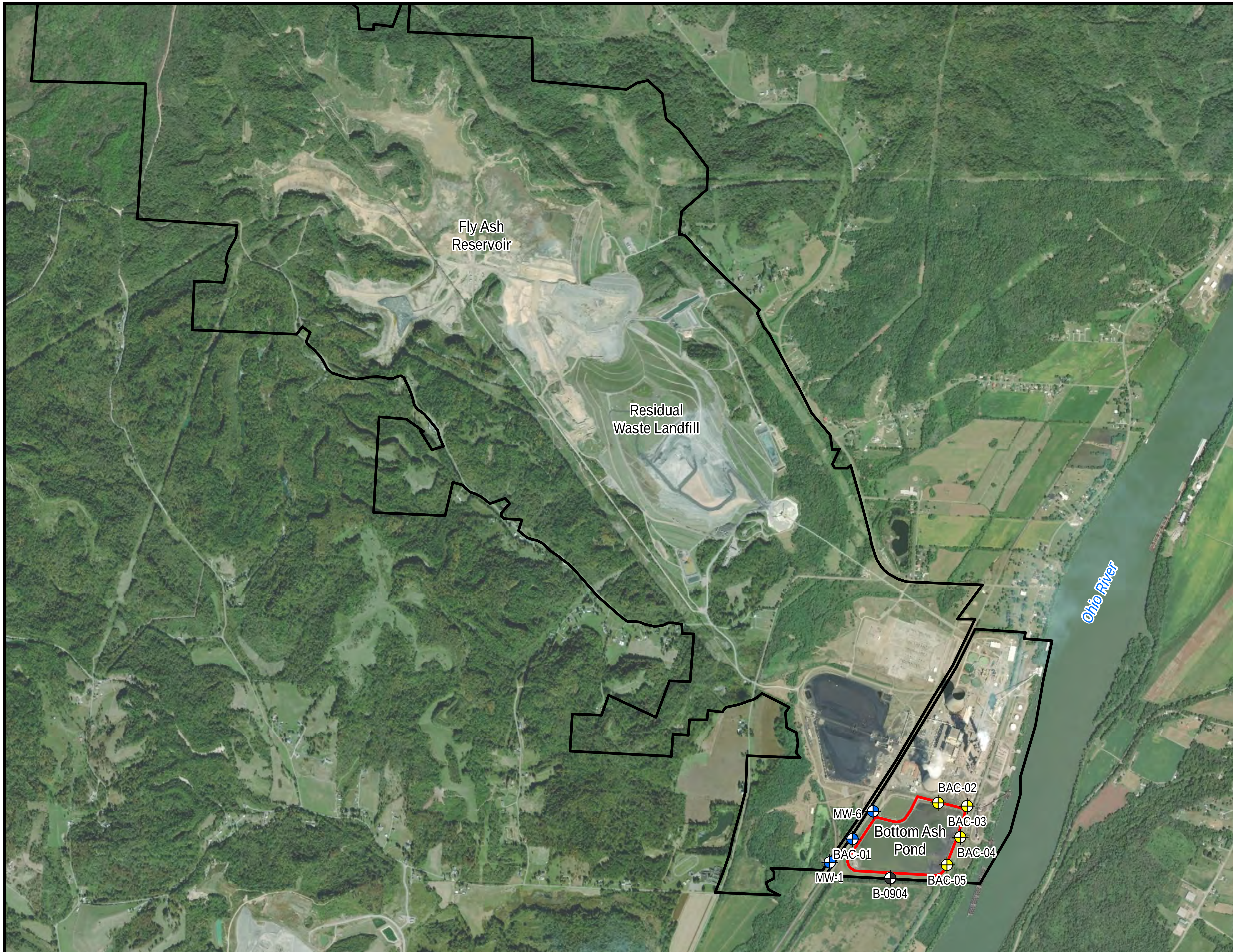
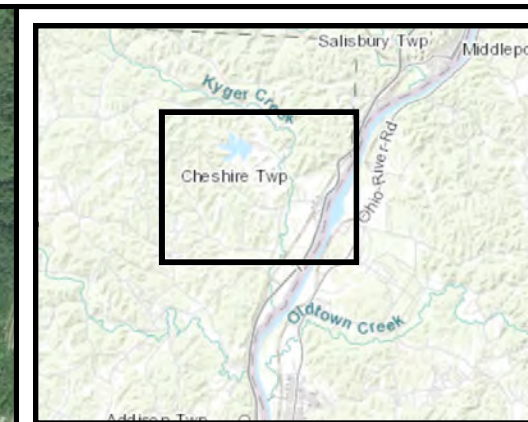
FIGURES

Figure 1-1: Gavin Plant Location
Gavin Generating Station
Cheshire, Ohio





Legend

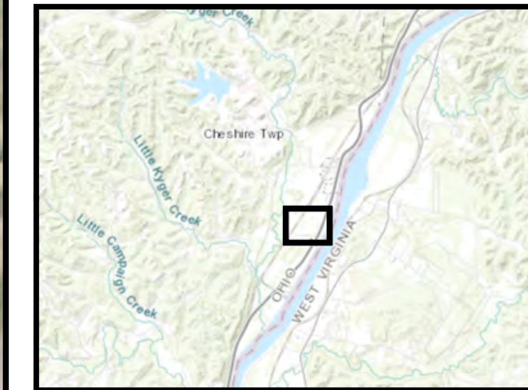
- Federal Upgradient Monitoring Well
- Federal Downgradient Monitoring Well
- Upgradient Monitoring Well (Not in Federal Program)
- Bottom Ash Pond
- Gavin Property Boundary

N

0 500 1,000 2,000 3,000 4,000
Feet

Figure 1-2: Bottom Ash Pond Location
Gavin Generating Station
Cheshire, Ohio

ERM



Legend

- Federal Upgradient Monitoring Well
- Federal Downgradient Monitoring Well
- Upgradient Monitoring Well (Not in Federal Program)

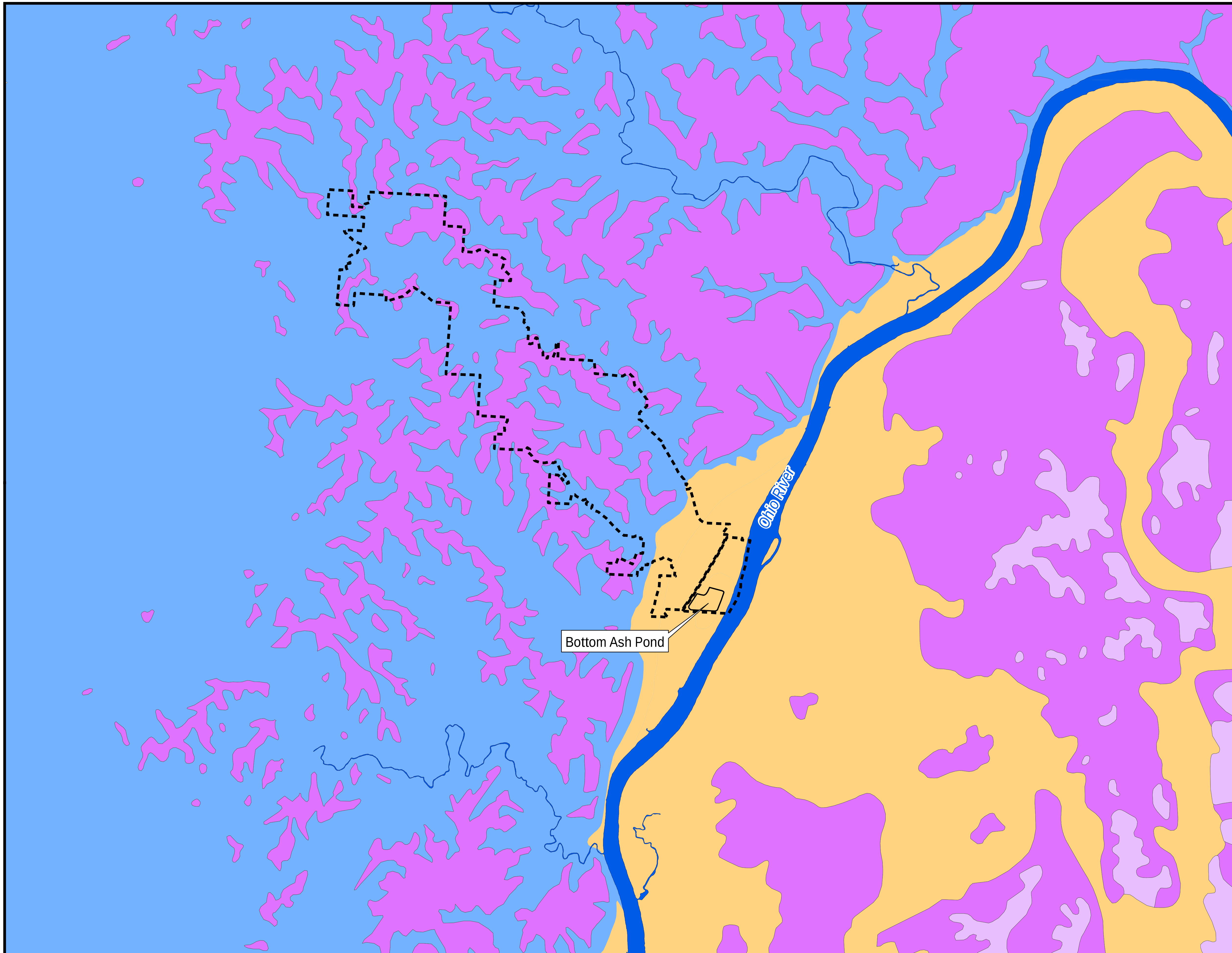
NOTES:
1. Locations are approximate
2. Aerial Imagery: ESRI World Imagery
   Reproduced under license in ArcGIS 10.7

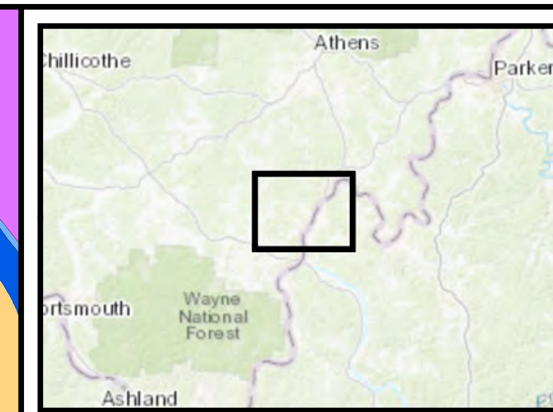
N

0 62.5 125 250 375 500
Feet

Figure 1-3: Existing Monitoring Well Network
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Dunkard Group

Monongahela Group

Conemaugh Group

NOTES:

1. Alluvial aquifer data from Ohio EPA and Sedimentary aquifer data from USGS

N

0 0.25 0.5 1 1.5 2

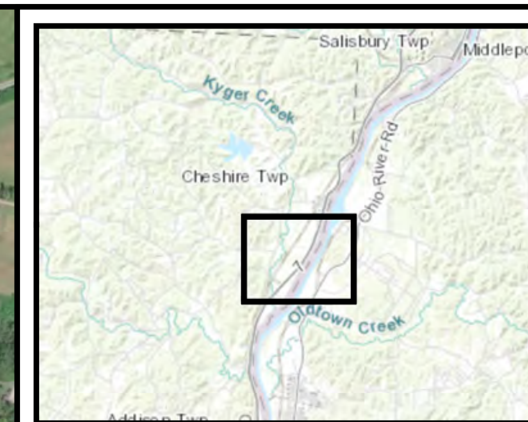
Miles

Figure 2-1: Sedimentary and Alluvial Aquifers

Gavin Generating Station

Cheshire, Ohio

ERM



Legend

- Federal Upgradient Monitoring Well
- Federal Downgradient Monitoring Well
- Upgradient Monitoring Well (Not in Federal Program)
- Gavin Bottom Ash Pond
- Kyger Creek Fly Ash

NOTES:

1. Kyger Creek features are from AEP. 1994. Hydrogeologic Site Investigation Plan for the Proposed North Fly Ash Pond Closure, Kyger Creek Station, Ohio Valley Electric Corporation, Gallia County, Ohio.

N

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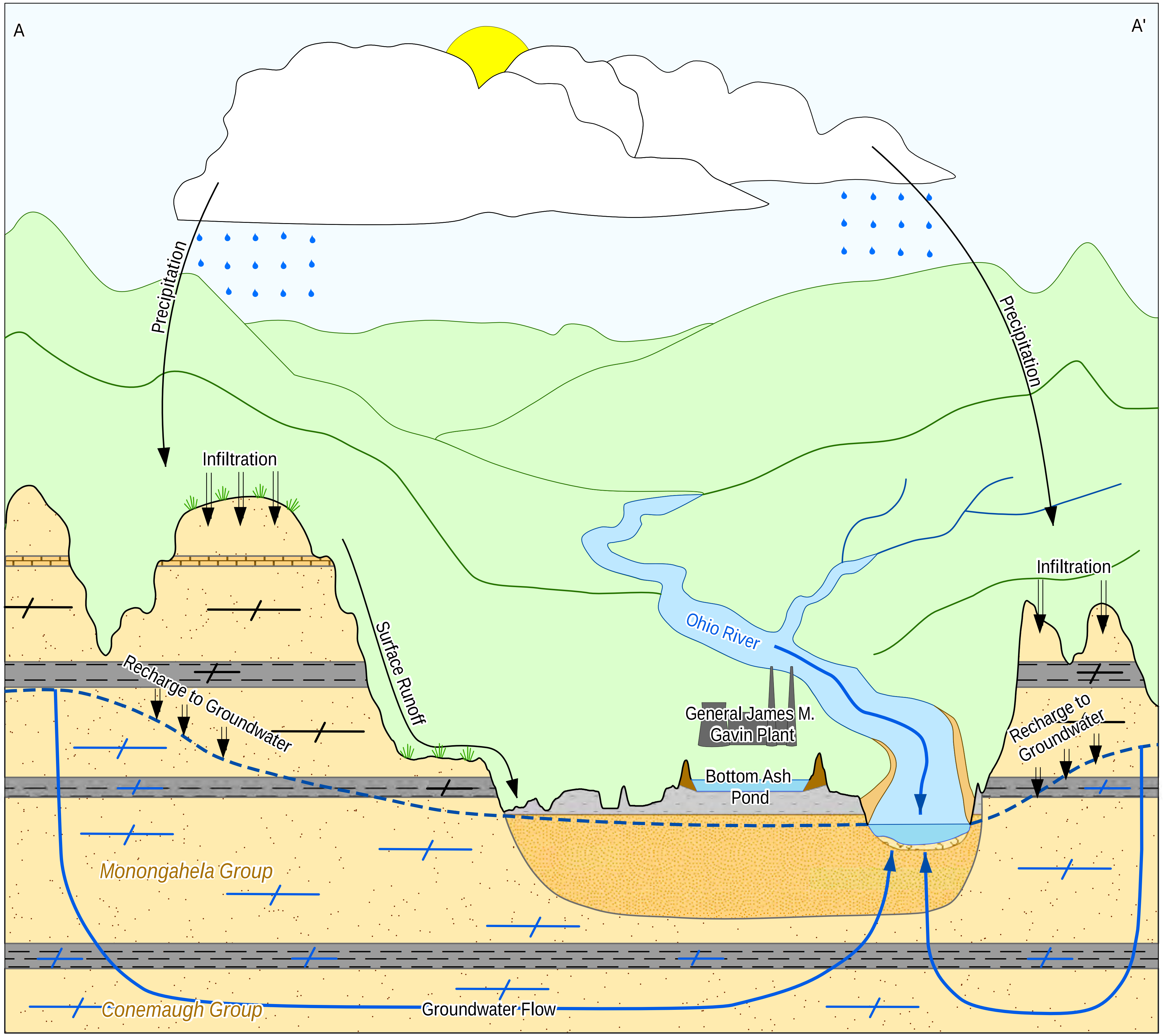
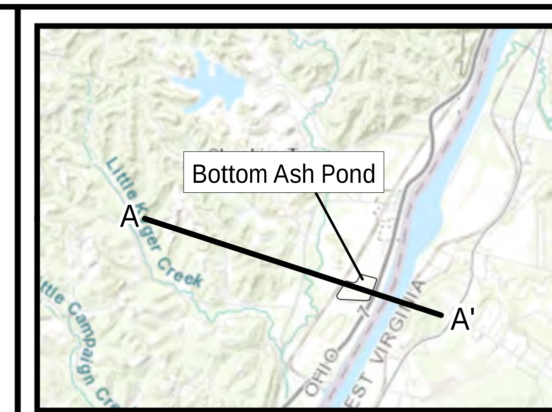
Feet

Figure 2-2: Location of Kyger Creek Generating Station
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

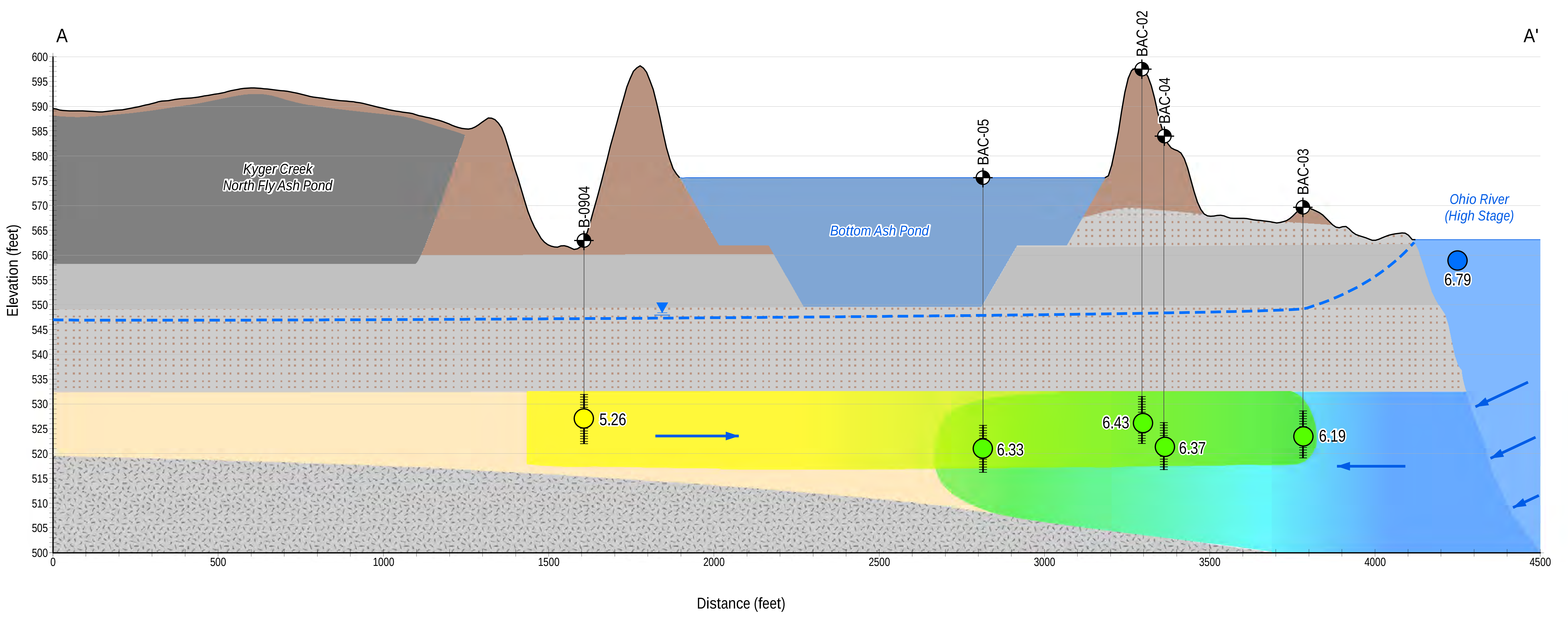
- Groundwater Flow Direction
- Water Table
- Saturated Fractures
- Unsaturated Fractures
- Fill
- Interbedded Silt/Clay
- Sand
- Coarse Sand Deposits
- Sandstone
- Fractured Limestone
- Fractured Shale

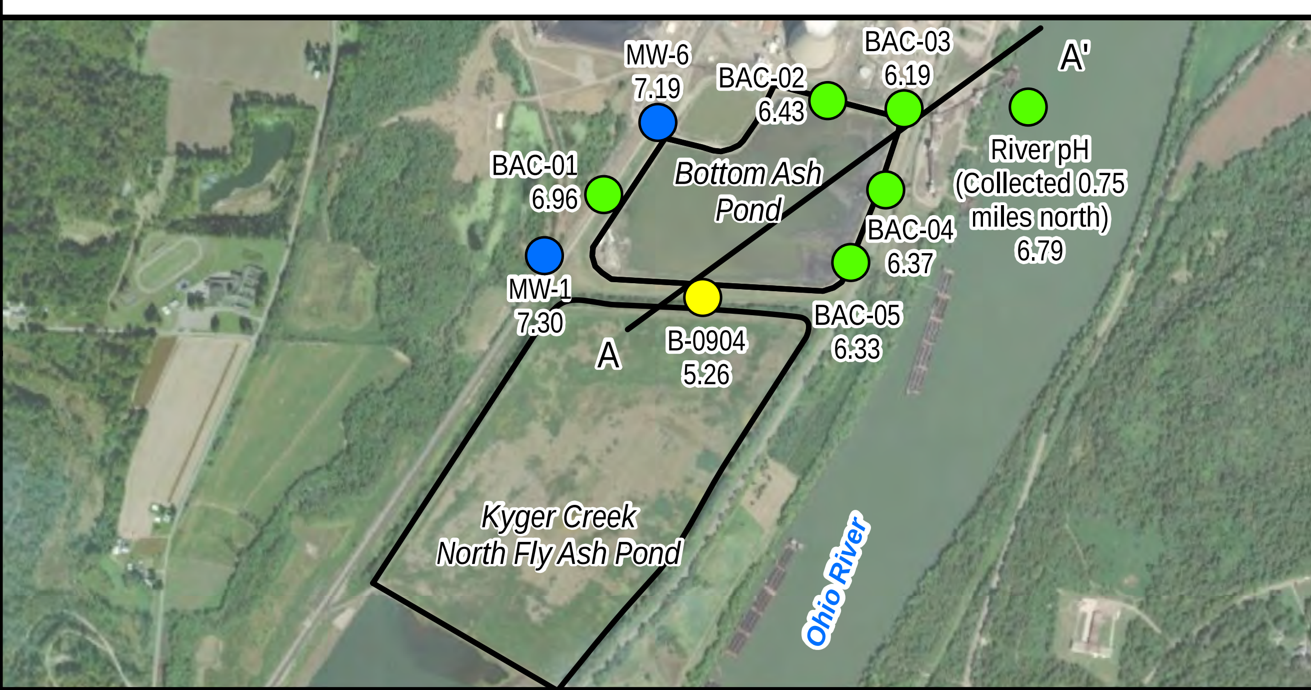
NOTES:
1. Sandstone bedrock units represent the Conemaugh Group and Monongahela Group Sedimentary Aquifers

0 250 500 1,000 1,500 2,000 2,500 3,000
Feet

Figure 3-1: Regional Groundwater Flow Patterns
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Potentiometric Surface
- Interpreted Groundwater Flow Direction

pH (Standard Units)

- <6
- 6 - 6.5
- >6.5

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

NOTE:
- Data collected march 2020

Figure 4-1: pH of the Ohio River and BAP Groundwater
Gavin Generating Station
Cheshire, Ohio

ERM

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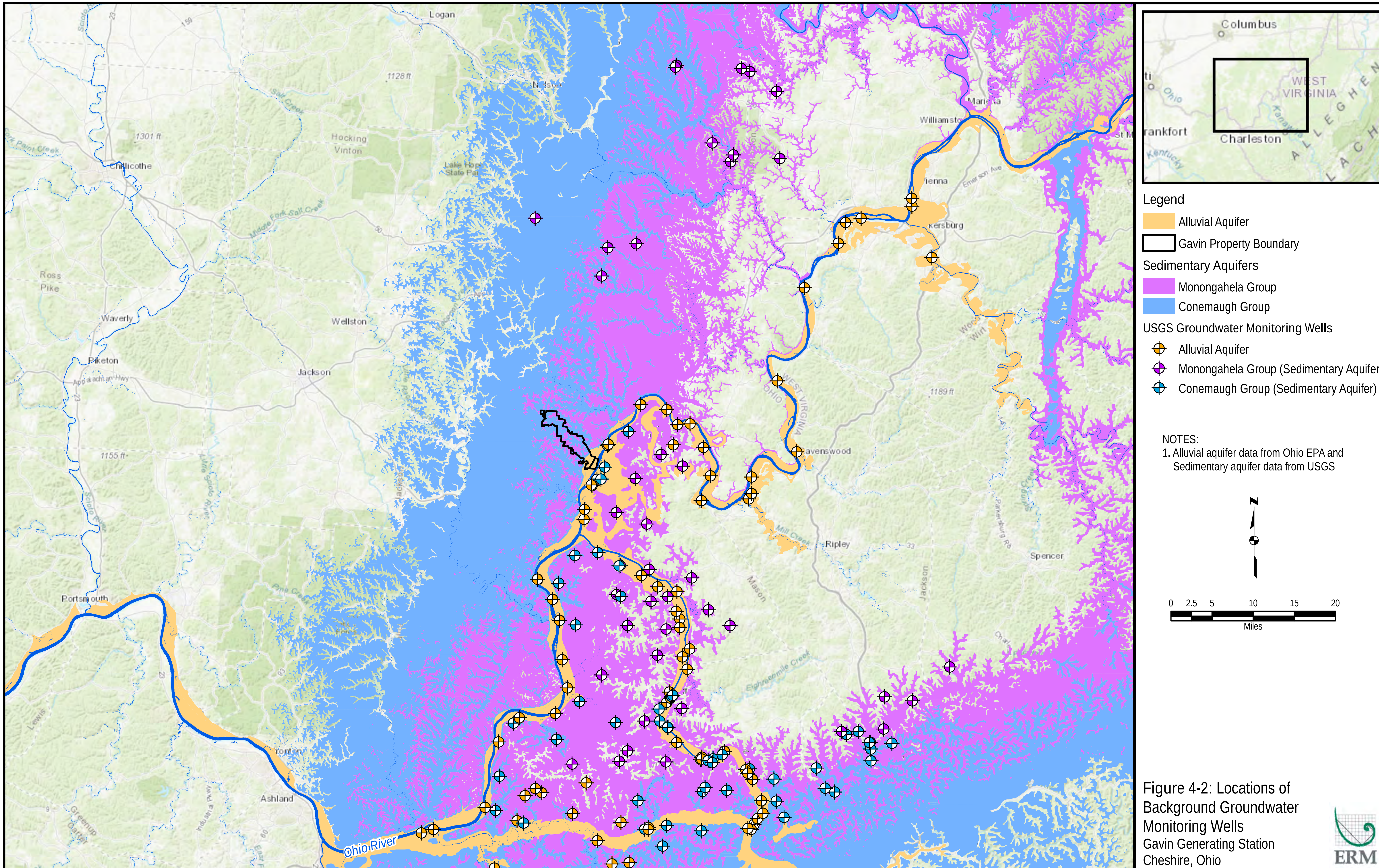


Figure 4-2: Locations of Background Groundwater Monitoring Wells
Gavin Generating Station
Cheshire, Ohio

Legend

0.054	Boron Concentration (mg/L)
(dark blue arrow)	Low (Typical) River State Groundwater Flow Direction to the Northeast*
(light blue arrow)	High River Stage Groundwater Flow Direction to the Northwest*
(black outline)	Coal Combustion Residuals Unit

Boron Concentration in

- <2 mg/L
- 2-3 mg/L
- >3 mg/L

Sample

- Groundwater
- Surface Water

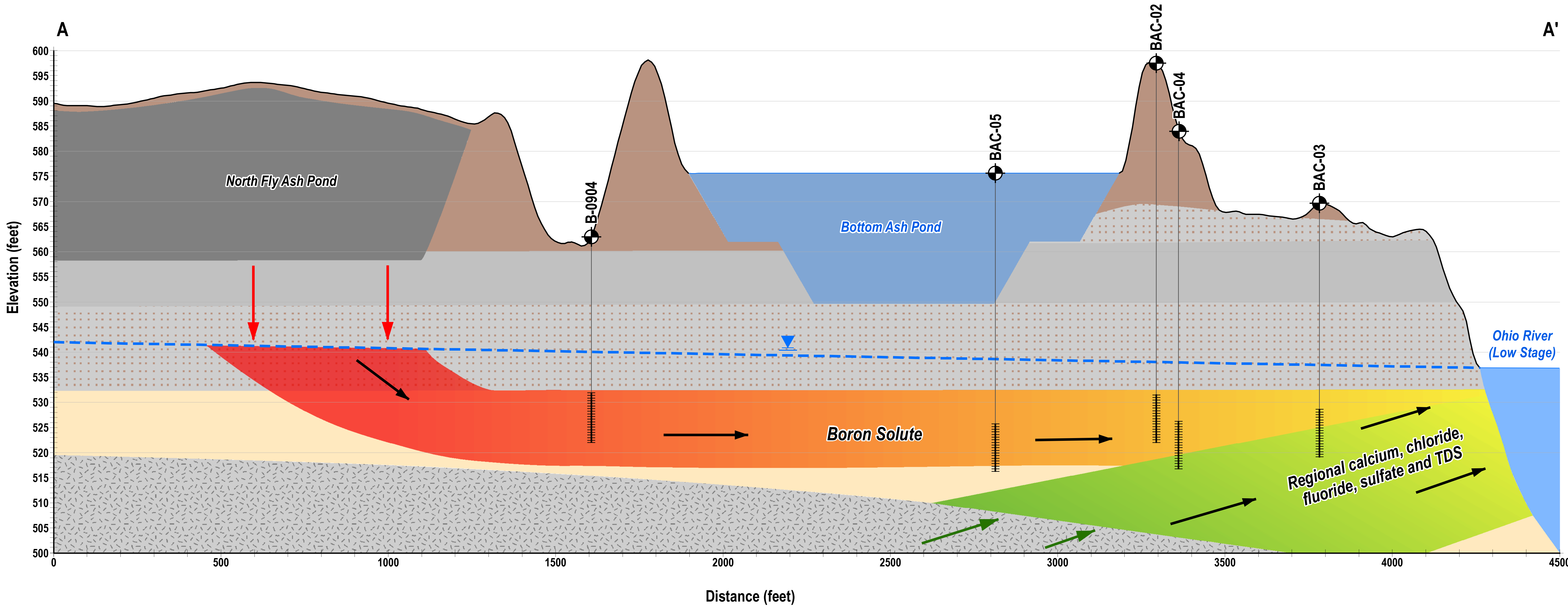
NOTES:
1. Groundwater analytical data is from March 2020
2. * Arrow length is relative to duration of low, high river stage

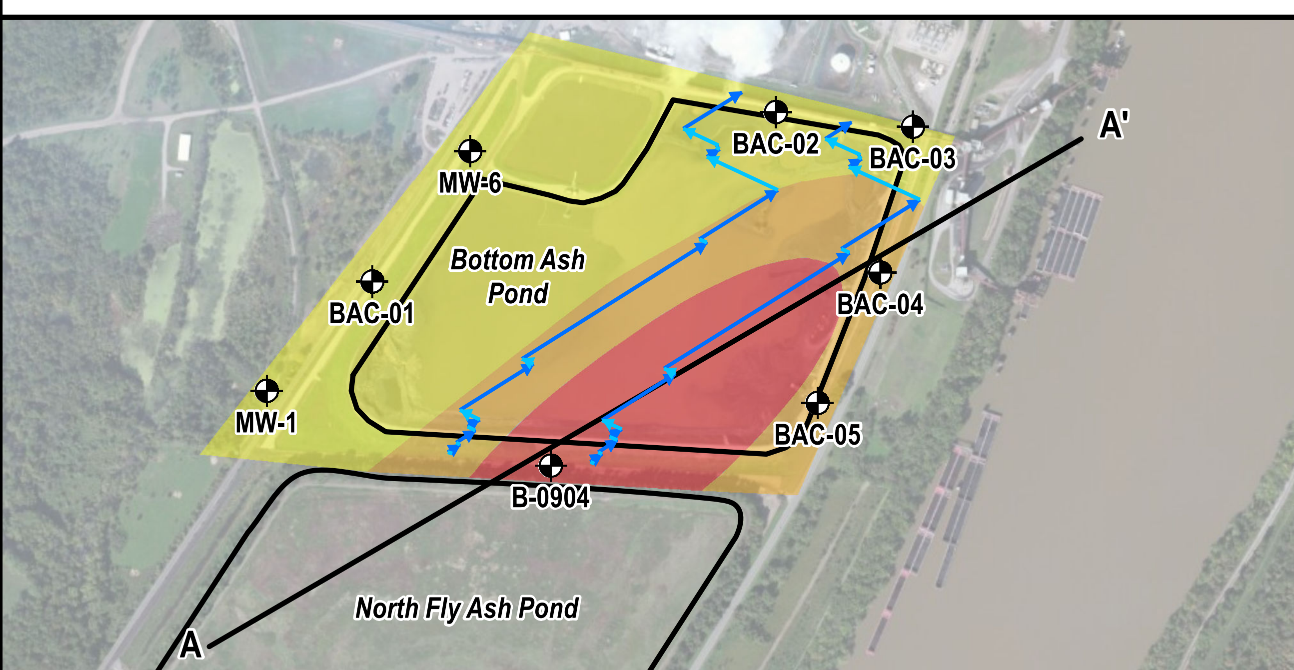
0 100 200 300 400 500
Feet

Figure 4-3: Boron Distribution in Groundwater

Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted Low River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca^{2+}, Cl^{-}, SO_4^{2-}, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-1: Low River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

ERM

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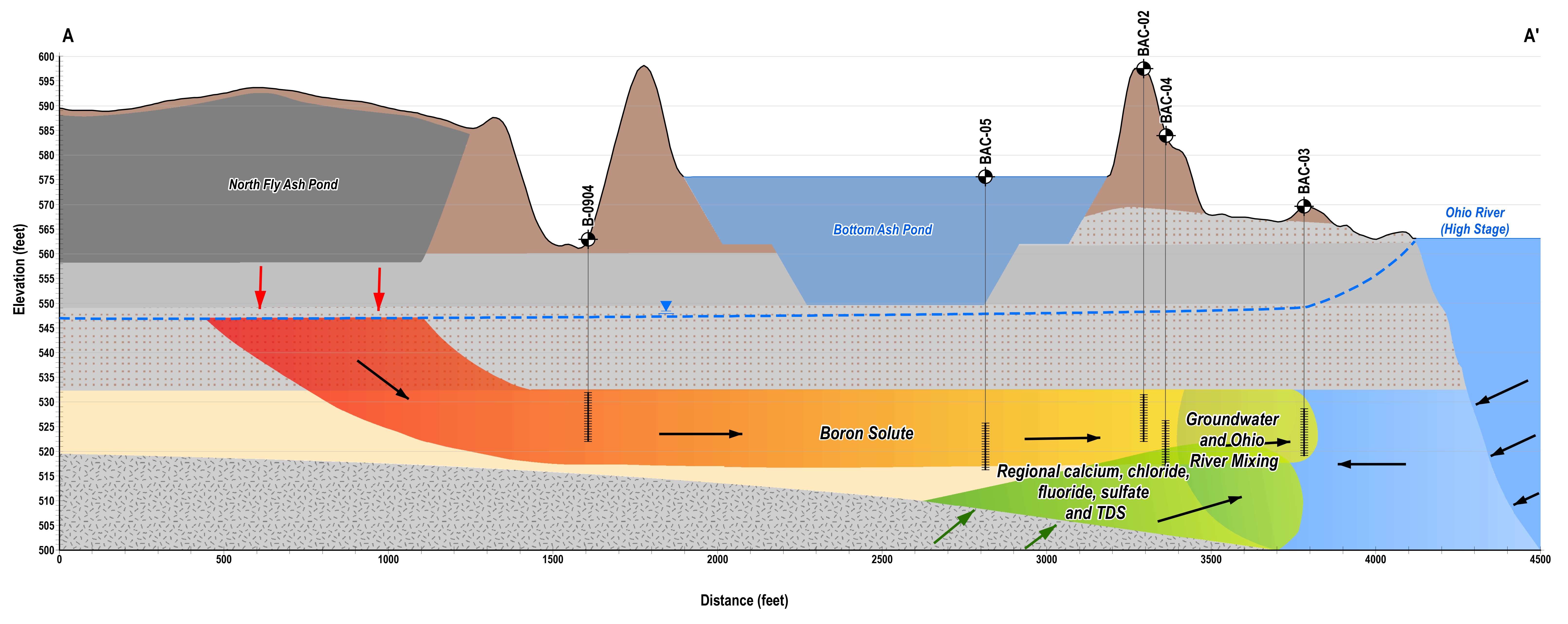

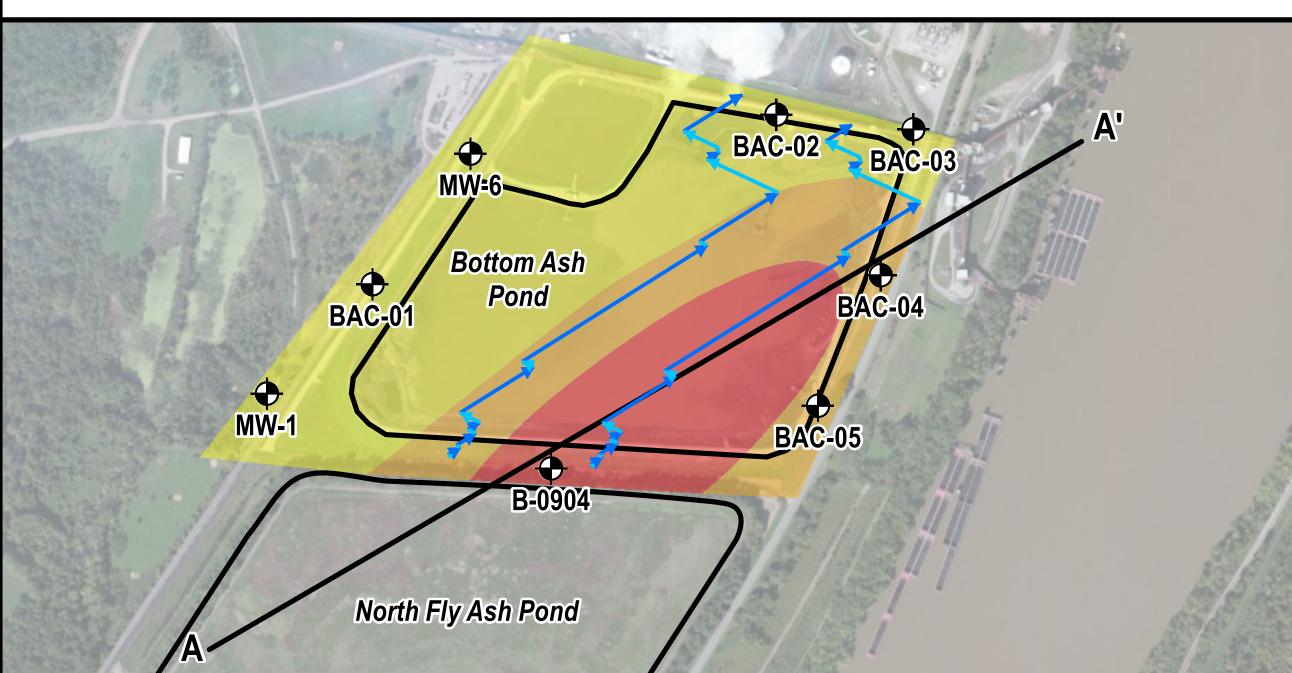

Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Ca^{2+}, Cl^{-}, SO_4^{2-}, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-2: High River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

ERM

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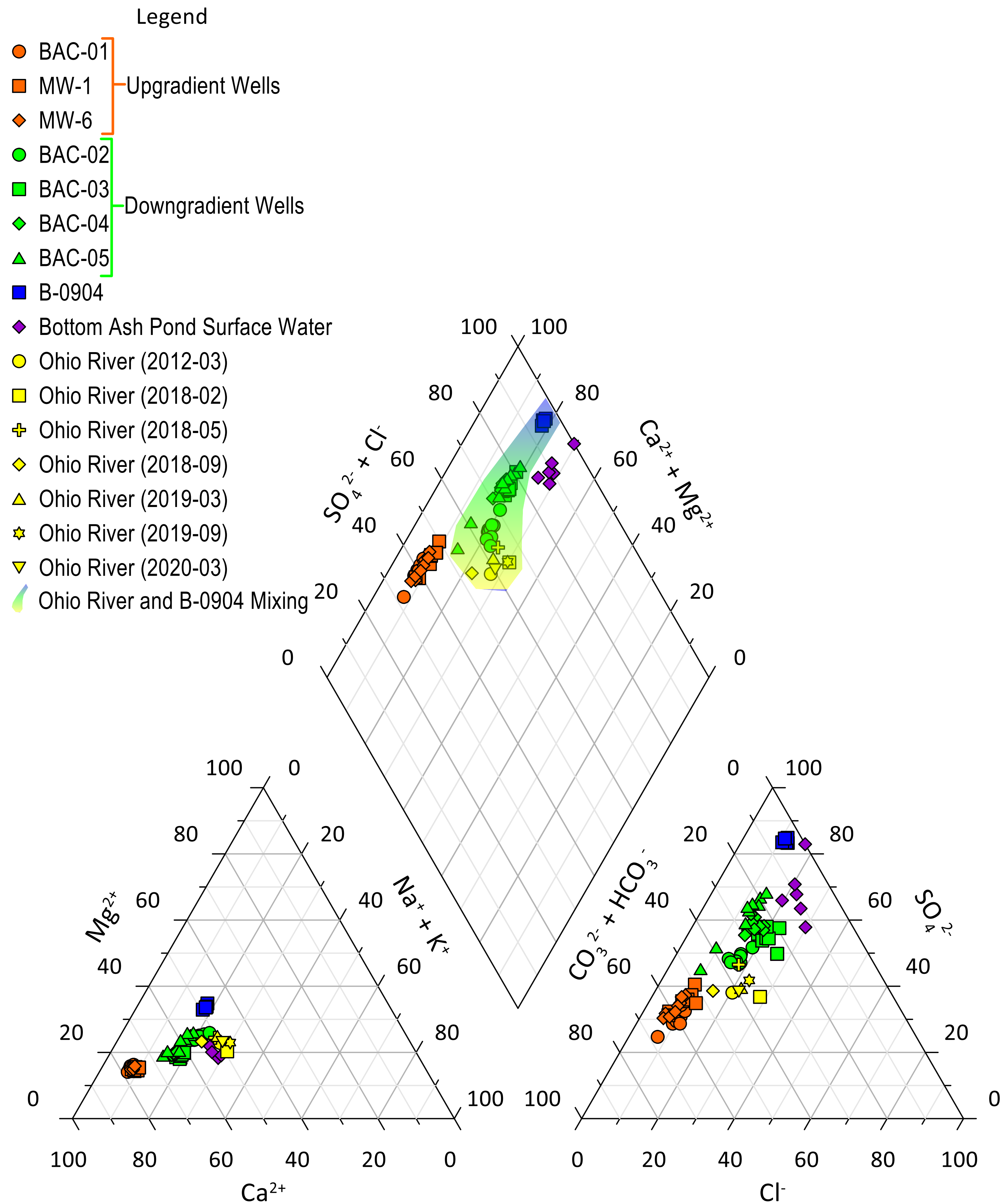

NOTES:
1. Date Range: March 2012 to March 2020
2. Only wells with complete data including all 8 piper diagram analytes are presented

Figure 6-1: BAP Piper Diagram
Gavin Generating Station
Cheshire, Ohio

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APPENDIX B GAVIN BOTTOM ASH POND SECOND SEMIANNUAL SAMPLING EVENT OF 2020 ALTERNATE SOURCE DEMONSTRATION REPORT

Gavin Bottom Ash Pond

Gavin Power, LLC

Second Semiannual Sampling Event of 2020 Alternate Source Demonstration Report

Gavin Power Plant
Cheshire, Ohio

31 January 2021

Project No.: 0545239

The business of sustainability

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Signature Page

31 January 2021

Gavin Bottom Ash Pond

Second Semiannual Sampling Event of 2020 Alternate Source Demonstration Report

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Acronyms and Abbreviations

Name	Description
ASD	Alternate Source Demonstration
BAC	Bottom Ash Complex
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCR Rule	Coal Combustion Residuals in Landfills and Surface Impoundments
CFR	Code of Federal Regulations
Gavin	Gavin Power, LLC
mg/L	milligrams per liter
NFAP	North Fly Ash Pond
Plant	General James M. Gavin Power Plant
SFAP	South Fly Ash Pond
SSI	Statistically significant increase
TDS	Total Dissolved Solids
USGS	United States Geological Survey

1. INTRODUCTION

1.1 Regulatory and Legal Framework

In accordance withTitle 40 Code of Federal Regulations (CFR), Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments (CCR Rule) – Gavin Power, LLC (Gavin) has been implementing the groundwater monitoring requirements of 40 CFR § 257.90 *et seq.* for the Bottom Ash Pond (BAP) CCR Surface Impoundment at the General James M. Gavin Power Plant (Plant). Gavin calculated background levels and conducted statistical analyses for Appendix III constituents in accordance with 40 CFR § 257.93(h). Currently, Gavin is performing detection monitoring at the BAP in accordance with 40 CFR § 257.94. Statistically significant increases (SSIs) over background concentrations were detected in downgradient monitoring wells for Appendix III constituents for the second semiannual groundwater sampling event of 2020 and are explained in this Alternate Source Demonstration (ASD) Report.

An SSI for one or more Appendix III constituents is a potential indication of a release of constituents from the CCR unit to groundwater. In the event of an SSI, the CCR Rule provides that "… the owner or operator may demonstrate that a source other than the CCR unit caused the SSI over background levels for a constituent or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality…" (40 CFR § 257.94(e)(2)). If it is demonstrated that the SSI is the result of a source other than the CCR unit, then the CCR unit may remain in the Detection Monitoring Program instead of transitioning to an Assessment Monitoring Program. To implement this demonstration, an ASD must be made in writing and the accuracy of the information must be verified through certification by a qualified Professional Engineer (40 CFR § 257.94(e)(2)).

The United States Environmental Protection Agency (USEPA) guidance document, "Solid Waste Disposal Facility Criteria Technical Manual, EPA530-R-93-017, Subpart E" (USEPA 1993), specifies six lines of evidence (listed below) that must be addressed to determine whether an SSI resulted from a source other than the regulated disposal unit.

1. An alternative source exists.
2. A hydraulic connection exists between the alternative source and the well with the significant increase.
3. Constituent(s) (or precursor constituents) are present at the alternative source or along the flow path from the alternative source prior to possible release from the unit.
4. The relative concentration and distribution of constituents in the zone of contamination are more strongly linked to the alternative source than to the unit when the fate and transport characteristics of the constituents are considered.
5. The concentration observed in groundwater could not have resulted from the unit given the waste constituents and concentrations in the unit leachate and wastes, and the site hydrogeologic conditions.
6. The data supporting conclusions regarding the alternative source are historically consistent with the hydrogeologic conditions and findings of the monitoring program.

This ASD Report addresses each of these lines of evidence for the SSIs detected in groundwater beneath the BAP.

1.2 Background

The Plant is a coal-fired generating station located in Gallia County in Cheshire, Ohio, bounded to the east by the Ohio River (Figure 1-1). The BAP is one of three CCR units at the Plant that are subject to regulation under the CCR Rule and is located adjacent to and immediately south of the main Plant area along the Ohio River (Figure 1-2). Adjacent to the BAP is the smaller Reclaim Pond (Figure 1-3) which, along with the BAP, make up the Bottom Ash Complex (BAC) that has operated since 1974.

The groundwater monitoring well network consists of three upgradient monitoring wells (BAC-01, MW-1, and MW-6) and four downgradient monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05) positioned around the perimeter of the BAP (Figure 1-3). In addition, monitoring well B-0904 is located south of the BAP and is used in this ASD Report to define the shallow groundwater quality migrating from the Kyger Creek North Fly Ash Pond (NFAP) under the BAP. In 2020, monitoring wells BAC-06 and BAC-07 were installed to provide two additional upgradient monitoring wells screened in the uppermost aquifer. The uppermost alluvial aquifer (Figure 2-1) monitored by the groundwater well network exhibits the following characteristics (Geosyntec 2016):

- The alluvial aquifer consists of fine to coarse sand with some gravel that grades progressively finer with decreasing depth;
- It is approximately 10-feet to 35-feet thick in the BAP area; and
- It is located below an approximate 20-foot-thick silty clay confining layer and above a shale bedrock unit of the Conemaugh Group.

Consistent with the CCR Rule and the Groundwater Monitoring Plan developed for Gavin (ERM 2017), a prediction limit approach was used to identify potential effects to groundwater. Upper prediction limits, and a lower prediction limit specifically for pH, were established based on the upgradient groundwater data. The 2017 Annual Groundwater Monitoring and Corrective Action Report was prepared to document the status of the groundwater monitoring program for the BAP (ERM 2018a) and included results from eight sampling events performed from August 2016 to August 2017. The 2017 report compared upper and lower prediction limits to the August 2017 results from the downgradient wells. Alternate Source Demonstration (ASD) reports (ERM 2018b, ERM 2018c, ERM 2019b, ERM 2019c, ERM 2020c, and ERM 2020d) were prepared to address SSIs which were identified during the initial and subsequent reporting periods.

The second semiannual groundwater sampling event of 2020 was performed in September 2020. The data from this sampling event were compared to the upper and lower prediction limits and SSIs for Appendix III analytes were identified. Table 1-1 summarizes occurrences of SSIs from the September 2020 sampling event.

Table 1-1: SSIs in Groundwater beneath the BAP

Analyte	Monitoring Well			
	BAC-02	BAC-03	BAC-04	BAC-05
Boron	X	X	X	X
Calcium	ϕ	ϕ	ϕ	ϕ
Chloride	X	X	X	X
Fluoride	ϕ	ϕ	ϕ	ϕ
pH	X	X	X	X
Sulfate	X	X	X	X
Total Dissolved Solids	X	ϕ	ϕ	ϕ

Notes: ϕ = No SSI; X = SSI; BAP = Bottom Ash Pond; SSI = statistically significant increase.
Results are for the downgradient wells sampled in September 2020.

Consistent with previous ASD Reports, this ASD Report identifies the mixing of upgradient groundwater and Ohio River surface water as the key factor controlling groundwater pH between the BAP and the Ohio River. This ASD Report also identifies the regional discharge of groundwater as the source of chloride, sulfate, and total dissolved solids (TDS); the Kyger Creek NFAP is identified as the source of boron. Supporting information and additional discussion of each of the lines of evidence discussed in Section 1.1 are presented in subsequent sections of this ASD Report.

2. DESCRIPTION OF ALTERNATE SOURCES

The first ASD Report for the BAP (ERM 2018b) identified and described three alternate sources for the Appendix III constituents: the Ohio River, the regional geology, and the neighboring Kyger Creek Generating Station. A summary of each of these alternate sources is provided below.

2.1 Ohio River

The Ohio River extends approximately 981 river miles from Pittsburgh, Pennsylvania to Cairo, Illinois and drains an area of approximately 205,000 square miles (ORSANCO 2018). The Ohio River is approximately 700 feet east of the BAP, and the alluvial aquifer beneath the BAP is hydraulically connected to the river. When the Ohio River floods, water from the river mixes with groundwater within the alluvial aquifer (ERM 2018b) beneath the BAP. The mixing of groundwater and river water is discussed in Section 3; the quality of the Ohio River water that mixes with groundwater is discussed in Section 4.

2.2 Regional Background

The regional bedrock geology near the Plant includes Pennsylvanian-age sedimentary rocks from the Monongahela and Conemaugh Formations, with the Morgantown and Cow Run Sandstone members being part of the latter. These sedimentary rocks consist primarily of shale and siltstone, with minor amounts of mudstone, sandstone, and incidental amounts of limestone and coal (United States Geological Survey [USGS] 2005). Overlying the Pennsylvanian-age rocks are Quaternary-age alluvium that consists primarily of sand, silt, clay, and gravel (OEPA 2018). The sedimentary rocks form the ridges and valleys west of the Ohio River, and the unconsolidated sand, silt, clay, and gravel, are located along the Ohio River and tributaries. The consolidated sedimentary rocks and the unconsolidated alluvium form the two major aquifers near the Plant (Figure 2-1). The interaction of groundwater with rocks and minerals within these aquifers can influence the concentration of Appendix III constituents, for example via dissolution (ORSANCO 1984).

Naturally occurring brine, which is known to have elevated levels of chloride, sulfate, and other trace elements, exists in the subsurface in the Ohio River Valley (Stout et al. 1932; ORSANCO 1984; ODNR 1995). Some of the brines also exist near the land surface. For example, brine was discovered at the land surface approximately 10 miles southwest of the Plant in Gallipolis, Ohio and was utilized for the commercial production of salt beginning in 1807 (Geological Survey of Ohio 1932). Naturally occurring brine was also identified at the land surface in Jackson, Ohio approximately 30 miles west of the Plant (ODNR 1995). The regional presence of shallow brine indicates the potential for naturally occurring brine to contribute Appendix III constituents to groundwater at the Plant.

To account for natural and anthropogenic influences on Appendix III constituents on a regional scale, background groundwater data were obtained from USGS databases. The background groundwater data set is discussed further in Section 4.

2.3 Kyger Creek Generating Station

The Kyger Creek Generating Station is located along the Ohio River in Gallia County, south of the Plant (Figure 2-2). The Kyger Creek Fly Ash Pond complex consists of the 110-acre NFAP and 60-acre South Fly Ash Pond (SFAP). The construction history and groundwater monitoring results of these ponds are summarized in the first ASD Report (ERM 2018b). The Kyger Creek NFAP is located less than 300 feet from the BAP and the units share an approximately 2,000-foot-long border (Figure 2-2). The Kyger Creek NFAP has a higher potential to impact groundwater than the BAP because the Kyger Creek NFAP contains fly ash, which when compared to bottom ash, has a greater tendency to leach CCR constituents due to higher concentrations of CCR constituents and increased surface area due to smaller particle size (Cox et al. 1978; Jones et al. 2012), as described further in Section 7.

3. HYDRAULIC CONNECTIONS TO THE ALTERNATE SOURCES

Explanations of the hydraulic connections between potential alternate sources and the downgradient wells of the BAP were previously provided in the first ASD Report for the BAP (ERM 2018b). A summary of each of these connections is provided below.

3.1 Ohio River

Both the Gavin BAP and the Kyger Creek NFAP are located above the alluvial aquifer (Geosyntec 2016; AGES 2016; ERM 2018b). Groundwater in the alluvial aquifer typically flows from the vicinity of the BAP and Kyger Creek NFAP toward the Ohio River (ERM 2018b). Exceptions to this flow direction occur when the river stage (elevation of the surface water in the river) exceeds approximately 540 feet above mean sea level (ERM 2018b). When this water level condition occurs, groundwater flow reverses and generally flows westward from the Ohio River toward the BAP and Kyger Creek NFAP (ERM 2018b). The correlation of the flow reversals with Ohio River flooding is strong evidence that the alluvial aquifer is hydraulically connected to the Ohio River (ERM 2018b).

3.2 Regional Background

Regional groundwater within the fractured sedimentary bedrock flows from northwest to southeast toward the Ohio River (ORSANCO 1984). Precipitation that falls in areas of higher topographic elevation northwest of the Plant infiltrates the land surface and recharges the underlying aquifers. Groundwater then flows from areas of higher topographic elevation (which correspond to higher hydraulic head) to areas of lower topographic elevation (which correspond to lower hydraulic head). As groundwater flows from northwest to southeast, it migrates both horizontally and vertically through a network of fractures within the sedimentary bedrock. Near the Plant, groundwater in the bedrock aquifer mixes with groundwater in the alluvial aquifer, which then discharges to the Ohio River (Figure 3-1). Thus, regional groundwater is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b).

3.3 Kyger Creek Generating Station

The Ohio River stage elevation records were used to identify the frequency and duration of flow reversals as discussed in Section 3.1 and were combined with the groundwater velocity estimates to develop groundwater flow paths under the BAP (ERM 2018b). The following three key points are associated with the interpreted groundwater flow paths:

- The Kyger Creek NFAP is hydraulically upgradient of the four monitoring wells (BAC-02, BAC-03, BAC-04, and BAC-05) that are downgradient of the Gavin BAP.
- Due to the prevailing northeast flow direction, the Kyger Creek NFAP is not situated upgradient of the western edge of the BAP – where upgradient monitoring wells MW-1, BAC-01, and MW-6 are located.
- State monitoring well B-0904 is directly downgradient of the Kyger Creek NFAP and upgradient of the BAP.

It is evident that the Kyger Creek NFAP is hydraulically connected to the downgradient BAP monitoring wells (ERM 2018b) based on the prevalent northeastern direction of groundwater flow and the presence of the same alluvial aquifer beneath both the Kyger Creek NFAP and the Gavin BAP.

4. CONSTITUENTS ARE PRESENT AT THE ALTERNATE SOURCES OR ALONG THE FLOW PATHWAYS

4.1 Ohio River

The pH of the Ohio River is near neutral and the pH of groundwater emanating from the Kyger Creek NFAP, as observed in well B-0904, is slightly acidic (ERM 2018b). As described in Section 3, the hydrogeologic data indicate that water from the Ohio River mixes with groundwater in the alluvial aquifer during times of river flooding. This mixing process results in an intermediate pH that is between the pH of the Ohio River and the pH of the Kyger Creek NFAP. Table 4-1 and Figure 4-1 summarize this pattern observed in the September 2020 data.

Table 4-1: Groundwater and Surface Water pH Values

Location	pH
Kyger Creek NFAP Groundwater (B-0904, March 2020)	5.26
BAP Upgradient Groundwater (BAC-06 and BAC-07, September 2020)	6.51–6.81
BAP Downgradient Groundwater (BAC-02 through BAC-05, September 2020)	6.15–6.50
Ohio River (September 2020)	7.05

Notes: BAP = Bottom Ash Pond; NFAP = North Fly Ash Pond

The September 2020 results remain consistent with previous ASD Reports for the BAP (ERM 2018b, 2018c, 2019b, 2019c, 2020c, and 2020d). These results demonstrate that the pH of the Ohio River water is higher than Kyger Creek groundwater; the mixing of these waters results in the intermediate pH observed in groundwater downgradient of the BAP. Monitoring wells BAC-06 and BAC-07 are not similarly impacted by acidic groundwater migrating from Kyger Creek, as evidenced by the higher pH, because the well screens are deeper than the well screen at B-0904, and are more influenced by the regional discharge of groundwater from bedrock to the alluvial aquifer, as described further in Section 6 (Figure 4-1).

4.2 Regional Background

Regional background groundwater quality data were obtained from the USGS National Water Information System database. Groundwater results were selected for monitoring wells constructed within the alluvial, Monongahela Group, and Conemaugh Group aquifers located within 50 miles of the Plant (Figure 4-2). The USGS background data were compared to downgradient BAP data (Wells BAC-02, BAC-03, BAC-04, and BAC-05) and Ohio River data collected in March 2020. As presented in Table 4-2, the concentrations of chloride, sulfate, and TDS in groundwater downgradient of the BAP are generally between the concentrations in USGS background data for regional groundwater (within 50 miles of the Plant) and the Ohio River. These results are consistent with previous ASD Reports for the BAP (ERM 2018b, 2018c, 2019b, 2019c, 2020c, and 2020d) and, along with Figure 3-1, demonstrate that chloride, sulfate, and TDS are present along flow pathways from the sedimentary bedrock aquifers to the alluvial aquifer beneath the BAP.

Table 4-2: Comparison of USGS Regional Background to BAP and Ohio River

Analyte	Units	USGS Background (Max)	Downgradient BAP[a]	Ohio River[a]
Chloride	mg/L	9,900	38–63	31
Sulfate	mg/L	2,700	170–260	77
TDS	mg/L	9,910	420–690	240

Notes: BAP = Bottom Ash Pond; mg/L = milligrams per liter; TDS = total dissolved solids; USGS = United States Geological Survey.
[a] Results from samples collected in September 2020.

4.3 Kyger Creek Generating Station

The concentration of boron in groundwater downgradient of the BAP (Figure 4-3) ranges from 1.3 milligrams per liter (mg/L) to 2.5 mg/L in the September 2020 samples. Figure 4-3 depicts the distribution of boron at the northern boundary of the Kyger Creek NFAP and along the flow pathways, as summarized by the following points:

- The highest boron concentrations in BAP downgradient wells were measured at wells BAC-05 and BAC-04, which are located downgradient of the Kyger Creek NFAP.
- Monitoring well B-0904 is situated downgradient of the Kyger Creek NFAP and upgradient of the BAP and has a higher boron concentration than any BAP downgradient well.
- Concentrations decrease with distance downgradient from the Kyger Creek NFAP, along the northeastern flow path.
- Monitoring wells BAC-06 and BAC-07 demonstrated slightly lower concentrations than measured in groundwater from monitoring well B-0904, likely due to the slightly deeper position of the well and the greater influence of regional groundwater discharge from the underlying bedrock aquifer to the alluvial aquifer.

In addition to the Ohio Environmental Protection Agency (OEPA) correspondence that concluded that groundwater below the Kyger Creek NFAP appears to be impacted by a release from the Kyger Creek NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]), the Kyger Creek SFAP data also suggest that boron is present in groundwater below both Kyger Creek fly ash ponds. Table 4-3 summarizes boron analytical results from eight groundwater sampling events conducted between October 2015 and September 2017 at Kyger Creek SFAP downgradient monitoring wells (AGES 2018).

Table 4-3: Kyger Creek SFAP Boron Results

Analyte	Units	Maximum	Average
Boron	mg/L	17.7	6.8

Notes: mg/L = milligrams per liter; SFAP = South Fly Ash Pond.

The average concentration of boron (6.8 mg/L) in the Kyger Creek SFAP is higher than the highest concentration of boron measured in groundwater beneath the BAP (2.5 mg/L) in September 2020. The Kyger Creek SFAP and NFAP both manage fly ash generated at the Kyger Creek Generating Station; thus, it is reasonable to expect that the chemical characteristics of the fly ash are similar in both units. Given the elevated boron concentrations in groundwater downgradient of the Kyger Creek SFAP and considering that both units are unlined, elevated concentrations of boron in groundwater downgradient of the Kyger Creek NFAP would be expected. Thus, this evidence supports the conclusion that boron is present at the Kyger Creek Generating Station.

5. LINKAGES OF CONSTITUENT CONCENTRATIONS AND DISTRIBUTIONS BETWEEN ALTERNATE SOURCES AND DOWNGRADIENT WELLS

5.1 Ohio River

As described in Section 3 and in the first ASD Report for the BAP (ERM 2018b), the groundwater elevation and flow directions provide sound evidence of groundwater flow reversals and the mixing of Ohio River surface water and groundwater. The intermediate pH of groundwater downgradient of the BAP (i.e., the value between the pH of Kyger Creek groundwater and the pH of the Ohio River) is consistent with the mixing of river water and groundwater. This evidence suggests there is a linkage between groundwater downgradient of the BAP and the Ohio River.

5.2 Regional Background

As described in Section 3.2 and illustrated on Figure 3-1, groundwater flowing in the sedimentary bedrock aquifers discharges to the alluvial aquifer along the Ohio River, including the portion beneath the BAP. As described in Section 4.2, regional concentrations of chloride, sulfate, and TDS are higher than respective groundwater concentrations downgradient of the BAP. Based on these observations, it is likely that the discharge of groundwater from the sedimentary bedrock aquifers to the alluvial aquifer under the BAP (Figure 5-1 and Figure 5-2) is an alternate source for these constituents. This evidence suggests that there is a linkage between groundwater downgradient of the BAP and regional background.

5.3 Kyger Creek Generating Station

When the river stage is low (Figure 5-1), groundwater in the alluvial aquifer migrates in a northeasterly direction from the Kyger Creek NFAP, under the BAP, and eventually discharges to the Ohio River. During times of higher river stage (Figure 5-2), groundwater in the alluvial aquifer temporarily reverses flow direction and river water flows into the alluvial aquifer. Despite the temporary reversals of groundwater flow caused by flooding of the Ohio River, the overall, long-term flow direction is to the northeast. This indicates that the source of boron detected in the monitoring wells downgradient of the BAP is the Kyger Creek NFAP.

6. RELEASES FROM THE BAP ARE NOT SUPPORTED AS THE SOURCES

6.1 Chemical Fingerprints

The geochemical fingerprints of surface water from the BAP, groundwater from the BAP, groundwater from the Kyger Creek NFAP, and surface water from the Ohio River were determined using a Piper diagram. The Piper diagram is a graphical procedure commonly used to interpret sources of dissolved constituents in water and evaluate the potential for mixing of waters from different sources (Piper 1944). The samples presented on the diagram were collected from 2012 through 2020. The primary observations and conclusions based on the BAP Piper diagram (Figure 6-1) are the following:

- Multiple samples collected from a single location (e.g., the Ohio River or Well B-0904) tended to be tightly clustered, indicating that the chemical signatures of individual locations were consistent over time.
- Groundwater from BAP upgradient wells MW-1, BAC-01, and MW-6 has a unique geochemical signature dominated by calcium and bicarbonate. This groundwater flows under the west-northwest portion of the BAP and does not appear to be influenced by the Ohio River or Kyger Creek NFAP.
- Groundwater from well B-0904, which is downgradient of the Kyger Creek NFAP and upgradient of the BAP, is dominated by calcium and sulfate and has a signature that is distinct from all other chemical signatures on the diagram.
- Surface water from the Ohio River exhibits a distinct signature that plots closer to the center of the Piper diagram.
- Groundwater from BAP downgradient wells BAC-02, BAC-03, BAC-04, and BAC-05 plots on the Piper diagram between the Ohio River and Kyger Creek NFAP groundwater. This is an independent line of evidence that groundwater under a majority of the BAP is a mixture of groundwater from the Kyger Creek NFAP (represented by well B-0904, which is upgradient of the BAP) and the Ohio River.
- Groundwater from monitoring wells BAC-06 and BAC-07 is dominated by calcium, carbonate and sulfate, and has an intermediate signature between the upgradient wells (BAC-01, MW-1 and MW-06) and groundwater from B-0904. These results, and the boron results discussed in Section 4.3, indicate groundwater from BAC-06 and BAC-07 may be a mixture of deeper non-impacted alluvial groundwater and shallower alluvial groundwater migrating from Kyger Creek. Given that this data represents the base information from these wells (2020), this interpretation will be confirmed or revised based on additional data to be collected in the future.

Based on the data summarized above and the chemical fingerprints of the groundwater at issue, the BAP is not deemed to be the source of the SSIs.

7. ALTERNATE SOURCE DATA ARE HISTORICALLY CONSISTENT WITH HYDROGEOLOGIC CONDITIONS

7.1 Ohio River

The hydraulic connection of the Ohio River to the alluvial aquifer was established after the last deglaciation (Kozar and McCoy 2004). Seasonal flooding of the Ohio River, which has occurred regularly over the period that the Plant has existed, is the driving force behind the mixing of surface water and groundwater. Thus, source data for the Ohio River are historically consistent with the hydrogeologic conditions and findings of the monitoring program.

7.2 Regional Background

This ASD Report provides background groundwater quality data for the fractured sedimentary bedrock aquifers found within and beyond the boundary of the Plant. Flow patterns of regional groundwater through fractured bedrock near the BAP were established after the last deglaciation, which occurred approximately 14,000 years ago (Hansen 2017). Assuming a conservatively high effective porosity of 1 percent results in an estimated groundwater velocity of 80 feet per year for the Morgantown Sandstone and 50 feet per year for the Cow Run Sandstone (ERM 2020b). These rates would allow ample time for groundwater to migrate from upgradient regional sources onto Plant property since the end of the last glaciation. The data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

7.3 Kyger Creek Generating Station

The Kyger Creek NFAP was constructed in 1955 with its base on native soil, without an engineered liner system to contain leachate. The unit was used to manage fly ash until it was drained and closed in 1997, although dewatered ash is still present within the Kyger Creek NFAP. Groundwater flows under the Kyger Creek NFAP in a northeasterly direction toward and under the Gavin BAP. Given the six decades that this unit has contained fly ash and the alluvial aquifer groundwater velocity estimates of 1,400 to 2,200 feet per year (ERM 2020a), ample time has passed for groundwater to migrate from the Kyger Creek NFAP beneath the BAP. The following evidence therefore supports that the Kyger Creek NFAP is the alternate source of boron:

- The distribution of boron in groundwater beneath the BAP (Section 4).
- Analytical results from groundwater samples collected below the Kyger Creek SFAP suggest boron is present in Kyger Creek groundwater. Given the similarity in construction and types of CCR managed, it is reasonable to interpret Kyger Creek SFAP groundwater data as representative of Kyger Creek NFAP groundwater quality (Section 4).
- The chemical fingerprinting evidence suggests groundwater from Kyger Creek mixes with Ohio River water under the BAP (Section 6).
- The Ohio Environmental Protection Agency concluded that groundwater appears to be impacted by a release from the Kyger Creek NFAP (Appendix A of the first ASD Report for the BAP [ERM 2018b]).

In addition, a comparison of the materials managed provides evidence that the BAP is not the source of boron – that the Kyger Creek NFAP is a more likely source of boron. The Kyger Creek NFAP has contained fly ash since 1955, while the BAP has been used primarily for the management of bottom ash since 1974. Bottom ash and fly ash have different physical and chemical properties; laboratory investigations have demonstrated elements (including Appendix III constituents) have a much greater potential to leach from fly ash compared to bottom ash (Cox et al. 1978; Jones et al. 2012). The higher concentrations of boron observed in Kyger Creek SFAP groundwater compared to the lower concentration of boron observed in groundwater downgradient of the BAP are consistent with the known leaching properties of fly ash and bottom ash. Boron, therefore, is more likely to leach from the Kyger Creek SFAP than the BAP based on the historical use of each unit. These observations support the conclusion that the Kyger Creek NFAP, and not the BAP, is the source of boron in groundwater under the BAP. Thus, the data supporting these conclusions are historically consistent with hydrogeologic conditions and findings of the BAP monitoring program.

8. CONCLUSIONS

The SSIs identified in this ASD Report are based on samples from monitoring wells downgradient of the BAP collected in September 2020. The data were reviewed for quality assurance, statistically analyzed, and reported to Gavin on 25 November 2020. In response to the SSIs, this ASD Report was prepared within the required 90-day period in accordance with 40 CFR § 257.94(e)(2).

All SSIs in the downgradient BAP monitoring wells have been determined to result from alternate sources: mixing with the Ohio River, regional groundwater discharge, and the Kyger Creek Power Plant. Table 8-1 summarizes the six lines of evidence for each of the SSIs.

Table 8-1: BAP ASD Summary

Analyte	SSI Location	Six Lines of Evidence from USEPA Guidance					
		Alternate Source	Hydraulic Connection	Constituent Present at Source or along Flow Path	Constituent Distribution More Strongly Linked to Alternate Source	Constituent Could Not Have Resulted from the BAP	Data Are Historically Consistent with Hydrogeologic Conditions
Boron	BAC-02 BAC-03 BAC-04 BAC-05	Kyger Creek NFAP	X	X	X	X	X
Chloride	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
pH	BAC-02 BAC-03 BAC-04 BAC-05	Mixing with Ohio River	X	X	X	X	X
Sulfate	BAC-02 BAC-03 BAC-04 BAC-05	Regional Groundwater Discharge	X	X	X	X	X
TDS	BAC-02	Regional Groundwater Discharge	X	X	X	X	X

Notes: BAP = Bottom Ash Pond; NFAP = North Fly Ash Pond; SSI = statistically significant increase; TDS = total dissolved solids; USEPA = United States Environmental Protection Agency.

In conclusion, the BAP is not the source of the SSIs associated with the second semiannual sampling event groundwater results for 2020. Thus, Gavin will continue detection monitoring at the BAP in accordance with 40 CFR § 257.94(e)(2).

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I, or an agent under my review, have prepared this Alternate Source Demonstration Report for the Bottom Ash Pond and it meets the requirements of 40 CFR § 257.94(e)(2). To the best of my knowledge, the information contained in this Report is true, complete, and accurate.

____

James A. Hemme, P.E.
State of Ohio License No.: 72851

Date: _______29 January 2021________

9. REFERENCES

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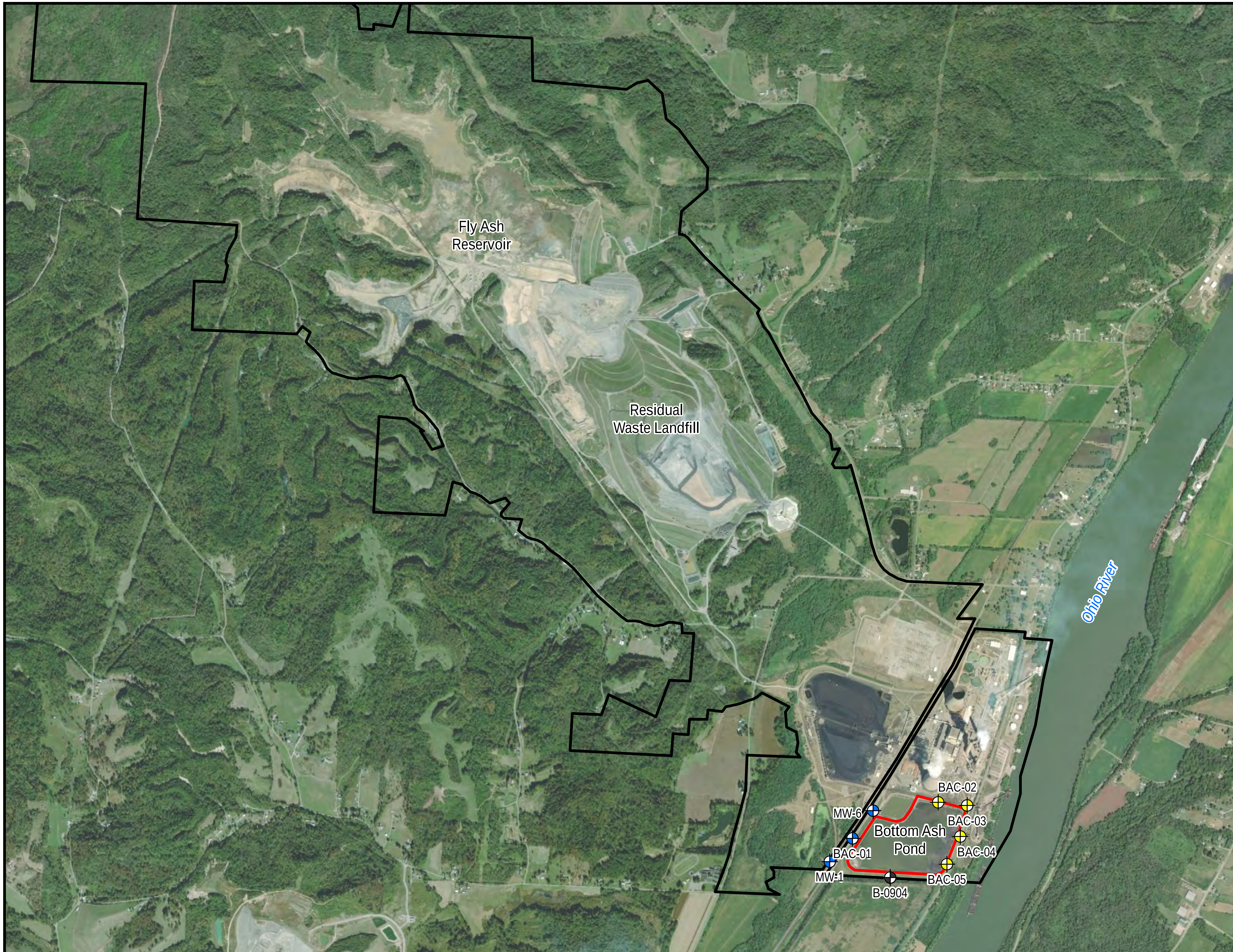
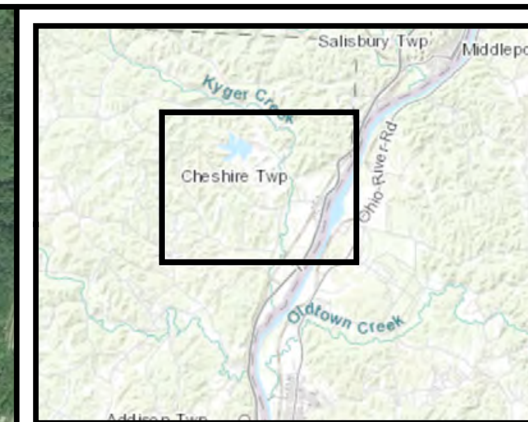
FIGURES

Figure 1-1: Gavin Plant Location
Gavin Generating Station
Cheshire, Ohio





Legend

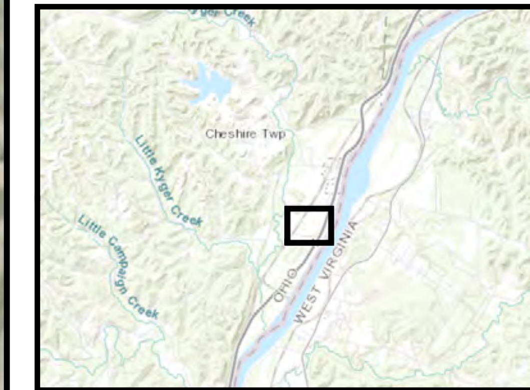
- Federal Upgradient Monitoring Well
- Federal Downgradient Monitoring Well
- Upgradient Monitoring Well (Not in Federal Program)
- Bottom Ash Pond
- Gavin Property Boundary

N

0 500 1,000 2,000 3,000 4,000
Feet

Figure 1-2: Bottom Ash Pond Location
Gavin Generating Station
Cheshire, Ohio

ERM



Legend

- Federal Upgradient Monitoring
- Federal Downgradient Monitoring
- Upgradient Monitoring Well (Not in Federal Program)
- Approximate location of Bottom Ash Pond boundary

NOTES:
1. Locations are approximate
2. Aerial Imagery: ESRI World Imagery Reproduced under license in ArcGIS 10.7

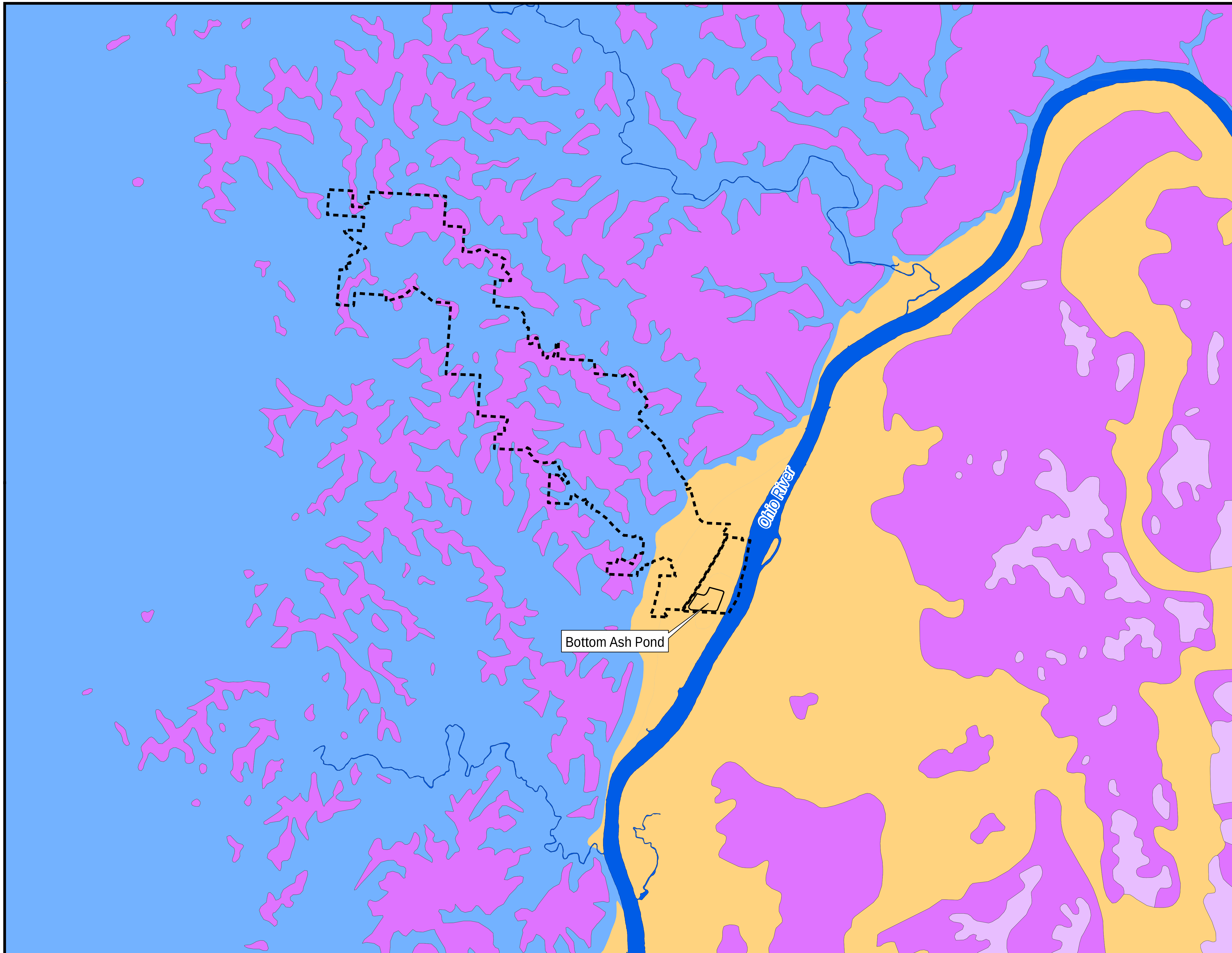
N

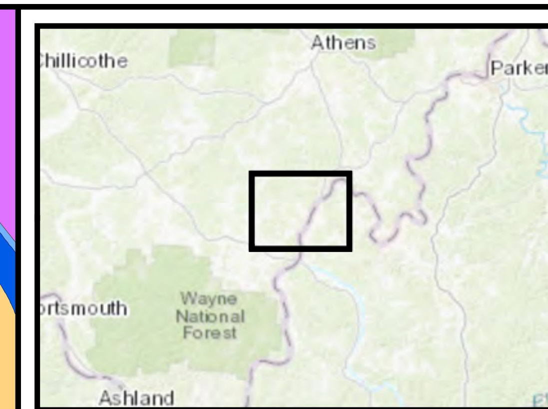
0 62.5 125 250 375 500
Feet

Figure 1-3: Existing Monitoring Well Network
Gavin Generating Station
Cheshire, Ohio

ERM

Q:\Boston\Team\DMMV\Clients_F_K\Gavin\GavinPowerPlant\MXD\MW_System_Certification\Figure1_2_ExistingMWNetwork_20201109.mxd - nathan.roberts - 11/9/2020





Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Dunkard Group

Monongahela Group

Conemaugh Group

NOTES:
1. Alluvial aquifer data from Ohio EPA and Sedimentary aquifer data from USGS

N

0 0.25 0.5 1 1.5 2

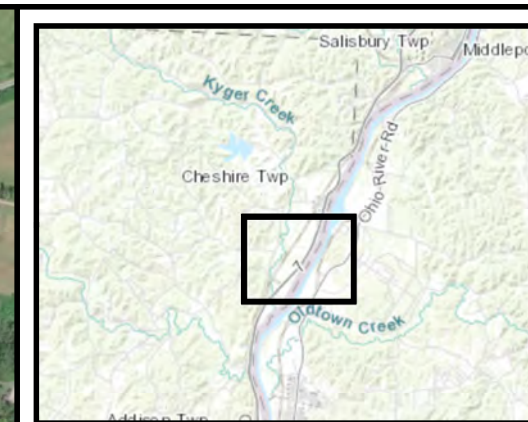
Miles

Figure 2-1: Sedimentary and Alluvial Aquifers

Gavin Generating Station

Cheshire, Ohio

ERM



Legend

- Federal Upgradient Monitoring Well
- Federal Downgradient Monitoring Well
- Upgradient Monitoring Well (Not in Federal Program)
- Gavin Bottom Ash Pond
- Kyger Creek Fly Ash

NOTES:

1. Kyger Creek features are from AEP. 1994. Hydrogeologic Site Investigation Plan for the Proposed North Fly Ash Pond Closure, Kyger Creek Station, Ohio Valley Electric Corporation, Gallia County, Ohio.

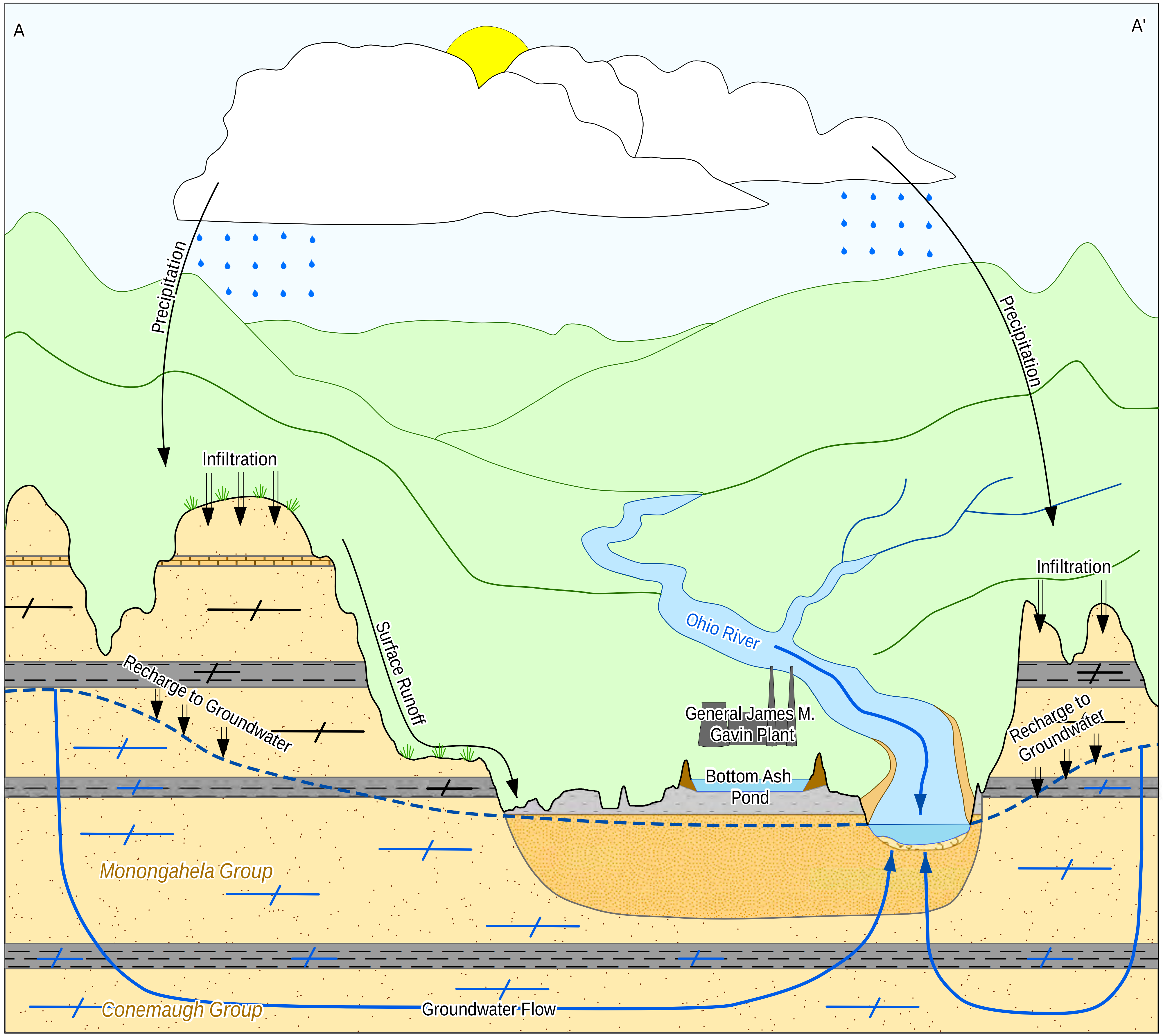
N

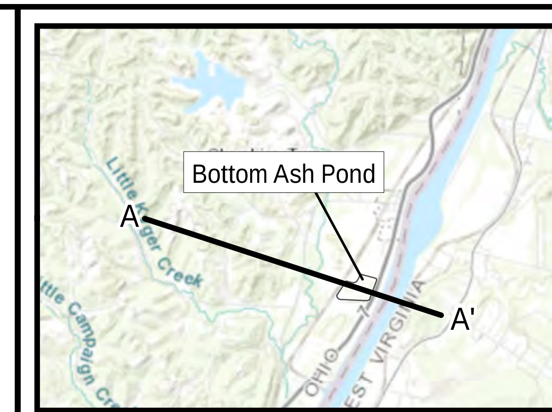
0 250 500 1,000 1,500 2,000
Feet

Figure 2-2: Location of Kyger Creek Generating Station

Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Groundwater Flow Direction
- Water Table
- Saturated Fractures
- Unsaturated Fractures
- Fill
- Interbedded Silt/Clay
- Sand
- Coarse Sand Deposits
- Sandstone
- Fractured Limestone
- Fractured Shale

NOTES:

1. Sandstone bedrock units represent the Conemaugh Group and Monongahela Group Sedimentary Aquifers

0 250 500 1,000 1,500 2,000 2,500 3,000
Feet

Figure 3-1: Regional Groundwater Flow Patterns
Gavin Generating Station
Cheshire, Ohio

ERM

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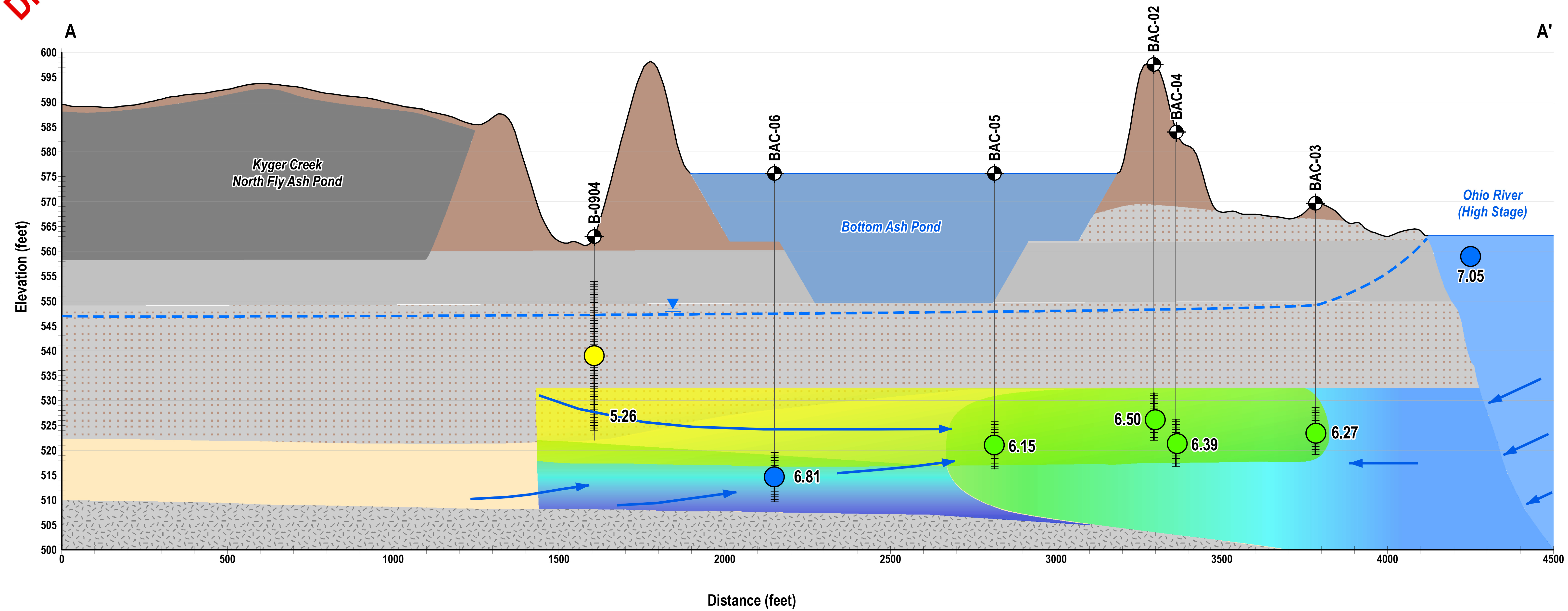

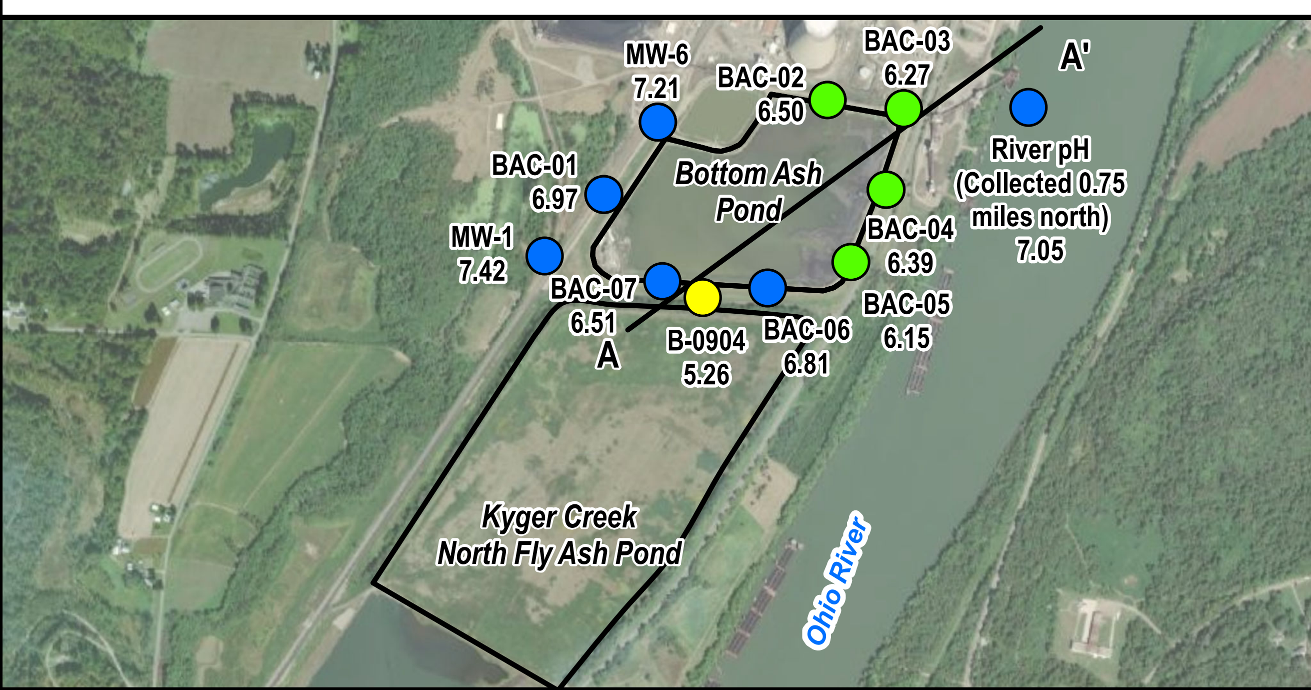

Legend

- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Potentiometric Surface
- Interpreted Groundwater Flow Direction

pH (Standard Units)

- <6
- 6 - 6.5
- >6.5

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

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PREPARED AT THE REQUEST OF COUNSEL

NOTE:
- Data collected September 2020 and B-0904 collected in March 2020.

Figure 4-1: pH of the Ohio River and BAP Groundwater
Gavin Generating Station
Cheshire, Ohio

ERM

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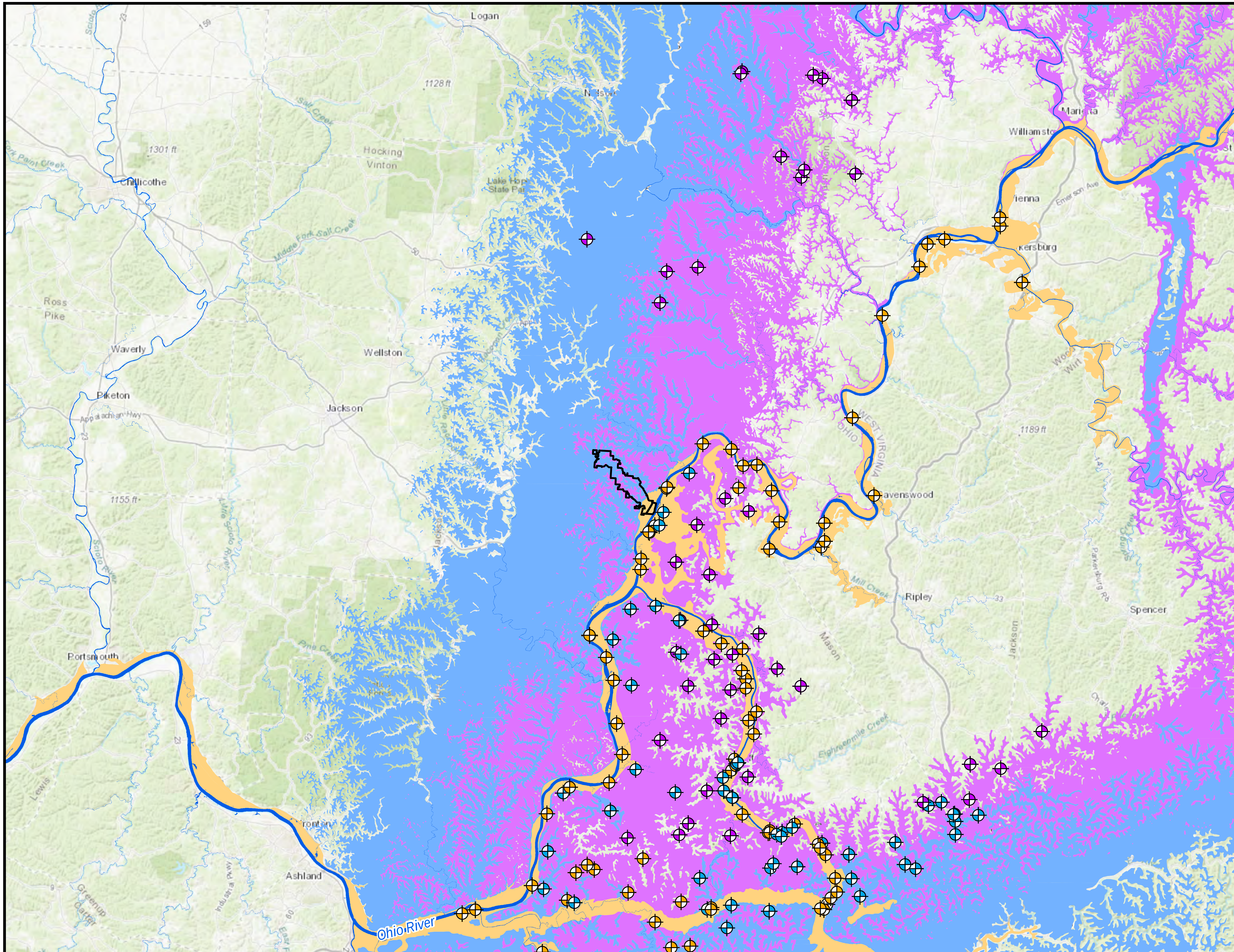


Legend

- Alluvial Aquifer
- Gavin Property Boundary

Sedimentary Aquifers

- Monongahela Group
- Conemaugh Group

USGS Groundwater Monitoring Wells

- Alluvial Aquifer
- Monongahela Group (Sedimentary Aquifer)
- Conemaugh Group (Sedimentary Aquifer)

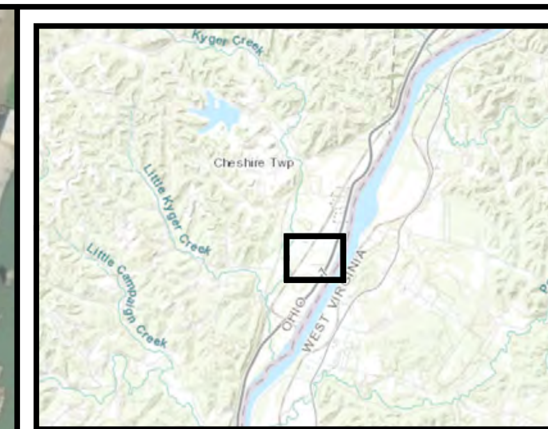
NOTES:
1. Alluvial aquifer data from Ohio EPA and Sedimentary aquifer data from USGS

N

0 2.5 5 10 15 20
Miles

Figure 4-2: Locations of Background Groundwater Monitoring Wells
Gavin Generating Station
Cheshire, Ohio

ERM



Legend

0.054 Boron Concentration (mg/L)

Low (Typical) River State Groundwater Flow Direction to the Northeast*

High River Stage Groundwater Flow Direction to the Northwest*

Coal Combustion Residuals Unit

Boron Concentration in Groundwater

<1.5 mg/L

1.5-3 mg/L

>3 mg/L

Sample Type

Groundwater

Surface Water

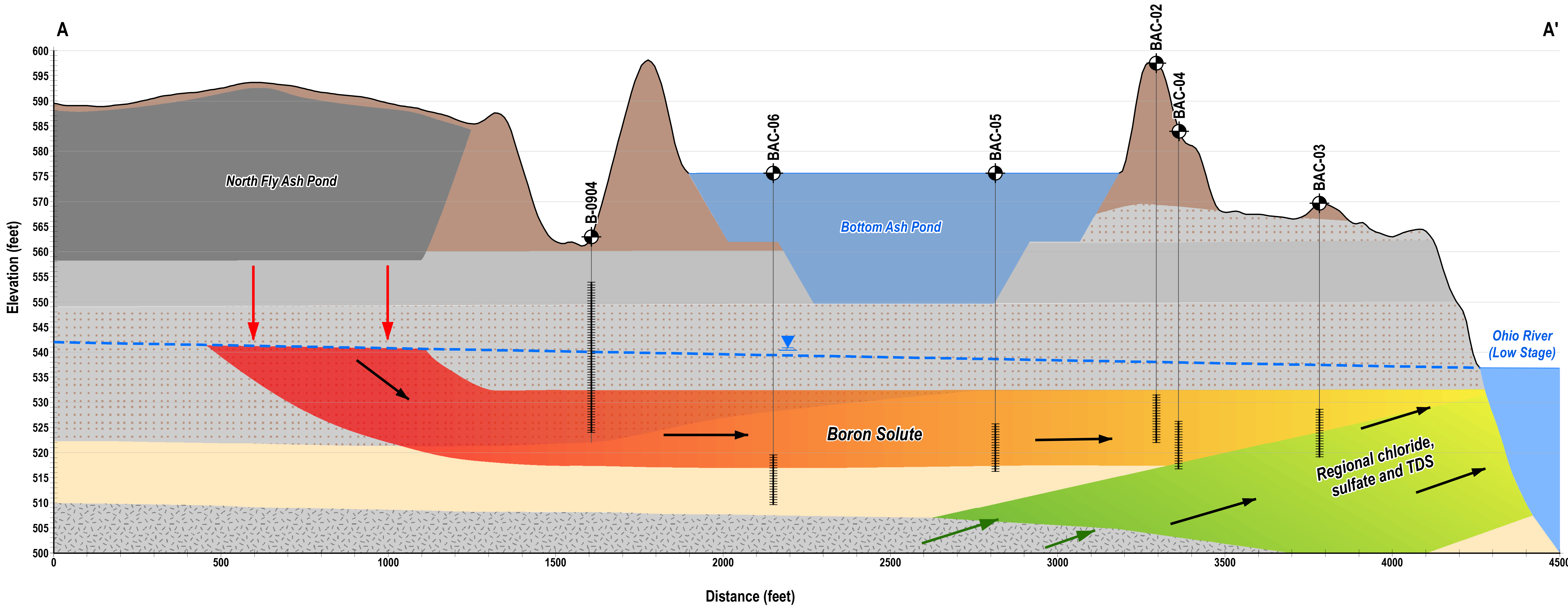
NOTES:
1. All boron data are from samples collected in September 2020 except from B-0904, which was collected in March 2020.
2. * Arrow length is relative to duration of low, high river stage

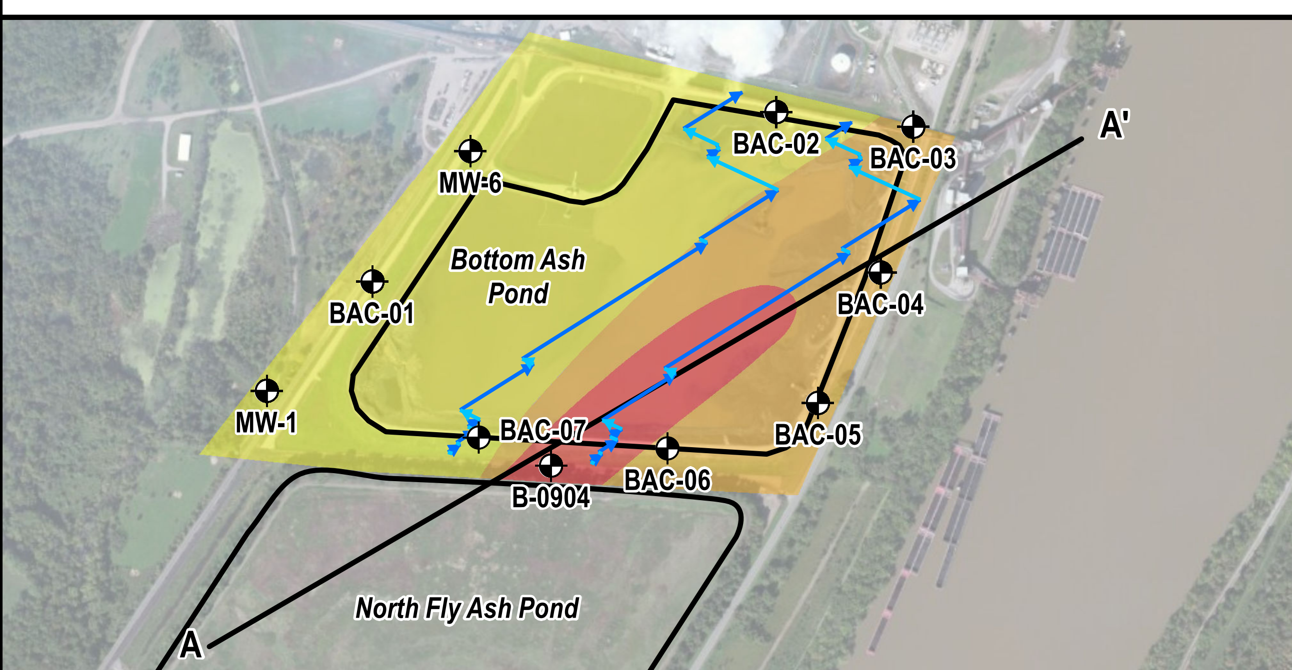
N

0 100 200 300 400 500
Feet

Figure 4-3: Boron Distribution in Groundwater
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

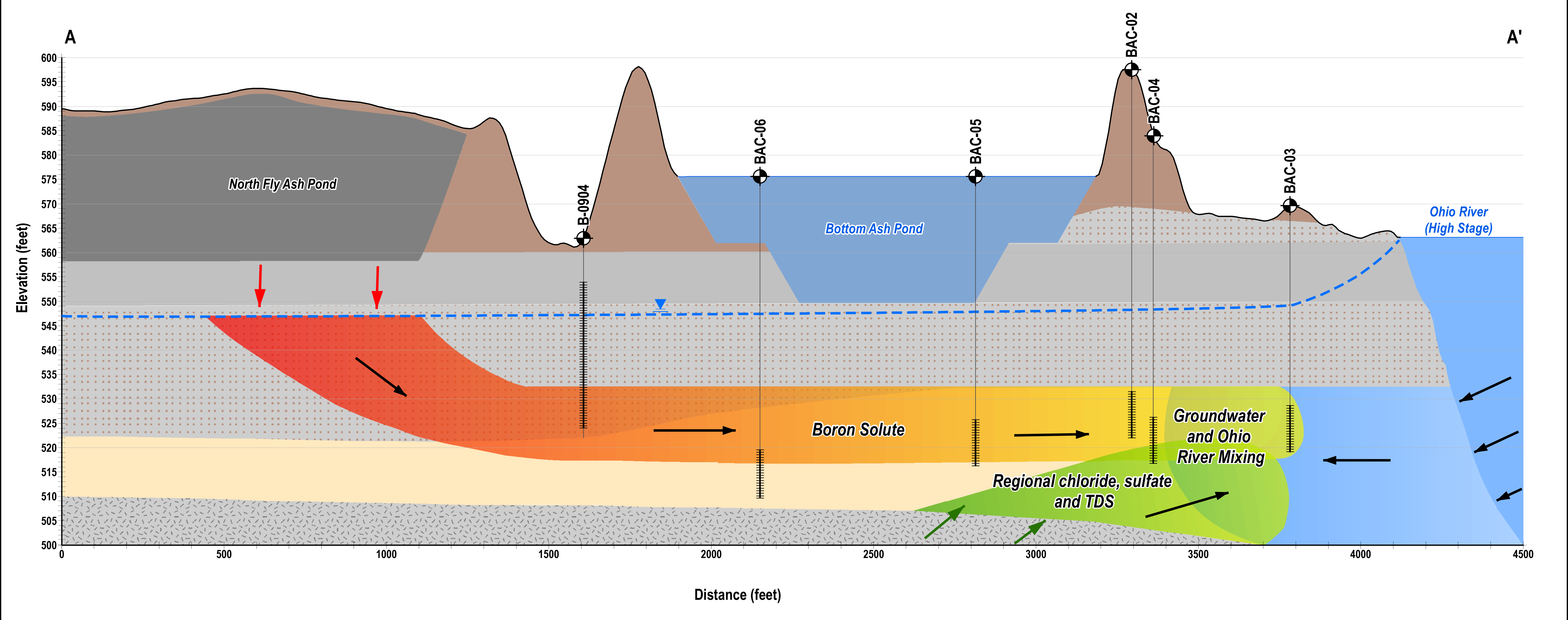
- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted Low River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Cl^-, SO_4^{2-}, and TDS

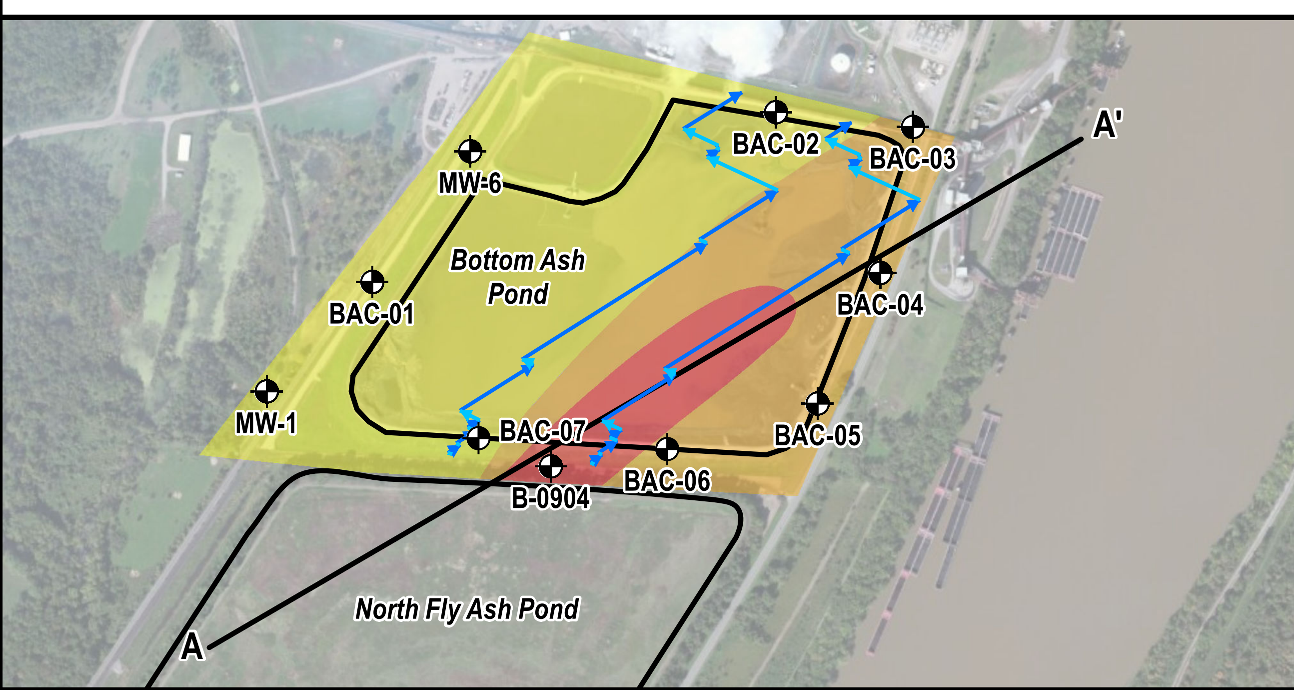
Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-1: Low River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

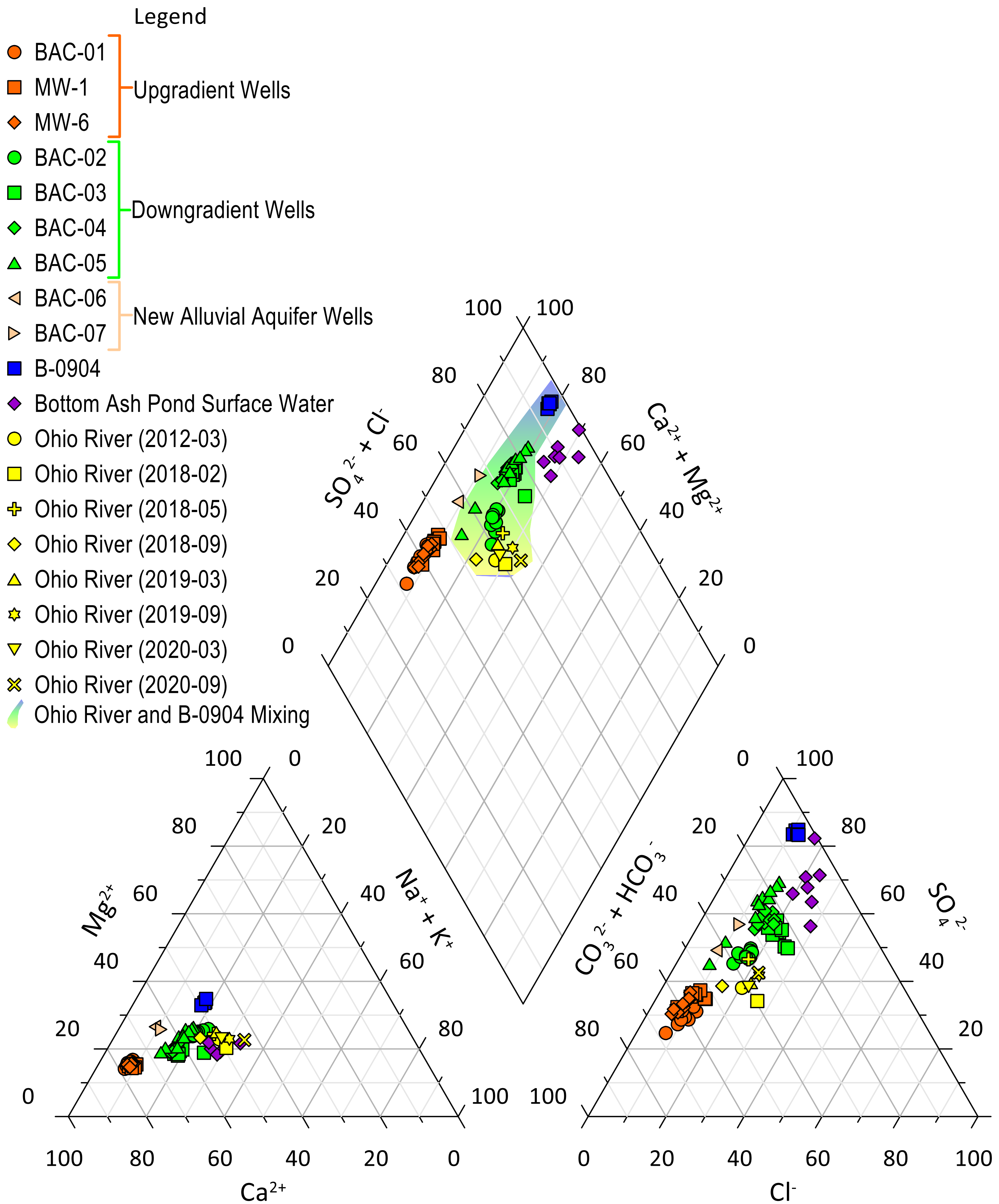
- Monitoring Well
- Cross Section Location
- Borehole
- Well Screen
- Interpreted High River Piezometric Surface
- Low River Stage Flow Direction
- High River Stage Flow Direction
- Interpreted Groundwater Flow Direction
- Interpreted Leachate from NFAP
- Interpreted Regional Source of Cl^-, SO_4^{2-}, and TDS

Interpreted Geology

- Sandy Clayey Gravel with Bottom Ash
- Silt/Clay
- Silt/Clay Interbedded with Fine Sand
- Sand
- Bedrock

Figure 5-2: High River Stage Cross Section
Gavin Generating Station
Cheshire, Ohio

ERM



NOTES:

1. Date Range: March 2012 to September 2020
2. Only wells with complete data including all 8 piper diagram analytes are presented

Figure 6-1: BAP Piper Diagram
Gavin Generating Station
Cheshire, Ohio

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Guyana	Singapore
Hong Kong	South Africa
India	South Korea
Indonesia	Spain
Ireland	Sweden
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APPENDIX C ANALYTICAL DATA SUMMARY

Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01	BAC-01
	Date	2016-08-26	2016-10-03	2016-11-28	2017-02-07	2017-03-28	2017-05-03	2017-06-13	2017-07-14	2018-02-28	2018-05-16	2018-09-18	2019-03-16
		N	N	N	N	N	N	N	N	N	N	N	N
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L			222	214						240	210	200 B
Aluminum	mg/L					0.49	0.045 J	0.05 U	0.05 U				
Antimony	mg/L	2E-05 J	2E-05 J	1E-05 J	2E-05 J	0.002 B	0.002 U	0.002 U	0.002 U				
Arsenic	mg/L	0.00078	0.00042	0.0004	0.00106	0.0022 J	0.005 U	0.005 U	0.005 U				
Barium	mg/L	0.0725	0.0611	0.0641	0.0625	0.075 B	0.063	0.064	0.062				
Beryllium	mg/L	1E-05 J	2E-05 U	2E-05 U	9E-06 J	0.001 U	0.001 U	0.001 U	0.001 U				
Bicarbonate Alkalinity as CaCO3	mg/L									220	240	210	200 B
Boron	mg/L	0.104	0.095	0.11	0.162	0.11 J	0.12	0.13 J	0.13 JB	0.12	0.12	0.12	0.11
Bromide	mg/L			0.1 J	0.1 J	0.19 J	0.16 J	0.15 J	0.16 J				
Cadmium	mg/L	2E-05 J	2E-05 J	2E-05 J	2E-05	0.001 U	0.001 U	0.001 U	0.001 U				
Calcium	mg/L	113	105	114	107	110 JB	100	110	110	110	100	100	100
Carbonate Alkalinity as CaCO3	mg/L									5 U	5 U	5 U	5 U
Chloride	mg/L	20.4	21.5	22.2	23.4	23	22	22	23	23	19	25	27
Chromium	mg/L	0.0004	0.0002	0.000207	0.000312	0.0013 JB	0.002 U	0.002 U	0.002 U				
Cobalt	mg/L	0.00052	0.000168	0.000164	0.000439	0.00095 J	0.0002 J	0.001 U	0.001 U				
Conductivity, Field	uS/cm	645	646	661	644						621		
Copper	mg/L					0.0014 JB	0.002 U	0.002 U	0.002 U				
Dissolved Oxygen, Field	mg/L	0.76	0.16	0.78	0.76						0.17		
Dissolved Solids, Total	mg/L	434	402	380	360	420	400	420 J	420 J	410	380	410	390
Fluoride	mg/L	0.1 J	0.1 J	0.1 J	0.1 J	0.14	0.14	0.14	0.14	0.12	0.13 F2	0.12	0.12
Iron	mg/L					1.4 B	0.16	0.085 J	0.1 U				
Lead	mg/L	0.00244	0.000255	0.000283	0.00058	0.001 J	0.001 U	0.001 U	0.001 U				
Lithium	mg/L	0.008	0.0009 J	0.006	0.004	0.0034 J	0.0024 J	0.0035 J	0.0038 J				
Magnesium	mg/L			13.4	12.8	12 B	13	14	13	12	12	12	13
Manganese	mg/L					0.19 JB	0.1	0.048	0.049				
Mercury	mg/L	5E-06 U	5E-06 U	5E-06 U	5E-06 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U				
Molybdenum	mg/L	0.00037	0.00071	0.00055	0.00147	0.0014 J	0.01 U	0.01 U	0.01 U				
Nickel	mg/L					0.0018 JB	0.002 U	0.002 U	0.002 U				
pH, Field	pH units	6.82	6.83	6.85	6.75	6.82	6.79	6.76	6.67		6.83	6.86	6.93
Potassium	mg/L			1.57	1.74	1.6 B	1.4	1.4	1.4	1.6	1.5	1.4	1.6
Radium-226	pCi/L	0.244	0.323	0.186	0.173	0.0827 U	0.0201 U	0.418	0.0636 U				
Radium-226/228	pCi/L	0.549	0.526	1.114	0.449	0.316	0.0267 U	0.559	0.195 U				
Radium-228	pCi/L	0.305	0.203	0.928	0.276	0.233 U	0.00664 U	0.141 U	0.131 U				
Redox Potential, Field	mV	148.6	166.8	93	135.6								
Selenium	mg/L	0.0002	0.0002	0.0001	0.0001 J	0.0011 J	0.005 U	0.005 U	0.005 U				
Silver	mg/L					9.6E-05 J	0.001 U	0.001 U	0.001 U				
Sodium	mg/L			11.6	10.8	10 JB	11 B	11	11 J	11	11	11	11
Strontium	mg/L			0.19	0.174	0.18 B	0.16 B	0.17 B	0.17				
Sulfate	mg/L	112	105	111	95.3	92	92	95	95	91	84 F1	98	110
Temperature, Field	deg C	16.2	13.9	13.8	14.4						14.5		
Thallium	mg/L	1E-05 J	8.4E-05	2E-05 J	1E-05 J	0.001 U	0.001 U	0.001 U	0.001 U				
Turbidity, Field	NTU	9.2	5.1	6.1	13.6	18.3	2.1	1.8	0.5		15.3	4.23	
Vanadium	mg/L					0.0012 J							
Zinc	mg/L					0.02 U	0.02 U	0.02 U	0.02 U				

Notes:
FD = Field duplicate sample
N = Normal environmental sample
deg C = Degree Celcius
mg/L = Milligrams per liter
mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
pCi/L = Picocuries per liter
B: Compound was found in the blank and sample.
J: Result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value.
U: Indicates the analyte was analyzed for but not detected.
F1 = MS and/or MSD Recovery is outside acceptance limits.
Empty cells = Not analyzed

Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	BAC-01	BAC-01	BAC-01	BAC-02	BAC-02	BAC-02	BAC-02	BAC-02	BAC-02	BAC-02	BAC-02	BAC-02
	Date	2019-09-19	2020-03-11	2020-09-09	2016-08-25	2016-10-03	2016-11-28	2017-02-07	2017-03-28	2017-05-03	2017-06-13	2017-06-13	2017-07-19
		N	N	N	N	N	N	N	N	N	FD	N	N
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L	190	200	190			285	273					
Aluminum	mg/L								0.15	0.078	0.041 J	0.035 J	0.1
Antimony	mg/L				6E-05	3E-05 J	4E-05 J	2E-05 J	0.00035 JB	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L				0.00159	0.00124	0.00146	0.00067	0.00072 J	0.00075 J	0.005 U	0.00075 J	0.00078 J
Barium	mg/L				0.0515	0.0489	0.0492	0.0358	0.05 B	0.048	0.049	0.051	0.052
Beryllium	mg/L				3.5E-05	2.3E-05	2.6E-05	7E-06 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Bicarbonate Alkalinity as CaCO3	mg/L	190	200	190									
Boron	mg/L	0.096 J	0.11	0.15 J	1.72	1.92	2.17	2.08	2.5 J	2.4	2.6 J	2.7 J	2.7 JB
Bromide	mg/L						0.624	0.483	0.73	0.12 J	0.74	0.74	0.77
Cadmium	mg/L				0.0003	0.00031	0.0003	0.00025	0.00035 J	0.00032 J	0.00043 J	0.00041 J	0.00036 J
Calcium	mg/L	96	100	96	149	156	168	161	170 JB	180	180	180	190
Carbonate Alkalinity as CaCO3	mg/L	5 U	5 U	5 U									
Chloride	mg/L	21	27	29	82.8	91.8	95	97.3	100	21	110	110	110
Chromium	mg/L				0.0013	0.0008	0.00129	0.00432	0.0012 JB	0.0015 J	0.0016 J	0.002 U	0.0011 J
Cobalt	mg/L				0.00333	0.00257	0.00266	0.00178	0.0019	0.0018	0.0018	0.0017	0.0025
Conductivity, Field	uS/cm		633	612	1279	1355	1436	1434					
Copper	mg/L								0.0014 JB	0.002 U	0.002 U	0.002 U	0.002 U
Dissolved Oxygen, Field	mg/L				0.63	0.39	0.94	1.18					
Dissolved Solids, Total	mg/L	350	380	360	824	858	896	860	1000	1000	1100 J	1000 J	1100 J
Fluoride	mg/L	0.12	0.13	0.046 J	0.19	0.1 J	0.08 J	0.17	0.17	0.032 J	0.17	0.17	0.16
Iron	mg/L								0.39 B	0.27	0.15	0.11	0.39
Lead	mg/L				0.00284	0.00184	0.00158	0.000589	0.0008 J	0.00068 J	0.0006 J	0.00068 J	0.00089 J
Lithium	mg/L				0.01	0.004	0.005	0.001 U	0.0022 J	0.008 U	0.008 U	0.008 U	0.0025 J
Magnesium	mg/L	12	13	13			43.9	43.9	46 B	51	51	52	49
Manganese	mg/L								4.1 JB	4.3	4.4	4.5	4.7
Mercury	mg/L				3E-06 J	7E-06	5E-06 U	3E-06 J	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L				0.00109	0.00044	0.00081	0.00201	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nickel	mg/L								0.022 B	0.022	0.02	0.021	0.024
pH, Field	pH units	6.94	6.96	6.97	6.2	6.19	6.14	6.1	6.18	6.13		6.08	6.02
Potassium	mg/L	1.4	1.5	1.6			3.66	3.43	3.6 B	3.7	3.6	3.6	4
Radium-226	pCi/L				0.934	0.233	0.12	0.204	0.0599 U	0.0438 U	0.113	0.072 U	0.0813 U
Radium-226/228	pCi/L				1.073	0.855	0.0347	0.1452	0.298 U	0.375 U	0.29 U	0.305 U	-0.104 U
Radium-228	pCi/L				0.139	0.622	-0.0853	-0.0588	0.238 U	0.331 U	0.177 U	0.233 U	-0.186 U
Redox Potential, Field	mV				112.3	164.6	115.3	143.3					
Selenium	mg/L				0.0003	0.0002	0.0002	6E-05 J	0.00048 J	0.005 U	0.005 U	0.005 U	0.005 U
Silver	mg/L								0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Sodium	mg/L	9.6	11	11			67.3	64.6	68 JB	74 B	73	74	73 JB
Strontium	mg/L						0.499	0.479	0.55 B	0.56 B	0.51 B	0.53 B	0.63
Sulfate	mg/L	110	92	100	288	341	359	346	410	80	430	420	440
Temperature, Field	deg C		14	14	19.9	17.2	16	16.2					
Thallium	mg/L				0.000128	3E-05 J	9.3E-05	3E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Turbidity, Field	NTU	8	2	26.5	8.1	9.6	9.3	5.4	2.2	2.5		2	7.4
Vanadium	mg/L								0.005 U				
Zinc	mg/L								0.02 U	0.02 U	0.02 U	0.02 U	0.02 U

Notes:
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mg/L = Milligrams per liter
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NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

Analyte	Unit	FEDERAL BAC-02 2018-02-28 N	FEDERAL BAC-02 2018-05-15 FD	FEDERAL BAC-02 2018-05-15 N	FEDERAL BAC-02 2018-09-18 FD	FEDERAL BAC-02 2018-09-18 N	FEDERAL BAC-02 2019-03-16 N	FEDERAL BAC-02 2019-09-18 N	FEDERAL BAC-02 2020-03-11 N	FEDERAL BAC-02 2020-09-09 N	FEDERAL BAC-03 2016-08-26 N	FEDERAL BAC-03 2016-10-03 N	FEDERAL BAC-03 2016-11-28 N
Alkalinity, Total as CaCO3	mg/L		300	310	280	280	290 B	250	280	240			96.6
Aluminum	mg/L												
Antimony	mg/L										5E-05	2E-05 J	2E-05 J
Arsenic	mg/L										0.00027	0.00024	0.00016
Barium	mg/L										0.0469	0.045	0.0422
Beryllium	mg/L										1E-05 J	2E-05 U	2E-05 U
Bicarbonate Alkalinity as CaCO3	mg/L	260	300	310	280	280	290 B	250	280	240			
Boron	mg/L	2	2.3	2.4	2.5	2.5	2.3	1.4	1.9	1.3	2.14	2.06	2.07
Bromide	mg/L												0.151
Cadmium	mg/L										0.00015	9E-05	8E-05
Calcium	mg/L	160	160	170	170	160	150	130	140	110	97.8	93.7	90.4
Carbonate Alkalinity as CaCO3	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U			
Chloride	mg/L	97	110	110	100	100	96	68	82	62	52.1	52.8	48.2
Chromium	mg/L										0.0007	0.0006	0.000458
Cobalt	mg/L										0.000468	0.00026	0.000169
Conductivity, Field	uS/cm			1469					1361	1091	767	752	749
Copper	mg/L												
Dissolved Oxygen, Field	mg/L			0.26							1.1	0.2	0.68
Dissolved Solids, Total	mg/L	900	950	980	970	980	920	580	880	690	528	476	416
Fluoride	mg/L	0.16	0.16	0.16	0.16	0.2	0.15	0.15	0.18	0.12	0.07 J	0.09 J	0.07 J
Iron	mg/L												
Lead	mg/L										0.00184	0.000641	0.00048
Lithium	mg/L										0.009	0.006	0.007
Magnesium	mg/L	41	44	47	44	45	44	36	43	33			16.2
Manganese	mg/L												
Mercury	mg/L										5E-06 U	1.6E-05	5E-06 U
Molybdenum	mg/L										0.00031	0.00138	0.0005
Nickel	mg/L												
pH, Field	pH units			6.18		6.2	6.33	6.43	6.43	6.5	6.12	6.03	6.04
Potassium	mg/L	3.8	3.8	3.9	3.6	3.6	3.8	2.6	3.5	2.6			1.9
Radium-226	pCi/L										0.0989	0.13	0.0518
Radium-226/228	pCi/L										0.2129	-0.14	0.3818
Radium-228	pCi/L										0.114	-0.27	0.33
Redox Potential, Field	mV										213.7	236.8	192.3
Selenium	mg/L										7E-05 J	6E-05 J	0.0001 U
Silver	mg/L												
Sodium	mg/L	63	66	70	68	68	69	56	70	58			30.5
Strontium	mg/L												0.211
Sulfate	mg/L	360	390	390	390	400	370	310	340	260	211	204	200
Temperature, Field	deg C			17.5					15	17	18.6	15.4	14.5
Thallium	mg/L										3E-05 J	2E-05 J	1E-05 J
Turbidity, Field	NTU			17.3		2.02		5	1	0.6	3.9	8.1	7.6
Vanadium	mg/L												
Zinc	mg/L												

Notes:
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mV = Milivolts
NTU = Nephelometric Turbidity Unit
uS/cm = Microsiemens per centimeter
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03	BAC-03
	Date	2017-02-07	2017-03-28	2017-05-02	2017-05-02	2017-06-13	2017-07-14	2018-02-28	2018-05-15	2018-09-18	2019-03-16	2019-09-19	2020-03-12
		N	N	FD	N	N	N	N	N	N	N	N	FD
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L	88.2							100	93	91 B	85	100
Aluminum	mg/L		0.059	0.049 J	0.042 J	0.05 U	0.05 U						
Antimony	mg/L	3E-05 J	0.00048 JB	0.002 U	0.002 U	0.002 U	0.002 U						
Arsenic	mg/L	0.00031	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U						
Barium	mg/L	0.0426	0.05 B	0.048	0.048	0.045	0.044						
Beryllium	mg/L	8E-06 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U						
Bicarbonate Alkalinity as CaCO3	mg/L							90	100	93	91 B	85	100
Boron	mg/L	2.24	2.3 J	2.1	2.1	2 J	2 JB	2.3	2.5	2.2	2.2	2	1.6
Bromide	mg/L	0.1 J	0.17 J	0.15 J	0.15 J		0.16 J						
Cadmium	mg/L	8E-05	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U						
Calcium	mg/L	95.7	97 JB	96	96	89	88	95	96	92	91	87	100
Carbonate Alkalinity as CaCO3	mg/L							5 U	5 U	5 U	5 U	5 U	5 U
Chloride	mg/L	52.2	68	72	72	62	61	62	56	57	59	52	78
Chromium	mg/L	0.00115	0.00054 JB	0.002 U	0.002 U	0.002 U	0.002 U						
Cobalt	mg/L	0.000317	0.00027 J	0.00024 J	0.00025 J	0.001 U	0.001 U						
Conductivity, Field	uS/cm	762							731				819
Copper	mg/L		0.0031 B	0.002 B	0.0019 JB	0.0017 JB	0.002 U						
Dissolved Oxygen, Field	mg/L	0.83							0.15				
Dissolved Solids, Total	mg/L	514	520	510	510	500 J	500 J	500	540	500	480	480	560
Fluoride	mg/L	0.07 J	0.071	0.071	0.071	0.071	0.07	0.072	0.085	0.073	0.12	0.062	0.068
Iron	mg/L		0.14 B	0.13	0.1	0.1 U	0.1 U						
Lead	mg/L	0.00168	0.00093 J	0.00096 J	0.00083 J	0.00055 J	0.001 U						
Lithium	mg/L	0.006	0.0056 J	0.0049 J	0.0049 J	0.0033 J	0.0067 J						
Magnesium	mg/L	17.6	17 B	18	18	17	17	17	17	16	18	16	20
Manganese	mg/L		0.24 JB	0.23	0.22	0.19	0.15						
Mercury	mg/L	5E-06 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U						
Molybdenum	mg/L	0.0006	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U						
Nickel	mg/L		0.0044 B	0.0042	0.048	0.0035	0.0035						
pH, Field	pH units	6.05	6.07		6.05	5.89	5.93		6.16	6.12	6.26	6.19	6.19
Potassium	mg/L	2.12	1.9 B	1.9	1.9	1.8	1.8	1.8	1.7	1.8	2	1.7	2
Radium-226	pCi/L	0.281	0.0181 U	0.065 U	-0.0333 U	0.0442 U	0.235						
Radium-226/228	pCi/L	0.17	0.102 U	0.345	0.271 U	0.0882 U	0.506						
Radium-228	pCi/L	-0.111	0.0838 U	0.28 U	0.304 U	0.044 U	0.272						
Redox Potential, Field	mV	248.5											
Selenium	mg/L	4E-05 J	0.005 U	0.005 U	0.005 U	0.005 U	0.0011 JB						
Silver	mg/L		3.3E-05 J	0.001 U	0.001 U	0.001 U	0.001 U						
Sodium	mg/L	31.2	31 JB	34 B	34 B	33	34 J	31	30	31	32	29	35
Strontium	mg/L	0.222	0.22 B	0.22 B	0.22 B	0.2 B	0.21						
Sulfate	mg/L	196	180	180	180	190	190 J	210	200	200	200	210	200
Temperature, Field	deg C	14.8							16.5				15
Thallium	mg/L	3E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U						
Turbidity, Field	NTU	5.1	2.1		4.2	2.3	1.9		1.03	1.36		2	0.9
Vanadium	mg/L		0.005 U										
Zinc	mg/L		0.02 U	0.02 U	0.02 U	0.02 U	0.02 U						

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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	BAC-03	BAC-03	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04
	Date	2020-03-12	2020-09-10	2016-08-26	2016-10-03	2016-11-28	2017-02-07	2017-03-28	2017-05-02	2017-06-13	2017-07-19	2018-03-01	2018-03-01
		N	N	N	N	N	N	N	N	N	N	FD	N
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L	100	86			107	111					92	91
Aluminum	mg/L							0.041 J	0.76	0.63	1.6		
Antimony	mg/L			9E-05	7E-05	4E-05 J	7E-05	0.00046 JB	0.002 U	0.00071 J	0.002 U		
Arsenic	mg/L			0.00183	0.00134	0.00212	0.0017	0.002 J	0.0033 J	0.0045 J	0.0086		
Barium	mg/L			0.0624	0.0583	0.059	0.0597	0.06 B	0.07	0.065	0.077		
Beryllium	mg/L			2E-05 J	6E-06 J	9E-06 J	2.1E-05	0.001 U	0.001 U	0.00059 J	0.001 U		
Bicarbonate Alkalinity as CaCO3	mg/L	100	86									92	91
Boron	mg/L	1.6	1.7	2.56	2.53	2.61	2.7	2.7 J	2.5	2.7 J	2.5 JB	2.8	2.8
Bromide	mg/L					0.1 J	0.1 J		0.17 J	0.16 J	0.17 J		
Cadmium	mg/L			0.00011	4E-05	2E-05	9E-05	0.001 U	0.001 U	0.00036 J	0.00022 J		
Calcium	mg/L	100	73	99.1	98.2	96.7	99.6	94 JB	94	83	86	94	94
Carbonate Alkalinity as CaCO3	mg/L	5 U	5 U									5 U	5 U
Chloride	mg/L	78	63	42.6	44.5	40.9	40		48	47	49	52	52
Chromium	mg/L			0.0006	0.0009	0.000238	0.00081	0.00034 JB	0.005	0.0029	0.0039		
Cobalt	mg/L			0.00807	0.00627	0.00577	0.00553	0.0066	0.0083	0.0087	0.0095		
Conductivity, Field	uS/cm	819	684	696	761	751	765						
Copper	mg/L							0.00037 JB	0.0088 B	0.0055 B	0.0064		
Dissolved Oxygen, Field	mg/L			0.77	0.4	0.67	0.98						
Dissolved Solids, Total	mg/L	550	420	516	488	448	498		530	520 J	520 J	500	490
Fluoride	mg/L	0.081	0.037 J	0.08 J	0.09 J	0.08 J	0.09 J		0.11	0.079	0.077	0.087	0.084
Iron	mg/L							1.8 B	3.8	4.6	8.7		
Lead	mg/L			0.00106	0.000367	0.000277	0.00102	0.00037 J	0.0035	0.0037	0.0064		
Lithium	mg/L			0.007	0.006	0.01	0.006	0.0067 J	0.0068 J	0.0048 J	0.0082		
Magnesium	mg/L	19	15			17.7	18	18 B	19	18	17	18	18
Manganese	mg/L							1.4 JB	2	1.4	1.4		
Mercury	mg/L			5E-06 U	1.9E-05	5E-06 U	5E-06 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U		
Molybdenum	mg/L			0.00057	0.00465	0.00037	0.00365	0.00061 J	0.01 U	0.01 U	0.01 U		
Nickel	mg/L							0.012 B	0.013	0.0088	0.012		
pH, Field	pH units	6.19	6.27	6.41	6.17	6.19	6.23	6.18	6.2	6.04	5.94		
Potassium	mg/L	2	1.8			1.95	2	1.9 B	2	1.8	2.1	1.8	1.8
Radium-226	pCi/L			0.764	0.226	0.235	0.19		0.17	0.152	0.274		
Radium-226/228	pCi/L			0.8152	0.467	0.34	0.017		0.641	0.178 U	0.576		
Radium-228	pCi/L			0.0512	0.241	0.105	-0.173		0.47	0.0263 U	0.302 U		
Redox Potential, Field	mV			330.2	59.6	24	24.3						
Selenium	mg/L			0.0001	6E-05 J	8E-05 J	0.0001 J	0.005 U	0.005 U	0.005 U	0.005 U		
Silver	mg/L							0.00011 J	0.002	0.00026 J	0.00042 J		
Sodium	mg/L	34	37			28.7	27.9	27 JB	29 B	27	27 JB	29	28
Strontium	mg/L					0.218	0.218	0.21 B	0.21 B	0.16 B	0.19		
Sulfate	mg/L	200	170	215	214	209	200		220 J	230	220	210	220
Temperature, Field	deg C	15	16	19.35	16.6	15.1	15						
Thallium	mg/L			7.2E-05	4E-05 J	3E-05 J	5.3E-05	0.001 U	0.001 U	0.001 U	0.001 U		
Turbidity, Field	NTU	0.9	2.9	9.1	5	9	9.2	0.8	44.7	58.9	108.1		
Vanadium	mg/L												
Zinc	mg/L							0.02 U	0.016 J	0.02 U	0.016 J		

Notes:
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-04	BAC-05	BAC-05	BAC-05	BAC-05
	Date	2018-05-15	2018-09-18	2019-03-16	2019-03-16	2019-09-18	2019-09-18	2020-03-12	2020-09-10	2016-08-26	2016-10-03	2016-11-28	2017-02-07
		N	N	FD	N	FD	N	N	N	N	N	N	N
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L	96	91	100 B	100 B	96	96	100	89			144	105
Aluminum	mg/L												
Antimony	mg/L									0.00023	7E-05	9E-05	3E-05 J
Arsenic	mg/L									0.00298	0.00143	0.00177	0.00065
Barium	mg/L									0.0585	0.0478	0.0459	0.0495
Beryllium	mg/L									0.000118	4.7E-05	5.9E-05	1E-05 J
Bicarbonate Alkalinity as CaCO3	mg/L	96	91	100 B	100 B	96	96	100	89				
Boron	mg/L	2.9	2.8	3	2.9	2.7	2.6	2.4	2.4	3.32	3.72	3.99	2.78
Bromide	mg/L											0.09 J	0.1 J
Cadmium	mg/L									0.00033	9E-05	5E-05	8E-05
Calcium	mg/L	95	92	95	96	90	91	92	89	93.4	90.8	97.7	89
Carbonate Alkalinity as CaCO3	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U				
Chloride	mg/L	49	40	41	41	37	37	45	48	31.6	28.5	24.6	36.2
Chromium	mg/L									0.0048	0.0018	0.00208	0.000652
Cobalt	mg/L									0.0111	0.00814	0.00536	0.00852
Conductivity, Field	uS/cm	721						736	730	730	706	702	751
Copper	mg/L												
Dissolved Oxygen, Field	mg/L	0.93								3.43	1.19	0.59	0.86
Dissolved Solids, Total	mg/L	540	490	520	520	470	480	490	490	522	468	452	494
Fluoride	mg/L	0.085	0.082	0.082	0.078	0.082	0.08	0.087	0.04 J	0.1 J	0.15	0.17	0.1 J
Iron	mg/L												
Lead	mg/L									0.0066	0.00248	0.0021	0.000631
Lithium	mg/L									0.015	0.007	0.01	0.006
Magnesium	mg/L	18	17	18	18	17	17	18	19			16.9	17.9
Manganese	mg/L												
Mercury	mg/L									3E-06 J	1.4E-05	3E-06 J	5E-06 U
Molybdenum	mg/L									0.00147	0.00118	0.00139	0.00237
Nickel	mg/L												
pH, Field	pH units	6.17	6.24		6.46		6.39	6.37	6.39	6.58	6.63	6.64	6.2
Potassium	mg/L	1.8	1.8	1.9	2	1.7	1.8	1.8	1.8			1.7	1.7
Radium-226	pCi/L									0.41	1.12	0.378	0.0928
Radium-226/228	pCi/L									0.127	2.056	0.554	0.2258
Radium-228	pCi/L									-0.283	0.936	0.176	0.133
Redox Potential, Field	mV									9.9	111.5	14	68.6
Selenium	mg/L									0.0004	0.0002	0.0002	4E-05 J
Silver	mg/L												
Sodium	mg/L	28	27	28	28	26	27	28	28			22.9	28.3
Strontium	mg/L											0.16	0.162
Sulfate	mg/L	220	220	220	220	230	230	210	230	200	190	184	216
Temperature, Field	deg C	19.6						15	19	20.4	18.5	15.4	15.5
Thallium	mg/L									7.3E-05	5E-05 J	4E-05 J	5.4E-05
Turbidity, Field	NTU	33.2	21.5				28	34.8	32	96.7	72.3	50.1	7.8
Vanadium	mg/L												
Zinc	mg/L												

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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05	BAC-05
	Date	2017-03-28	2017-05-03	2017-06-13	2017-07-19	2018-03-01	2018-05-16	2018-06-20	2018-09-18	2019-03-16	2019-09-18	2020-03-11	2020-09-10
		N	N	N	N	N	N	N	N	N	N	N	N
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L					160	90	65	79	64 B	84	88	61
Aluminum	mg/L	0.11	0.17	0.43	0.43								
Antimony	mg/L	0.00048 JB	0.00057 J	0.002 U	0.002 U								
Arsenic	mg/L	0.00086 J	0.00097 J	0.0013 J	0.00084 J								
Barium	mg/L	0.04 B	0.052	0.039	0.041								
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U								
Bicarbonate Alkalinity as CaCO3	mg/L					160	90	65	79	64 B	84	88	61
Boron	mg/L	4.5 J	3.2	4.5 J	4.3 JB	3.9	2.9	2.8	2.8	2.5	2.5	2.8	2.5
Bromide	mg/L	0.13 J	0.14 J	0.1 J	0.1 J								
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U								
Calcium	mg/L	94 JB	100	90	87	84	74	70	76	70	69	79	68
Carbonate Alkalinity as CaCO3	mg/L					5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloride	mg/L	24	34	21	21	21	32	31	37	37	32	29	38
Chromium	mg/L	0.0016 JB	0.0013 J	0.0027	0.0092								
Cobalt	mg/L	0.004	0.0078	0.0042	0.0037								
Conductivity, Field	uS/cm						673					694	709
Copper	mg/L	0.0013 JB	0.002 U	0.0023 B	0.0042								
Dissolved Oxygen, Field	mg/L						0.5						
Dissolved Solids, Total	mg/L	480	540	460 J	460 J	420	470	470	480	470	450	440	480
Fluoride	mg/L	0.21	0.17	0.22	0.21	0.22	0.11	0.091	0.092	0.084	0.094	0.13	0.041 J
Iron	mg/L	0.63 B	0.78	1.7	1.4								
Lead	mg/L	0.0008 J	0.0012	0.0019	0.0015								
Lithium	mg/L	0.0042 J	0.0048 J	0.0021 J	0.0045 J								
Magnesium	mg/L	16 B	20	16	15	16	18	19	19	20	19	19	20
Manganese	mg/L	3.4 JB	7.7	3	2								
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U								
Molybdenum	mg/L	0.0011 J	0.01 U	0.01 U	0.01 U								
Nickel	mg/L	0.0095 B	0.02	0.008	0.012								
pH, Field	pH units	6.72	6.47	6.63	6.53		6.06		6.09	6.1	6.31	6.33	6.15
Potassium	mg/L	1.4 B	1.6	1.4	1.5	1.4	1.6	1.7	1.6	1.8	1.4	1.6	1.5
Radium-226	pCi/L	0.123	-0.0279 U	0.0494 U	0.0901 U								
Radium-226/228	pCi/L	0.241 U	0.253 U	0.0636 U	0.13 U								
Radium-228	pCi/L	0.118 U	0.281 U	0.0142 U	0.0398 U								
Redox Potential, Field	mV												
Selenium	mg/L	0.005 U	0.0011 J	0.005 U	0.005 U								
Silver	mg/L	0.0011	5.7E-05 J	0.00011 J	0.00013 J								
Sodium	mg/L	21 JB	28 B	22	21 JB	21	25	25	25	26	23	24	26
Strontium	mg/L	0.15 B	0.17 B	0.13 B	0.13								
Sulfate	mg/L	170	220 J	170	160	150	220	210	230	240	230	220	250
Temperature, Field	deg C						16.6					15	16
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U								
Turbidity, Field	NTU	6.2	5.3	26.6	25.1		21.3		16.1		37	9.6	7.5
Vanadium	mg/L	0.005 U											
Zinc	mg/L	0.015 J	0.02 U	0.015 J	0.031								

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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	BAC-06	BAC-07	MW-1	MW-1	MW-1	MW-1	MW-1	MW-1	MW-1	MW-1	MW-1	MW-1
	Date	2020-09-10	2020-09-09	2016-08-25	2016-10-03	2016-11-28	2017-02-07	2017-03-28	2017-03-28	2017-05-03	2017-06-13	2017-07-14	2017-07-14
		N	N	N	N	N	N	FD	N	N	N	FD	N
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L	180	120			249	245						
Aluminum	mg/L							0.068	0.092	0.085	0.061	0.05 U	0.05 U
Antimony	mg/L			2E-05 J	2E-05 J	2E-05 J	2E-05 J	0.00063 JB	0.0006 JB	0.002 U	0.002 U	0.002 U	0.002 U
Arsenic	mg/L			0.00102	0.00087	0.00073	0.00087	0.00061 J	0.00064 J	0.005 U	0.005 U	0.005 U	0.00094 J
Barium	mg/L			0.0982	0.0914	0.0985	0.0899	0.1 B	0.1 B	0.1	0.11	0.1	0.1
Beryllium	mg/L			2E-05 J	1E-05 J	6E-06 J	7E-06 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Bicarbonate Alkalinity as CaCO3	mg/L	180	120										
Boron	mg/L	1.7	1.3	0.053	0.044	0.058	0.048	0.074 J	0.081 J	0.06 J	0.066 J	0.067 JB	0.068 JB
Bromide	mg/L					0.119	0.099	0.14 J	0.14 J	0.12 J	0.13 J	0.13 J	0.13 J
Cadmium	mg/L			2E-05 J	1E-05 J	5E-06 J	8E-06 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Calcium	mg/L	100	85	114	113	124	121	120 JB	120 JB	120	120	120	120
Carbonate Alkalinity as CaCO3	mg/L	5 U	5 U										
Chloride	mg/L	25	27	19.4	19.9	19.5	20	20	20	21	22	22	22
Chromium	mg/L			0.0007	0.0003	0.000175	0.000219	0.00027 JB	0.00049 JB	0.002 U	0.002 U	0.002 U	0.002 U
Cobalt	mg/L			0.000964	0.000769	0.000672	0.000763	0.0007 J	0.00072 J	0.00072 J	0.0007 J	0.00069 J	0.00078 J
Conductivity, Field	uS/cm	772	654	714	712	717	707						
Copper	mg/L							0.002 U	0.00074 JB	0.002 U	0.002 U	0.002 U	0.002 U
Dissolved Oxygen, Field	mg/L			0.57	0.54	0.75	0.75						
Dissolved Solids, Total	mg/L	510	450	466	440	447	455	460	470	470	490 J	470 J	480 J
Fluoride	mg/L	0.048 J	0.05 U	0.09	0.09	0.01	0.1	0.11	0.11	0.11	0.11	0.11	0.11
Iron	mg/L							0.24 B	0.27 B	0.3	0.24	0.093 J	0.095 J
Lead	mg/L			0.000495	0.000355	0.000124	0.000214	0.00031 J	0.00035 J	0.001 U	0.001 U	0.001 U	0.00076 J
Lithium	mg/L			0.008	0.004	0.006	0.006	0.0041 J	0.004 J	0.0033 J	0.0046 J	0.0052 J	0.0051 J
Magnesium	mg/L	25	21			14.1	14.2	13 B	13 B	14	14	14	13
Manganese	mg/L							0.48 JB	0.48 JB	0.5	0.51	0.49	0.47
Mercury	mg/L			5E-06 U	1.3E-05	5E-06 U	5E-06 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L			0.00045	0.00023	0.00022	0.00042	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Nickel	mg/L							0.00053 JB	0.00068 JB	0.002 U	0.002 U	0.002 U	0.002 U
pH, Field	pH units	6.81	6.51	7.21	7.2	7.16	7.09		7.16	7.15	7.13		6.98
Potassium	mg/L	1.5	1.4			1.57	1.82	1.4 B	1.4 B	1.4	1.4	1.4	1.4
Radium-226	pCi/L			1.63	0.285	0.309	0.248	0.119 U	0.209	0.179	0.069 U	0.17	0.258
Radium-226/228	pCi/L			2.081	2.045	0.2551	0.918	0.567	0.537	0.527	0.525	0.342	0.518
Radium-228	pCi/L			0.451	1.76	-0.0539	0.67	0.449	0.328 U	0.348 U	0.456	0.171 U	0.259 U
Redox Potential, Field	mV			-85.8	-29.2	-37.6	-37.5						
Selenium	mg/L			0.0001	7E-05 J	4E-05 J	5E-05 J	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.0012 JB
Silver	mg/L							0.00014 J	0.00025 J	0.00021 J	0.00019 J	0.001 U	0.001 U
Sodium	mg/L	15	16			16	13.5	15 JB	15 JB	16 B	15	16 J	15 J
Strontium	mg/L					0.218	0.219	0.2 B	0.2 B	0.2 B	0.2 B	0.2	0.2
Sulfate	mg/L	200	200	125	126	127	119	120	120	130	130	130	130
Temperature, Field	deg C	16	17	15.1	13.7	12.6	12.9						
Thallium	mg/L			3E-05 J	2E-05 J	1E-05 J	3E-05 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Turbidity, Field	NTU	15	23.8	8.6	7	9	8.8		2.9	3.3	3		0.6
Vanadium	mg/L							0.005 U	0.005 U				
Zinc	mg/L							0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U

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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

Analyte	Unit	FEDERAL MW-1 2018-02-28 N	FEDERAL MW-1 2018-05-15 N	FEDERAL MW-1 2018-09-18 N	FEDERAL MW-1 2019-03-16 N	FEDERAL MW-1 2019-09-17 N	FEDERAL MW-1 2020-03-11 N	FEDERAL MW-1 2020-09-10 N	FEDERAL MW-6 2016-08-26 N	FEDERAL MW-6 2016-10-03 N	FEDERAL MW-6 2016-11-28 N	FEDERAL MW-6 2017-02-07 N	FEDERAL MW-6 2017-03-28 N
Alkalinity, Total as CaCO3	mg/L		230	220	220 B	220	220	220			259	257	
Aluminum	mg/L												0.05 U
Antimony	mg/L								2E-05 J	5E-05 U	5E-05 U	1E-05 J	0.00059 JB
Arsenic	mg/L								0.00029	0.00035	0.00031	0.00031	0.00042 J
Barium	mg/L								0.148	0.138	0.141	0.123	0.15 B
Beryllium	mg/L								2E-05 U	2E-05 U	2E-05 U	2E-05 U	0.001 U
Bicarbonate Alkalinity as CaCO3	mg/L	220	230	220	220 B	220	220	220					
Boron	mg/L	0.054 J	0.054 J	0.076 J	0.054 J	0.056 J	0.066 J	0.093 J	0.045	0.054	0.045	0.122	0.065 J
Bromide	mg/L										0.107	0.3 U	0.14 J
Cadmium	mg/L								4E-05	3E-05	3E-05	3E-05	0.001 U
Calcium	mg/L	120	120	120	120	120	120	120	123	116	123	106	120 JB
Carbonate Alkalinity as CaCO3	mg/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U					
Chloride	mg/L	24	25	27	30	28	37	38	17.1	17.8	18	17.9	19
Chromium	mg/L								0.0005	0.0001	0.000822	0.00476	0.001 JB
Cobalt	mg/L								0.000403	0.000377	0.000383	0.000376	0.00052 J
Conductivity, Field	uS/cm		717				779	756	716	718	726	719	
Copper	mg/L												0.002 U
Dissolved Oxygen, Field	mg/L		0.12						0.04	0.3	0.66	0.99	
Dissolved Solids, Total	mg/L	470	500	490	520	510	490	470	476	434	456	454	480
Fluoride	mg/L	0.11	0.11	0.1	0.093	0.098	0.11	0.078	0.08 J	0.09 J	0.09	0.3 U	0.098
Iron	mg/L												0.031 JB
Lead	mg/L								3.9E-05	2E-05	2E-05 J	2.1E-05	0.00028 J
Lithium	mg/L								0.007	0.003	0.005	0.006	0.0042 J
Magnesium	mg/L	14	14	14	15	15	15	14			14.2	12.8	14 B
Manganese	mg/L												1.3 JB
Mercury	mg/L								5E-06 U	2E-06 J	5E-06 U	5E-06 U	0.0002 U
Molybdenum	mg/L								0.00073	0.00069	0.00064	0.00128	0.00078 J
Nickel	mg/L												0.00046 JB
pH, Field	pH units		7.14	7.16	7.35	7.29	7.3	7.42	7	7.04	7	6.96	7.03
Potassium	mg/L	1.5	1.4	1.5	1.6	1.5	1.5	1.4			1.93	1.64	1.7 B
Radium-226	pCi/L								0.87	0.444	0.31	0.141	0.0546 U
Radium-226/228	pCi/L								1.663	1.32	1.032	0.249	0.283 U
Radium-228	pCi/L								0.793	0.876	0.722	0.108	0.228 U
Redox Potential, Field	mV								165.3	171	105.8	145.2	
Selenium	mg/L								3E-05 J	0.0001 U	4E-05 J	5E-05 J	0.005 U
Silver	mg/L												4.4E-05 J
Sodium	mg/L	15	17	15	17	15	17	15			14.4	10.8	13 JB
Strontium	mg/L										0.228	0.174	0.22 B
Sulfate	mg/L	140	140	140	150	140	140	140	131	123	127	118	120
Temperature, Field	deg C		14.1				13	13	17.2	14.7	13.6	13.9	
Thallium	mg/L								2E-05 J	4E-05 J	2E-05 J	8.7E-05	0.001 U
Turbidity, Field	NTU		11.3	2.72		4	3.8	2.3	5.5	1.9	4	1.6	0.2
Vanadium	mg/L												0.005 U
Zinc	mg/L												0.02 U

Notes:
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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	MW-6	MW-6	MW-6	MW-6	MW-6	MW-6	MW-6	MW-6	MW-6	MW-6	MW-6	B-0904
	Date	2017-05-03	2017-06-13	2017-07-14	2018-02-28	2018-05-16	2018-09-18	2019-03-16	2019-09-18	2020-03-11	2020-09-09	2020-09-09	2018-03-01
		N	N	N	N	N	N	N	N	N	FD	N	N
Analyte	Unit												
Alkalinity, Total as CaCO3	mg/L					250	220	230 B	220	230	220	220	12
Aluminum	mg/L	0.05 U	0.05 U	0.05 U									
Antimony	mg/L	0.002 U	0.002 U	0.002 U									
Arsenic	mg/L	0.005 U	0.005 U	0.005 U									
Barium	mg/L	0.15	0.14	0.14									
Beryllium	mg/L	0.001 U	0.001 U	0.001 U									
Bicarbonate Alkalinity as CaCO3	mg/L				240	250	220	230 B	220	230	220	220	12
Boron	mg/L	0.06 J	0.067 J	0.064 JB	0.075 J	0.08 J	0.073 J	0.059 J	0.04 J	0.051 J	0.081 J	0.082 J	3.7
Bromide	mg/L	0.12 J	0.12 J	0.12 J									
Cadmium	mg/L	0.001 U	0.001 U	0.001 U									
Calcium	mg/L	120	120	120	120	120	120	120	110	110	110	110	47
Carbonate Alkalinity as CaCO3	mg/L				5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Chloride	mg/L	20	20	20	22	22	23	23	22	23	24	24	24
Chromium	mg/L	0.002 U	0.002 U	0.002 U									
Cobalt	mg/L	0.00044 J	0.00047 J	0.00053 J									
Conductivity, Field	uS/cm					729				726	685	685	
Copper	mg/L	0.002 U	0.002 U	0.002 U									
Dissolved Oxygen, Field	mg/L					0.13							
Dissolved Solids, Total	mg/L	460	480 J	470 J	470	460	480	450	340	450	430	440	390
Fluoride	mg/L	0.095	0.096	0.095	0.1	0.095	0.11	0.083	0.083	0.095	0.033 J	0.038 J	0.052
Iron	mg/L	0.1 U	0.1 U	0.1 U									
Lead	mg/L	0.001 U	0.001 U	0.001 U									
Lithium	mg/L	0.0033 J	0.0049 J	0.0053 J									
Magnesium	mg/L	14	15	14	14	14	14	15	13	14	14	14	21
Manganese	mg/L	1.5	1.4	1.5									
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U									
Molybdenum	mg/L	0.01 U	0.01 U	0.01 U									
Nickel	mg/L	0.002 U	0.002 U	0.002 U									
pH, Field	pH units	6.96	6.95	6.89		7.01	7.03	7.17	7.21	7.19	7.21	7.21	
Potassium	mg/L	1.7	1.6	1.7	1.7	1.7	1.6	1.8	1.6	1.7	1.6	1.6	0.79 J
Radium-226	pCi/L	0.124	0.113	0.174									
Radium-226/228	pCi/L	0.159 U	0.665	0.259 U									
Radium-228	pCi/L	0.0352 U	0.552	0.0855 U									
Redox Potential, Field	mV												
Selenium	mg/L	0.005 U	0.005 U	0.005 U									
Silver	mg/L	0.001 U	0.001 U	0.001 U									
Sodium	mg/L	13 B	13	14 J	13	13	13	14	13	13	14	14	20
Strontium	mg/L	0.21 B	0.21 B	0.22									
Sulfate	mg/L	130	130	130	130	120	130	130	140	120	130	130	220
Temperature, Field	deg C					14.2				13	14	14	
Thallium	mg/L	0.001 U	0.001 U	0.001 U									
Turbidity, Field	NTU	0.2	1.5	2.4		2.19	0.97		4	0.3	0.3	0.3	
Vanadium	mg/L												
Zinc	mg/L	0.02 U	0.02 U	0.02 U									

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Appendix C
Analytical Data Summary
Bottom Ash Pond
Gavin Power Plant

	Program	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
	Location ID	B-0904	B-0904	B-0904	B-0904	B-0904
	Date	2018-04-11	2018-05-16	2018-09-18	2019-03-16	2020-03-11
		N	N	N	N	N
Analyte	Unit					
Alkalinity, Total as CaCO3	mg/L		11	9.4	15 B	11
Aluminum	mg/L	0.14 F1				
Antimony	mg/L	0.002 UF1				
Arsenic	mg/L	0.005 UF1				
Barium	mg/L	0.018 F1				
Beryllium	mg/L	0.001 UF1*				
Bicarbonate Alkalinity as CaCO3	mg/L		11	9.4	15 B	11
Boron	mg/L	4.1	4	4	4.2	3.7
Bromide	mg/L	0.14 J				
Cadmium	mg/L	0.00098 JF1				
Calcium	mg/L	52 F1	47	45	49	45
Carbonate Alkalinity as CaCO3	mg/L		5 U	5 U	5 U	5 U
Chloride	mg/L	21	20	21	20	19
Chromium	mg/L	0.002 UF1				
Cobalt	mg/L	0.0035 F1				
Conductivity, Field	uS/cm		511			525
Copper	mg/L	0.002 UF1				
Dissolved Oxygen, Field	mg/L		0.92			
Dissolved Solids, Total	mg/L	360	360	380	360	350
Fluoride	mg/L	0.03 J	0.052	0.06	0.04 J	0.051
Iron	mg/L	0.64 F1				
Lead	mg/L	0.001 UF1				
Lithium	mg/L	0.0078 JF1^				
Magnesium	mg/L	19 F1	19	19	21	19
Manganese	mg/L	1.4 F1				
Mercury	mg/L	0.0002 U				
Molybdenum	mg/L	0.005 UF1				
Nickel	mg/L	0.035 F1				
pH, Field	pH units		5.04	5.08	5.22	5.26
Potassium	mg/L	0.44 JF1	0.46 J	0.72 J	0.63 J	0.55 J
Radium-226	pCi/L	0.13				
Radium-226/228	pCi/L	0.489				
Radium-228	pCi/L	0.359				
Redox Potential, Field	mV					
Selenium	mg/L	0.0012 JF1				
Silver	mg/L	6.6E-05 JF1				
Sodium	mg/L	20 F1	19	19	21	19
Strontium	mg/L	0.14				
Sulfate	mg/L	200	190	210	210	200
Temperature, Field	deg C		13.9			14
Thallium	mg/L	0.001 UF1				
Turbidity, Field	NTU		18.1	36.1		9.7
Vanadium	mg/L					
Zinc	mg/L	0.015 JF1				

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