Gavin Fly Ash Reservoir

Gavin Power, LLC

2018 Annual Groundwater Monitoring and Corrective Action Report

Gavin Power Plant
Cheshire, Ohio

31 January 2019

Project No.: 0469558

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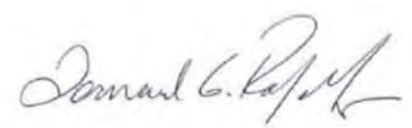

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Acronyms and Abbreviations

Name	Description
ASD	Alternate Source Demonstration
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
ERM	Environmental Resources Management
FAR	Fly Ash Reservoir
RWL	Residual Waste Landfill
SSI	Statistically significant increase

1. INTRODUCTION

The General James M. Gavin Power Plant (Plant) is a coal-fired generating station located in Gallia County in Cheshire, Ohio, along the Ohio River. The Plant consists of 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 Complex. The FAR is approximately 300 acres and is about 2.5 miles northwest of the Plant (Figure 1-1). From the mid-1970s until January 1995, fly ash was sluiced from the Plant to the former Stingy Run stream valley. The settled CCR materials were retained behind the Stingy Run Fly Ash Dam in the FAR. After January 1995, CCR materials were placed in the state-permitted RWL.

This report was produced by Environmental Resource Management (ERM), on behalf of Gavin Power, LLC, and documents the status of the groundwater monitoring program for the FAR, 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's operating record no later than 31 January 2019 (40 CFR § 257.105(h)(1)). Within thirty days of placing the report in the operating record, notification will be made to Ohio Environmental Protection Agency, and the report will be placed on the Plant's 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.	Sections 2.3 and 3.1
§ 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 CCR Unit and monitoring wells.	Figure 2-1
§ 257.90(e)(2)	Identification of new monitoring wells installed or abandoned during the preceding year and narrative description.	Sections 2.4, 4.0
§ 257.90(e)(3)	Summary of groundwater data, wells sampled, date sampled, and whether sample was required under detection or assessment monitoring.	Section 2.3, 3.2, Appendix D
§ 257.90(e)(4)	Narrative discussion of any transition between monitoring programs.	Section 4.0
§ 257.94(e)(2) (via § 257.90(e)(5))	Any ASD reports and related certifications.	Appendices A - C

2. PROGRAM STATUS § 257.90(E)

2.1 Monitoring Well Network

Hydrogeology within the FAR is characterized by a shallow zone of saturation that overlies an upper aquifer system that consists of sandstone and interbedded clay and shale units. The uppermost aquifer system, which includes the Morgantown sandstone and the Cow Run sandstone, is overlain by the Clarksburg Red Beds, which act as a confining layer.

The Morgantown and Cow Run monitoring well locations are shown on the site location map and aerial image provided on Figure 2-1. No new wells have been installed or decommissioned since the 2016 monitoring well network certification.

2.2 2016 and 2017 Groundwater Monitoring

The FAR monitoring wells were sampled eight times between August 2016 and July 2017. The monitoring well network certification (Geosyntec 2016) did not identify the upgradient-downgradient classification of each FAR well. Therefore, in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a), each well was assigned a preliminary upgradient-downgradient classification. Data from the upgradient wells was used to establish prediction limits, which were compared to the July 2017 downgradient well results, consistent with the CCR Rule and the Statistical Analysis Plan developed for Gavin (ERM 2017). This comparison resulted in the identification of statistically significant increases (SSI) for certain analytes in downgradient wells. ERM prepared an Alternate Source Demonstration (ASD) Report (ERM 2018b) to address the SSIs identified in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a). The ASD Report included further hydrogeologic evaluation to support refinement to the upgradient-downgradient classifications of the monitoring wells. These additional refinements included the following steps:

- Combined hydraulic information from both the state and federal monitoring well networks to develop higher resolution potentiometric surface figures;
- Evaluated the distribution of solutes in the Morgantown and Cow Run aquifers to further confirm interpreted groundwater flow directions; and
- Evaluated chemical fingerprints to determine if there was any evidence of wells being located downgradient from releases from the CCR units.

This information was used to reclassify a limited number of wells as downgradient or upgradient, and then recalculate the prediction limits, which were then compared to the 2017 downgradient well results. The updated comparison identified only one SSI for the FAR: fluoride at Morgantown sandstone Well 2016-01. The ASD Report (ERM 2018b) addressed multiple lines of evidence and concluded that fluoride in FAR groundwater was attributable to regional sources such as naturally occurring brine or fluoride-bearing minerals, or from human activities such as oil and gas well drilling, fertilizer use, and septic systems. Additional details of the reclassification of monitoring wells and descriptions of the identified alternate sources are included in the ASD Report provided in Appendix A.

2.3 2018 Sampling Summary

In 2018, the groundwater samples were collected as part of detection monitoring under 40 CFR § 257.94 and analyzed for the constituents listed in Appendix III to 40 CFR Part 257, Subpart D. A summary of the 2018 sample dates and the well gradient designation (upgradient or downgradient of the CCR unit) for the FAR monitoring well network is provided in Tables 2-1 and 2-2.

Table 2-1: 2018 Sampling Dates for FAR Morgantown Well Network

Sample Date	Upgradient Wells						Downgradient Wells		
	2016-03	2016-05	2016-11	96153R	96154R	96156	2016-01	2016-07	9910
3/6/18		Dry							
3/19/18							X		
3/21/18	X								
3/22/18			Dry	X	X				
3/26/18						X			
4/5/18								X	
4/13/18									Dry
5/11/18									
9/13/18				X	X				
9/25/18	X	Dry					X		X
9/28/18									
10/1/18			Dry						
10/23/18								X	

Sampling of certain Morgantown wells was limited in 2018 by the following factors:
Wells with sampling events marked with "dry" had an insufficient volume of water to allow collection of samples;
Upgradient monitoring Well 96148 consistently contained an insufficient volume of water for the past several years and thus was not sampled;
Upgradient monitoring Well 96152 consistently contained an insufficient volume of water for the past several years and thus was not sampled; and
Upgradient Well 96156 was damaged and could not be sampled in the second half of the year.

Table 2-2: 2018 Sampling Dates for FAR Cow Run Well Network

Sample Date	Upgradient Wells						Downgradient Wells	
	2016-04	2016-06	2016-09	2016-10	96147	MW-20	2016-02	2016-08
19/3/18							X	
22/3/18	X	X	X					
26/3/18						X		
28/3/18					X			
6/4/18				X				
11/5/18								
11/9/18	X							
13/13/18			X					
25/9/18		X					X	X
1/10/18				X				
4/10/18								
28/10/18					X			

Sampling of certain Cow Run wells was limited in 2018 by the following factors:
Well 2016-08 was not sampled during the March/April/May 2018 sampling event due to a malfunctioning pump, which was repaired for subsequent sampling events.
Well MW-20 could not be sampled during the September/October sampling event. A new pump was installed on 28/9/2018, but could not be sampled due to a blockage.

2.4 Monitoring Well Installation

As reported in the first Gavin FAR ASD Report (ERM 2018b), Gavin intended to install additional monitoring wells along the downgradient boundary of the FAR in 2018. In December 2018, Gavin attempted to install additional wells downgradient of the FAR. However, at the first selected drilling location, the Morgantown sandstone was absent, which prevented the installation of a monitoring well in this targeted interval. Gavin plans to install new monitoring wells at the downgradient boundary of the FAR once construction activities at the northern end of the RWL are completed. Completion of the RWL construction activities is anticipated in the fall of 2019.

2.5 Data Quality

ERM reviewed field and laboratory documentation to assess the validity, reliability, and usability of the analytical results. Samples collected in 2018 were analyzed by TestAmerica of North Canton, Ohio. Data quality information reviewed for these results included field sampling forms, chain-of-custody documentation, holding times, laboratory methods, cooler temperatures, 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 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). ERM's 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. 2018 RESULTS

3.1 2018 Groundwater Flow Direction and Velocity

Depth to groundwater measurements were collected in March and September 2018. Gavin personnel took depth to groundwater measurements at 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 reviewed for each sampling event. Groundwater elevations, interpreted potentiometric surface maps, and groundwater flow direction for wells screened in the Morgantown sandstone are presented on Figures 3-1 and 3-3. Groundwater elevations, potentiometric surface maps, and groundwater flow direction for wells screened in the Cow Run sandstone are presented on Figures 3-2 and 3-4.

The principal direction of groundwater flow in the uppermost aquifer system under the FAR (both in the Morgantown and Cow Run sandstone units) is from the north and northwest to the south and southeast, towards the Ohio River.

Groundwater velocity estimates reported in the 2017 Groundwater Monitoring and Corrective Action Report were calculated using an effective porosity of 0.30. Based on visual inspections of bedrock cores collected in 2018, ERM has utilized a lower effective porosity value in this report to estimate groundwater velocities for the fractured bedrock underlying the FAR.

3.1.1 Morgantown Sandstone Groundwater Velocity

A horizontal hydraulic gradient of 0.017 was calculated for the Morgantown sandstone using groundwater elevations calculated at Wells 2016-09 and 2016-20. Based on the measured horizontal hydraulic gradient, a hydraulic conductivity of 2.92 x 10^{-5} centimeters per second (Geosyntec 2012), and an effective porosity value of 0.01 for fractured bedrock, the velocity of groundwater through the Morgantown sandstone is estimated to be about 50 feet/year.

3.1.2 Cow Run Sandstone Groundwater Velocity

A horizontal hydraulic gradient of 0.010 was calculated for the Morgantown sandstone using groundwater elevations calculated at Wells 96154R and 2016-21. Based on the measured horizontal hydraulic gradient, a hydraulic conductivity of 7.18 x 10^{-5} centimeters per second (Geosyntec 2012), and an effective porosity value of 0.01 for fractured bedrock, the velocity of groundwater through the Cow Run sandstone is estimated to be about 80 feet/year.

3.2 Comparison of Results to Prediction Limits

Consistent with the CCR Rule and with Gavin's Statistical Analysis Plan (ERM 2017), 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. Documentation of the development of the upper prediction limits and lower prediction limit for the FAR is provided in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a).

3.2.1 March/April/May 2018 Sampling Event Results

Tables 3-1 and 3-2 summarize whether any SSIs were observed in the Morgantown and Cow Run downgradient wells for the first semiannual sampling event of 2018. The event took place between 19 March and 18 May 2018.

Table 3-1: SSIs from March/April/May 2018 Sampling Event—Morgantown

Analyte	2016-01	2016-07
Boron	ϕ	ϕ
Calcium	ϕ	ϕ
Chloride	ϕ	ϕ
Fluoride	X	ϕ
pH	X	ϕ
Sulfate	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ

ϕ = No SSI; X = SSI
Results are for the downgradient wells sampled from 19 March to 18 May 2018.
Downgradient Well 9910 was dry in April 2018 and could not be sampled.

Table 3-2: SSIs from March/April/May 2018 Sampling Event—Cow Run

Analyte	2016-02	2016-08
Boron	ϕ	ϕ
Calcium	X	ϕ
Chloride	X	ϕ
Fluoride	ϕ	ϕ
pH	ϕ	ϕ
Sulfate	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ

ϕ = No SSI; X = SSI
Results are for the downgradient wells sampled from 19 March to 18 May 2018.

Alternate sources were identified for each of the SSIs identified in the March/April/May sampling event data. This is documented in the first Gavin FAR Semiannual Sampling Event of 2018 ASD Report (ERM 2018c). This ASD Report identified regional background (calcium), naturally occurring brine (fluoride), local road salting practices (chloride), and concrete from improper well construction (pH) as the alternate sources for these SSIs. A copy of the first Gavin FAR Semiannual Sampling Event of 2018 ASD Report is included in Appendix B.

3.2.2 September/October 2018 Sampling Event Results

A comparison of the September/October 2018 results to the prediction limits identified SSIs for the following analytes in the downgradient wells, as summarized in Tables 3-3 and 3-4.

Table 3-3: SSIs from September/October 2018 Sampling Event—Morgantown

Analyte	2016-01	2016-07	9910
Boron	ϕ	ϕ	ϕ
Calcium	ϕ	ϕ	ϕ
Chloride	ϕ	ϕ	ϕ
Fluoride	X	ϕ	ϕ
pH	X	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ	ϕ

ϕ = No SSI; X = SSI
Results are for the downgradient wells sampled from 11 September to 23 October 2018.

Table 3-4: SSIs from September/October 2018 Sampling Event—Cow Run

Analyte	2016-02	2016-08
Boron	ϕ	ϕ
Calcium	X	ϕ
Chloride	X	ϕ
Fluoride	ϕ	ϕ
pH	ϕ	ϕ
Sulfate	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ

ϕ = No SSI; X = SSI
Results are for the downgradient wells sampled from 11 September to 23 October 2018.

Alternate sources were identified for each of the SSIs detected in the September and October 2018 data and documented in the Gavin FAR Second Semiannual Sampling Event of 2018 ASD Report (ERM 2018d). This ASD Report identified regional background (calcium), naturally occurring brine (fluoride), local road salting practices (chloride), and concrete from improper well construction (pH) as the alternate sources for these SSIs. A copy of the Gavin FAR Second Semiannual Sampling Event of 2018 ASD Report is included in Appendix C.

A summary of all analytical results obtained from the FAR groundwater monitoring is provided in Appendix D.

4. KEY FUTURE ACTIVITIES

The three ASD Reports prepared to date (provided in Appendices A, B, and C) concluded that sources other than the FAR were responsible for the identified SSIs. As required by 40 CFR § 257.94(e)(2), the demonstrations were completed within 90 days of detecting the SSIs and were certified by a qualified professional engineer. Because it met these requirements, the FAR currently remains in detection monitoring. Two rounds of groundwater sampling will be performed in 2019 at the FAR, and results will be compared to the prediction limits.

In accordance with an Ohio Environmental Protection Agency–issued Permit to Install, the Plant intends to continue expanding the RWL to the northwest in 2019. Following the RWL's expansion, the Plant plans to install up to four additional wells at the downgradient boundary of the FAR. If geologic conditions allow, two of the additional downgradient wells will be in the Cow Run sandstone and two will be in the Morgantown sandstone. Once installed, the wells will be incorporated into the Plant's well network through an update to the FAR Monitoring Well Network Certification.

5. REFERENCES

Environmental Resources Management (ERM). *Groundwater Monitoring Plan. Bottom Ash Complex, Fly Ash Reservoir, and Residual Waste Landfill*, *Gavin Plant, Cheshire Ohio*. 2017.

———. *2017 Annual Groundwater Monitoring and Corrective Action Report. Fly Ash Reservoir, Gavin Plant, Cheshire Ohio*. 2018a

———. *Gavin Fly Ash Reservoir Alternate Source Demonstration Report*. 2018b.

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Geosyntec. *Final Permit-To-Install Application. Expansion of the Gavin Plant Residual Waste Landfill. Hydrogeologic Study Report.* OAC 3745-30-05(C)(4). 2012.

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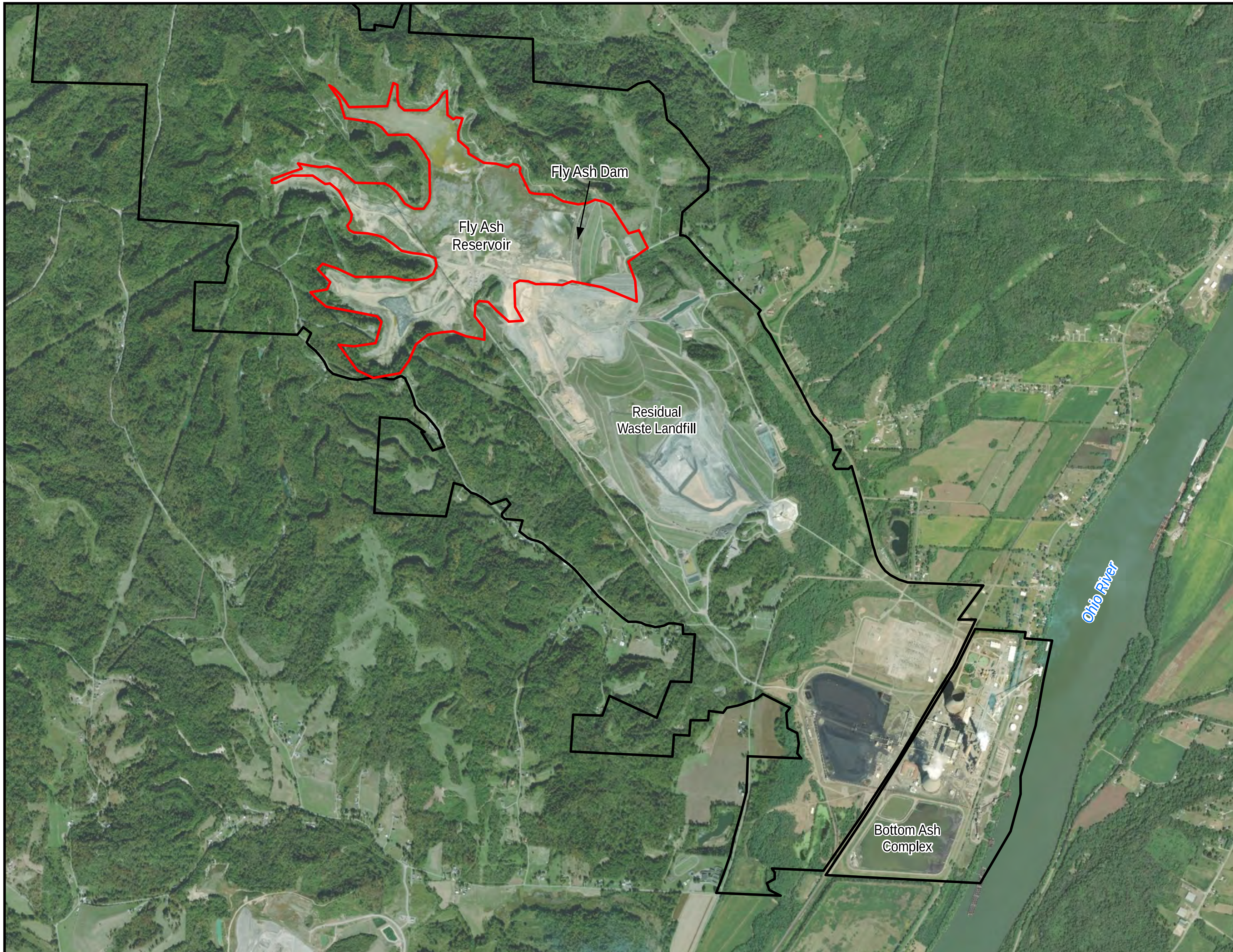
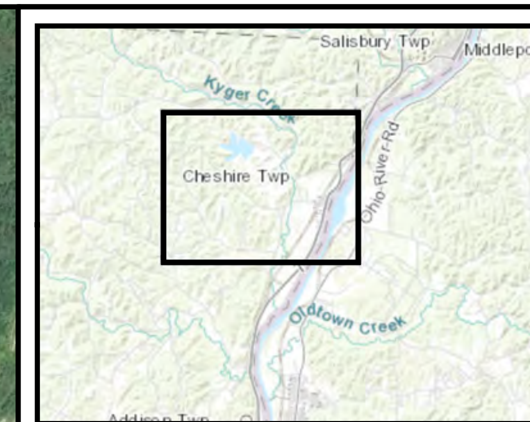
FIGURES





Legend

- Fly Ash Reservoir
- Gavin Property Boundary

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

Figure 1-1: Fly Ash Reservoir Location

Fly Ash Reservoir 2018 Annual Groundwater Monitoring and Corrective Action Report
Gavin Generating Station
Cheshire, Ohio

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Legend

- Federal Sampling Program Monitoring Well (Morgantown Sandstone)
- Federal Sampling Program Monitoring Well (Cow Run sandstone)

NOTES:
1. Locations are approximate
2. Aerial Imagery: USA NAIP 2015

0 170 340 680 1,020 1,360
Feet

Figure 2-1: Monitoring Well Network Map
Fly Ash Reservoir 2018 Annual Groundwater Monitoring and Corrective Action Report
Gavin Generating Station
Cheshire, Ohio

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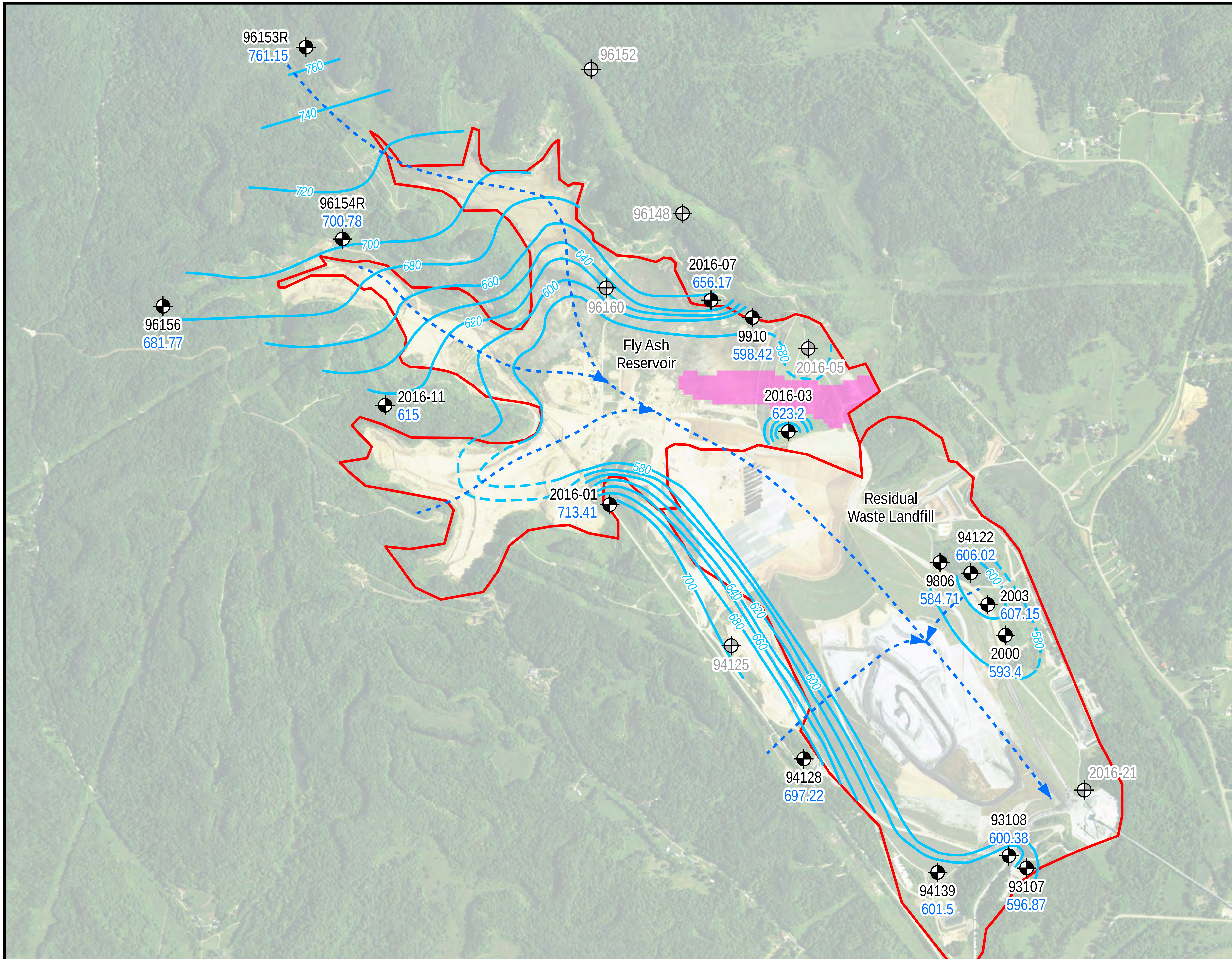
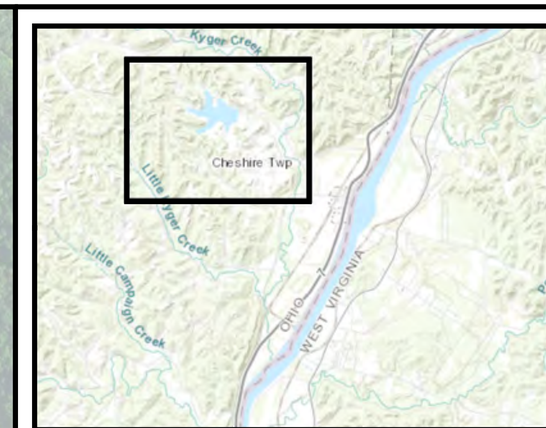




Legend

- Morgantown Sandstone Well
- Morgantown Sandstone Well not included in potentiometric surface interpretation*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contour (ft) (Dashed where inferred)
- Potential Groundwater Flow Direction
- CCR Unit
- Approximate area of valley erosion of the Morgantown Sandstone

NOTES:

- * Monitoring Well not included in potentiometric surface interpretation because it was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

N

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

Feet

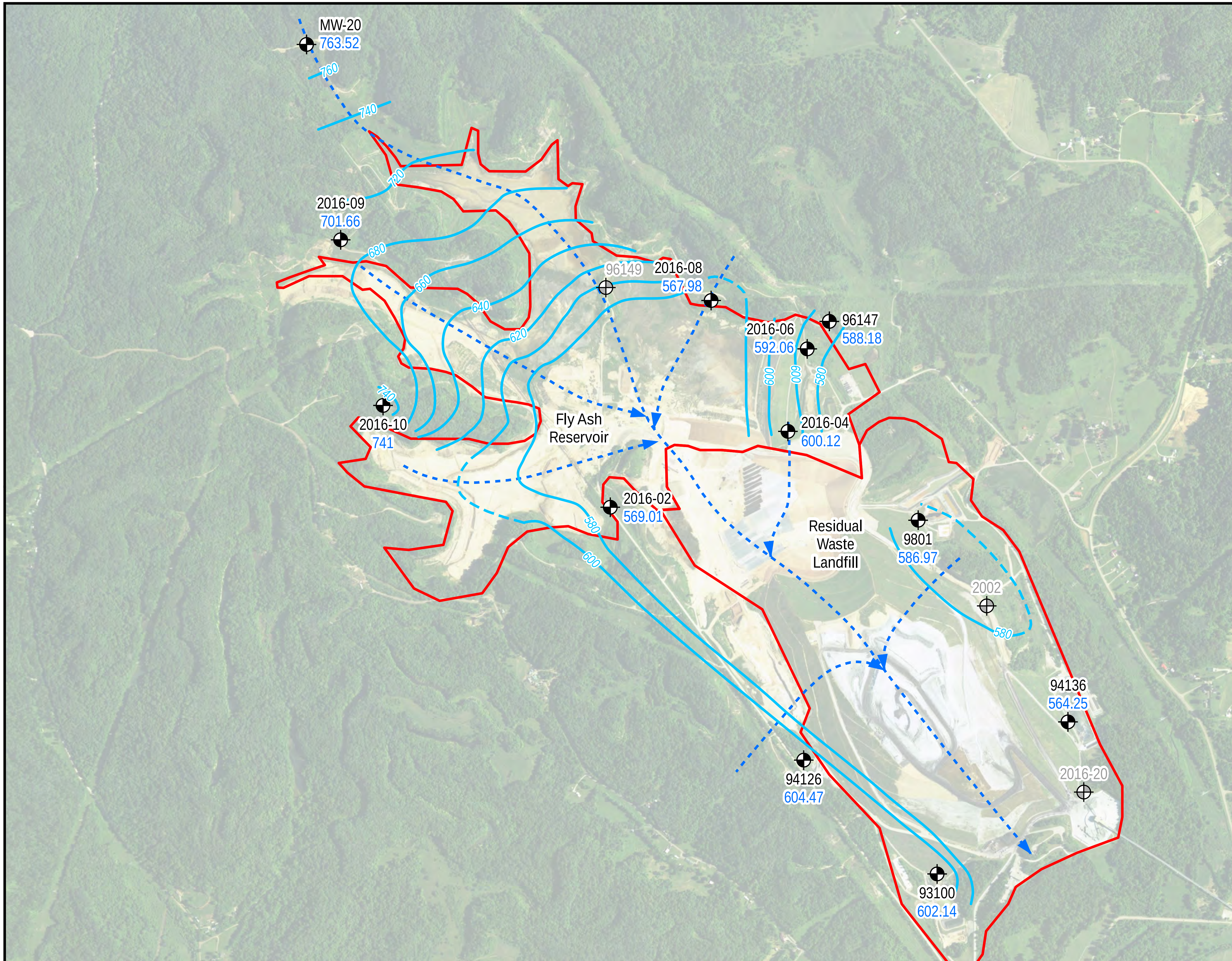
Figure 3-1: March 2018 Groundwater Flow Direction Map - Morgantown

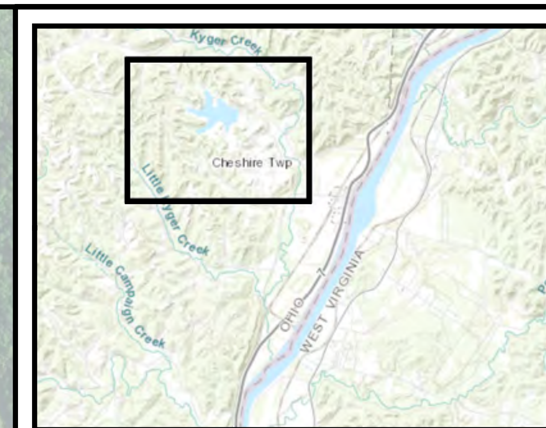
Fly Ash Reservoir 2018 Annual Groundwater Monitoring and Corrective Action Report

Gavin Generating Station

Cheshire, Ohio

ERM





Legend

- Cow Run Sandstone Well
- Cow Run Sandstone Well not included in potentiometric surface interpretation*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contour (ft) (Dashed where inferred)
- Potential Groundwater Flow Direction
- CCR Unit

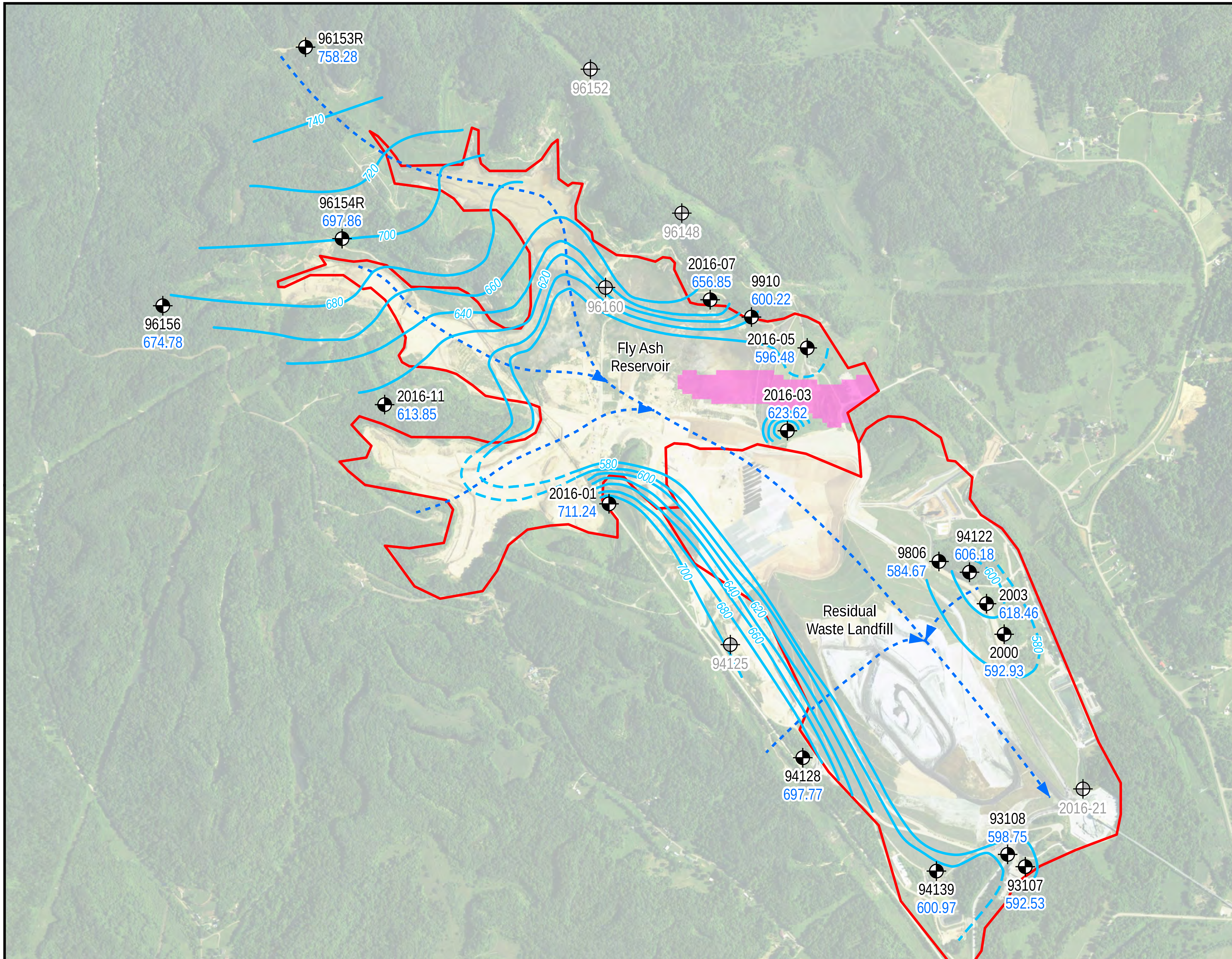
NOTES:
- * Monitoring Well not included in potentiometric surface interpretation because it was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

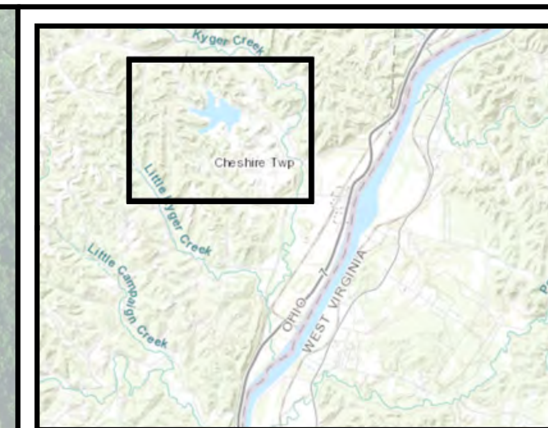
N

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

Figure 3-2: March 2018 Groundwater Flow Direction Map - Cow Run
Fly Ash Reservoir 2018 Annual Groundwater Monitoring and Corrective Action Report
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Morgantown Sandstone Well
- Morgantown Sandstone Well not included in potentiometric surface interpretation*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contour (ft) (Dashed where inferred)
- Groundwater Flow Direction
- CCR Unit
- Approximate area of valley erosion of the Morgantown Sandstone

NOTES:
- * Monitoring Well not included in potentiometric surface interpretation because it was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

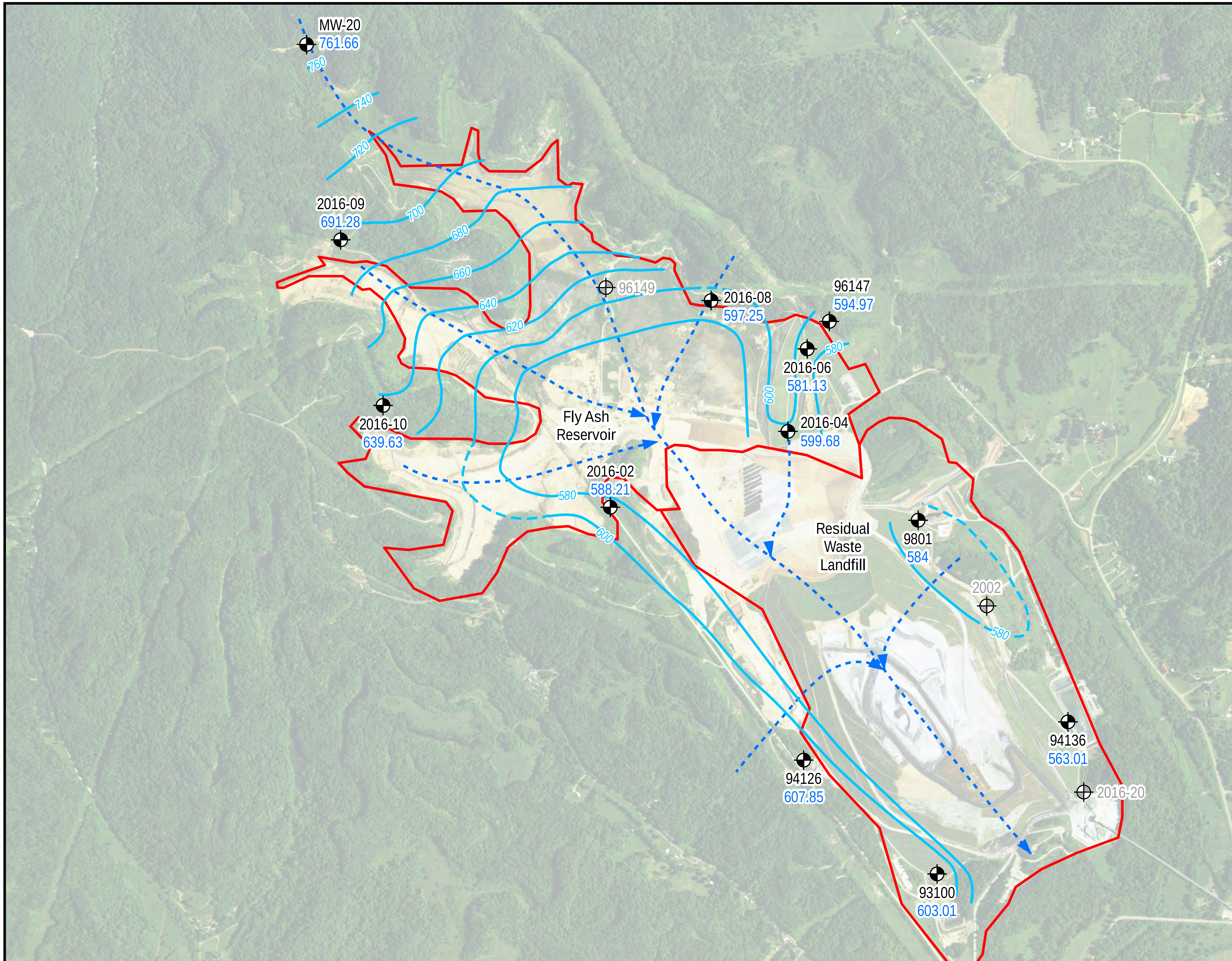
N

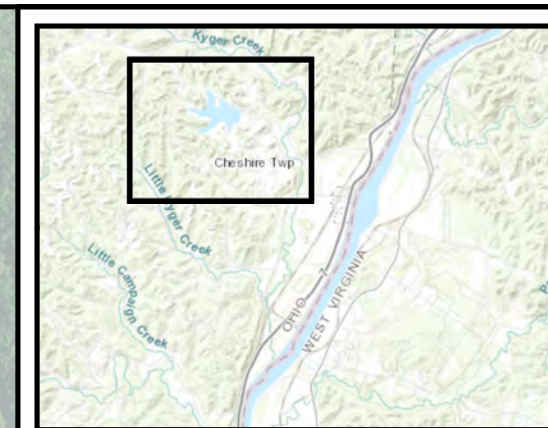
0 250 500 1,000 1,500 2,000
Feet

Figure 3-3: September 2018 Groundwater Flow Direction Map - Morgantown

Fly Ash Reservoir 2018 Annual Groundwater Monitoring and Corrective Action Report
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Cow Run Sandstone Well
- Cow Run Sandstone Well not included in potentiometric surface interpretation*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contour (ft) (Dashed where inferred)
- Potential Groundwater Flow Direction
- CCR Units

NOTES:
- * Monitoring Well not included in potentiometric surface interpretation because it was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

N

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

Figure 3-4: September 2018 Groundwater Flow Direction Map - Cow Run
Fly Ash Reservoir 2018 Annual Groundwater Monitoring and Corrective Action Report
Gavin Generating Station
Cheshire, Ohio

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APPENDIX A FLY ASH RESERVOIR ALTERNATE SOURCE DEMONSTRATION REPORT

Gavin Fly Ash Reservoir Alternate Source Demonstration

07.03.2018

Project No.: 0402270

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Contents

Table Listing

Figure Listing

Acronyms and Abbreviations

ASD	Alternate Source Demonstration
CCR	Coal Combustion Residuals
CCR Rule	Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments
CCR Unit	Bottom Ash Complex CCR Surface Impoundment
CFR	Code of Federal Regulations
EPA	United States Environmental Protection Agency
EPA Guidance	Solid Waste Disposal Facility Criteria Technical Manual, EPA 530-R-93-017
FAR	Fly Ash Reservoir
Gavin	Gavin Power, LLC
Plant	General James M. Gavin Power Plant
RWL	Residual Waste Landfill
SSI	statistically significant increase
UPL	upper prediction limit
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 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 Fly Ash Reservoir CCR Surface Impoundment (the "CCR Unit") at the General James M. Gavin Power Plant (the "Plant"). Gavin collected and analyzed at least eight baseline detection monitoring samples for each upgradient and downgradient well in the certified groundwater monitoring network before October 17, 2017, pursuant to 40 CFR § 257.94(b). Gavin calculated background levels and conducted statistical analyses for Appendix III constituents in accordance with 40 CFR § 257.93(h). Statistically significant increases (SSIs) over background concentrations in downgradient monitoring wells for Appendix III constituents were reported in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a).

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 statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality" (40 CFR § 257.94(e)(2)). If it can be demonstrated that the SSIs are due to an alternate source (other than the regulated CCR unit), then the CCR unit may remain in the Detection Monitoring Program instead of transitioning to an Assessment Monitoring Program. An Alternate Source Demonstration (ASD) must be made in writing, and the accuracy of the information must be verified through certification by a qualified Professional Engineer.

The CCR Rule and the regulatory preamble do not contain requirements or reference agency guidance for a successful ASD. However, the United States Environmental Protection Agency (EPA) previously issued guidance for conducting ASDs under the regulatory program governing Municipal Solid Waste Landfills (MSWLFs), upon which EPA modeled the groundwater monitoring provisions of the CCR Rule (see 80 Fed. Reg. 21302, 21396 [Apr. 17, 2015]). Because of the substantial similarity between the language governing ASDs in the CCR Rule and the MSWLF regulations, this guidance document provides a useful framework for ASDs under the CCR Rule.

This document, Solid Waste Disposal Facility Criteria Technical Manual, EPA 530-R-93-017, Subpart E (Nov. 1993) ("EPA Guidance"), lays out six lines of evidence that should be pursued in a demonstration that 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 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 demonstration will address each of these lines of evidence for the SSIs identified at the Fly Ash Reservoir.

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 Fly Ash Reservoir (FAR) is one of three CCR units at the Plant that are subject to regulation under the CCR Rule. The FAR is approximately 300 acres and is located about 2.5 miles northwest of the Plant (Figure 1-2). From the mid-1970s until January 1995, fly ash was sluiced from the Plant to the former Stingy Run stream valley. The settled CCR materials were retained behind the Stingy Run Fly Ash Dam in the unlined FAR.

The Ohio Environmental Protection Agency approved a Closure Plan for the FAR in 2016. Closure of the FAR is currently in progress and is anticipated to be completed by 2020. Closure has included a reduction in the water level behind the dam, dewatering of CCR materials, grading, and installation of a cap and storm water management structures. After closure, storm water will be conveyed through channels on top of the cover system and over the dam through a new spillway (AEP and Geosyntec 2016).

A Groundwater Monitoring Network Evaluation was performed to provide an assessment of the compliance of the groundwater monitoring network with the CCR Rule, 40 CFR § 257.91. The evaluation identified an uppermost aquifer comprised of sandstone and interbedded clayshale units, specifically the Morgantown Sandstone and Cow Run Sandstone, and indicated groundwater flows to the south and east (Geosyntec 2016).

The FAR monitoring wells identified in the Groundwater Monitoring Network Evaluation were sampled eight times between August 2016 and August 2017. Consistent with the CCR Rule and the Statistical Analysis Plan developed for Gavin (Appendix G of the Groundwater Monitoring Plan, ERM 2017), a prediction limit approach was used to identify potential impacts to groundwater. Upper prediction limits (UPLs) were established based on the upgradient data, and then compared to the most recent results from the downgradient wells. An initial comparison resulted in the identification of statistically significant increases for the following analytes in the downgradient wells, as summarized in Table 1-1 and Table 1-2 (ERM 2018a):

Table 1-1. Initial Determination of Statistically Significant Increases in FAR Cow Run Monitoring Wells

Analyte	2016-02	2016-04	2016-06	2016-08	2016-10	96147
Boron	X	ϕ	X	ϕ	X	X
Calcium	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Chloride	X	ϕ	ϕ	ϕ	X	ϕ
Fluoride	ϕ	ϕ	X	ϕ	ϕ	X
pH	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Total Dissolved Solids	X	ϕ	ϕ	ϕ	X	ϕ

Notes: ϕ = No SSI, X = SSI

Table 1-2. Initial Determination of Statistically Significant Increases in FAR Morgantown Monitoring Wells

Analyte	2016-01	2016-03	2016-15	2016-07	2016-11
Boron	ϕ	ϕ	ϕ	ϕ	ϕ
Calcium	ϕ	ϕ	ϕ	ϕ	ϕ
Chloride	ϕ	ϕ	ϕ	ϕ	ϕ
Fluoride	X	ϕ	ϕ	ϕ	ϕ
pH	ϕ	ϕ	ϕ	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ	ϕ	ϕ	ϕ

Notes: ϕ = No SSI, X = SSI

1.3 Alternate Source Demonstration Roadmap

As part of this ASD, ERM revisited the hydrogeologic conditions associated with the FAR and surrounding area to verify that the conceptual site model used to designate monitoring wells as either downgradient or upgradient remained valid given the extensive amount of groundwater level data that has been collected since the monitoring well network was established. The monitoring well network had previously been certified (Geosyntec 2016) and the initial identification of the upgradient-downgradient status of each FAR well was presented in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a). These reports are further summarized in Section 2. After the publication of the annual report (ERM 2018a), the hydrogeologic conditions associated with the FAR were further evaluated by performing the following steps:

- Refine potentiometric surface figures based on the available hydraulic information, solute distributions, and chemical fingerprints;
- Reclassify wells as downgradient or upgradient, if supported by the data review and refined potentiometric surfaces;
- Recalculate prediction limits; and

- Compare downgradient concentrations of Appendix III constituents to the recalculated background values to identify remaining SSIs.

The details of this reanalysis are presented in Section 2. The SSIs identified in the Cow Run Sandstone and the Morgantown Sandstone based on the comparison of downgradient concentrations to the updated prediction limits are summarized in Table 1-3 and Table 1-4, respectively.

Table 1-3. Revised Statistically Significant Increases in FAR Cow Run Monitoring Wells

Analyte	2016-02	2016-04	2016-06	2016-08	2016-10	96147
Boron	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Calcium	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Chloride	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Fluoride	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
pH	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ	ϕ	ϕ	ϕ	ϕ

Notes: ϕ = No SSI, X = SSI

Table 1-4. Revised Statistically Significant Increases in FAR Morgantown Monitoring Wells

Analyte	2016-01	2016-03	2016-15	2016-07	2016-11
Boron	ϕ	ϕ	ϕ	ϕ	ϕ
Calcium	ϕ	ϕ	ϕ	ϕ	ϕ
Chloride	ϕ	ϕ	ϕ	ϕ	ϕ
Fluoride	X	ϕ	ϕ	ϕ	ϕ
pH	ϕ	ϕ	ϕ	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ	ϕ	ϕ	ϕ

Notes: ϕ = No SSI, X = SSI

Based on the updated comparison, the only remaining SSI was fluoride at well 2016-01. The remainder of this ASD then presents the six lines of evidence specified by guidance to demonstrate that the fluoride SSI is attributable to an alternate source.

2 Hydrogeologic Interpretation

2.1 2016 Monitoring Well Network Evaluation

The Groundwater Monitoring Network Evaluation report (Geosyntec 2016) was prepared to provide an assessment of the compliance of the FAR groundwater monitoring with the CCR Rule, 40 CFR § 257.91. The report included the following:

- Description of the FAR inactive surface impoundment;
- Summary of the construction of the unit;
- Summary of the hydrogeologic setting;
- Description of the uppermost aquifer beneath the FAR; and
- Review of the monitoring well network.

The report concluded that the existing monitoring well network consisted of a sufficient number of wells (19 wells) installed at the appropriate depths to collect groundwater samples from the uppermost aquifer system and accurately represented the groundwater quality upgradient and downgradient of the FAR. The report concluded that the monitoring well network met the requirements of 40 CFR § 257.91, and interpreted the groundwater flow direction in the Morgantown Sandstone to be to the east and southeast (Figure 2-1). Although the monitoring well network may have met the minimum requirements of the CCR Rule, the report did not provide several key pieces of information needed to prepare the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a) required by 40 CFR § 257.90:

- The report did not identify which monitoring wells were upgradient and which were downgradient of the FAR;
- Groundwater flow directions were interpreted for the Morgantown Sandstone, but not for the Cow Run Sandstone; and
- The potentiometric surface map used data from only nine monitoring wells to reach conclusions on groundwater flow directions over an area greater than 1,000 acres, and thus did not provide enough information to determine with certainty the upgradient or downgradient status of all 19 wells in the FAR monitoring well network.

2.2 2017 Annual Groundwater Monitoring Report

The 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a) was prepared to document the status of the groundwater monitoring program for the FAR, summarize key actions completed, describe any problems encountered and actions taken, and project activities for the coming year. The report presented results from eight sampling events conducted from August 2016 to August 2017.

To calculate background concentrations, it was necessary to identify which of the monitoring wells in the network were upgradient wells. The first step in this process was to prepare updated potentiometric surface maps for the Morgantown Sandstone as well as the Cow Run Sandstone. Based on the proximity of the FAR and the Residual Waste Landfill (RWL), groundwater elevations from both CCR units were evaluated together. This resulted in a larger dataset and an improved understanding of groundwater flow directions. The Cow Run Sandstone showed the regional groundwater flow direction was to the southeast (Figure 2-2), and the Morgantown Sandstone potentiometric surface figure showed the same pattern. This interpretation was consistent with the 2016 Groundwater Monitoring Network Evaluation report (Geosyntec 2016); however, the updated potentiometric surfaces also demonstrated flow from the east, northeast, and northwest toward the

FAR. This interpretation also resulted in some wells whose upgradient-downgradient position relative to the FAR was unclear. In cases where the updated flow direction interpretation clearly showed a well as upgradient, it was classified as upgradient. In cases where the flow direction was less clear, the monitoring well was conservatively classified as downgradient. This approach had the following impacts on the reporting of SSIs in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a):

- More wells were classified as downgradient and fewer wells were classified as upgradient;
- Reliance on a relatively small number of upgradient wells resulted in a failure to capture the natural variability in background groundwater concentrations (i.e., prediction limits may not have been representative of the range of background conditions); and
- The use of prediction limits based on a small background data set increased the likelihood that downgradient concentrations would be incorrectly categorized as SSIs.

This initial comparison of prediction limits to downgradient concentrations was conservative because the classification of wells with an unclear status as downgradient reduced the likelihood that the calculated prediction limits would capture the natural range of background concentrations, which in turn increased the probability that the Detection Monitoring program would erroneously identify SSIs.

2.3 2018 Hydrogeological Evaluation

Two primary lines of evidence were used to revise our conceptual understanding of the FAR groundwater monitoring well network. This included careful re-analysis of the available geologic, hydrologic, and geochemical data to understand water flow directions. Additionally, a geochemical fingerprint analysis confirmed the conclusions developed in the revised conceptual model.

2.3.1 Updated Conceptual Site Model

Based on an examination of multiple lines of evidence, ERM restructured the hydrogeologic conceptual site model. Highlights of this restructured model include the following:

- A region of lower hydraulic pressure within the aquifer exists under the southeastern portion of the FAR, and extends south-eastward under the RWL as shown on Figure 2-3. This area of lower hydraulic pressure is located under portions of the FAR and RWL that have received CCR materials that act to reduce infiltration due to their lower permeability. The forested and pastured areas surrounding the FAR and RWL are more permeable and have higher infiltration than the fine compacted material in the FAR and RWL. Groundwater flows from the areas of higher pressure surrounding the FAR and RWL to areas of lower pressure within the FAR and RWL;
- Regional groundwater flows along the axis of the groundwater trough (the region of lower hydraulic pressure) toward the Ohio River;
- On the western side of the FAR groundwater flows from west to east, toward the groundwater trough, and then turns to the southeast and flows toward the Ohio River; and
- On the northeastern boundary of the FAR, groundwater flows from north to south, and then turns to the southeast and flows toward the Ohio River.

The following is a summary of the analyses performed and the lines of evidence that were developed to update and restructure the hydrogeologic conceptual site model. The analysis included the following:

- Long-term temporal trends in groundwater elevations of the Morgantown and Cow Run Sandstone monitoring wells were assessed to evaluate the potential for changes in historical groundwater flow directions, and to identify potentially anomalous groundwater elevations (Appendix A).

- The fractured bedrock of the Morgantown and Cow Run sandstone has relatively low hydraulic conductivity ($2.92X10^{-5}$ to $7.18X10^{-6}$ centimeters per second [cm/sec] (Geosyntec, 2012)), which causes very slow recharge after groundwater purging and sampling. Water levels from monitoring wells that appeared to still be recovering following purging were considered anomalous, and were excluded from the interpretation of the piezometric surface.
- ERM combined federal and state groundwater elevation data sets for monitoring wells of the Morgantown and Cow Run Sandstone units to increase spatial resolution and limit uncertainty in the interpretation of groundwater flow direction (Appendix A).
- Average groundwater elevations between February 2016 and July 2017 were used to interpret the potentiometric surfaces of the Morgantown (Figure 2-3) and Cow Run (Figure 2-4) Sandstones. This date range was selected to include as many wells as possible, to reduce uncertainty in the interpretation of groundwater flow directions. This date range is also reasonable given the relatively low hydraulic conductivity and associated low groundwater velocities in the Morgantown and Cow Run Sandstones. Groundwater flow directions based on a shorter period of time (i.e.,1-2 months) were evaluated and generally showed consistent groundwater flow directions, but were limited in spatial extent and thus are not presented.
- ERM reviewed the distribution of the Appendix III constituents to assist with the interpretation of groundwater flow directions. Sulfate was determined to be the most useful to assist with the interpretation of groundwater contours due to its widespread distribution in both the Cow Run and Morgantown Sandstones. In fractured bedrock settings such as the Morgantown and Cow Run Sandstones, solute concentrations are expected to vary over time due to variations in recharge, flow directions, and fracture characteristics (Bear, Tsang and de Marsily 1993). To account for the variability expected in this type of data set, and to maximize the utility of the data for the interpretation of groundwater flow directions, the maximum sulfate concentration observed from 1992 to 2018 was used to define the sulfate distribution in the Cow Run (Figure 2-5) and Morgantown (Figure 2-6) Sandstones. The sulfate distribution and groundwater elevation contour figures were developed together, which allowed the sulfate interpretations to inform the interpretation of groundwater flow directions. For example, the general trend of higher sulfate in hydraulically upgradient wells and declining concentrations along the flow path was used to confirm groundwater flow directions.
- The updated interpretation of regional groundwater flow in the Morgantown (Figure 2-3) and Cow Run (Figure 2-4) aquifers is from northwest to southeast towards the Ohio River. This interpretation is consistent with the interpretation presented in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a) and the Monitoring Well Network Evaluation (Geosyntec 2016).
- Both the Morgantown and Cow Run have similar interpreted groundwater flow direction, confirming the significance of the groundwater trough and the effect of the RWL on groundwater flow direction in this area.

2.3.2 Geochemical Fingerprinting

Piper diagrams are a secondary line of evidence used to confirm that upgradient well assignments were correct. The piper diagram is a graphical procedure commonly used in groundwater studies to interpret sources of dissolved constituents in water and evaluate the potential for mixing of waters from different sources (Piper 1944). A piper diagram allows for the development of a geochemical fingerprint based on the relative proportions of cations (calcium, sodium, potassium, and magnesium) and anions (chloride, sulfate, carbonate, and bicarbonate) in water samples. In this study, the piper diagrams were used to determine if there is evidence of impact from the CCR unit on groundwater. If there was no evidence of CCR impact, the well could be classified as upgradient or downgradient, based on the primary lines of evidence discussed above. If the piper diagrams provide evidence of impact, then the well could only be classified as downgradient, based on the assumption that a leaking CCR unit can only impact groundwater at and downgradient of the CCR unit.

As described in Section 1.2, fly ash was sluiced from the Plant to the FAR from the mid-1970s until January 1995. Analytical results are available for surface water samples collected approximately every 6 months from 1998 to 2016 from the discharge point at the FAR overflow tower. These results represent the geochemical fingerprint of water used to sluice fly ash to the FAR. Similarly, FAR seepage is water collected from channels located at the base of the Fly Ash Dam, and represents the geochemical fingerprint of water in contact with fly ash that has seeped through the dam. FAR seepage data are available from 2012 to 2016. Those geochemical fingerprints can be compared with the groundwater collected from the monitoring wells at the FAR (both the Morgantown Sandstone and the Cow Run wells). If a monitoring well within the Morgantown or Cow Run geologic units has a geochemical fingerprint that is comparable to the Fly Ash Dam discharge water and/or the FAR seepage water geochemical fingerprint, then those groundwater wells should likely be classified as downgradient. In contrast, if those wells have a geochemical fingerprint that is distinct from the geochemical fingerprint of the Fly Ash Dam discharge water and the FAR seepage water, then the well may be hydraulically upgradient or downgradient.

As shown in Figure 2-7, groundwater samples collected from FAR Morgantown Sandstone monitoring wells generally plot in the middle of the diamond, in the region of intermediate geochemical signature, or on the right side, in the region characterized by elevated sodium, potassium and chloride. Conversely, FAR discharge water and seepage, which have been in direct contact with fly ash, show a distinct chemical signature dominated by elevated calcium and sulfate. In this case, no FAR Morgantown wells have a signature similar to FAR discharge or seepage, and therefore no Morgantown wells must be classified as downgradient based on the geochemical signature.

As shown on Figure 2-8, groundwater samples collected from FAR Cow Run Sandstone monitoring wells generally plot on the right side of the diamond, in the region characterized by elevated sodium, potassium and chloride. Conversely, FAR discharge and seepage samples, which have been in direct contact with fly ash, show a distinct chemical signature dominated by elevated calcium and sulfate. With one exception, no FAR Cow Run wells have a signature similar to FAR discharge or seepage. That exception is groundwater from upgradient monitoring well MW-20, which is known to have an elevated concentration of sulfate (Figure 2-5). The maximum historical concentration of sulfate at well MW-20 is 2,500 mg/L and the concentrations between August 2016 and July 2017 ranged from 1,600 mg/L to 2,200 mg/L. The most likely source of sulfate in well MW-20 is acid mine drainage from nearby upgradient coal mines, which can be seen on Figure 2-5, and oxidation of naturally occurring sulfide minerals in the Cow Run Sandstone (ERM 2018b). Based on this information, it is appropriate to utilize the distribution of sulfate to assist with the determination of groundwater flow directions and to maintain well MW-20 as an upgradient monitoring well. Therefore, no Cow Run wells must be classified as downgradient based on the geochemical signature.

2.3.3 Revised Monitoring Well Network for Fly Ash Reservoir

Based on the considerations presented in Section 2.3.1 and 2.3.2, certain monitoring wells previously classified as downgradient were reclassified as upgradient. The updated FAR monitoring well network is presented in Table 2-1 for the Morgantown Sandstone and in Table 2-2 for the Cow

Run Sandstone. In addition to the existing wells listed in these two tables, new monitoring wells are planned to be installed this year downgradient of the FAR in the Morgantown and Cow Run Sandstones. The revised monitoring well network will be reviewed and certified by a qualified Professional Engineer once the additional wells are installed and confirmed to yield appropriate samples.

Table 2-1. Updated Morgantown Well Network

Upgradient Monitoring Wells	Downgradient Monitoring Wells
96153R	2016-01
96154R	2016-07
96156	96160
96152	
96148	
2016-11	
2016-03	
2016-05	

Table 2-2. Updated Cow Run Well Network

Upgradient Monitoring Wells	Downgradient Monitoring Wells
MW-20	2016-08
2016-09	2016-02
2016-10	96149
2016-06	
2016-04	
96147	

2.4 Revised Background Upper Prediction Limits with the Updated Monitoring Well Network

Based on the revised identification of upgradient monitoring wells, the prediction limits were recalculated for the Appendix III constituents in accordance with the Statistical Analysis Plan (ERM 2017). The updated prediction limits were developed using samples collected during the first eight sampling events, which were conducted between August 2016 and August 2017. With the revised UPLs, only a single SSI was found: fluoride in well 2016-01 (Morgantown Sandstone). Details on the recalculation of the UPLs are included in Appendix B.

With the exception of the one SSI reported above, all previously identified SSIs in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a) were due to previous misclassifications of wells as downgradient. The remaining sections of this document provide the six lines of evidence outlined in the EPA Guidance to demonstrate an alternate source for the fluoride SSI at well 2016-01.

3 Description of Alternative Sources

3.1 Naturally Occurring Fluoride Sources

Two naturally occurring sources of fluoride likely contributed to elevated fluoride in groundwater below the FAR: 1) mobilization of fluoride from naturally occurring rocks and minerals, and 2) naturally occurring brine.

Fluorite and apatite are naturally occurring minerals known to release fluoride to Ohio's groundwater. Fluoride concentrations in Ohio groundwater correlate with groundwater depth. Deeper groundwater typically has a longer travel time in the subsurface, providing longer contact time and greater leaching of fluoride from rocks and minerals to groundwater (OEPA 2012a). The groundwater velocity within the Morgantown Sandstone is estimated to be approximately 0.2 feet per year (ERM 2017). This relatively low velocity suggests groundwater within the Morgantown Sandstone could have a long contact time with the aquifer materials, which would facilitate the leaching of naturally occurring fluoride. A comparison of fluoride concentrations in the FAR and the RWL by geologic unit (Figure 3-1) shows generally higher fluoride concentrations in the deeper rock formations (Connellsville, Morgantown and Cow Run) and lower concentrations in the shallower alluvial aquifer. This pattern of higher fluoride concentration with greater depth is consistent with state-wide patterns in fluoride concentration reported by OEPA (2012a) and indicate the concentration of fluoride is related to the age of groundwater at the Plant.

Naturally occurring brines in the Appalachian Basin are known to contain fluoride at concentrations as high as 33 mg/L (Kelly 1973, and Poth 1962). Brines in the Ohio River valley exist at depths of 300 to 500 feet below the ground surface, and are known to be rich in calcium, chloride, sulfate, and other trace elements (Ohio River Valley Water Sanitation Commission 1984). Some of the brines exist close to the land surface. For example, brine was discovered at the land surface approximately 10 miles south of the Plant in Gallipolis, Ohio and was used 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 presence of brine in the region, both in the subsurface and at the land surface, indicates the potential for naturally occurring brine to contribute Appendix III constituents to shallow groundwater at the Plant.

3.2 Anthropogenic Sources of Fluoride

Human activities that could contribute fluoride to groundwater include agricultural run-off, infiltration of fertilizers, and discharges from septic systems (OEPA 2012a). Given the presence of agricultural land to the north and west of the Plant (Figure 3-2), it is possible that use of fertilizer is a contributing source of fluoride. Other regional activities with the potential to influence the concentration of Appendix III constituents in groundwater include:

- The drilling of oil and gas wells, which could allow brines from deeper strata to migrate upward to shallower water-bearing rock strata (OEPA 2003);
- Over-pumping water supply wells, which allows the upward migration of brines that naturally occur in deeper rock strata (Ohio River Valley Water Sanitation Commission 1984); and
- The use of brine on roadways for ice and dust control (OEPA 2012b).

To account for natural and anthropogenic sources of fluoride on a regional scale, background groundwater data were obtained from the United States Geological Survey (USGS) National Water Information System database (USGS 2018). The background groundwater data set is discussed further in Section 5.

4 Hydraulic Connections to the Alternate Source

The regional bedrock geology near the Plant includes Pennsylvanian age (299 to 311 million years old) sedimentary rocks from the Monongahela and Conemaugh Groups. These sedimentary rocks consist primarily of shale and siltstone, with minor amounts of mudstone, sandstone, and incidental amounts of limestone and coal (USGS 2005). As shown in Figure 4-1, regional groundwater flow near and surrounding the FAR occurs primarily within fractured sedimentary rocks of the Monongahela Group and the Conemaugh Group, which contains the Morgantown Sandstone (USGS 1981; USGS 2016). These sedimentary rock groups extend west of the FAR, where agricultural activities and road salting activities could contribute fluoride to surface water runoff prior to infiltration into the underlying aquifers. Septic systems could also contribute fluorinated water directly to the subsurface. As shown in Figure 4-2, regional groundwater flows through the fractured rock from the north and west, under the FAR, to the south and east toward the Ohio River. While migrating through the fractured rock, groundwater also has the potential to interact with fluoride-containing minerals. Based on these considerations, the fractured rocks of the Monongahela and Conemaugh Groups, including the Morgantown Sandstone, are hydraulically connected to potential alternate sources.

5 Constituent is Present at the Alternate Source or Along Flow Path

Background groundwater data were obtained from the USGS National Water Information System database (USGS 2018) and results were selected from monitoring wells constructed within the Monongahela Group and Conemaugh Group aquifers located within 50 miles of the Plant (Figure 5-1). Table 5-1 summarizes the range of fluoride concentrations observed in these wells.

Table 5-1. Range of Regional Fluoride Concentrations

Analyte	Units	Minimum	Maximum
Fluoride	mg/L	0.2	8.8

mg/L =milligrams per liter

The maximum fluoride value is associated with a groundwater sample collected by the USGS from a monitoring well located approximately 1.2 miles southeast of the Plant, across the Ohio River in West Virginia. This sample is unlikely to be impacted by Plant operations, because the Ohio River is a regional discharge boundary for groundwater on both sides of the river, and thus it is unlikely that groundwater from the Plant could cross under the river and continue to flow eastward toward the USGS monitoring well.

These results indicate fluoride is naturally present in Monongahela and Conemaugh background groundwater. As described in Section 3, the fractured rock aquifers could be the alternate source or they could act as the flow path from an alternate source. Although results from March through July 2017 were above background, the concentration of fluoride at well 2016-01 has been declining since June 2017, and the March 2018 result was below the regional background value of 8.8 milligrams per liter (Figure 5-2).

6 Linkages of Constituent Concentrations and Distributions between Alternate Source and Downgradient Wells

As described in Sections 4 and 5, groundwater with dissolved fluoride flows from upgradient recharge areas via the Morgantown Sandstone and migrates under the FAR. The regional background concentration of fluoride is higher than the fluoride concentration measured in well 2016-01 in March 2018, which demonstrates regional background could be the alternate source.

As shown in the Morgantown piper diagram (Figure 2-7), upgradient monitoring wells 96153R, 96154R, 96156, 2016-03, 2016-05 and 2016-11 plot in the same general area on the piper diagram as downgradient wells 2016-01 and 2016-07. The similarity in geochemical signatures shows the groundwater beneath and downgradient of the FAR likely originated from the same source as the upgradient groundwater, and thus the Morgantown groundwater under the FAR is hydraulically connected to the upgradient alternate source.

7 The Fly Ash Reservoir Could not be the Source

As seen in Figure 2-7, the discharge and seepage results plot in the upper portion of the piper diagram, which represents a high calcium and sulfate fingerprint. If water in contact with fly ash (i.e., seepage water or discharge water) were to be released from the FAR and mix with groundwater, the elevated calcium and sulfate concentrations would cause the groundwater signature to become more like the discharge and seepage signatures (i.e., plot higher in the diamond portion of the piper diagram). Based on the data presented in Figure 2-7, it is clear that groundwater in the Morgantown Sandstone has not mixed with FAR discharge or seepage because they plot in distinct regions on the piper diagram, and thus the FAR could not be the source of fluoride detected in well 2016-01.

If FAR leachate were the source of an SSI for fluoride in groundwater, the concentration of fluoride in the leachate would need to be at or above the UPL (5.02 mg/L), and the concentration in leachate would need to be higher than the concentration in groundwater. A comparison of the concentrations of fluoride in FAR leachate (Table 7-1) to the concentrations of fluoride in groundwater at monitoring well 2016-01 (2.8 mg/L – 17 mg/L) shows that fluoride in FAR leachate is lower than the UPL, and lower than the lowest concentration of fluoride in groundwater. These results demonstrate FAR leachate is not the source of the fluoride SSI at well 2016-01.

Table 7-1. FAR Fluoride Leachate Analytical Results

Analyte	Units	FAR Discharge (1998 – 2016)		FAR Seepage (2012 - 2016)	
		Minimum	Maximum	Minimum	Maximum
Fluoride	mg/L	0.35	0.51	0.15	0.19

If the FAR did have a release of leachate, it would not be possible to have a release of fluoride only because the leachate would contain other water-soluble elements contained in the fly ash. As summarized in Table 7-2, FAR leachate contains various water-soluble elements, including the rest of the Appendix III constituents. Figure 5-2 shows that during the period from October 2016 to June 2017, when the concentration of fluoride in groundwater at well 2016-01 increased, the concentrations of boron, calcium, chloride, pH, sulfate and TDS did not show upward trends. These results further demonstrate the FAR could not be the source of fluoride in well 2016-01.

Table 7-2. FAR Leachate Analytical Results Excluding Fluoride

Analyte	Units	FAR Discharge (1998 – 2016)		FAR Seepage (2012 - 2016)	
		Minimum	Maximum	Minimum	Maximum
Boron	mg/L	0.578	5.03	0.83	12.9
Calcium	mg/L	71.5	170	82	280
Chloride	mg/L	1.9	12.6	0.83	12.9
pH	Standard units	3.42	8.5	6.8	8.4
Sulfate	mg/L	196	857	195	872
Total Dissolved Solids	mg/L	454	1310	485	1480

8 Alternate Source Data are Historically Consistent with Hydrogeologic Conditions

This report provides background groundwater quality for the fractured sedimentary rock aquifers found within and beyond the boundary of the FAR. The patterns of regional groundwater flow through fractured rock near the FAR were established after the last deglaciation, which occurred approximately 14,000 years ago (Hansen 2017). The estimated groundwater velocity for the Morgantown Sandstone is 0.2 feet per year (ERM 2017), which 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 monitoring program.

9 Conclusions

Eight groundwater sampling events were performed at the FAR from 2016 to 2017, and the results were summarized in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a). The report presented an evaluation of the 2016 to 2017 data, and reported SSIs over background levels for each of the Appendix III parameters. In response to the SSIs, this ASD was prepared in accordance with 40 CFR § 257.94(e)(2).

A majority of the SSIs were addressed by a detailed hydrogeologic analysis that supported reclassifying some wells as upgradient. For the remaining SSI, various natural and anthropogenic sources were identified, as described below.

Cow Run Formation

- There were four SSIs for boron, and all can be attributed to the previous misclassification of certain monitoring wells as downgradient.
- There were two SSIs for chloride, and both can be attributed to the previous misclassification of certain monitoring wells as downgradient.
- There were two SSIs for fluoride, and both can be attributed to the previous misclassification of certain monitoring wells as downgradient.
- There were two SSIs for total dissolved solids, and both can be attributed to the previous misclassification of certain monitoring wells as downgradient.

Morgantown Formation

There was one SSI for fluoride, and it was attributed to various background sources. The lines of evidence that the FAR was not the source are summarized in Table 9-1.

Table 9-1. Fluoride Alternate Source Demonstration Lines of Evidence

Line of Evidence	Rationale
Alternate source	Fluoride is present in background groundwater and it can be attributed to regional sources such as naturally occurring brine or fluoride-bearing minerals, or from human activities such as oil and gas well drilling, fertilizer use, and septic systems. In addition, the March 2018 result from well 2016-01 showed fluoride was within the range of regional values.
Hydraulic connection	Regional groundwater flows under the Residual Waste Landfill
Constituent present along Flow path	Fluoride is present along flow paths
Concentrations linked to source	Fluoride in FAR groundwater is within the range of regional values
Concentrations could not have resulted from the CCR unit	Piper diagrams show different chemical fingerprint between groundwater and FAR discharge
Data are historically consistent with hydrogeologic conditions	Background fluoride is historically consistent with hydrogeologic conditions

The FAR was not the source of the SSIs reported in the 2017 Annual Groundwater Monitoring and Corrective Action Report (ERM 2018a), and thus the Plant will continue with Detection Monitoring in accordance with 40 CFR § 257.94.

Professional Engineer Certification

I hereby certify that I or an agent under my review has prepared this Alternate Source Demonstration Report for the Fly Ash Reservoir in accordance with 40 CFR § 257.94(e). 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: _7/3/2018_________________________

References

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Figures

Figure 1-1: Gavin Plant Location
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

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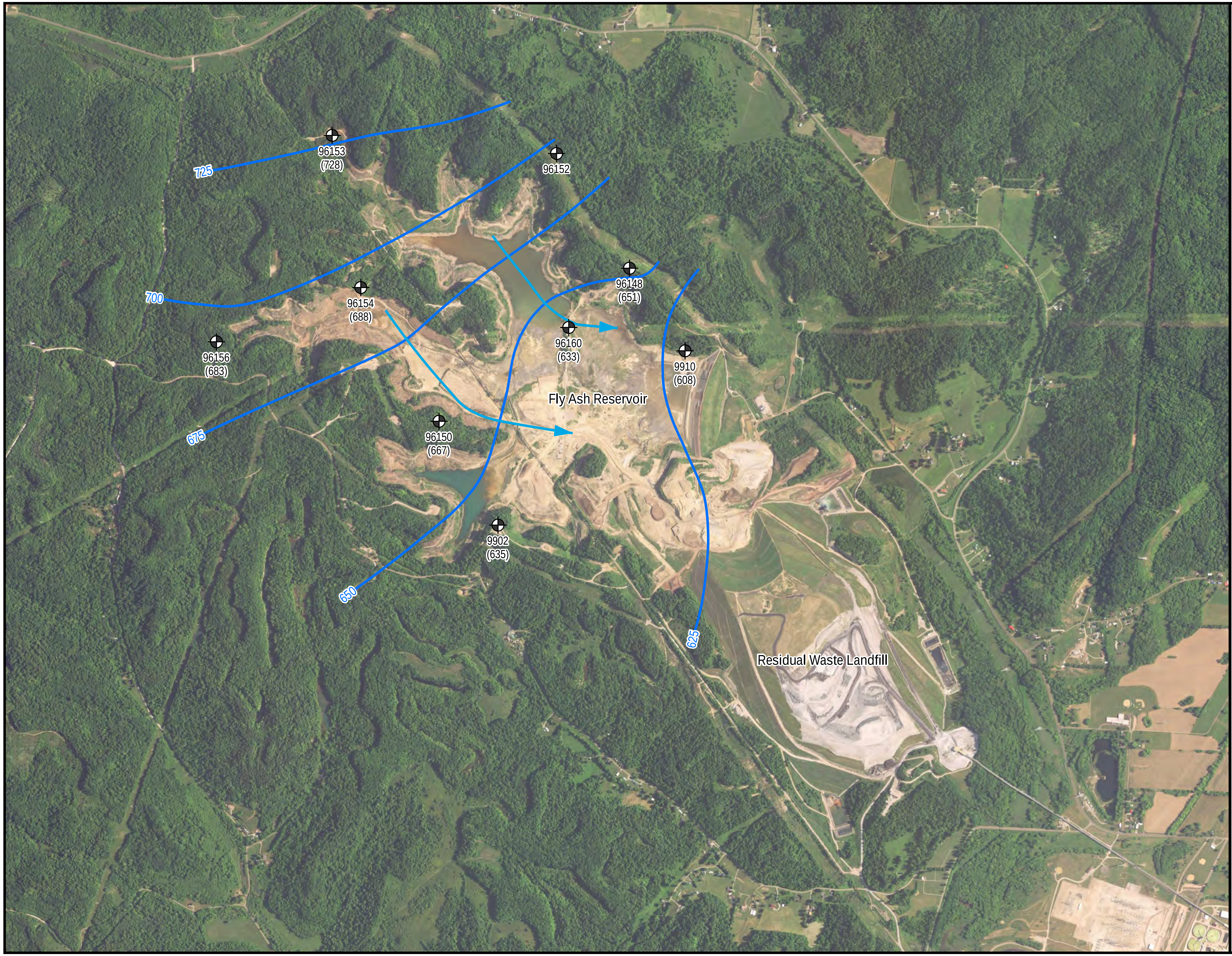
Figure 1-2: Fly Ash Reservoir Location
Fly Ash Reservoir Alternate
Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM



Legend

- Monitoring Well Location
- (683) Groundwater Elevation (ft)
- Groundwater Elevation Contour
- Groundwater Flow Direction

NOTES:

1. All monitoring well and groundwater data from Geosyntec Groundwater Monitoring Network Evaluation Report, 2016.
2. Only the wells screened in the Morgantown Sandstone are presented on this map.
3. Contour lines are approximate and based on a 5-year average of the groundwater elevations in the monitoing wells screened within the Morgantown Sandstone.
4. Aerial Imagery: USA NAIP Imagery Reproduced under license in ArcGIS 10.5

N

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

Figure 2-1: Potentiometric Surface Map from 2016 Monitoring Well Network Evaluation Report

Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

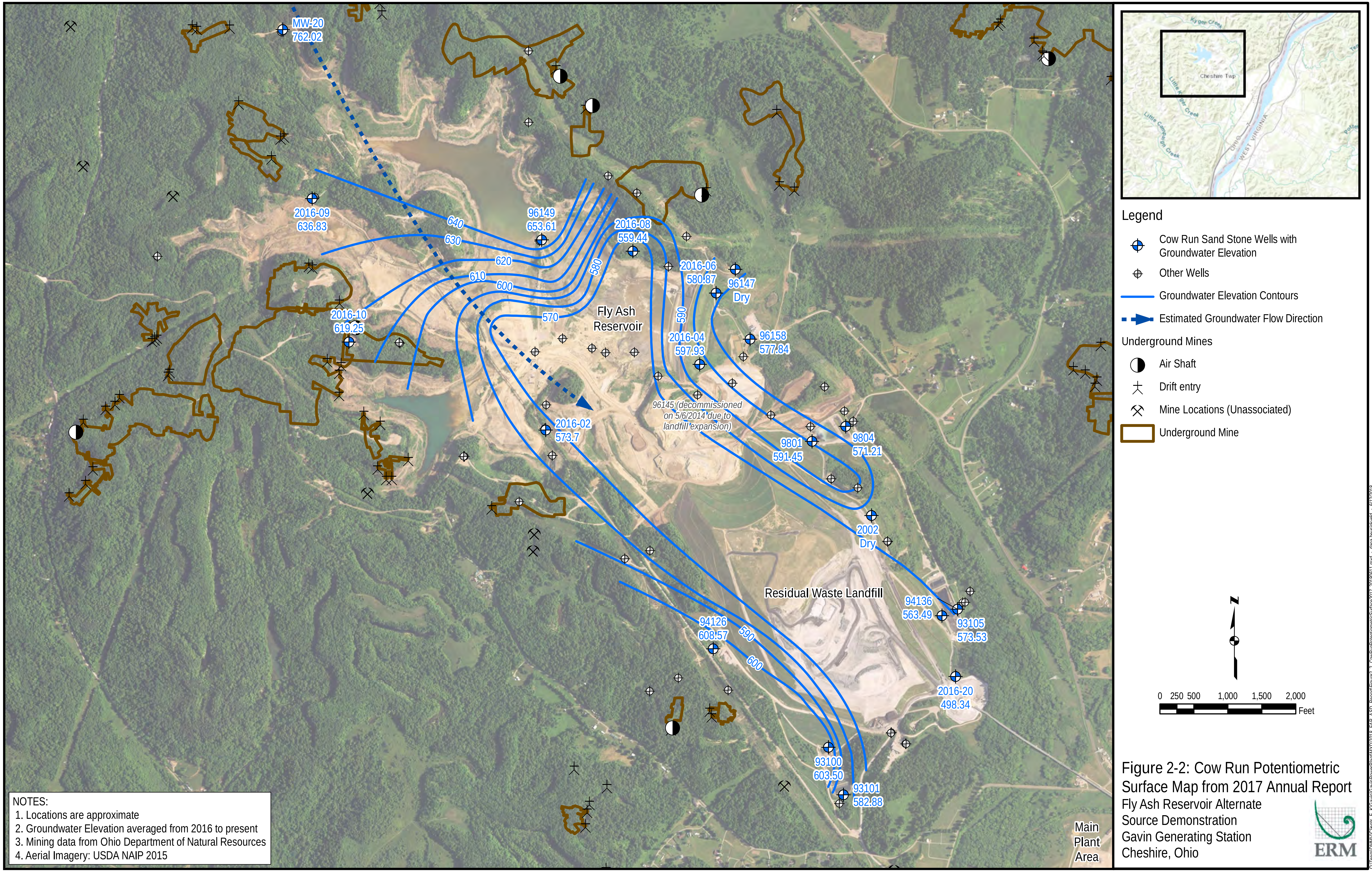
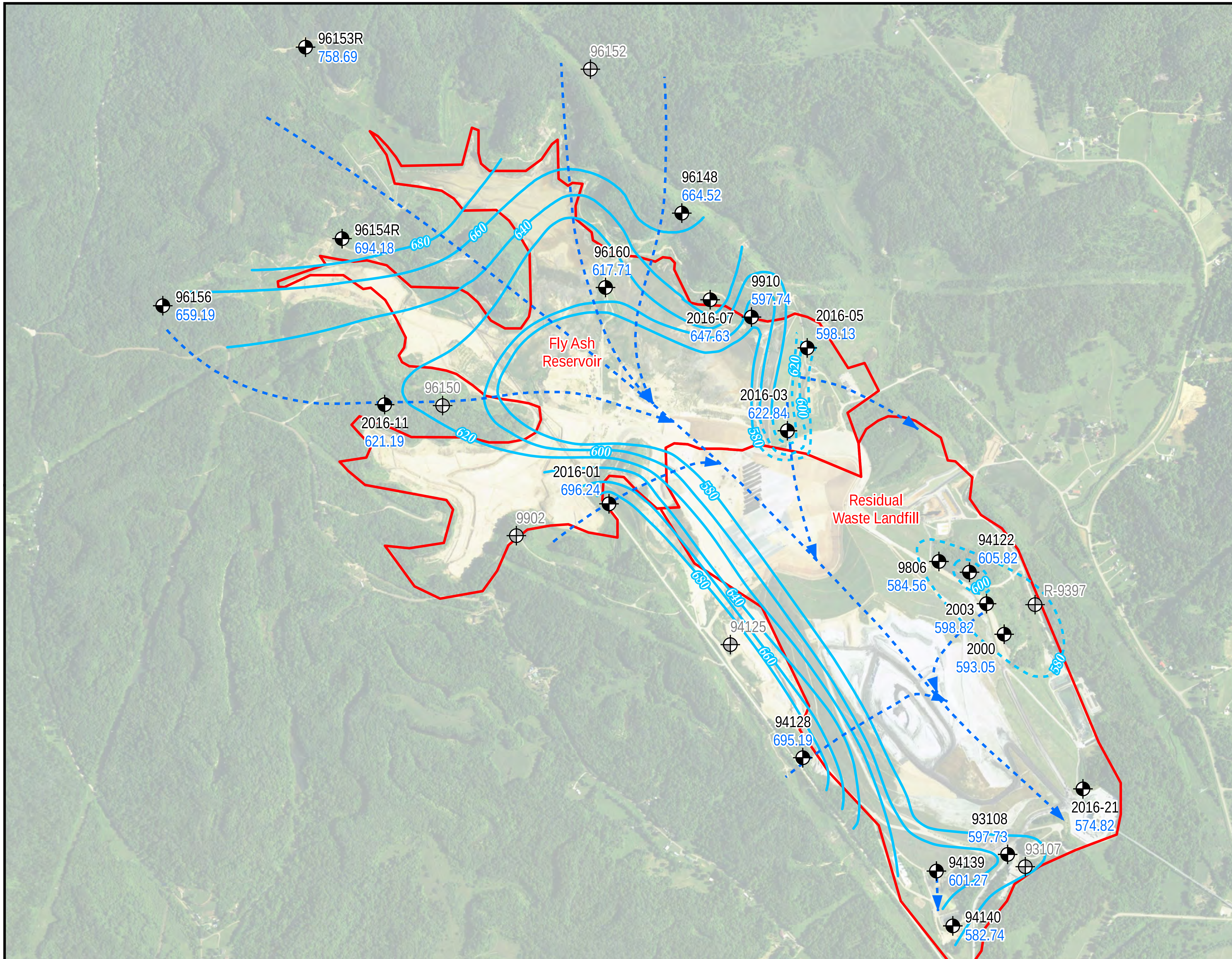
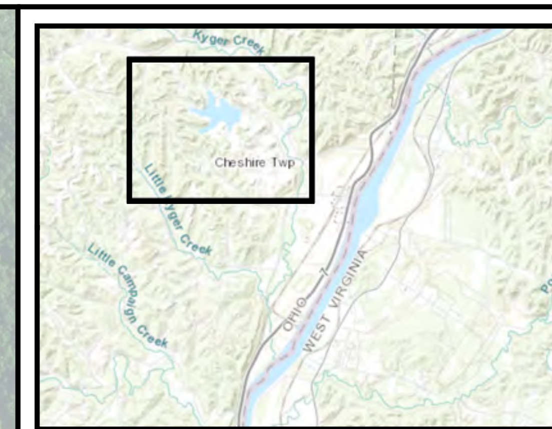


Figure 2-2: Cow Run Potentiometric Surface Map from 2017 Annual Report
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio





Legend

- Morgantown Sandstone Wells
- Morgantown Sandstone Well Not Used for Potentiometric Surface*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contours (ft)
- Groundwater Flow Direction
- CCR Units

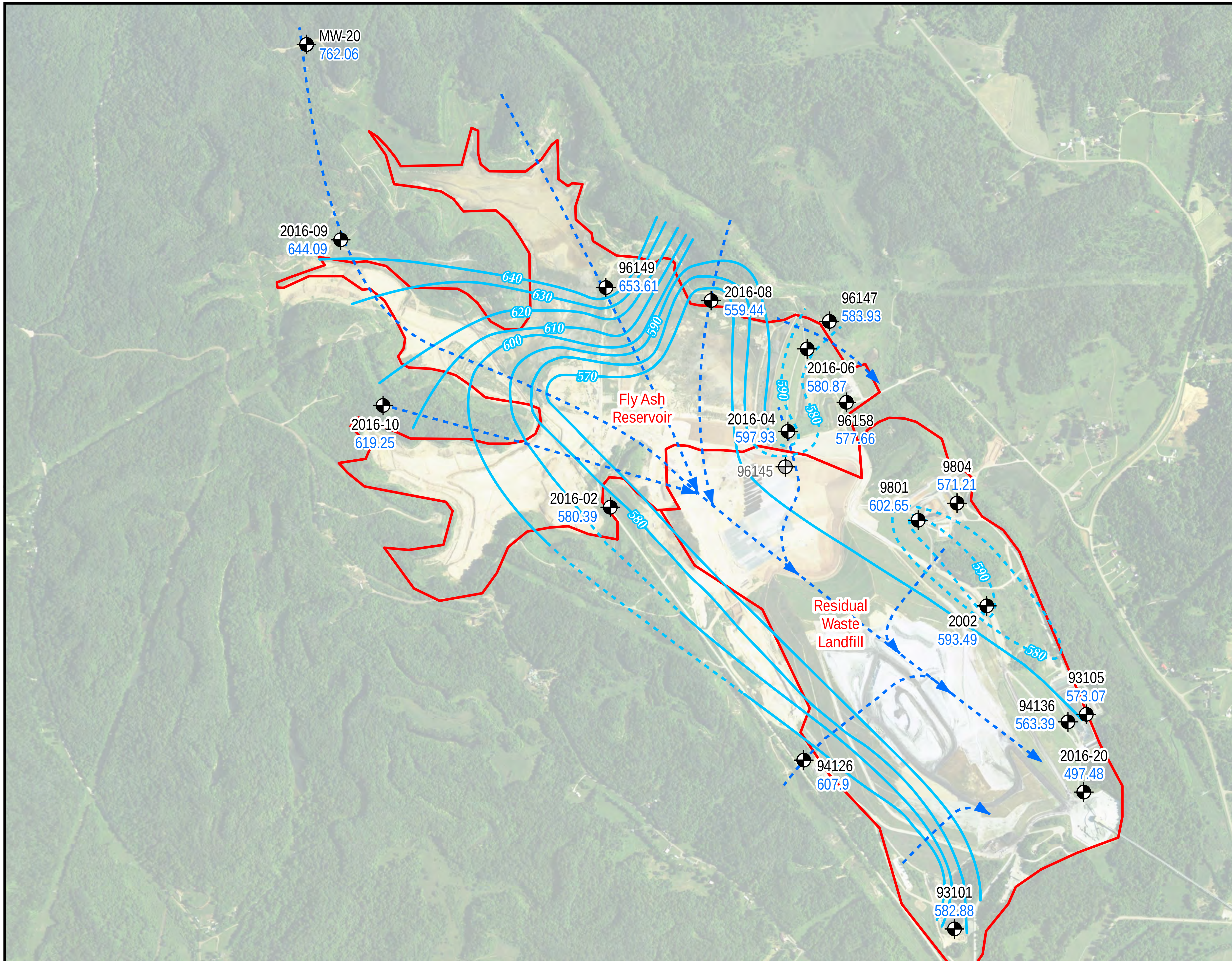
NOTES:
- Potentiometric contours are based on average groundwater elevations between January 2016 and August 2017.
- *Average groundwater elevations were not calculated because the monitoring well was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

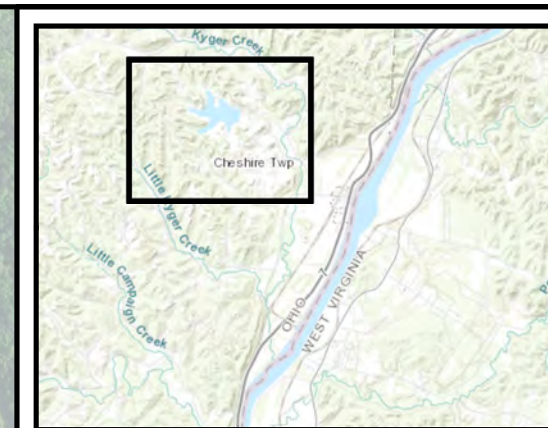
N

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

Figure 2-3: Morgantown Potentiometric Surface Map
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Chesire, Ohio

ERM





Legend

- Cow Run Sandstone Wells
- Cow Run Sandstone Well Not Used for Potentiometric Surface*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contours (ft)
- Groundwater Flow Direction
- CCR Units

NOTES:
- Potentiometric contours are based on average groundwater elevations between January 2016 and August 2017.
- *Average groundwater elevations were not calculated because the monitoring well was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

N

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

Figure 2-4: Cow Run Potentiometric Surface Map
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

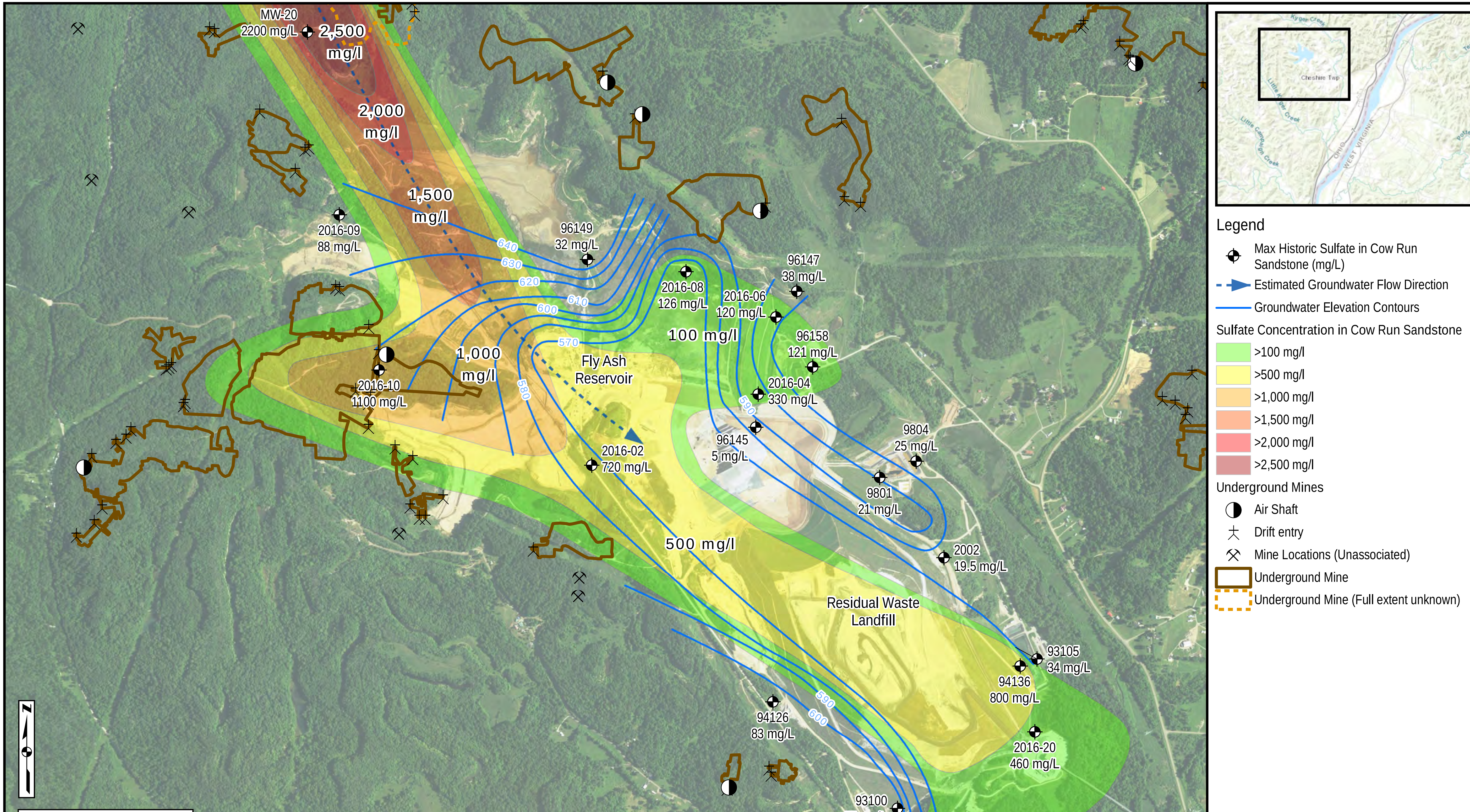


Figure 2-5: Cow Run Sulfate Distribution
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

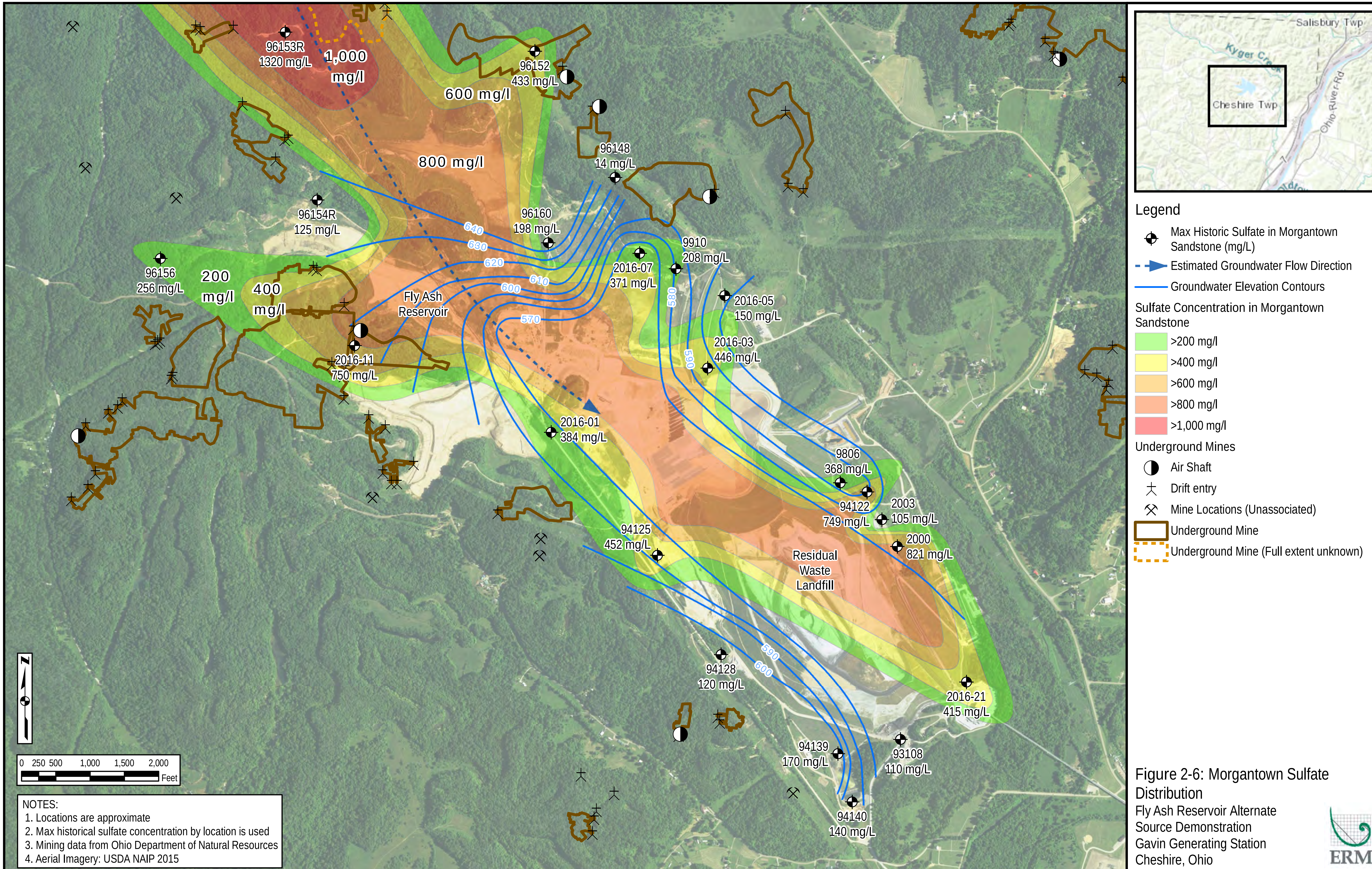


Figure 2-6: Morgantown Sulfate Distribution
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

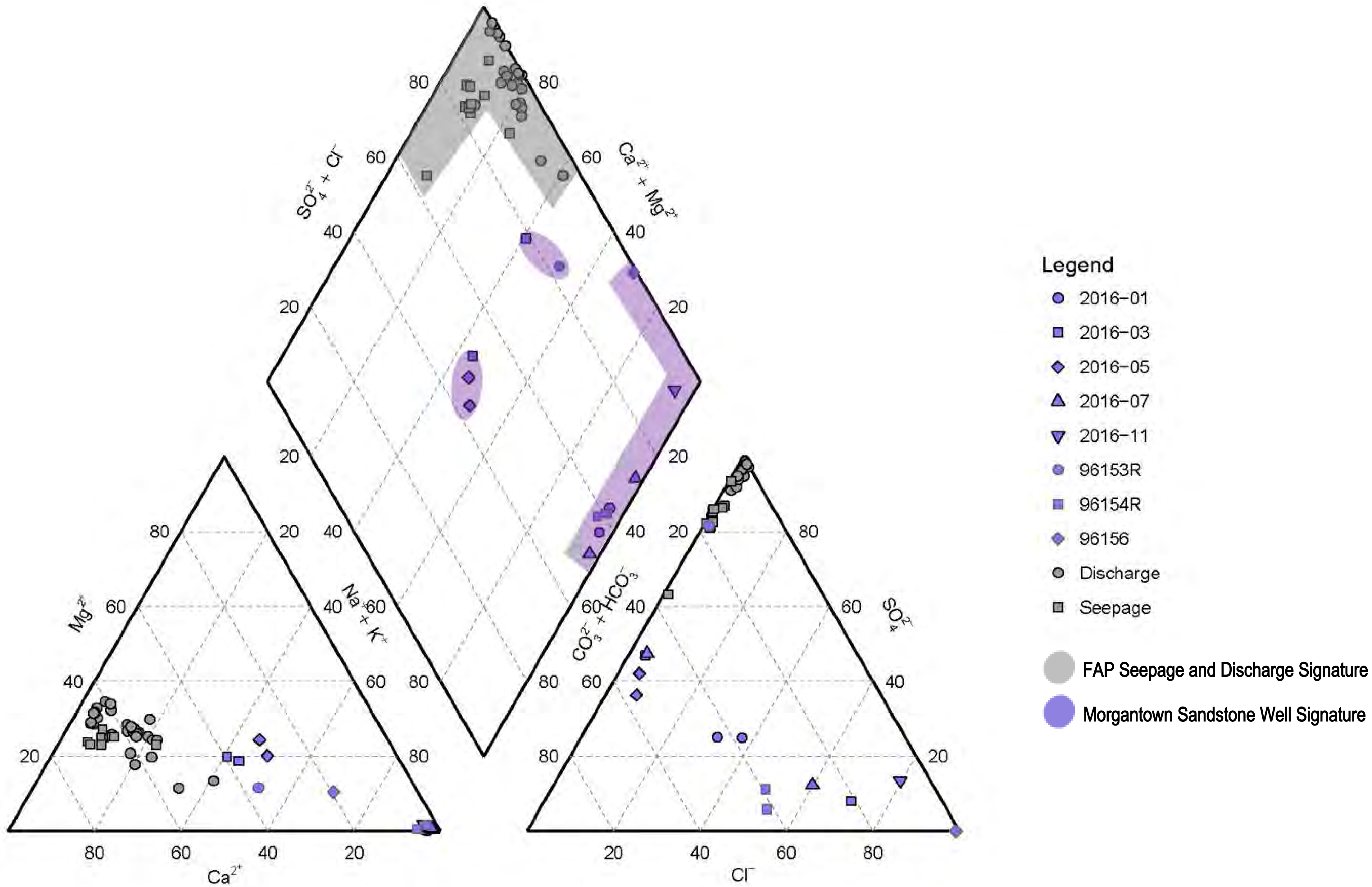


Figure 2-7: FAR Piper Diagram for the Morgantown Sandstone
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

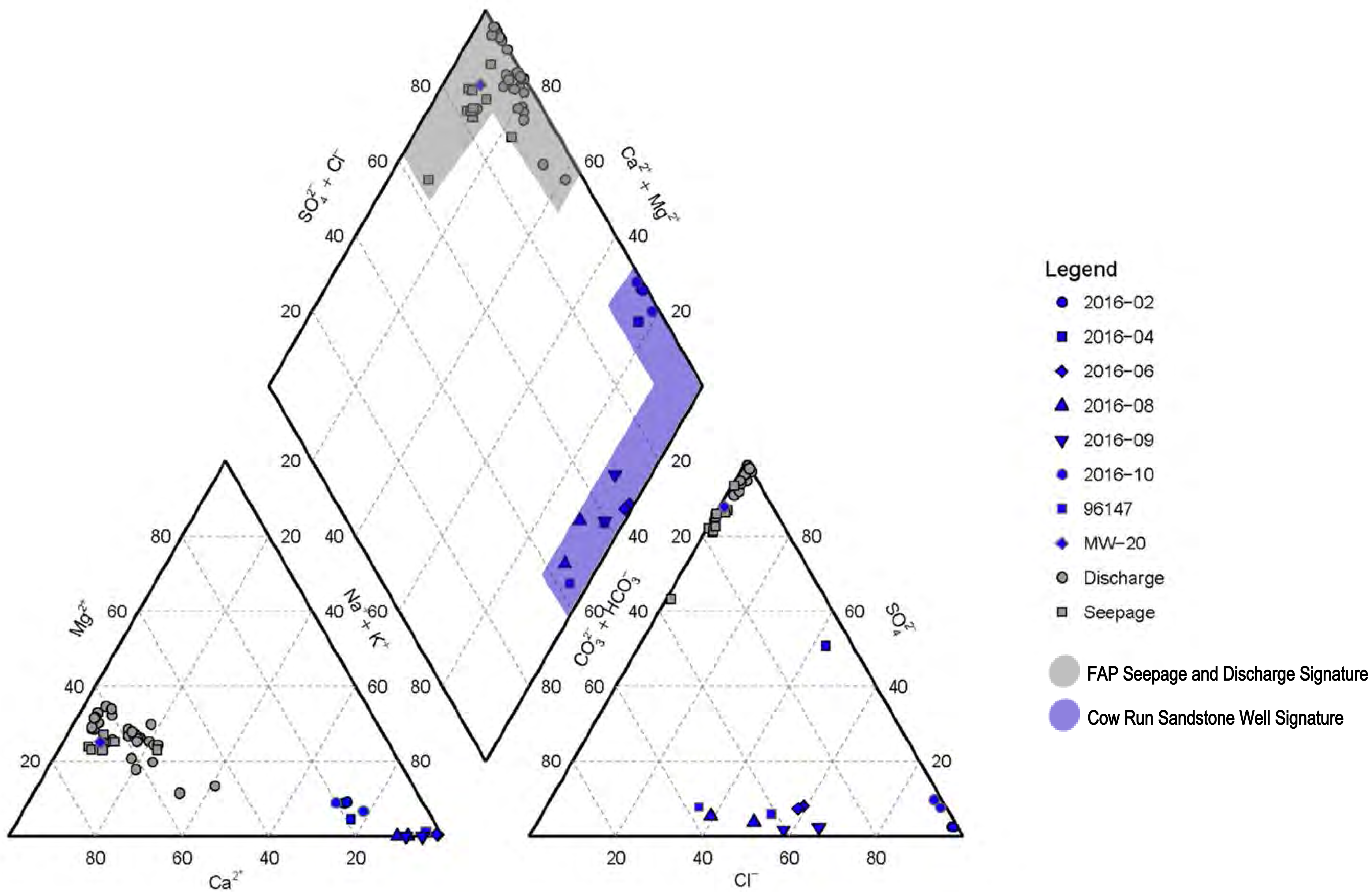
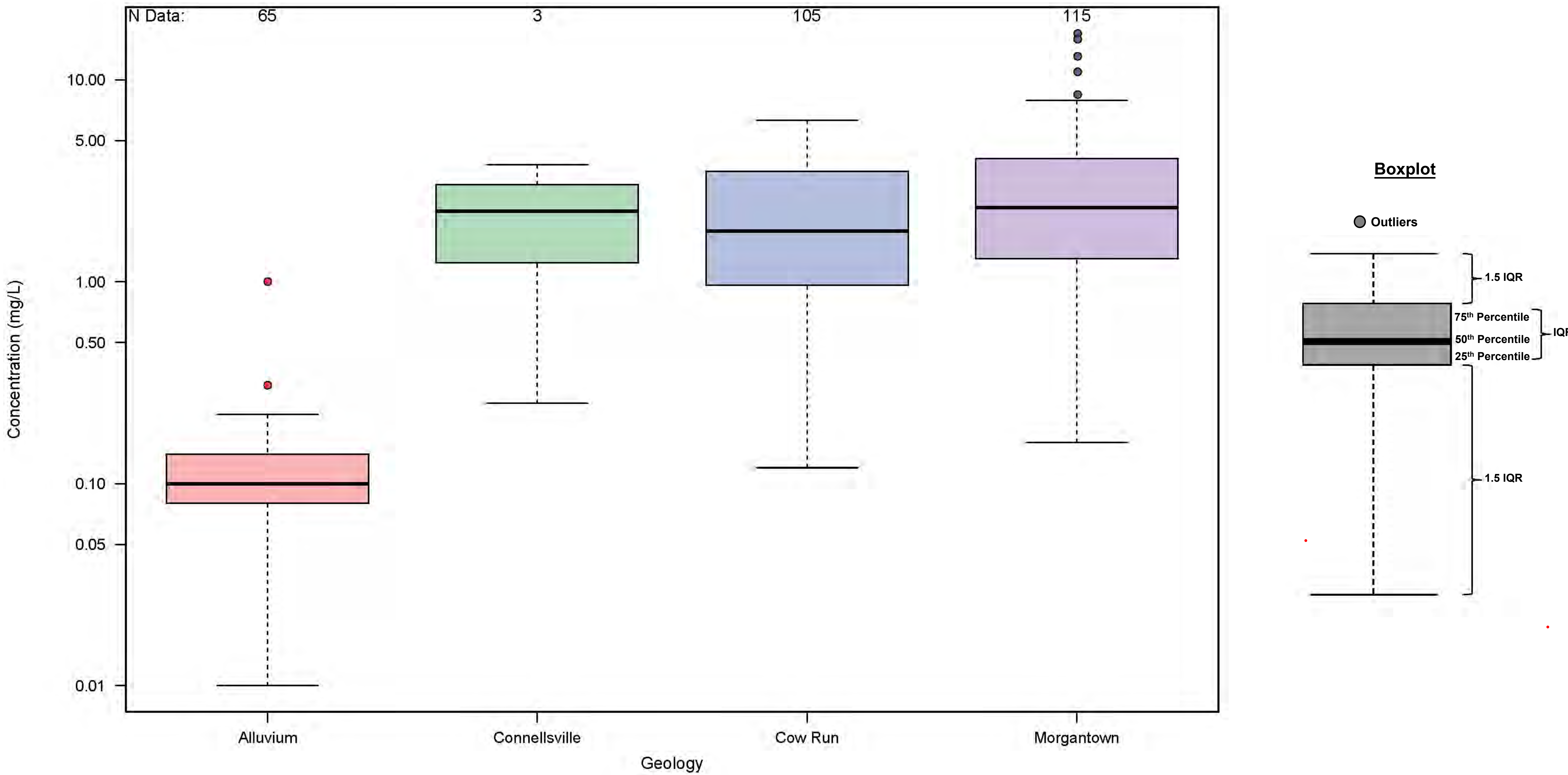


Figure 2-8: FAR Piper Diagram for the Cow Run Sandstone

Fly Ash Reservoir Alternate Source Demonstration

Gavin Generating Station

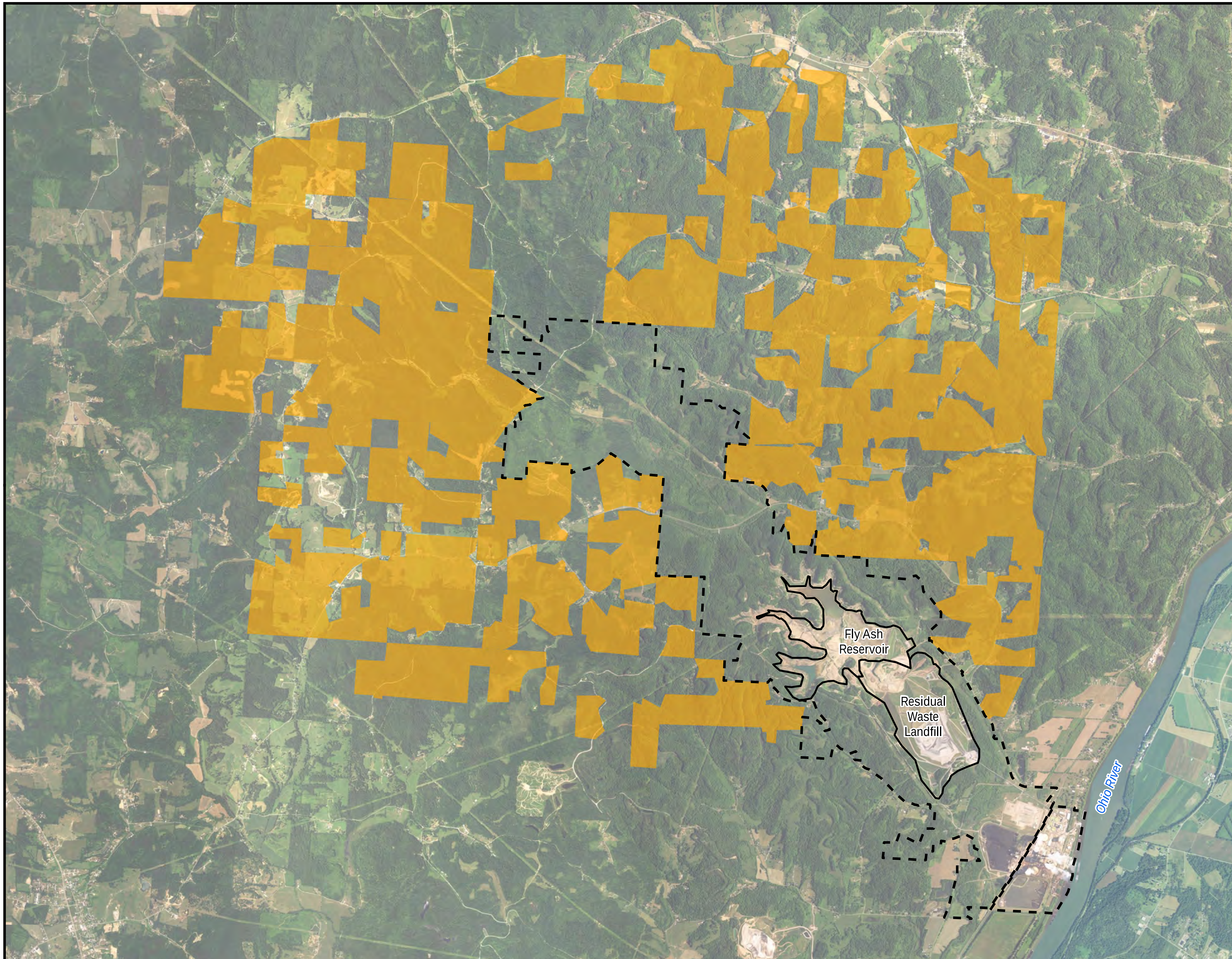
Cheshire, Ohio

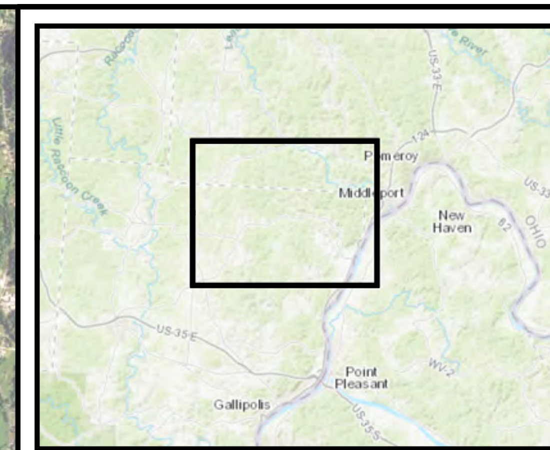


NOTE: Data were collected from 2013-11-13 to 2018-04-13

Figure 3-1: Fluoride in Sedimentary and Alluvial Aquifers
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

Gavin Property Boundary

Parcels Zoned as Agricultural

NOTES:
1. Parcel zoning data from Ohio DNR
2. Aerial Imagery: USDA NAIP 2015

N

0 0.5 1 1.5 2

Miles

Figure 3-2: Agricultural Lands Around the Gavin Station

Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

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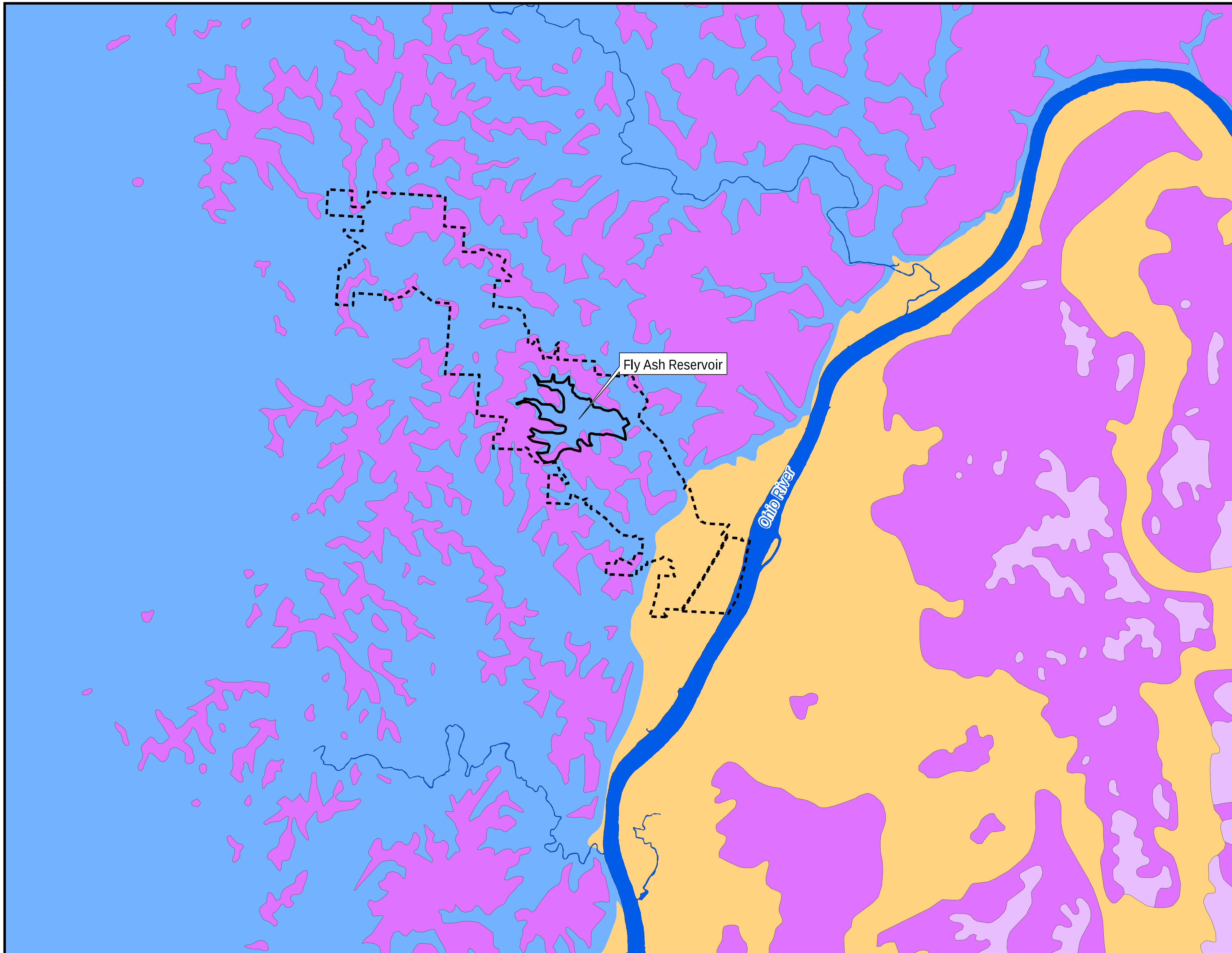
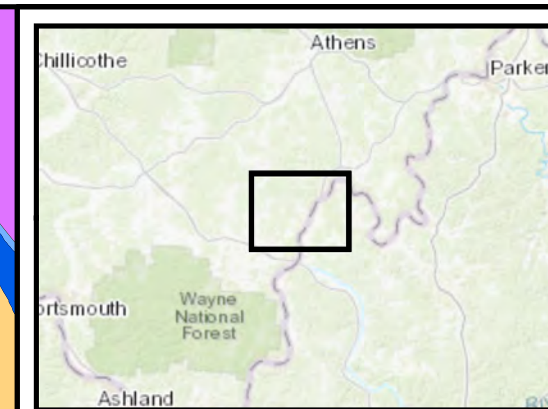




Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Conemaugh Group

Monongahela Group

Dunkard Group

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

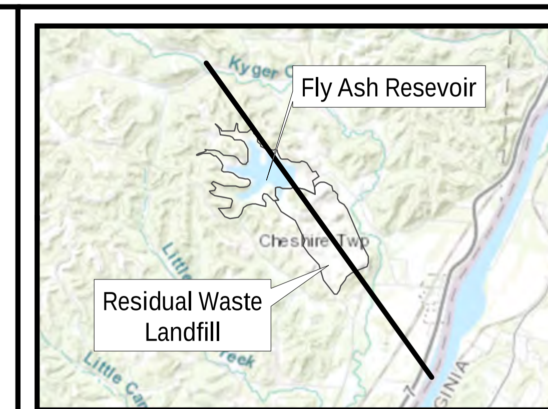
N

0 0.25 0.5 1 1.5 2
Miles

Figure 4-1: Sedimentary and Alluvial Aquifers

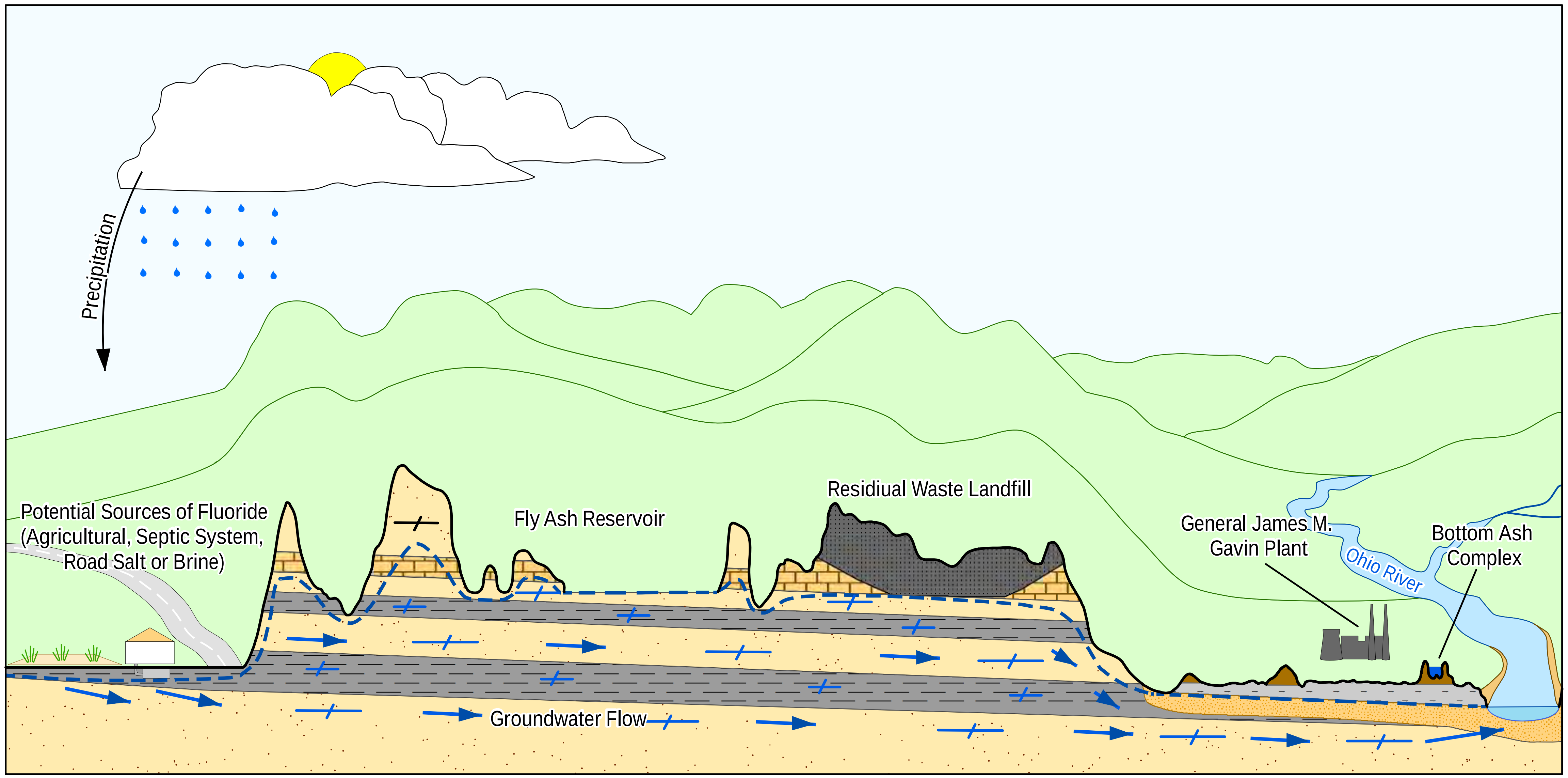
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM



Legend

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



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

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

Figure 4-2: Regional Groundwater Flow Patterns

Fly Ash Resevoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

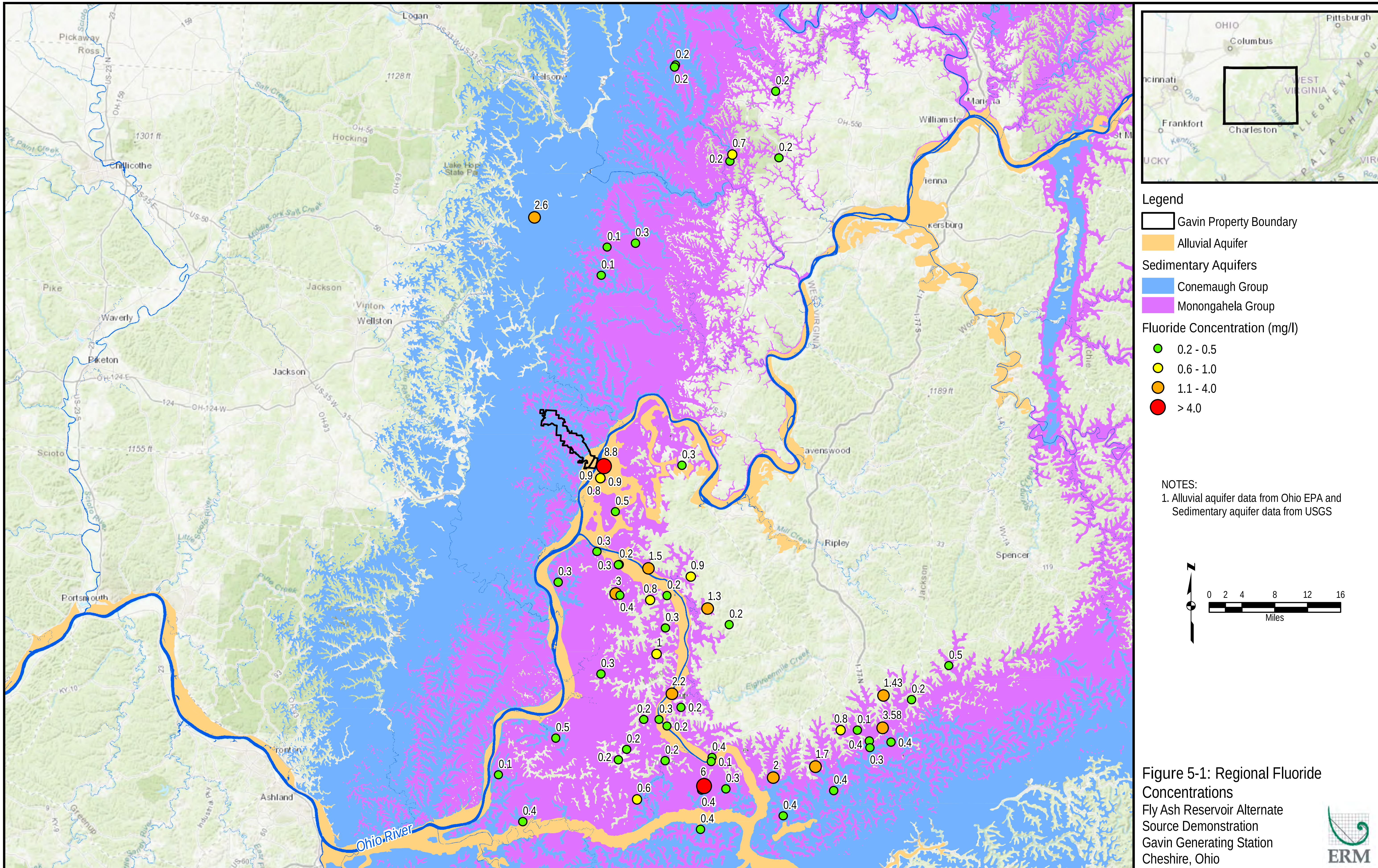
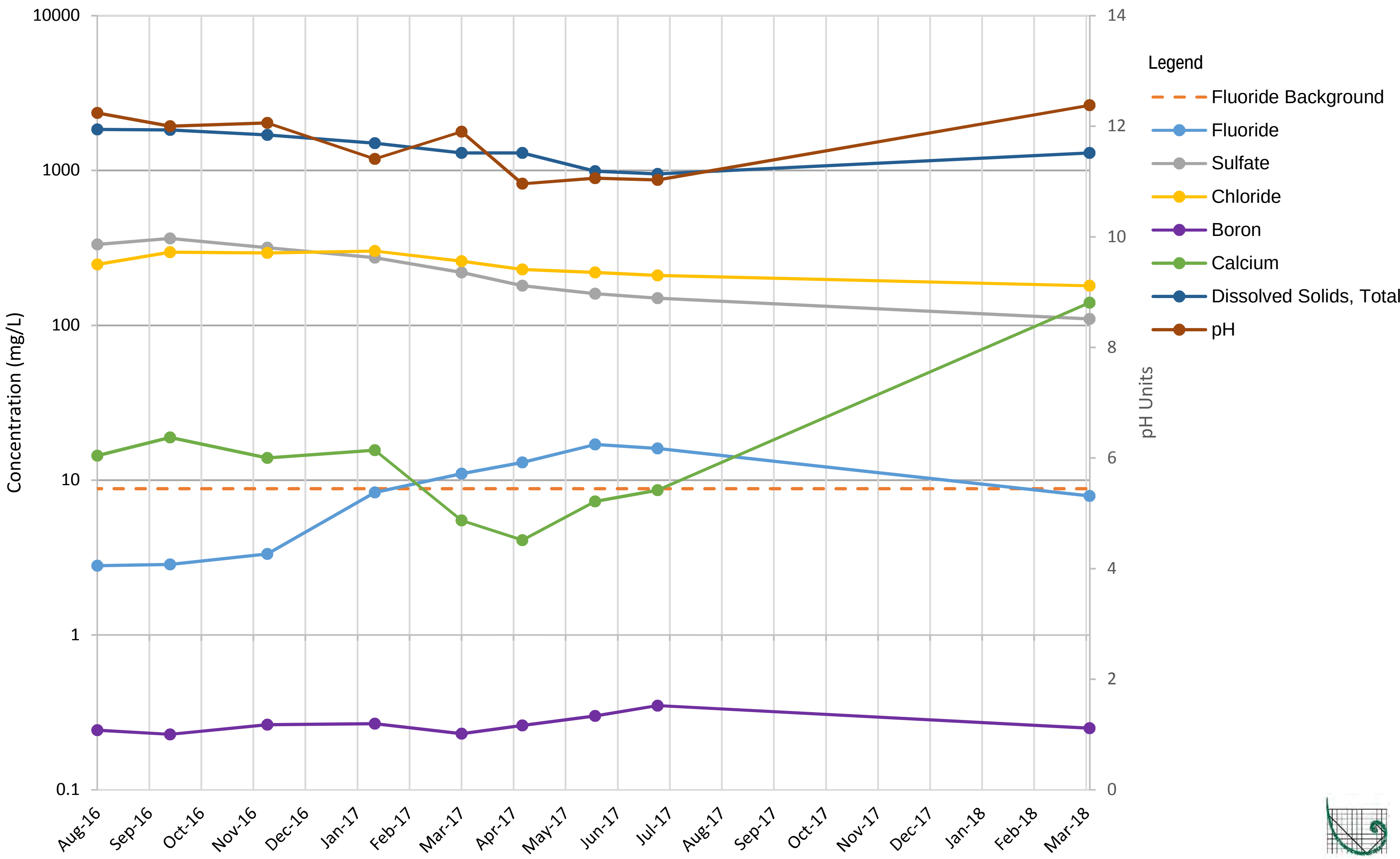


Figure 5-1: Regional Fluoride Concentrations
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

Figure 5-2: Analytical Results for Morgantown Sandstone Monitoring Well 2016-01
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station, Chesire Ohio



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Appendix A: Groundwater Elevation Data

Morgantown Fly Ash Reservoir

Monitoring Well ID	Units	Dates and Water Level Values									
96153 R	ft. amsl	6/1/2016 759.02	8/23/2016 758.34	10/3/2016 757.49	11/13/2016 756.90	11/29/2016 757.10	1/30/2017 No sample- pump issue	3/21/2017 761.85	4/25/2017 760.68	6/6/2017 758.76	7/12/2017 758.08
96154 R	ft. amsl	8/23/16 696.05	10/3/16 694.70	11/13/2016 694.82	11/29/16 670.27	1/30/17 693.30	3/21/17 695.88	4/25/17 694.28	6/6/17 678.02	7/12/17 690.22	
96156	ft. amsl	5/25/2016 684.07	8/23/16 671.20	10/3/16 661.97	11/9/2016 648.67	11/29/16 649.52	1/30/17 665.50	3/21/17 659.99	4/25/17 655.81	6/6/17 646.23	7/12/17 648.93
96150	ft. amsl	Well dry									
2016-11	ft. amsl	8/23/2016 633.14	10/3/2016 638.30	11/29/2016 622.29	1/30/2017 618.95	3/21/2017 618.75	4/25/2017 615.34	6/6/2017 614.7	7/12/2017 614.68	8/10/2017 614.53	
96152	ft. amsl	Well damaged, can't sample									
96148	ft. amsl	6/1/2016 662.50	11/16/2016 666.53								
96160	ft. amsl	5/26/2016 628.08	11/9/2016 607.33								
2016-07	ft. amsl	8/24/2016 661.07	10/5/2016 655.40	11/30/2016 654.28	1/31/2017 650.48	3/22/2017 645.11	4/27/2017 641.09	6/7/2017 635.8	7/13/2017 641	8/10/2017 644.42	
9910	ft. amsl	5/25/2016 599.09	8/23/16 598.06	10/3/16 598.54	11/9/2016 597.07	11/30/16 596.63	1/31/17 597.29	3/22/17 597.86	4/27/17 598.22	6/7/17 597.05	7/13/17 597.57
2016-05	ft. amsl	8/25/2016 598.02	10/5/2016 598.03	12/1/2016 598.07	2/1/2017 598.32	3/27/2017 598.13	4/27/2017 598.26	6/8/2017 598.8	7/14/2017 598.06		
2016-03	ft. amsl	8/24/2016 622.24	10/3/2016 623.14	12/1/2016 623.65	1/31/2017 622.89	3/27/2017 622.59	4/27/2017 622.87	6/7/2017 622.71	7/14/2017 622.66		
9902	ft. amsl	Well dry									
2016-01	ft. amsl	8/24/16 706.22	10/5/16 703.41	11/30/16 703.82	1/31/17 689.44	3/22/17 677.44	4/26/17 696.59	6/7/17 639.15	7/13/17 696.77		

Morgantown Residual Waste Landfill

Monitoring Well ID	Units	Dates and Water Level Values													
94125	ft. amsl	8/24/16 588.18	10/5/16 598.73	12/2/16 585.57	2/6/17 584.69	3/29/17 583.23	4/28/17 584.63	6/8/17 DRY	7/17/17 DRY						
94128	ft. amsl	4/13/16 696.96	8/23/16 696.41	10/5/16 697.04	10/30/16 696.42	12/1/16 686.58	2/2/17 694.00	3/23/17 696.3	4/18/17 696.44	5/2/17 672.58	5/2/2017 DUP 672.58	6/8/17 689.81	7/18/17 693.36		
94139	ft. amsl	1/16/2016 601.84	4/15/2016 601.91	4/15/16 DUP 601.91	8/23/16 601.34	10/5/16 600.98	10/24/2016 600.99	12/2/16 600.90	2/2/17 601.08	3/29/17 599.19	4/28/17 601.34	5/10/2017 601.14	6/12/17 601.31	6/12/17 DUP 601.31	7/18/17 601.1
94140	ft. amsl	4/13/16 583.03	10/22/16 582.07	10/22/16 DUP 582.07	4/19/17 583.11										
93107	ft. amsl	Not Gauged													
93108	ft. amsl	4/21/2016 605.75	8/24/16 596.19	10/6/16 599.99	11/4/2016 599.28	12/2/16 595.74	2/2/17 599.44	3/23/17 598.94	4/19/2017 599.30	5/2/17 596.85	6/12/17 595.54	7/18/17 595.99			
2016-21	ft. amsl	8/25/2016 576.69	10/6/2016 574.77	12/1/2016 574.93	2/8/2017 574.77	3/29/2017 574.84	5/2/2017 574.83	6/12/2017 574.77	7/17/2017 572.72						
2000	ft. amsl	4/20/2016 593.34	8/24/16 592.63	10/6/16 592.87	10/30/2016 592.88	12/1/16 593.17	2/2/17 593.32	3/23/17 594.03	4/24/2017 593.25	5/1/17 593.23	6/12/17 593.02	7/17/17 592.8			
2003	ft. amsl	8/24/16 613.99	10/5/16 605.59	11/1/2016 606.76	12/1/16 601.38	2/8/17 600.21	3/27/17 596.83	4/27/2017 590.70	5/1/17 591.67	6/12/17 599.18	7/19/17 588.98	8/18/17 591.76			
R-9397	ft. amsl	Not Gauged													
94122	ft. amsl	1/2/2016 605.16	4/28/2016 605.82	4/29/2017 605.82											
9806	ft. amsl	4/20/2016 584.48	8/24/16 584.51	10/5/16 584.48	10/30/2016 584.52	12/2/16 584.80	2/8/17 584.54	3/27/17 584.56	4/27/2017 584.25	5/1/17 584.62	6/27/17 584.65	7/19/17 584.65	8/18/17 584.63		

Cow Run Fly Ash Reservoir

Monitoring Well ID	Units	Dates and Water Level Values													
MW-20	ft. amsl	8/23/2016 761.62	10/5/2016 760.62	12/1/2016 760.19	1/26/2017 761.56	3/29/2017 765.23	4/25/2017 763.52	6/6/2017 762.21	7/14/2017 761.56						
2016-09	ft. amsl	8/23/2016 647.86	10/3/2016 643.79	11/29/2016 643.57	1/30/2017 644.54	3/21/2017 645.21	4/25/2017 633.54	6/6/2017 622.12	7/12/2017 614.04						
2016-10	ft. amsl	8/23/2016 617.48	10/3/2016 620.59	11/29/2016 625.64	1/30/2017 619.12	3/21/2017 622.23	4/25/2017 615.54	6/6/2017 616.37	7/12/2017 617						
96145	ft. amsl	Well closed 5/6/2014 for landfill expansion construction													
96149	ft. amsl	5/26/16 652.48	11/15/16 654.73												
2016-08	ft. amsl	8/24/2016 594.15	10/5/2016 574.68	11/30/2016 631.06	1/31/2017 563.05	3/22/2017 556.67	4/27/2017 552.53	6/7/2017 548.8	7/13/2017 543.88	8/10/2017 541.73					
2016-06	ft. amsl	8/25/2016 581.12	10/3/2016 580.61	12/1/2016 580.57	2/1/2017 580.74	3/27/2017 580.96	4/27/2017 581.1	6/8/2017 580.94	7/14/2017 580.91						
2016-04	ft. amsl	8/24/2016 600.02	10/3/2016 597.90	12/1/2016 600.55	1/31/2017 595.20	3/27/2017 597.73	4/27/2017 597.03	6/7/2017 597.60	7/14/2017 597.39						
96147	ft. amsl	5/27/16 592.11	8/23/16 588.50	10/5/16 583.05	11/9/16 585.82	11/30/16 583.50	1/31/17 584.15	3/22/17 584.05	4/27/17 582.98	6/7/17 583.73	7/13/17 584.14				
96158	ft. amsl	5/20/2016 578.22	5/20/2016 DUP 578.22	11/17/2016 577.09											
2016-02	ft. amsl	8/24/16 616.43	10/5/16 605.54	11/30/16 593.94	1/31/17 585.87	3/22/17 578.88	3/22/2017 DUP 578.88	4/26/17 562.73	4/26/2017 DUP 562.73	6/7/17 556.87	6/7/2017 DUP 556.87	7/13/17 542.82	7/13/2017 DUP 542.82		

Cow Run Residual Waste Landfill

Monitoring Well ID	Units	Dates and Water Level Values																						
9801	ft. amsl	4/20/16 602.65	8/24/16 586.05	10/6/16 586.04	10/30/16 585.50	12/2/16 583.26	2/1/17 585.94	3/29/17 586.08	4/28/17 585.9	4/29/17 586.19	6/9/17 584.35	6/9/17 DUP 584.35	7/17/17 585.78											
9804	ft. amsl	4/21/16 571.08	10/27/16 571.24	4/27/17 571.32																				
2002	ft. amsl	4/20/2016 593.49	8/24/2016 505.30	10/5/2016 506.31	11/1/2016 502.60	12/1/2016 493.83	2/8/2017 495.08	3/27/2017 494.49	4/27/2017 497.27	5/1/2017 497.39	6/12/2017 498.5	7/19/2017 499.45												
93105	ft. amsl	1/26/16 578.17	4/18/16 573.76	4/18/2016 DUP 573.76	7/21/16 574.64	10/24/16 565.30	1/25/17 578.91	4/28/17 564.15	7/24/17 576.53	7/24/2017 DUP 576.53														
94136	ft. amsl	1/16/2016 563.57	4/18/2016 563.80	5/26/2016 563.63	6/9/2016 563.63	7/26/2016 563.17	8/24/2016 596.25	8/24/16 563.25	9/9/2016 562.67	10/6/16 562.70	10/22/2016 562.56	10/22/2016 DUP 562.56	12/1/16 562.90	1/19/2017 564.01	1/19/2017 DUP 564.01	2/1/17 564.06	3/23/17 563.70	4/20/2017 564.37	4/20/2017 DUP 564.37	4/28/17 563.90	6/9/17 563.11	7/17/17 562.87	7/17/17 DUP 562.87	7/20/2017 563.04
2016-20	ft. amsl	8/26/2016 504.31	10/5/2016 496.41	12/1/2016 494.59	2/8/2017 499.53	3/29/2017 501.54	5/17/2017 501.06	6/12/2017 494.59	7/17/2017 494.66															
93101	ft. amsl	4/13/2016 583.05	10/24/2016 582.46	4/19/2017 583.12																				
94126	ft. amsl	4/13/2016 614.84	4/13/2016 DUP 614.84	8/23/16 609.86	10/5/16 611.75	10/30/2016 604.25	12/1/16 532.25	2/2/17 591.99	3/23/17 606.32	3/23/2017 DUP 606.32	4/18/2017 600.36	5/17/17 516.29	6/8/17 541.19	7/18/17 576.91										

Appendix B: Revised Background Calculations

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LIST OF TABLES

LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
LPL	lower prediction limit
mg/L	milligrams per liter
SS	Sandstone
SSI	statistically significant increase
StAP	Statistical Analysis Plan
SU	standard units
TDS	total dissolved solids
UPL	upper prediction limit
EPA	U.S. Environmental Protection Agency

1.0 STATISTICAL ANALYSIS AND RESULTS

Consistent with the Coal Combustion Residuals Rule and the Statistical Analysis Plan (StAP) that is in the operating record (ERM 2017), a prediction limit approach (40 Code of Federal Regulations [CFR] §257.93(f)) was used to identify potential impacts to groundwater. The steps outlined in the decision framework in the StAP include:

- Individual well comparisons to determine if wells can be pooled
- Establishment of the upgradient dataset
- Calculating prediction limits
- Comparing downgradient wells to prediction limits

1.1 POOLED VS. INDIVIDUAL WELL COMPARISONS

When multiple upgradient wells were available within the same geologic formation, concentrations were compared among these wells to determine if they could be pooled to create a single upgradient dataset, or alternately, if the background data set should be established for each individual upgradient well. For each analyte, boxplots (see Attachment A, Figure A-1) and Kruskal Wallis results (see Attachment B, Table B-1) are provided for upgradient wells.

The statistical test shows that for Cow Run Sandstone and Morgantown Sandstone upgradient wells, individual well analysis is appropriate for all analytes. Table 1 identifies the statistical analysis that was used for each analyte.

Table 1 Analysis Type for Each Upgradient Dataset

Geology	Analyte	Analysis Type
Cow Run SS	Boron	Individual
Cow Run SS	Calcium	Individual
Cow Run SS	Chloride	Individual
Cow Run SS	Fluoride	Individual
Cow Run SS	pH	Individual
Cow Run SS	Sulfate	Individual
Cow Run SS	TDS	Individual
Morgantown SS	Boron	Individual
Morgantown SS	Calcium	Individual

Geology	Analyte	Analysis Type
Morgantown SS	Chloride	Individual
Morgantown SS	Fluoride	Individual
Morgantown SS	pH	Individual
Morgantown SS	Sulfate	Individual
Morgantown SS	TDS	Individual

SS = Sandstone; TDS = total dissolved solids

1.2 ESTABLISHMENT OF UPGRADIENT DATASET

When evaluating the concentrations of analytes in groundwater, U.S. Environmental Protection Agency (EPA) guidance (2009) recommends performing a quality check of the data to identify any anomalies. In addition to the data validation that was performed, descriptive statistics, outlier testing, and checking for temporal stationarity were completed to finalize the upgradient dataset. Supporting documentation is provided in Attachments A and B and is discussed below.

1.2.1 Descriptive Statistics

Descriptive statistics were calculated for upgradient wells and analytes at the site (see Attachment B, Table B-2). The descriptive statistics highlight a number of relevant characteristics about the Cow Run Sandstone upgradient datasets including:

- There are a total of 42 well-analyte combinations for the upgradient dataset (six upgradient monitoring wells and seven Appendix III constituents for Detection Monitoring).
- All well-analyte combinations have detection rates greater than or equal to 50 percent.
- Forty-one well-analyte combinations have 100 percent detects.
- Twenty-eight well-analyte combinations follow a normal distribution (using Shapiro-Wilks Normality Test), eight well-analyte combinations follow a log-normal distribution, and the remaining six well-analyte combinations have no discernible distribution.

For the Morgantown Sandstone upgradient datasets, descriptive statistics highlight the following:

- There are a total of 42 well-analyte combinations for the upgradient dataset (six upgradient monitoring wells and seven Appendix III constituents for Detection Monitoring).
- Forty well-analyte combinations have detection rates greater than or equal to 50 percent.
- Forty well-analyte combinations have 100 percent detects.
- Thirty-two well-analyte combinations follow a normal distribution (using Shapiro-Wilks Normality Test), two well-analyte combinations follow a log-normal distribution, and the remaining eight well-analyte combinations have no discernible distribution.

1.2.2 Outlier Determination

As discussed in the StAP, both statistical and visual outlier tests were performed on the upgradient datasets. Data points identified as both a statistical and visual outliers (see Attachment A, Figure A-2 and Attachment B, Table B-3) were reviewed by the project hydrogeologists to determine if these data points should be excluded from the dataset. A total of 10 potential outliers were identified with visual and statistical tests. After careful review, one of these were excluded from Upper Prediction Limit (UPL) calculations (see Attachment B, Table B-3).

1.2.3 Checking for Temporal Stability

A trend test was calculated for all detected values in the upgradient wells as long as they had at least five detected data points and at least 50 percent detection rate. A summary report of the Mann Kendall trend test results and time series plots can be found Attachment A, Figure A-3 and Attachment B, Table B-4. The following summarize the results of the trend analysis across the two geologic types:

- There are a total of 84 well-analyte combinations in the upgradient dataset.
- Seventy-four well-analyte combinations meet the data requirements of the trend test.
- Twelve well-analyte combinations had a significant increasing trend.
- Three well-analyte combination had a significant decreasing trend.
- Fifty-nine well-analyte combinations had no significant trend (i.e., concentrations were stable over time).

1.3 ESTABLISHING UPPER PREDICTION LIMITS

As described in the StAP, a multi-part assessment of the monitoring wells was performed to determine what type of UPL should be used for the analysis. A complete table of UPLs and the methods used to calculate them can be found in Attachment B, Table B-5.

Upgradient wells that had fewer than five detected values utilized the maximum concentration in the upgradient dataset for the UPL. The 10 well-analyte combinations that did not meet the minimum data requirements for a calculated UPL are listed below:

- Boron in well 2016-11
- Calcium in well 2016-11
- Chloride in well 2016-11
- Fluoride in wells 2016-10, 2016-11, and 96156
- pH in well 2016-11
- Sulfate in wells 2016-11 and 96156
- Total dissolved solids (TDS) in well 2016-11

A total of 15 well-analyte combinations were found to have either increasing or decreasing trends. For these well-analyte pairs, a bootstrapped UPL calculated around a Theil Sen trend was used to derive a more accurate UPL (ERM 2017).

The remaining 59 well-analyte combinations were found to have no significant trend. Sanitas was used to calculate static UPLs using an annual site-wide false positive rate of 0.1 and a 1-of-2 retesting approach as discussed in the StAP.

1.3.1 Final UPL Selection

A final UPL was selected for each analyte and compared to the most recent sample in downgradient wells. All analytes had a UPL value calculated for each of the upgradient wells; the maximum UPL was selected as the representative UPL for each analyte (or the minimum lower prediction limit [LPL] in the case of pH) (ERM 2017). All final UPL values are shown in Table 2 below and Attachment B, Table B-5.

Table 2 Final UPLs for each Analyte and Geologic Unit

UPL Type	Geology	Analyte	LPL	UPL	Unit
Individual	Cow Run SS	Boron		0.653	mg/L
Individual	Cow Run SS	Calcium		532	mg/L
Individual	Cow Run SS	Chloride		13,900	mg/L
Individual	Cow Run SS	Fluoride		6.96	mg/L
Individual	Cow Run SS	pH	6.5	12.8	SU
Individual	Cow Run SS	Sulfate		2,440	mg/L
Individual	Cow Run SS	TDS		22,600	mg/L
Individual	Morgantown SS	Boron		0.723	mg/L
Individual	Morgantown SS	Calcium		437	mg/L
Individual	Morgantown SS	Chloride		17,000	mg/L
Individual	Morgantown SS	Fluoride		5.02	mg/L
Individual	Morgantown SS	pH	6.78	11.5	SU
Individual	Morgantown SS	Sulfate		1,990	mg/L
Individual	Morgantown SS	TDS		25,500	mg/L

LPL = lower prediction limit; mg/L = milligrams per liter; SU = standard units; TDS = total dissolved solids; UPL = upper prediction limit

1.4 CONCLUSIONS

The downgradient samples collected during the August 2017 sampling event were used for compliance comparisons. All downgradient wells were below the UPLs with the following exceptions (Table 3 below, and Attachment B, Table B-6).Concentrations in well 2016-01 are significantly increasing for fluoride from August 2016 through July 2017. However, measurements taken from July 2017 to March 2018 show a declining trend in the concentration in fluoride.

Table 3 Downgradient Measurements that Exceed the UPL

Geology	Analyte	Well	UPL	Sample Date	Value	Unit
Morgantown SS	Fluoride	2016-01	5.02	2017-07-13	16	mg/L

LPL = lower prediction limit; mg/L = milligrams per liter; UPL = upper prediction limit

2.0 REFERENCES

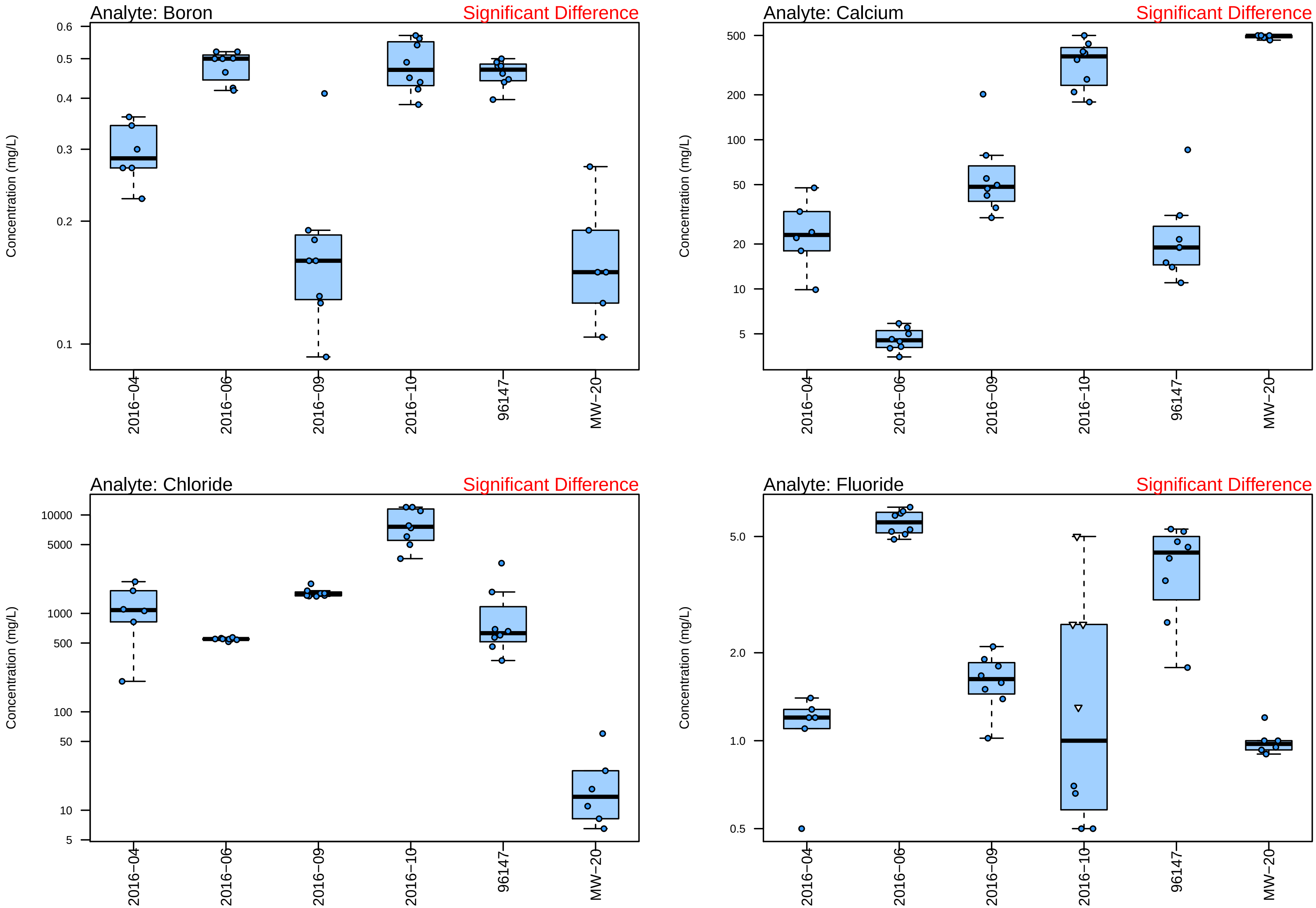
Environmental Resources Management (ERM). 2017. *Groundwater Monitoring Plan. Bottom Ash Complex, Fly Ash Reservoir, and Residual Waste Landfill*. Gavin Plan, Cheshire Ohio.

EPA. 2009. *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities*. Unified Guidance. USEPA/530/R/09/007. Office of Resource Conservation and Recovery. Washington, D.C.

Attachment A
Figures

Figure A-1
Boxplots of Upgradient Wells

Boxplots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS



Boxplots of Upgradient Wells
Unit: Fly Ash Reservoir
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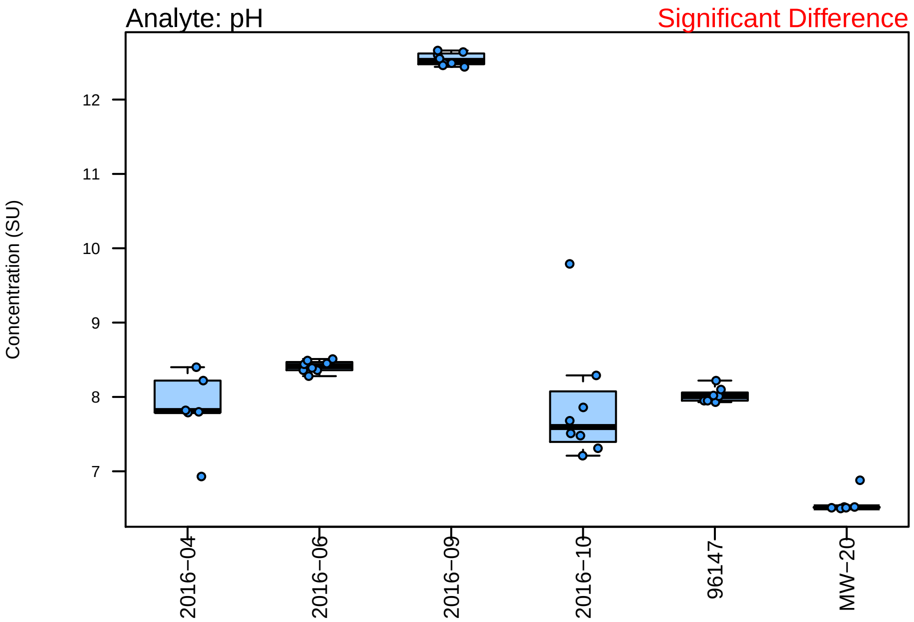
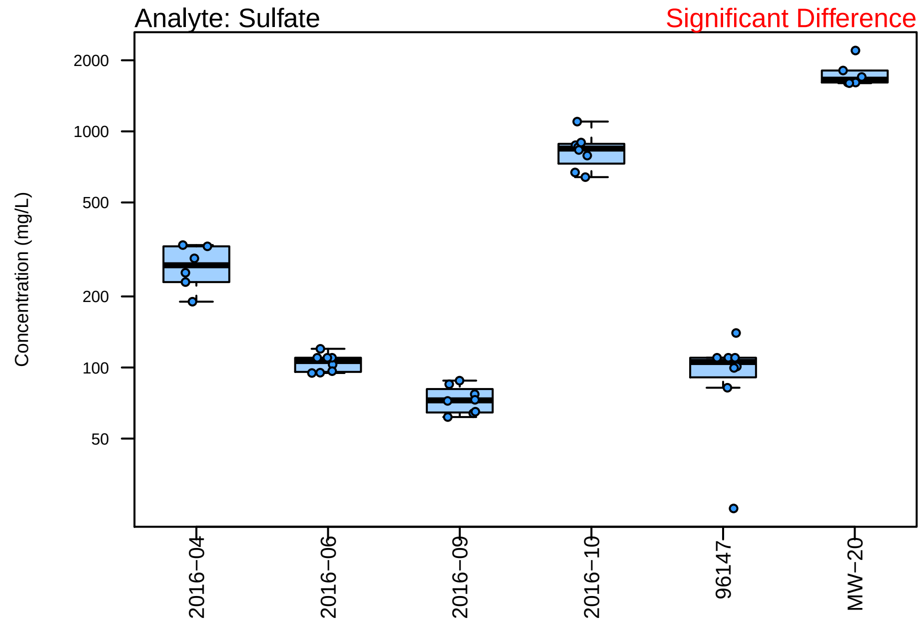
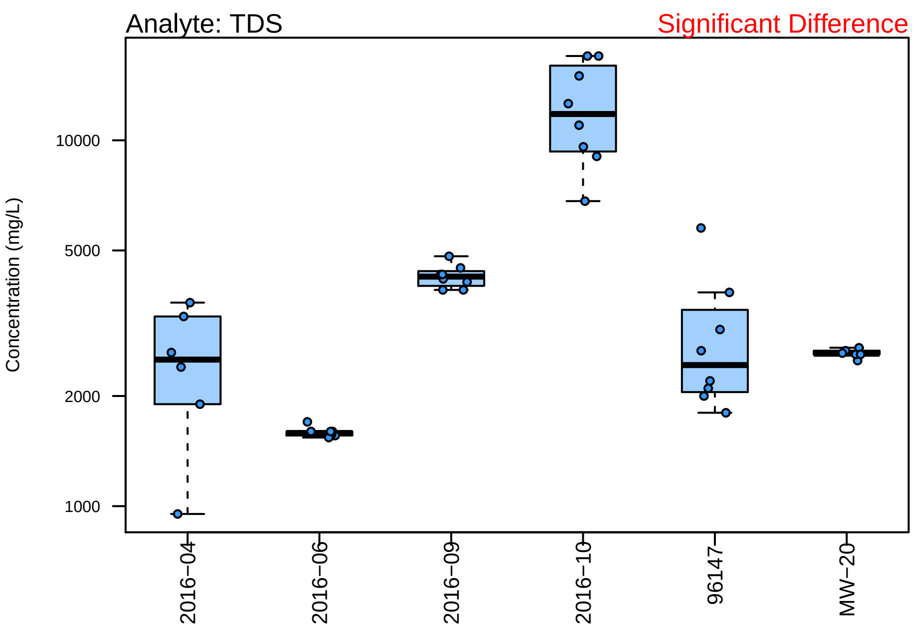
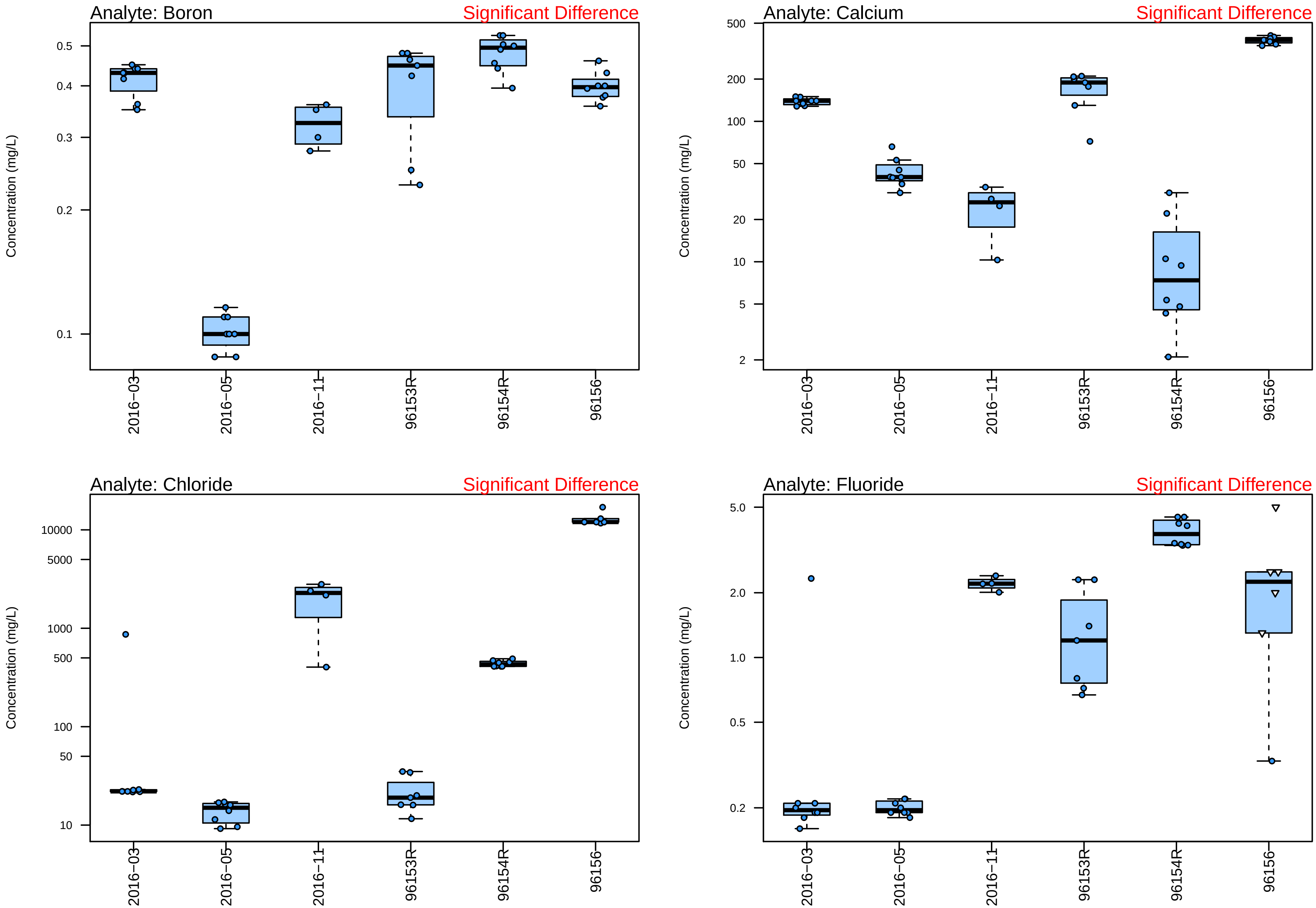


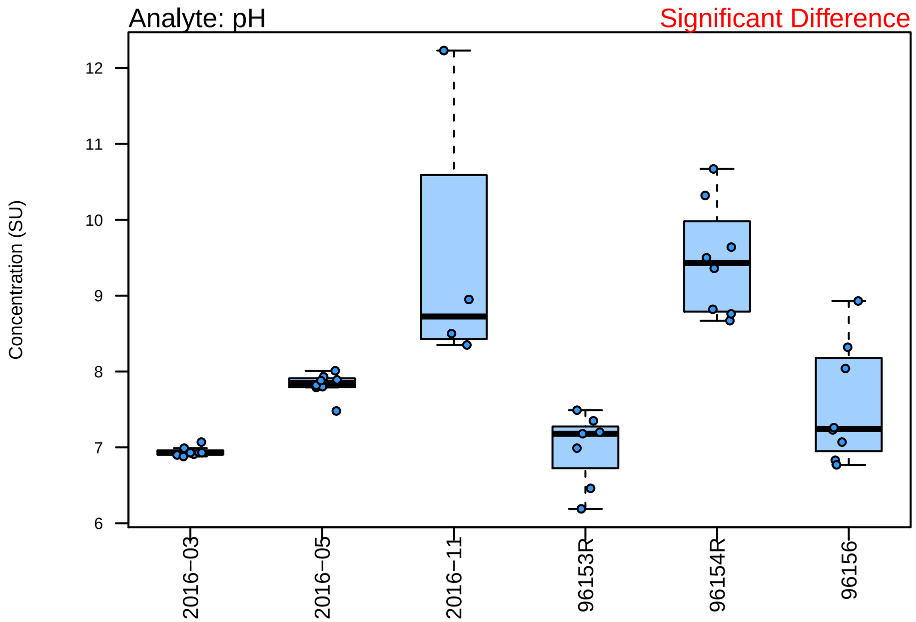


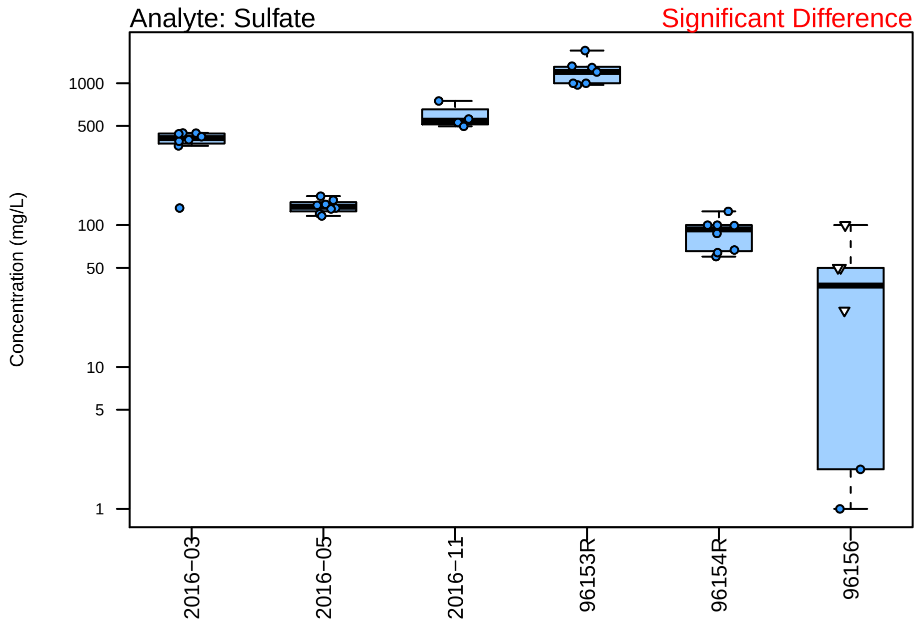


Boxplots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



Boxplots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS





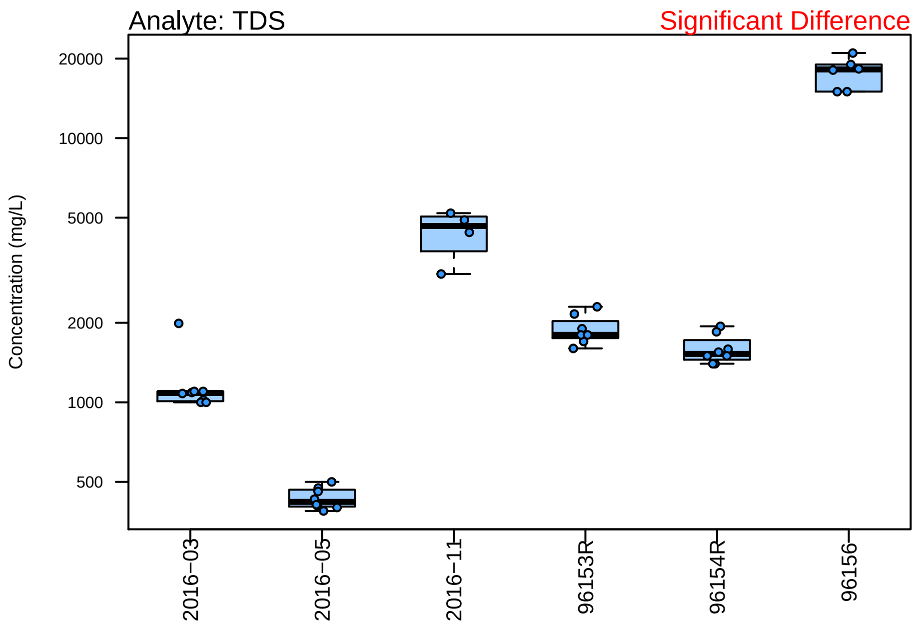
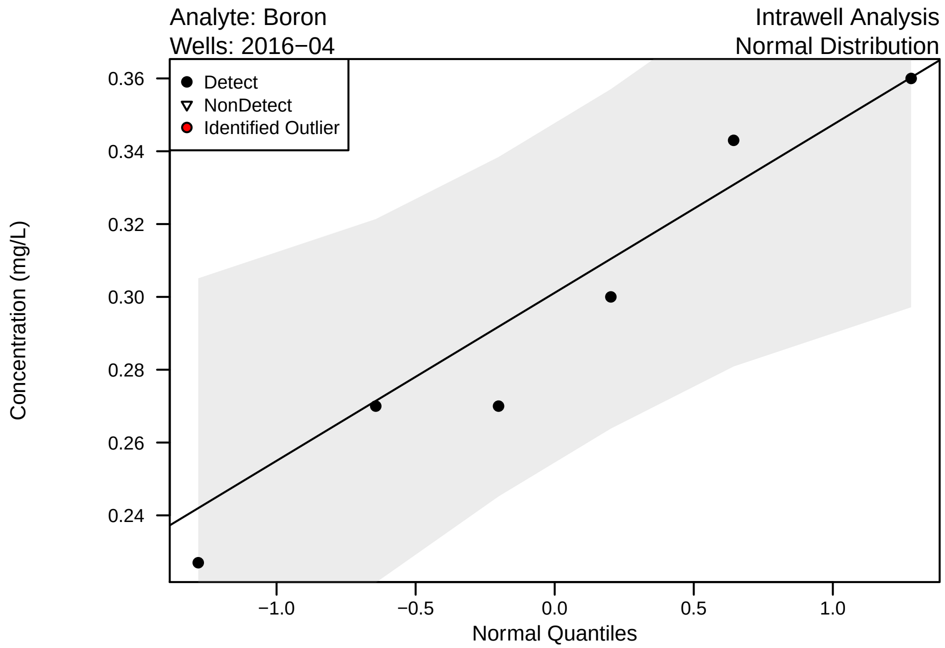


Figure A-2
QQ Plots of Upgradient Wells

QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS



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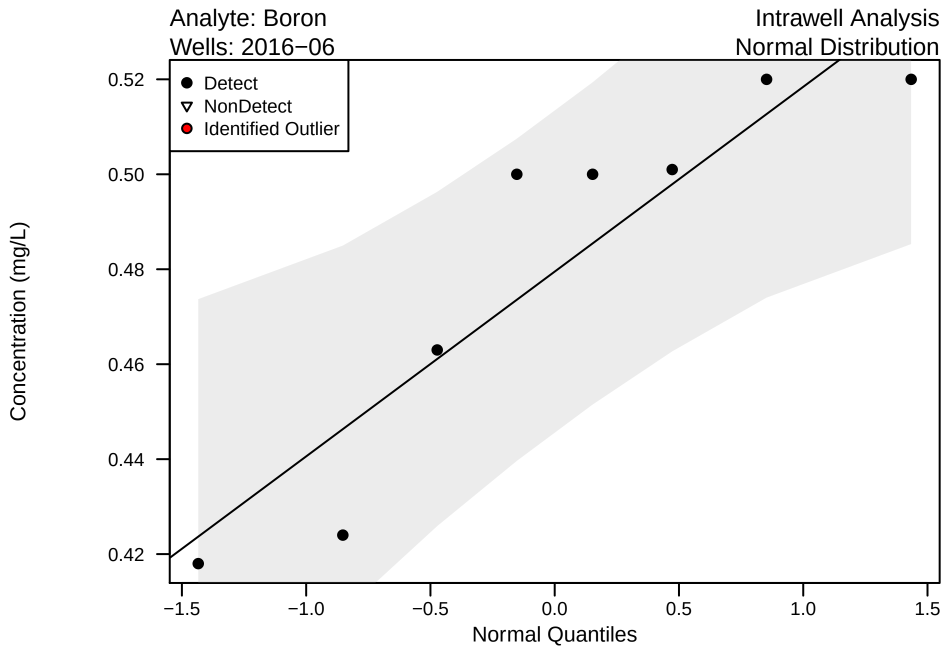

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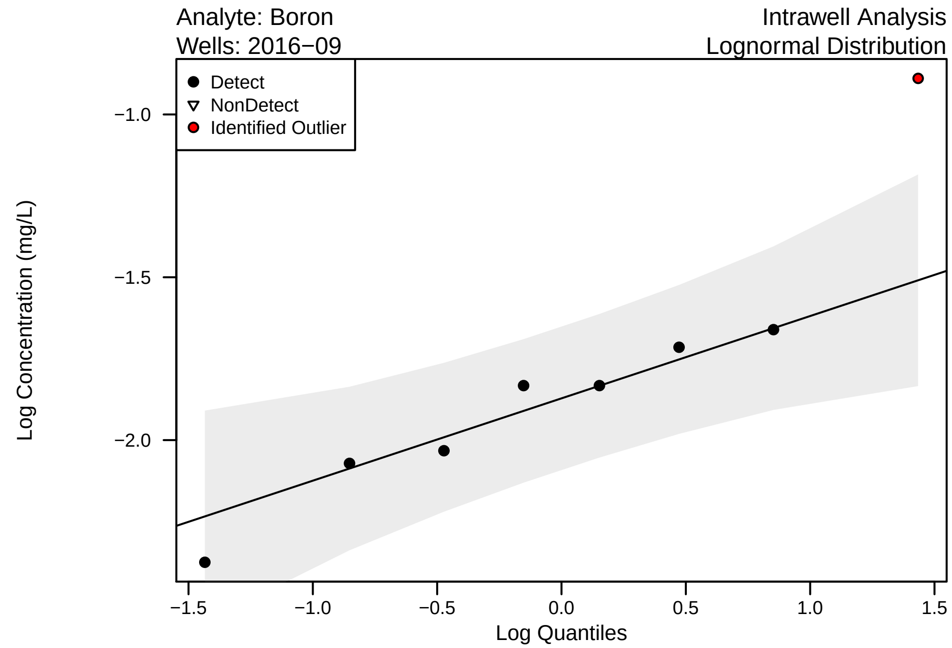

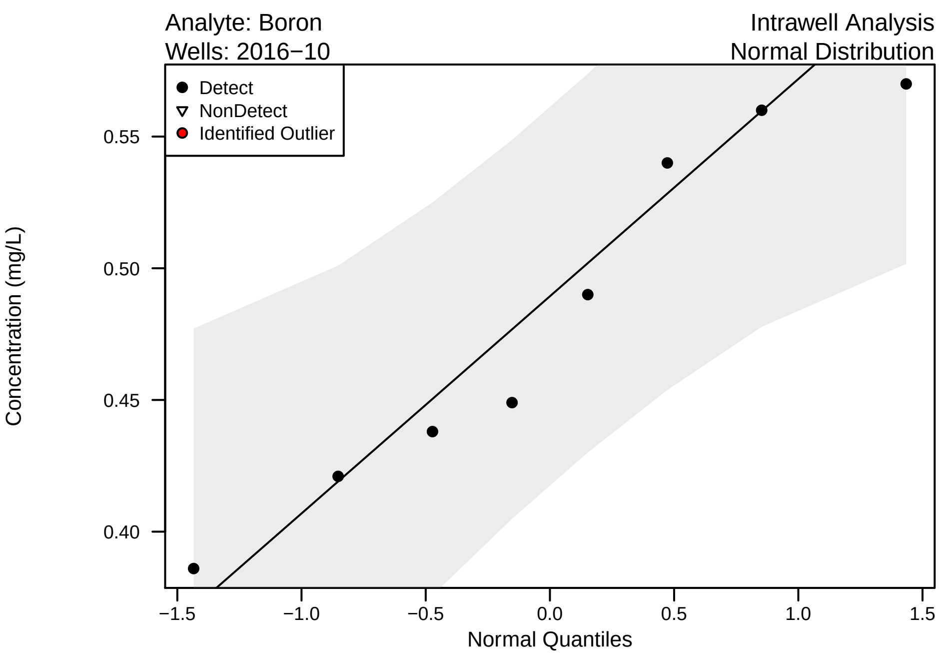

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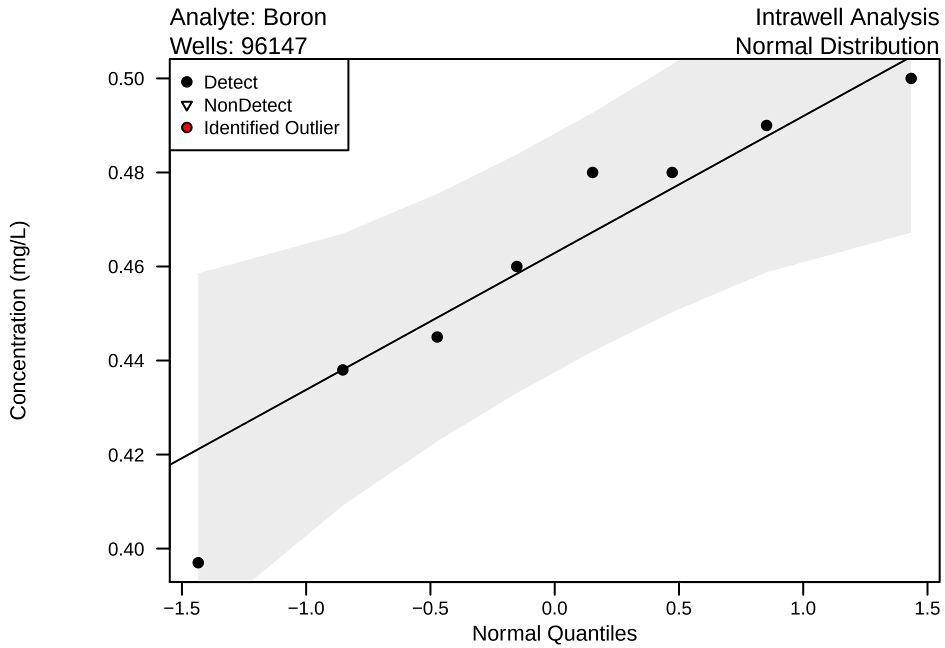

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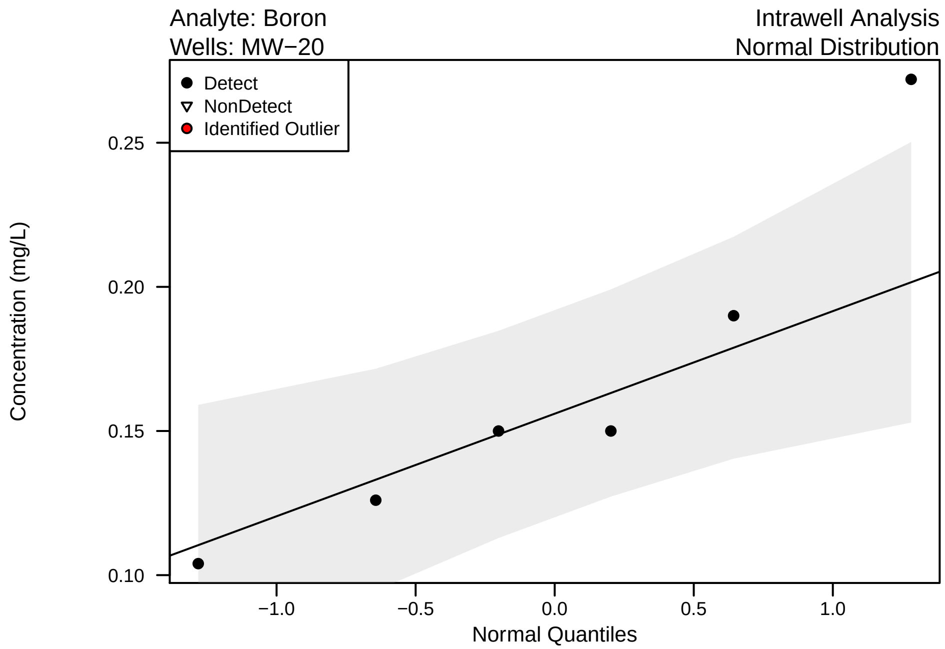

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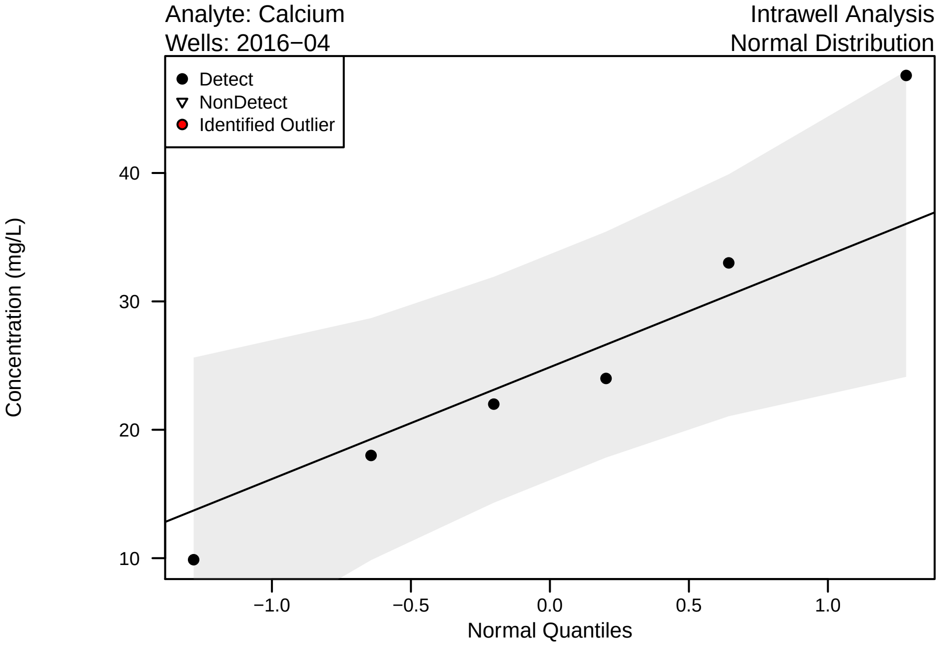

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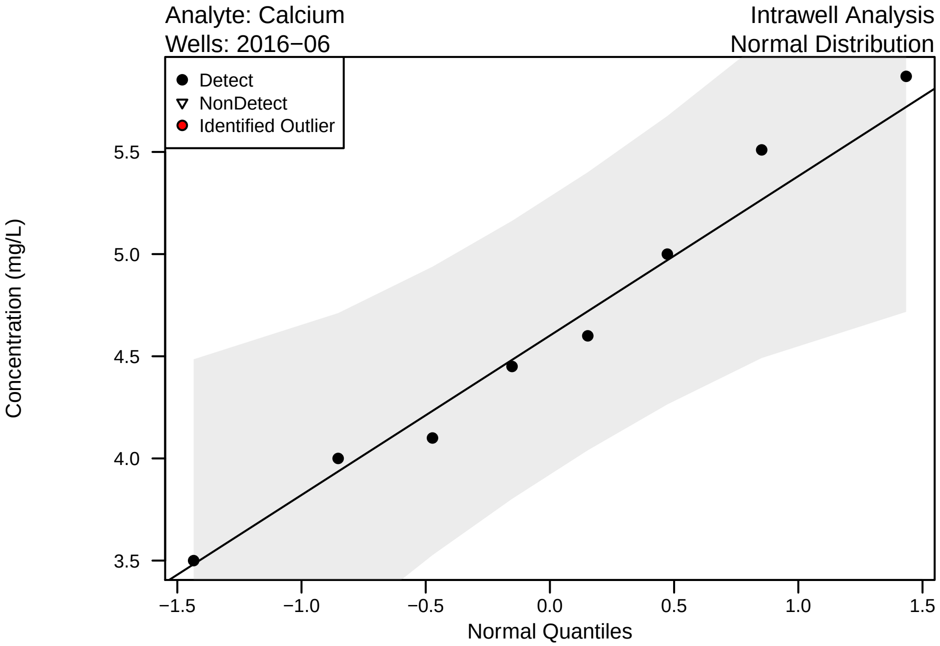

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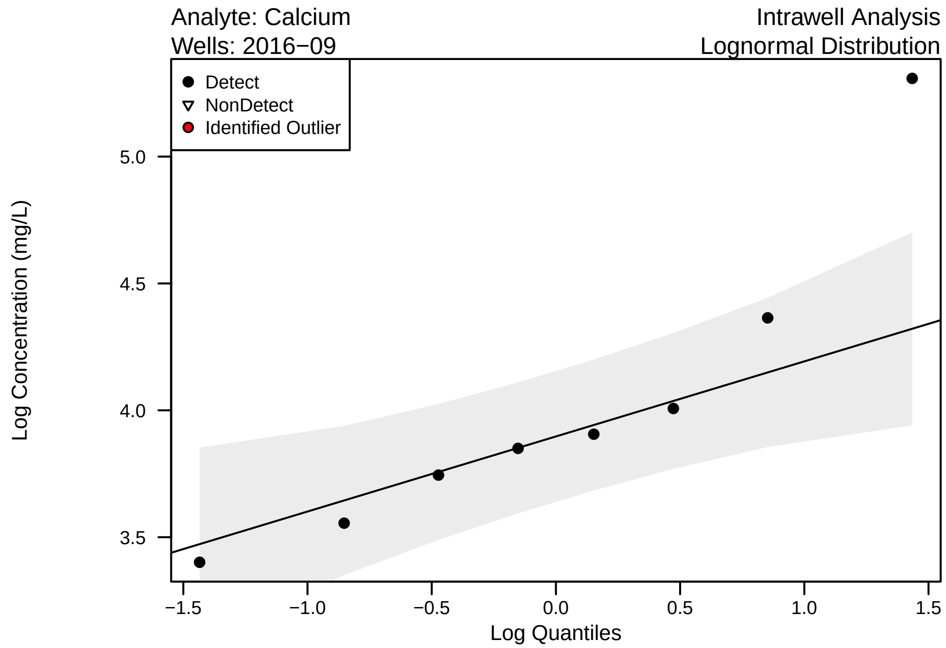

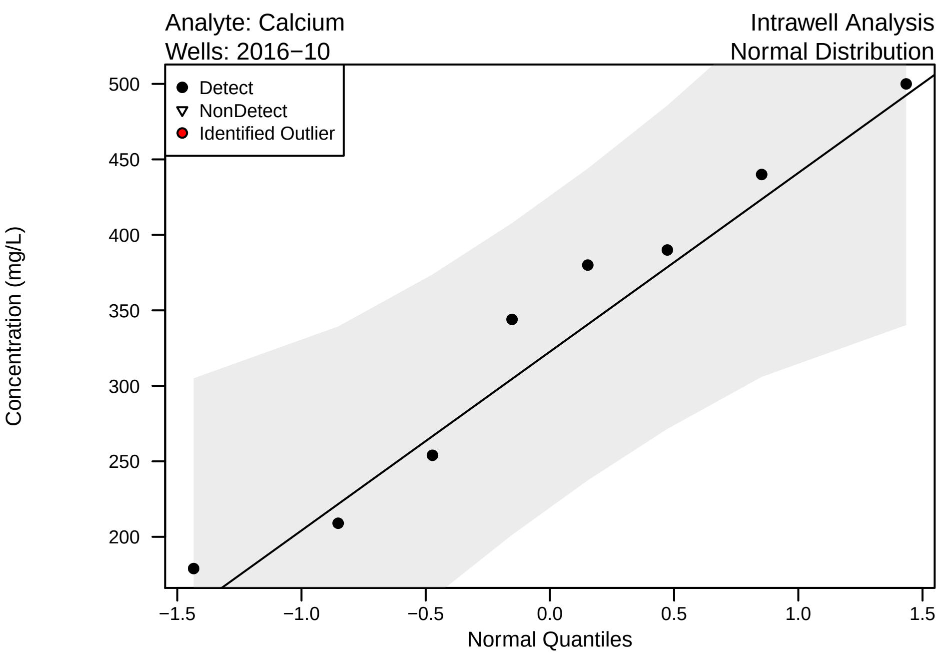

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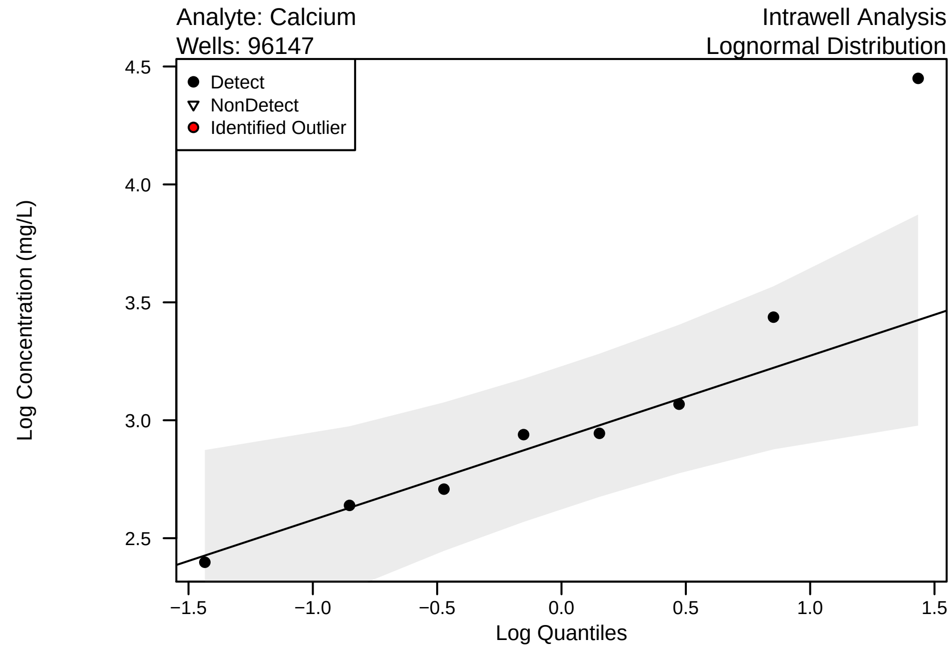

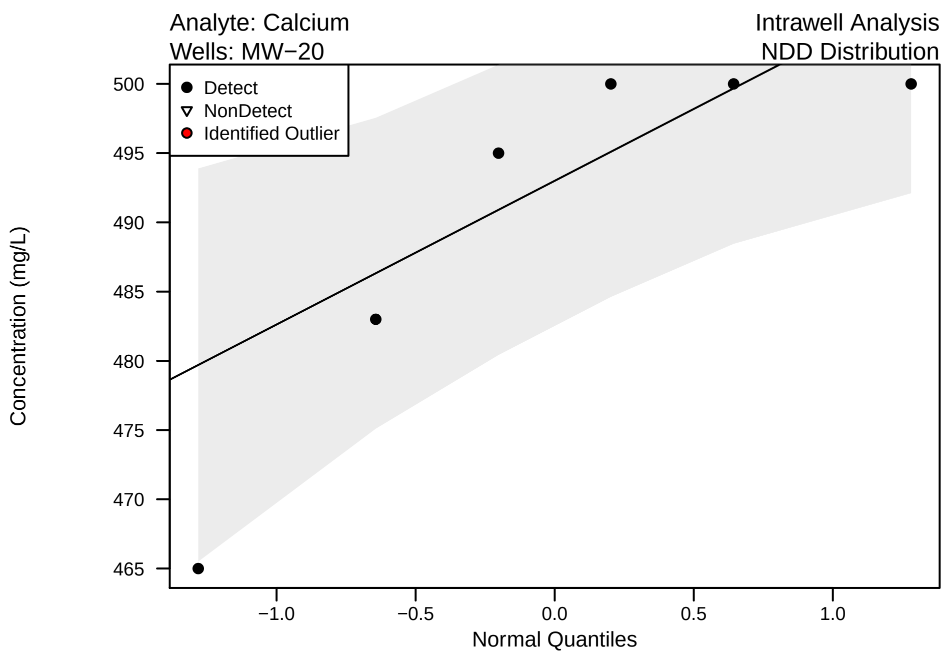

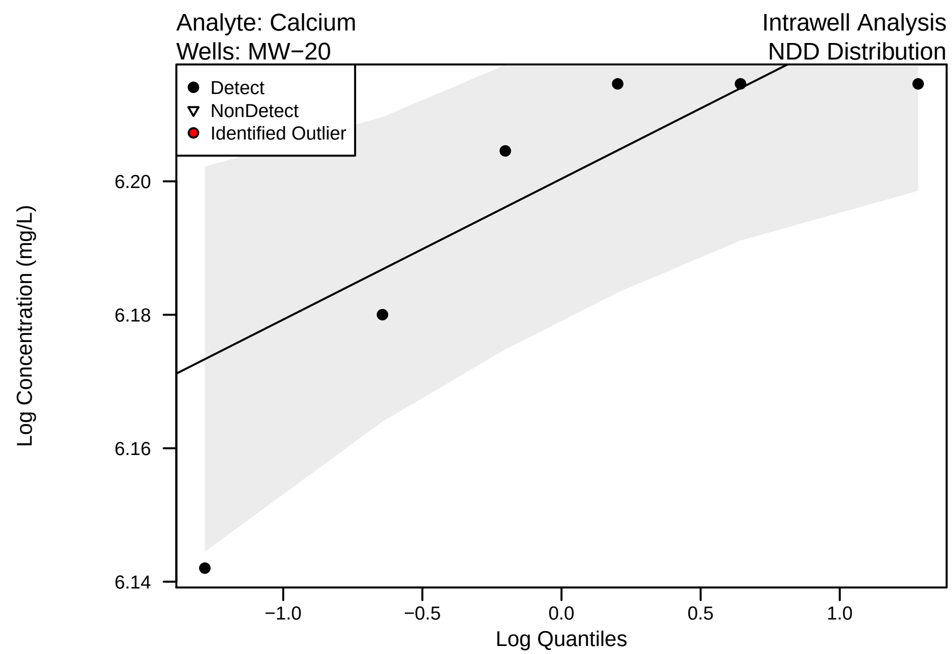

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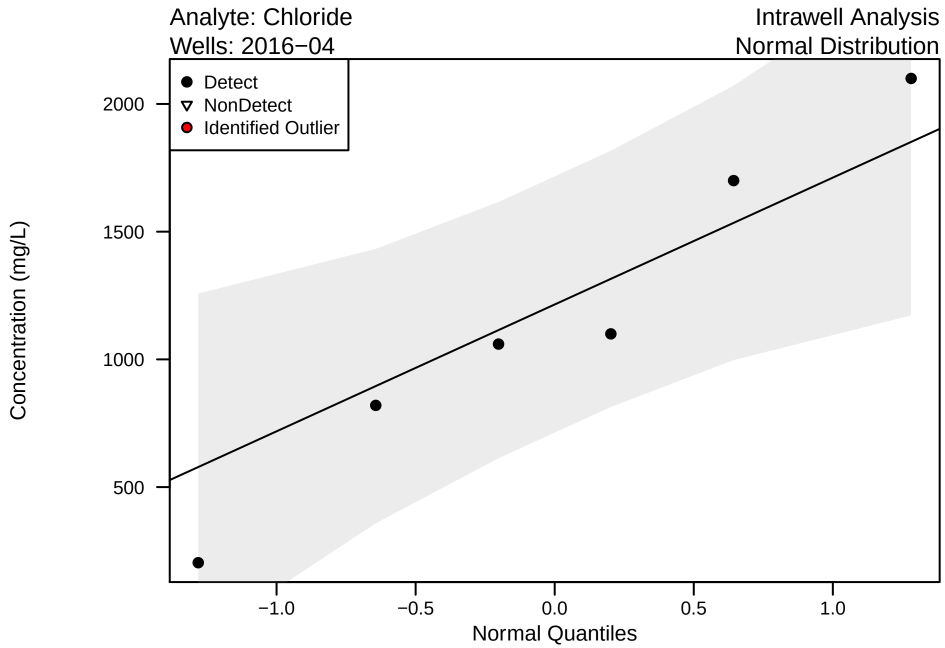

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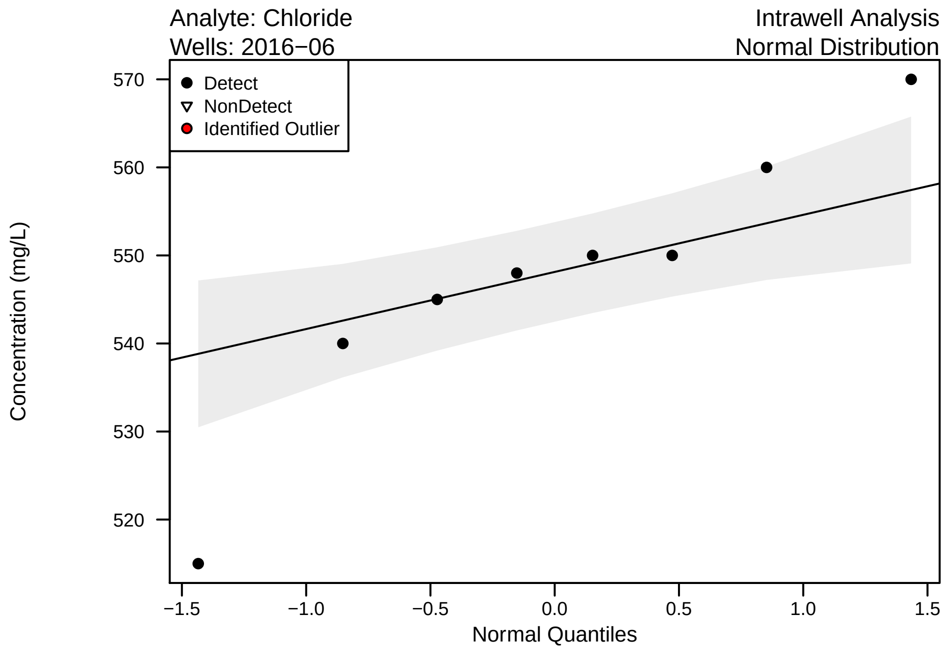

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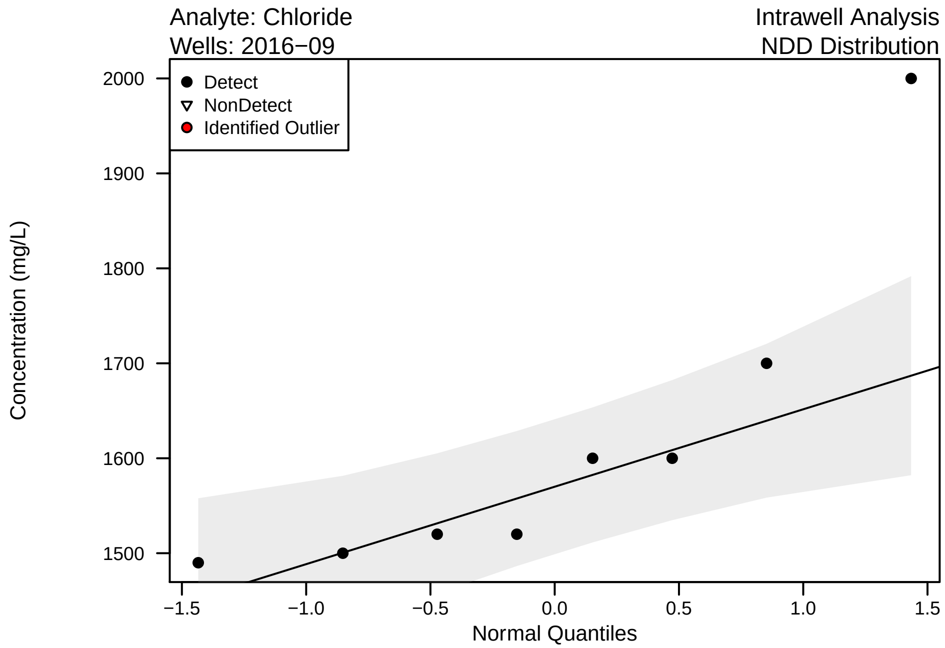

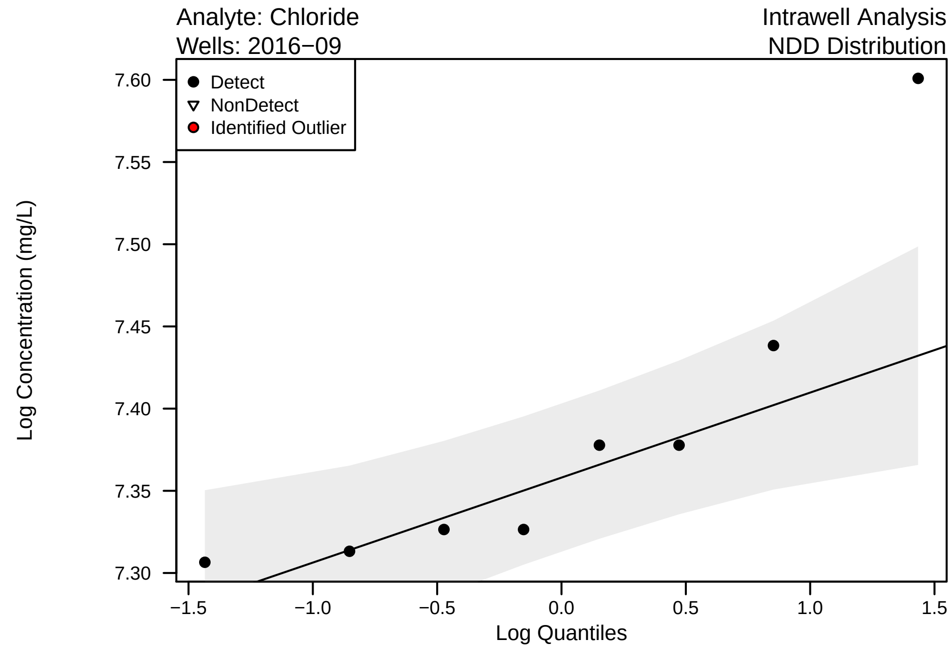

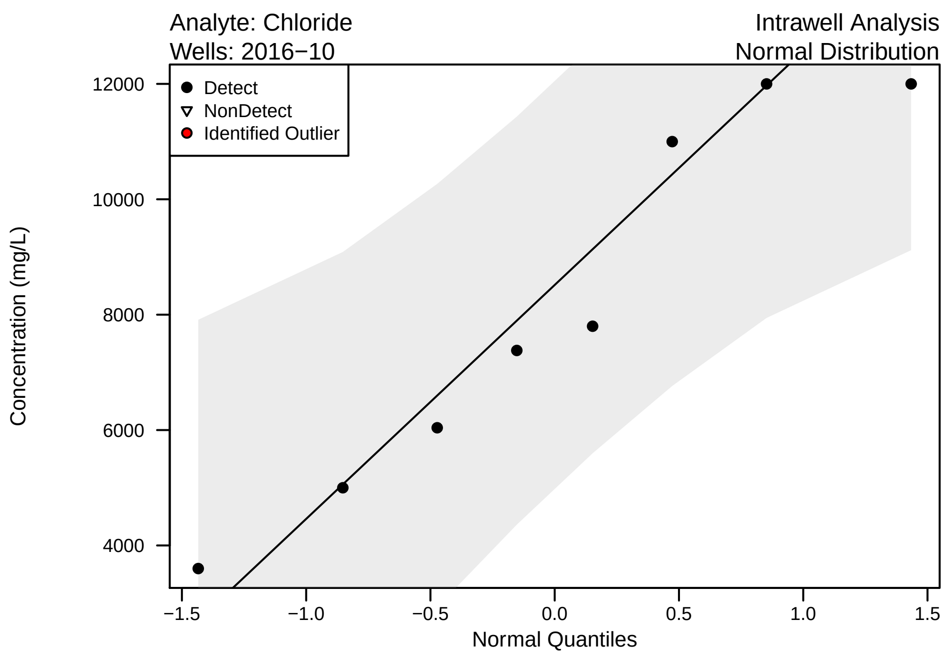

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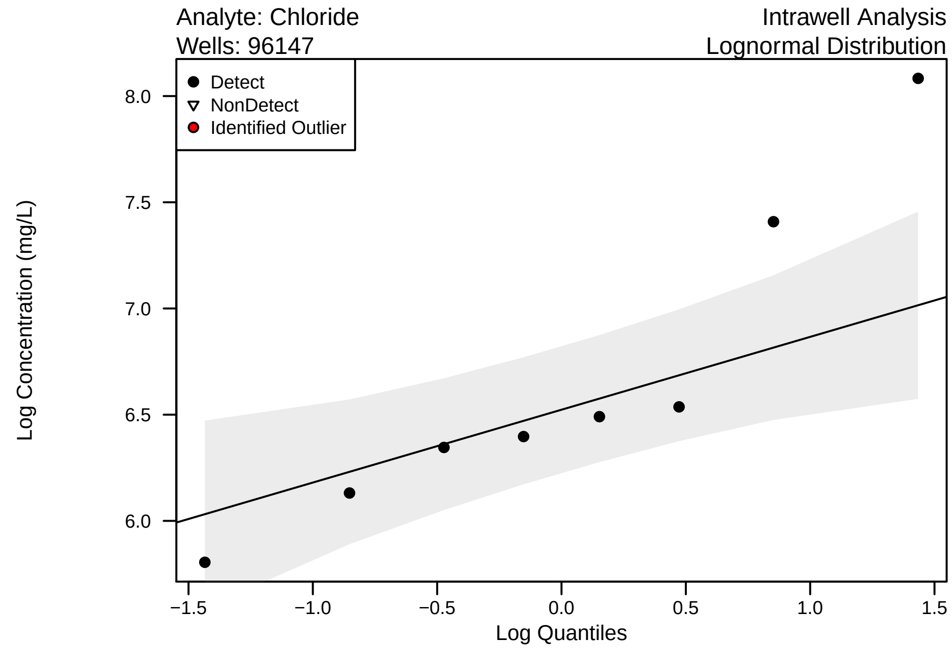

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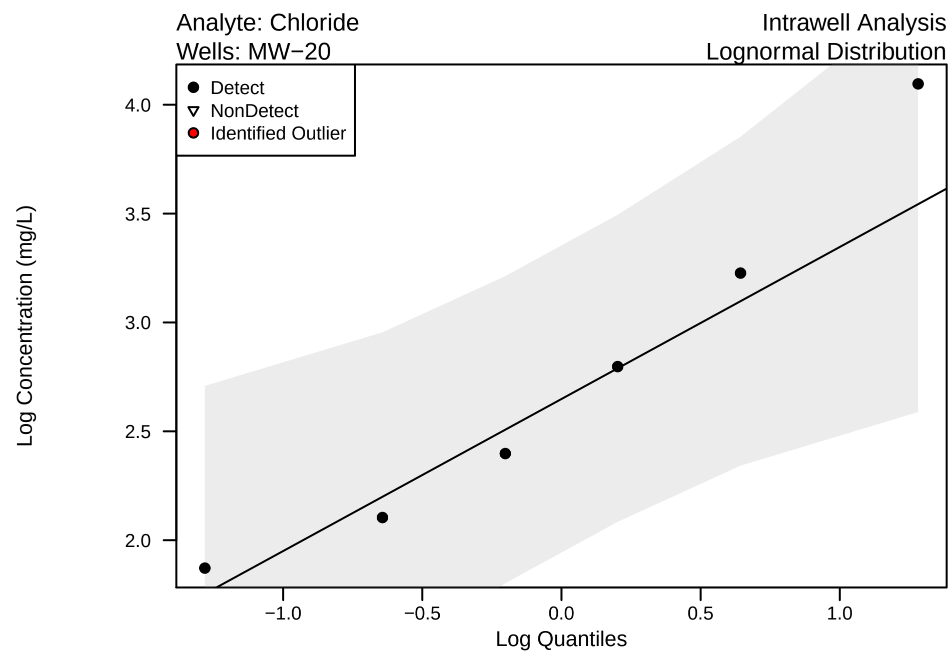

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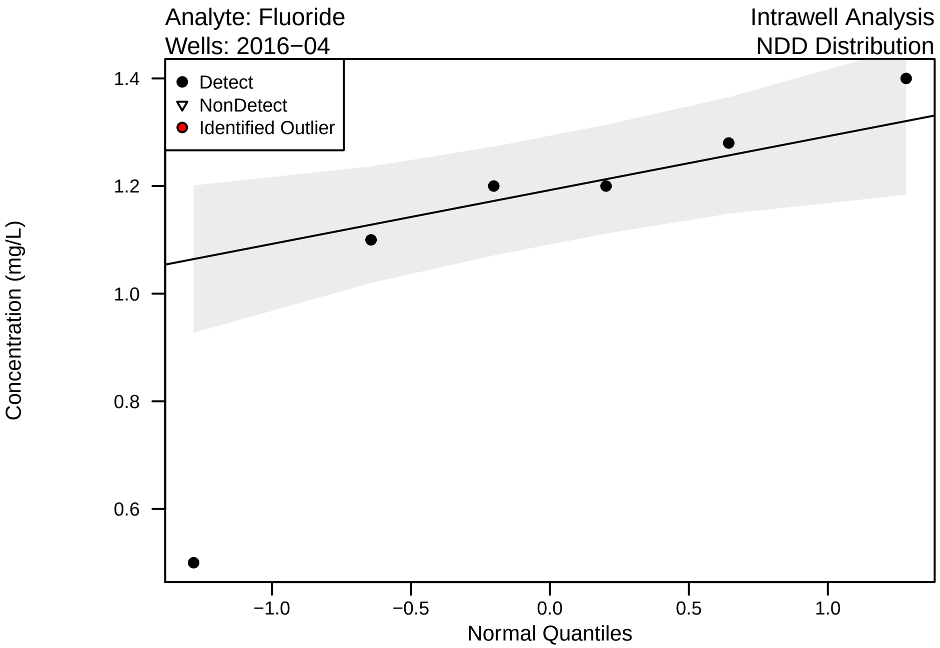

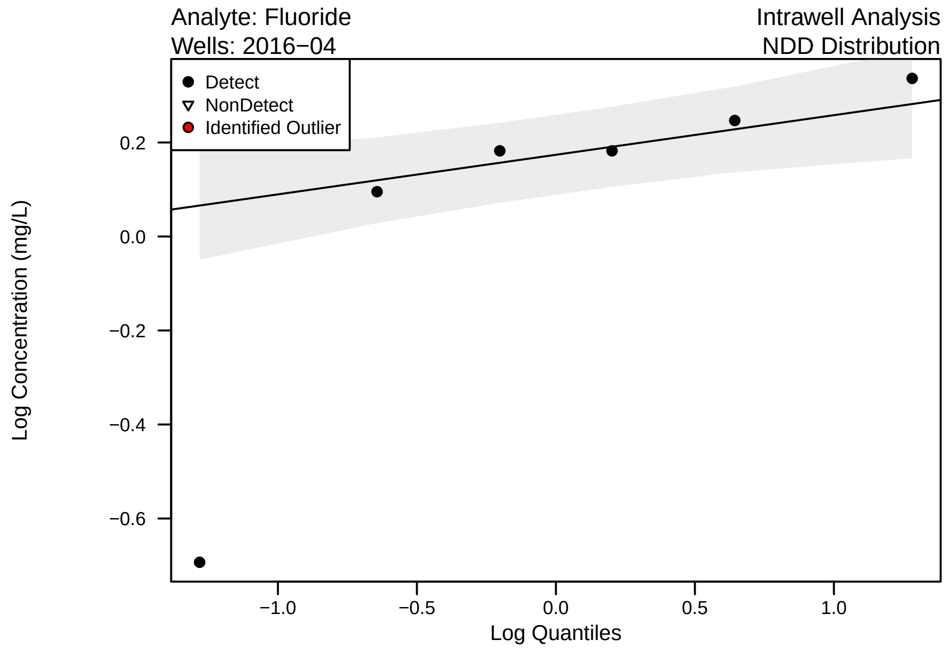

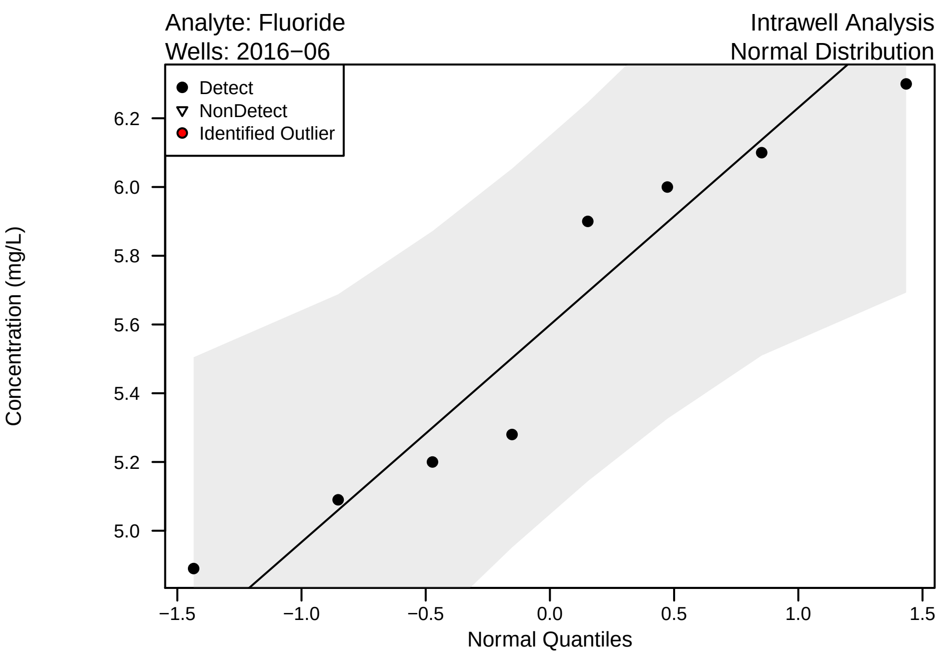

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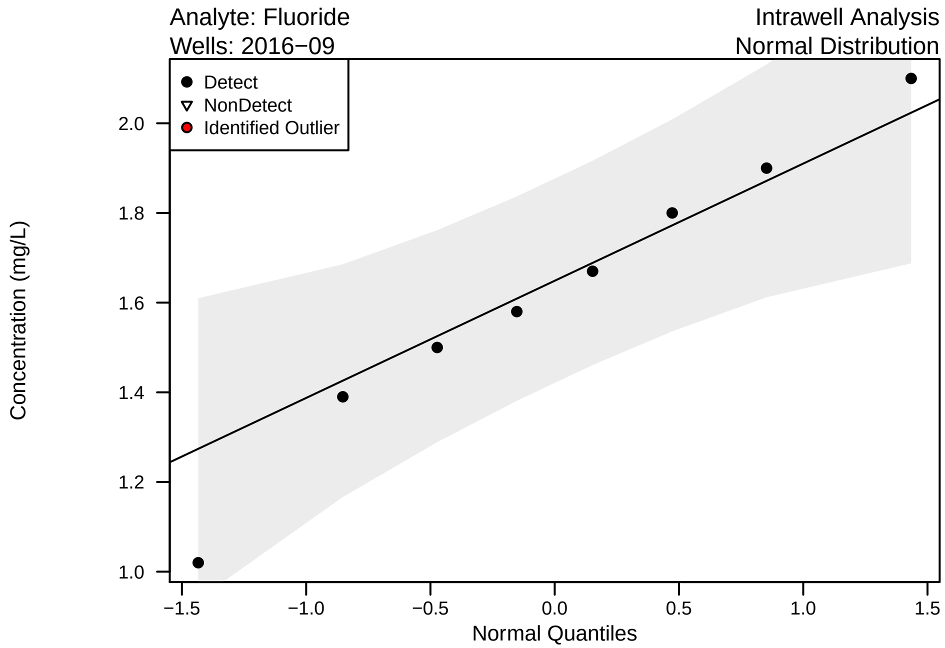

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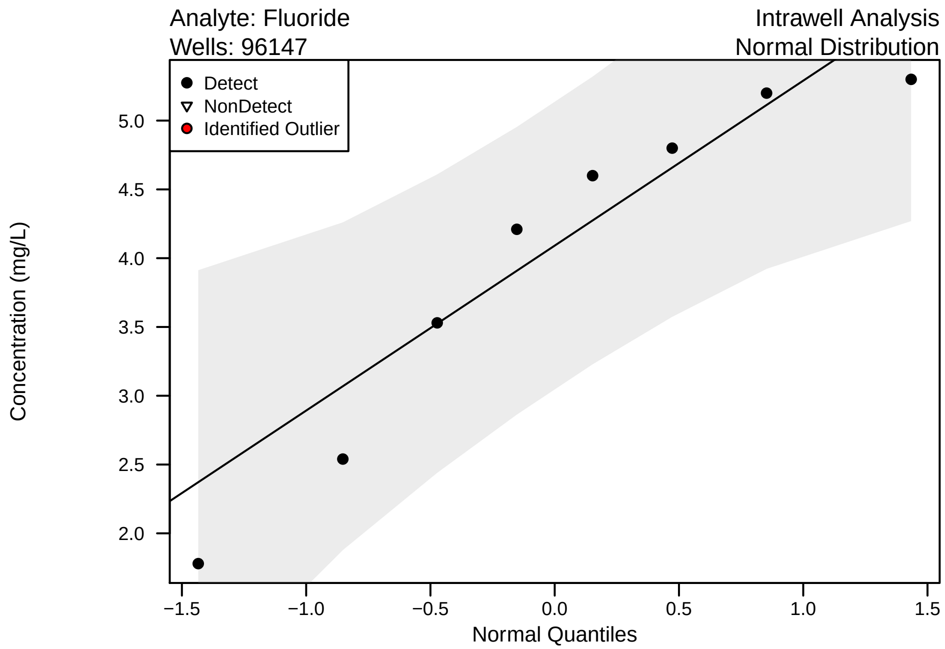

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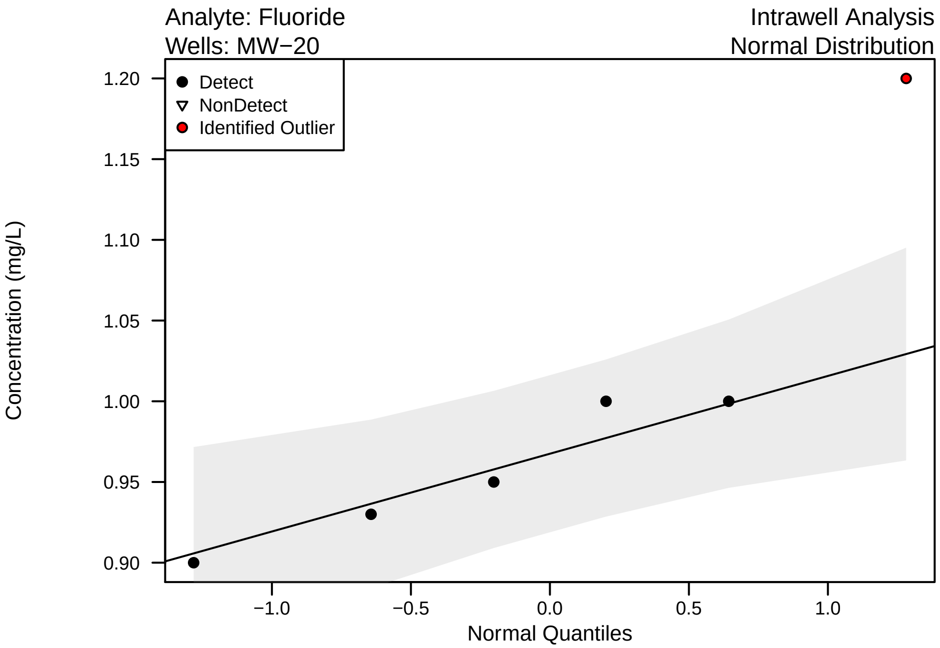

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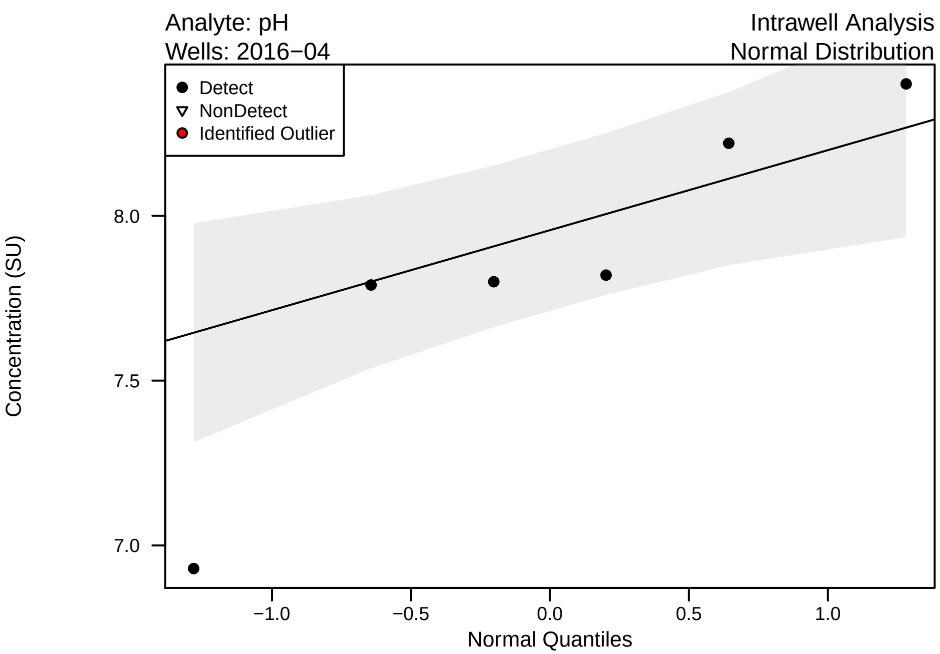

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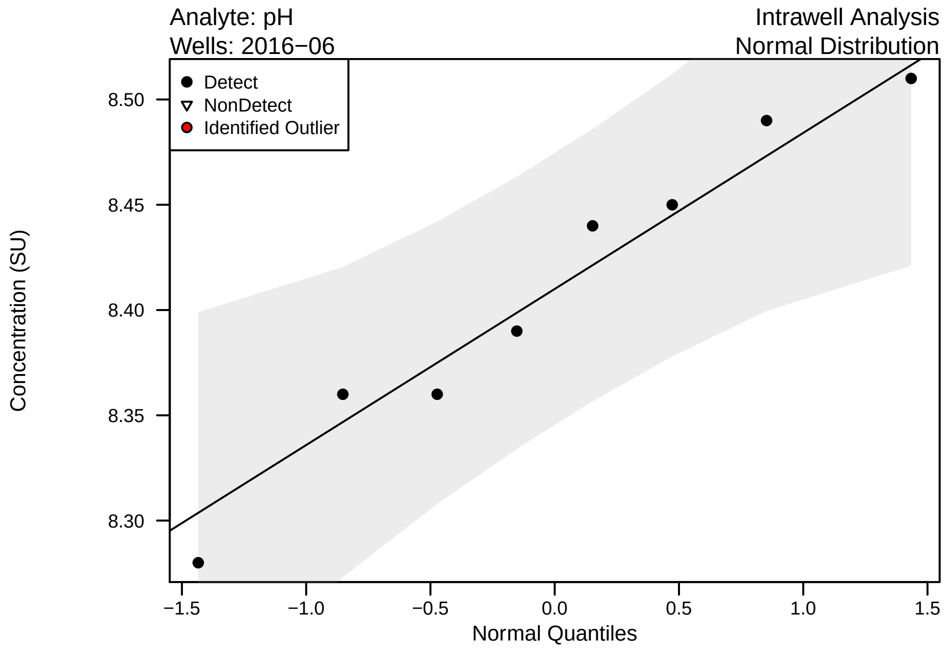

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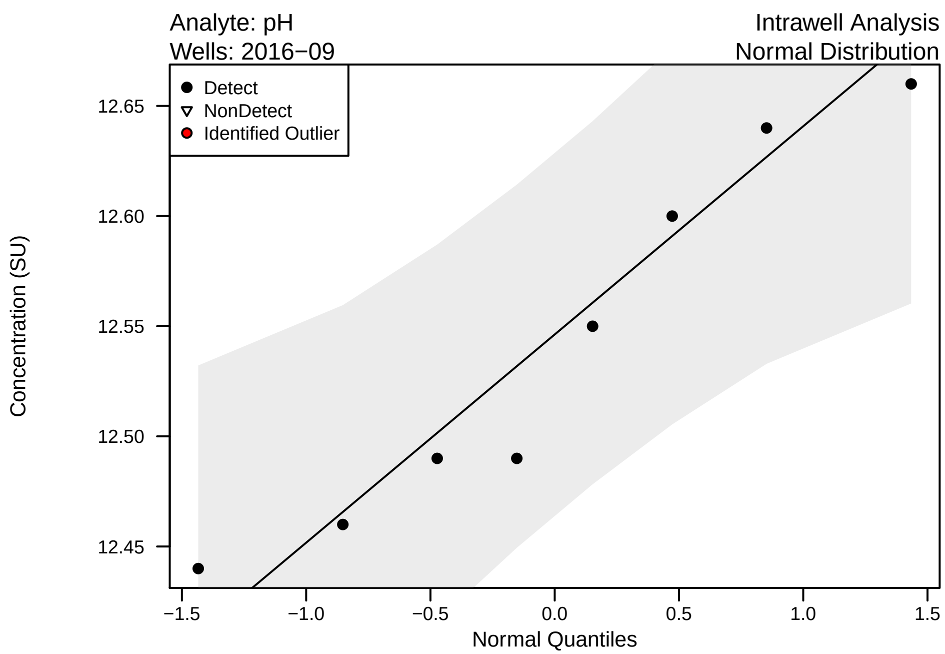

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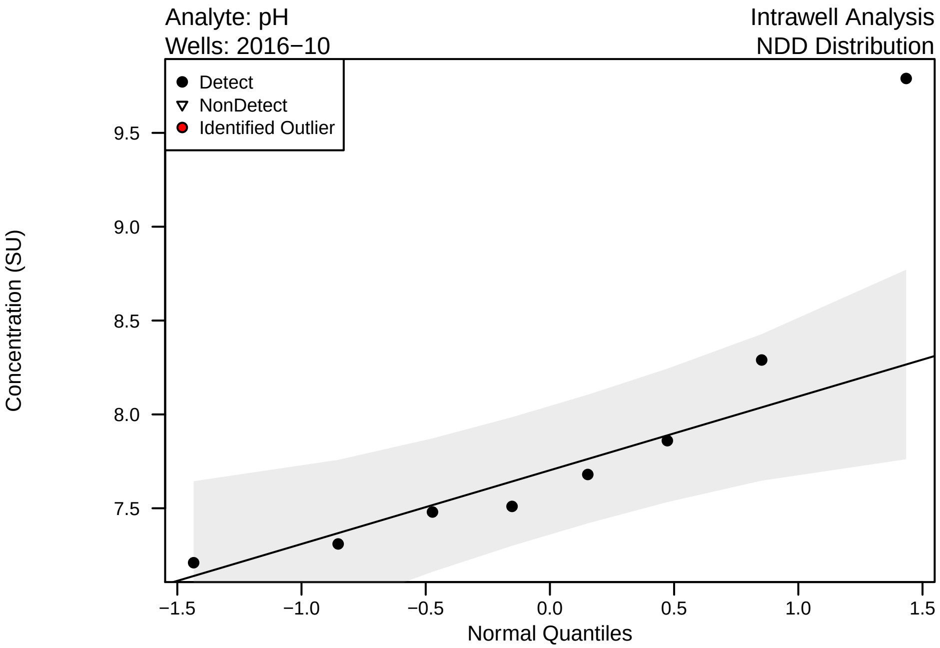

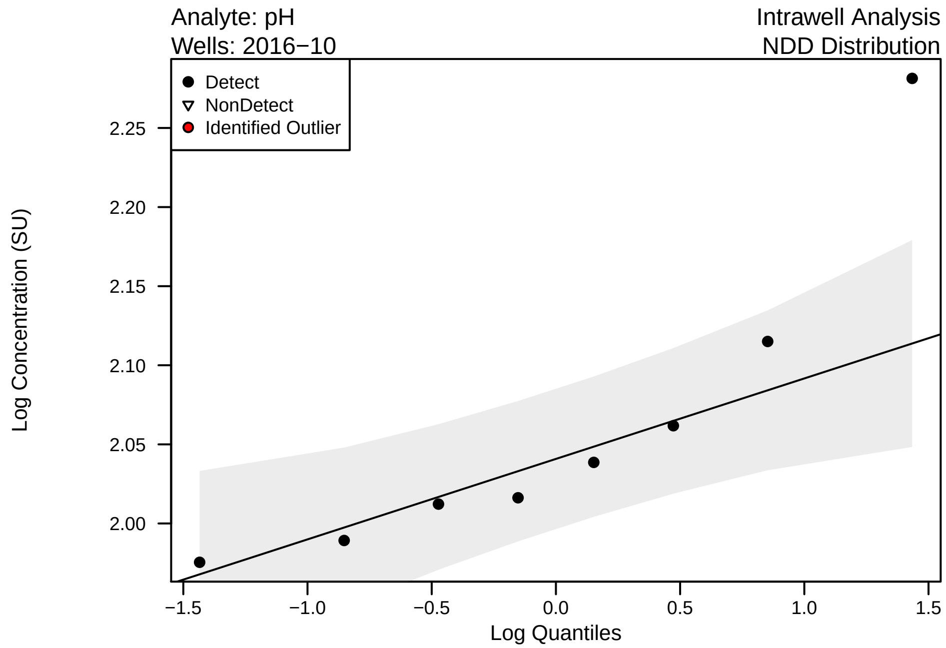

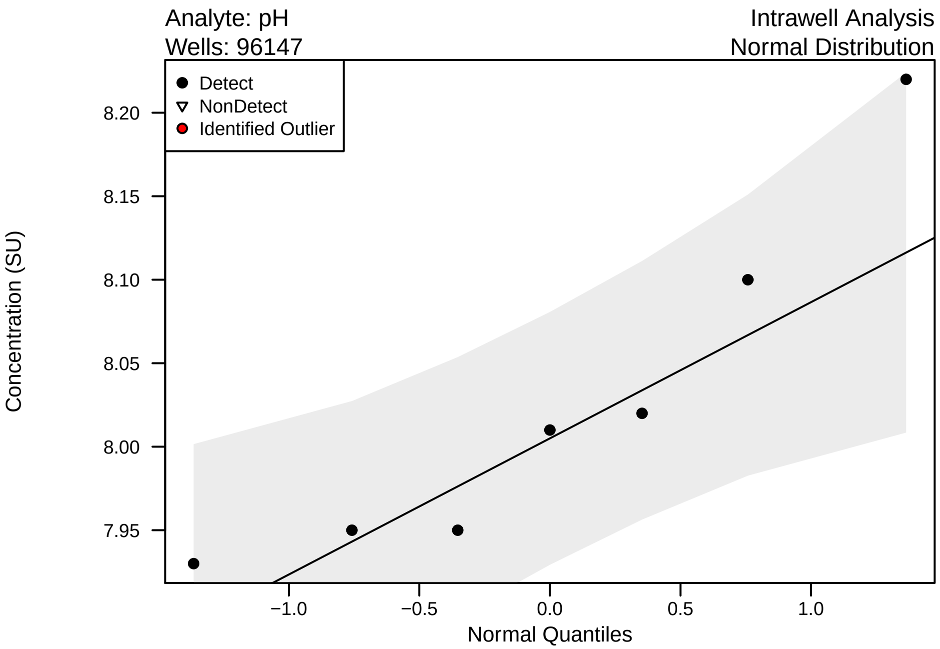

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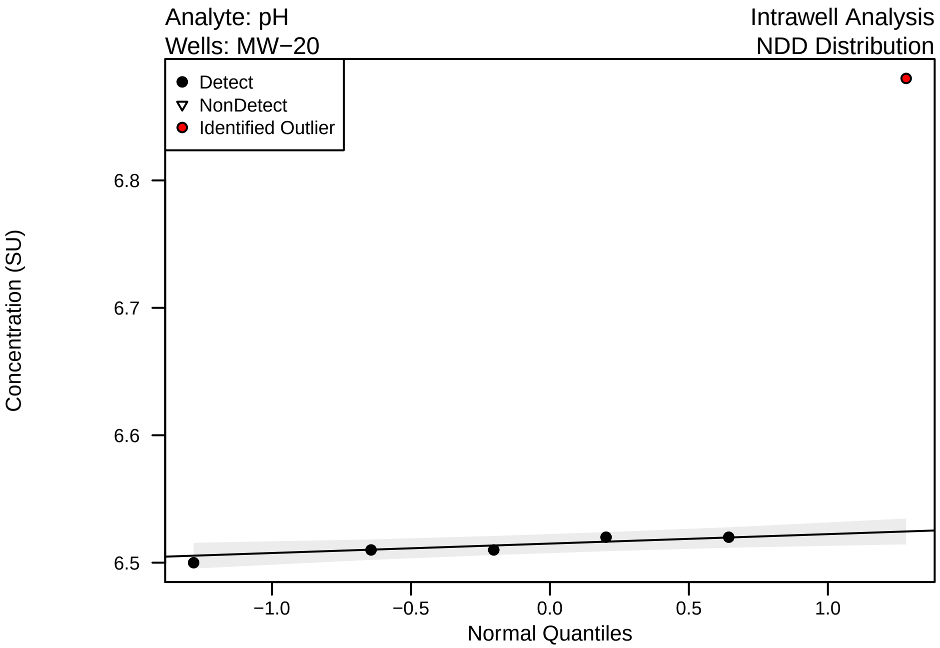
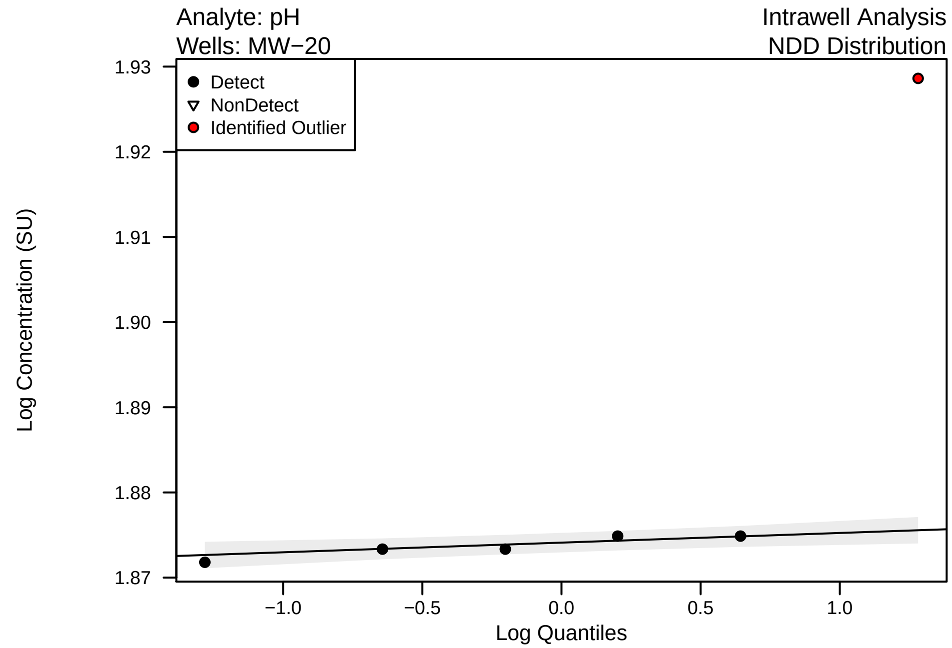
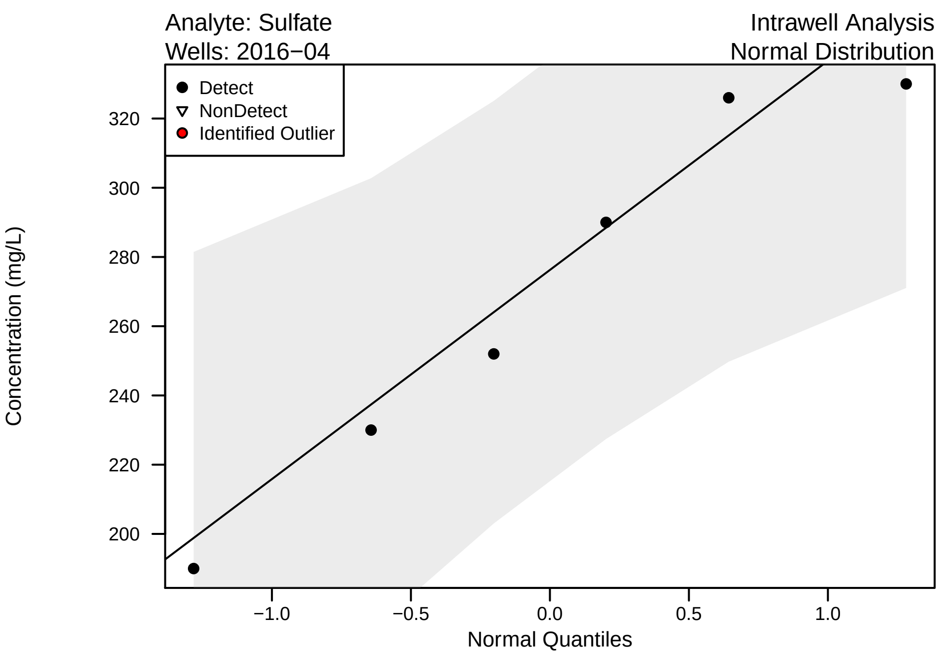
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS







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QQ Plots of Upgradient Wells
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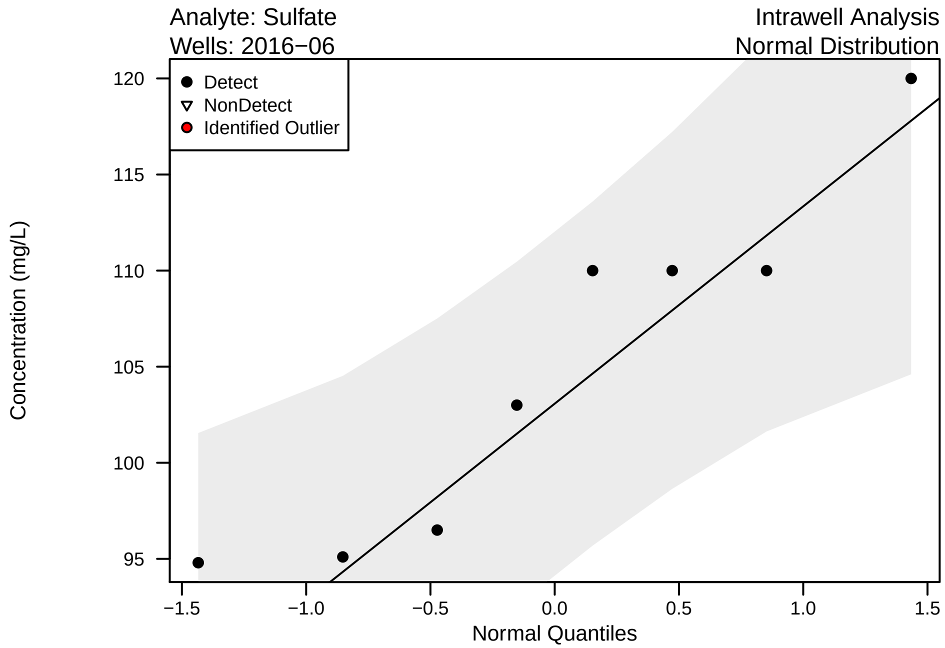
Geology: Cow Run SS



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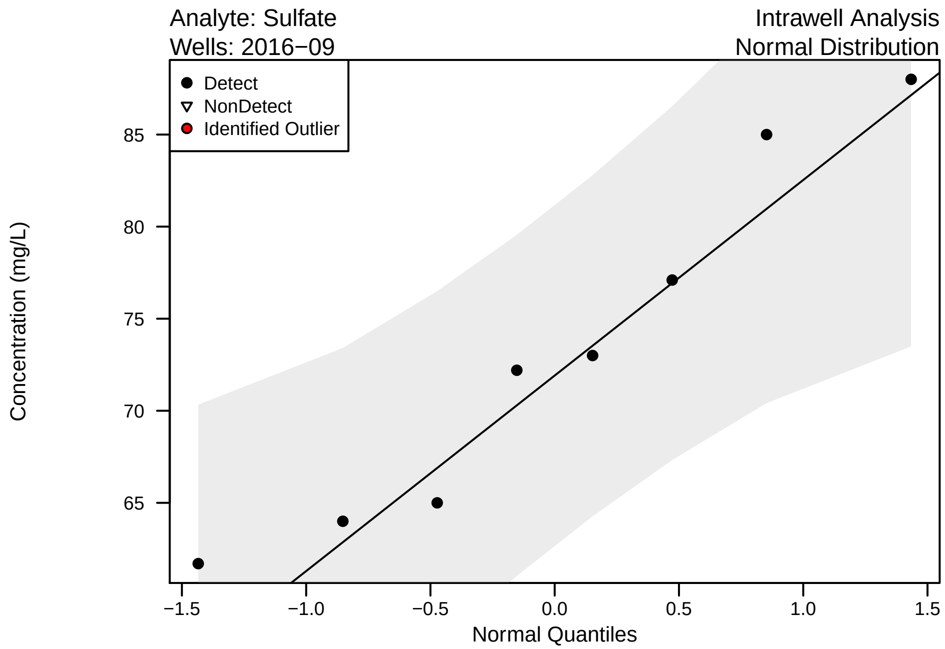

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QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
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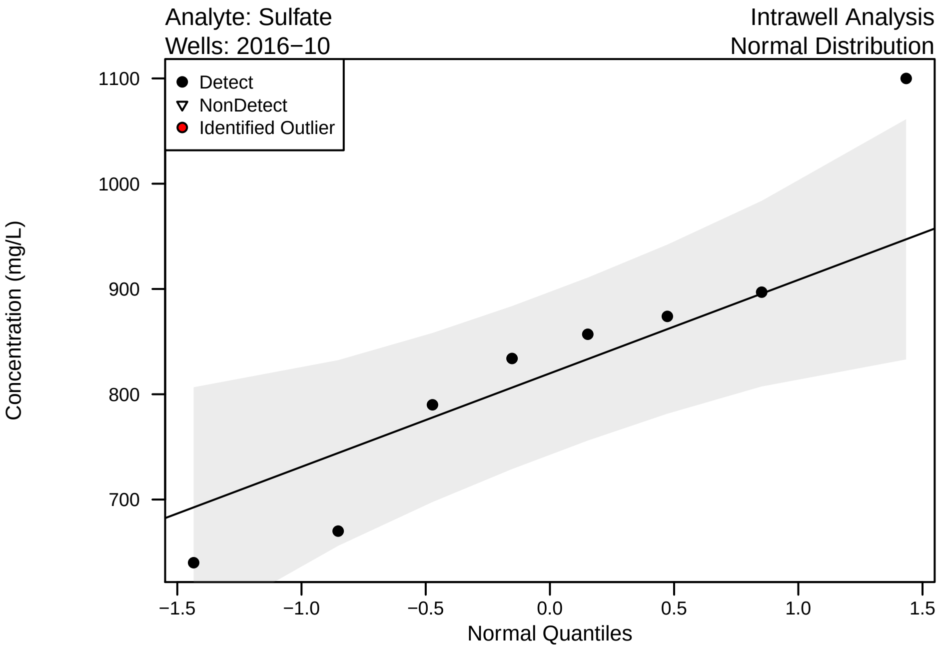

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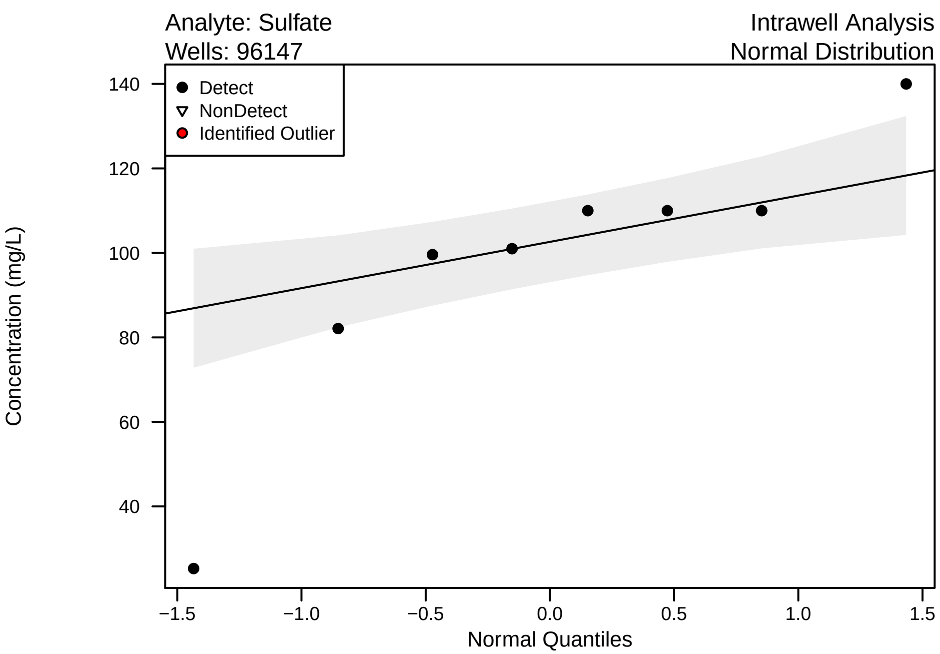

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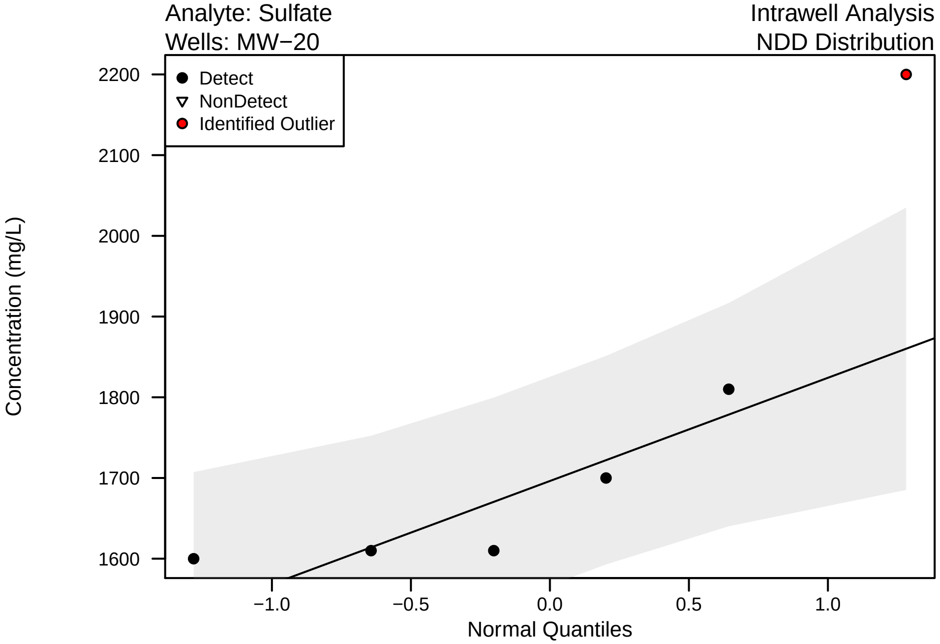
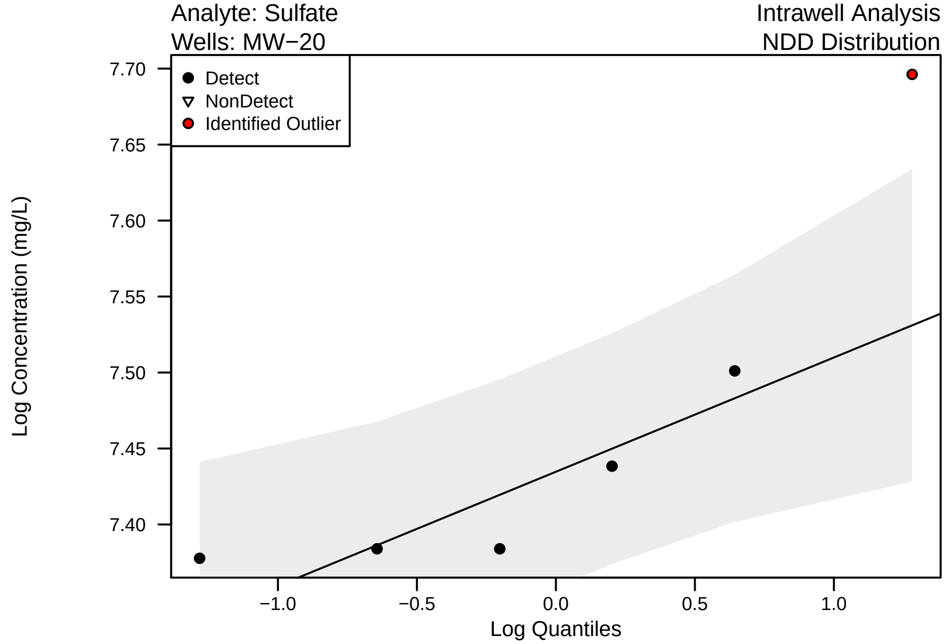
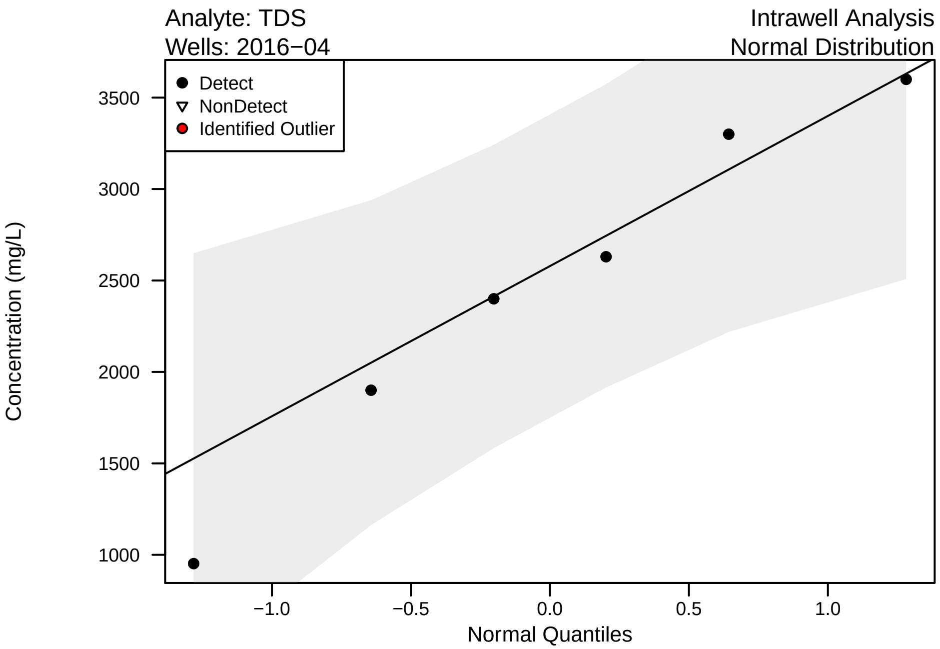
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS







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QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS

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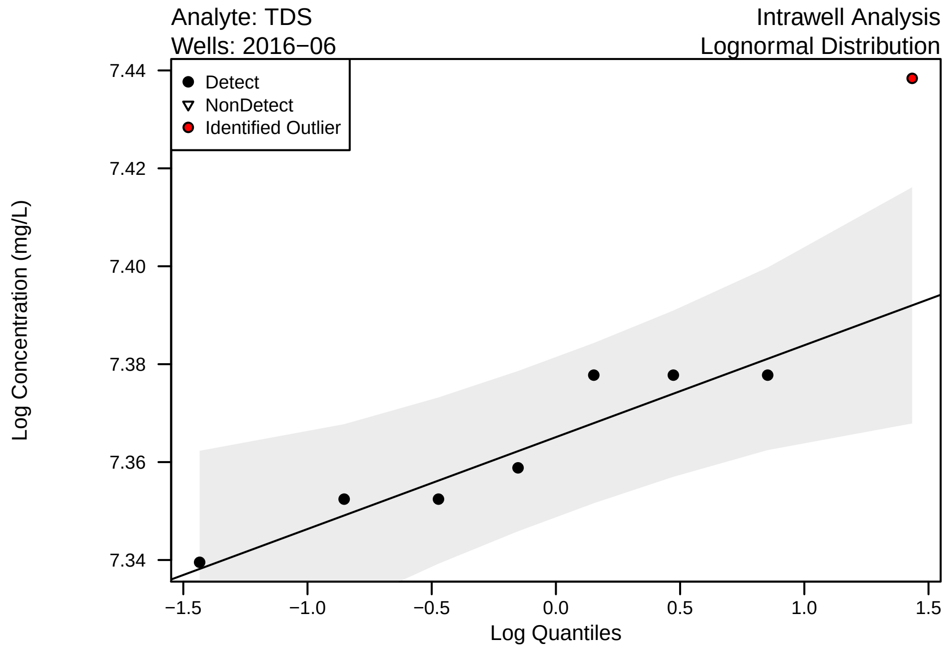

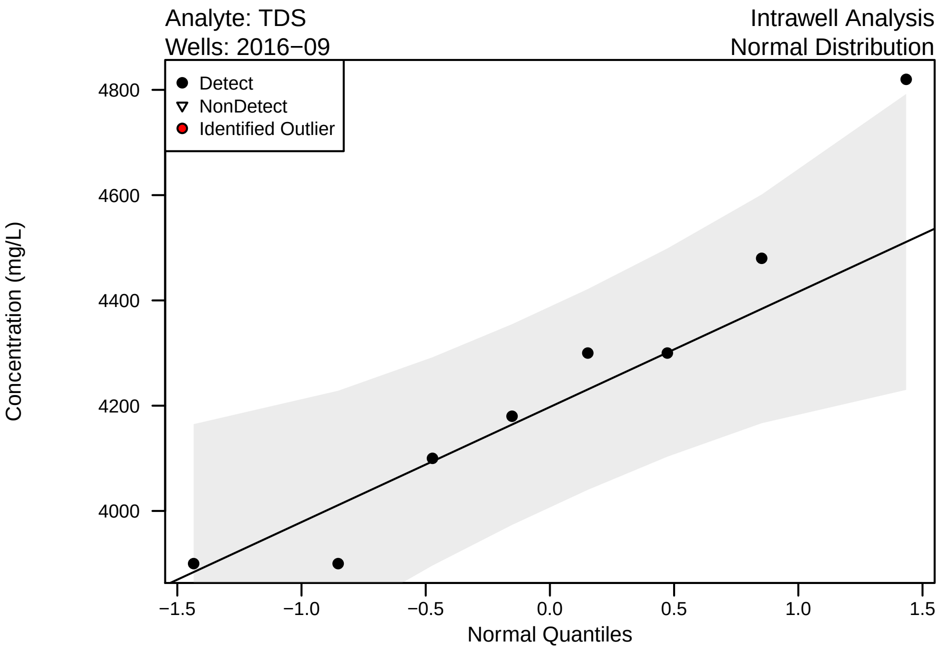

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QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
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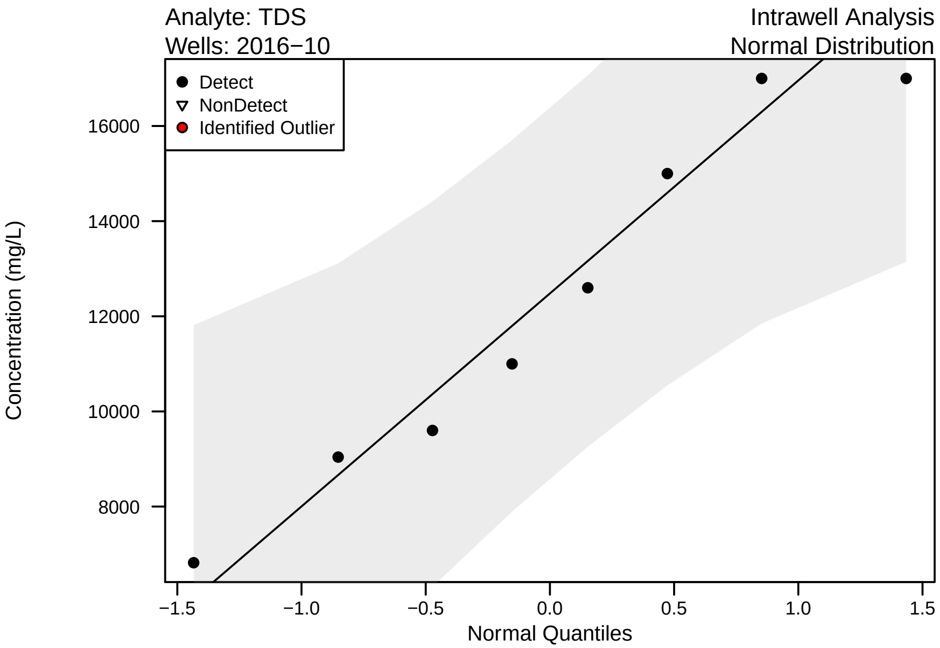

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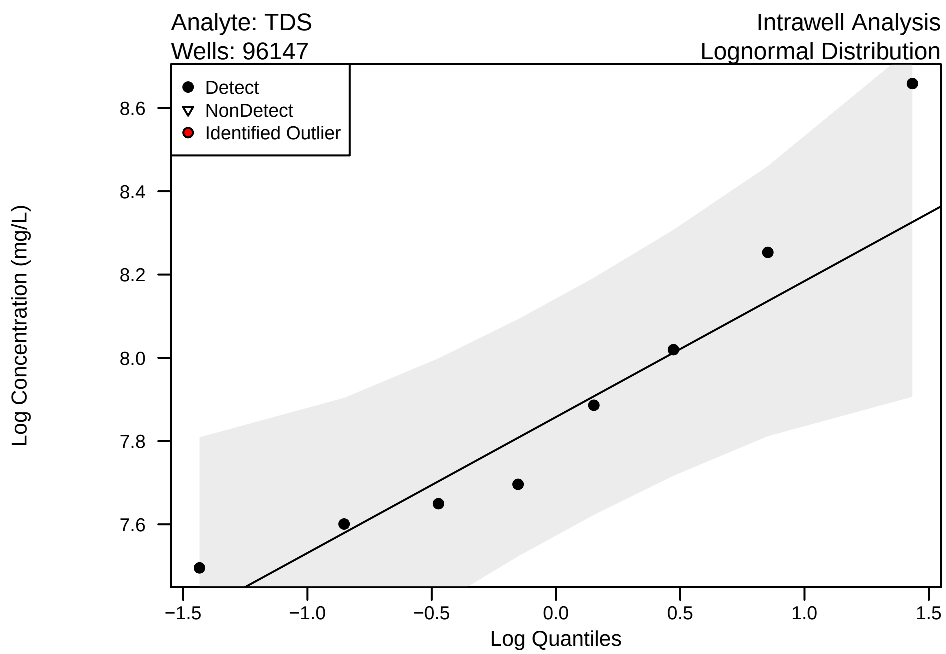
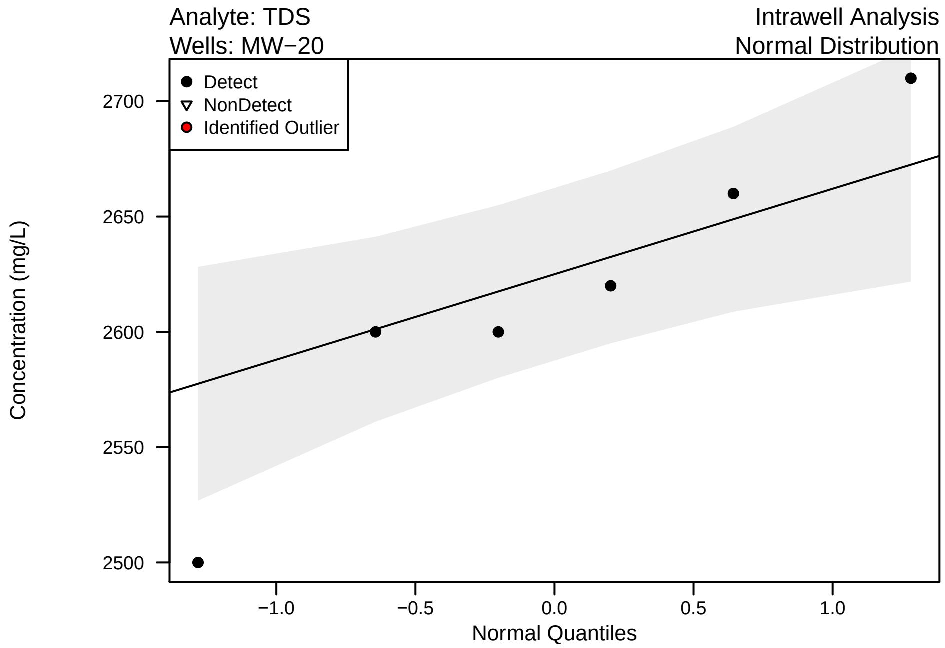


QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS



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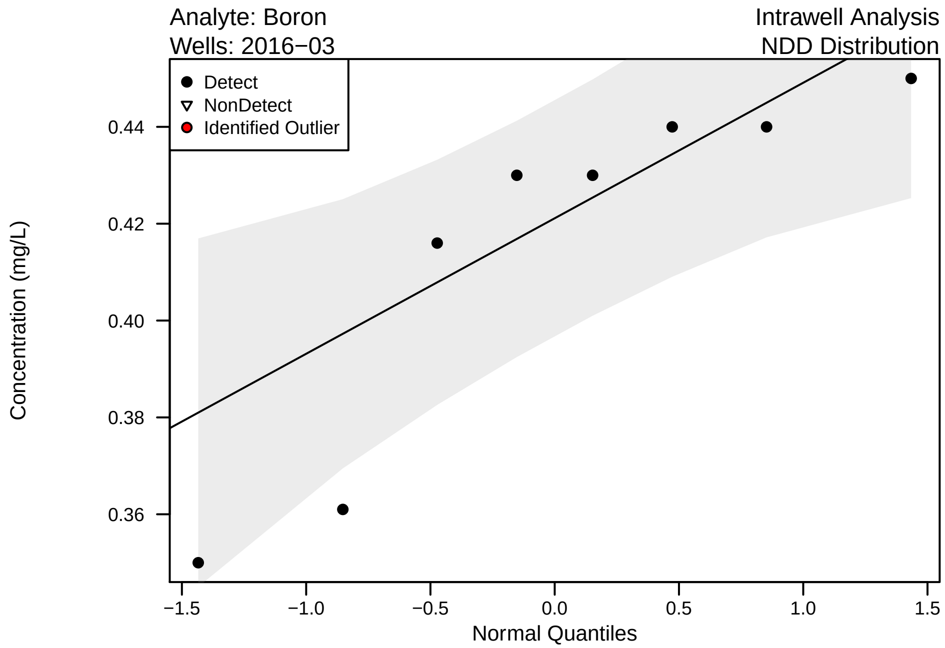
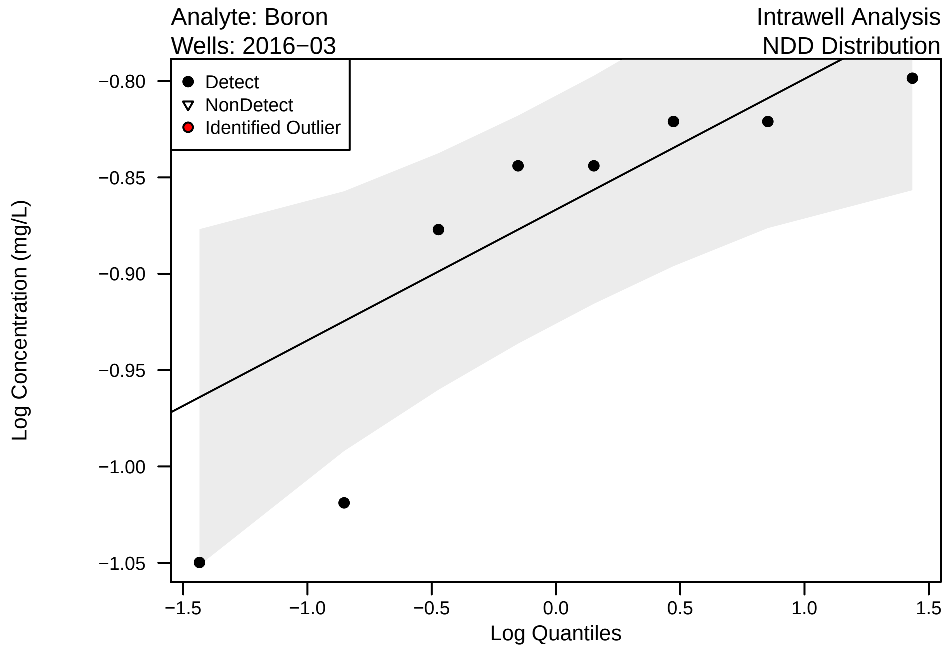
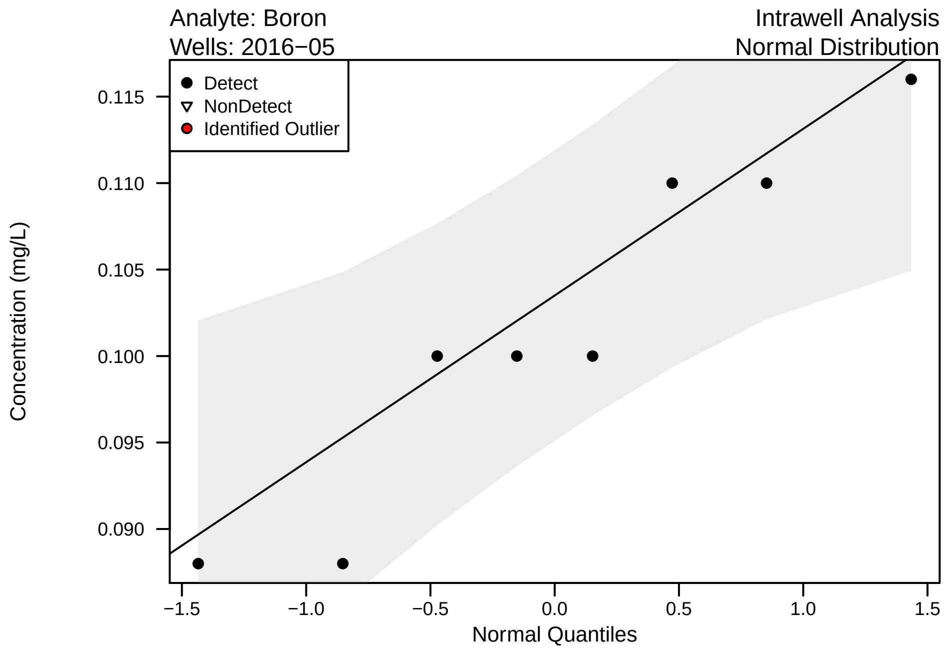
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS







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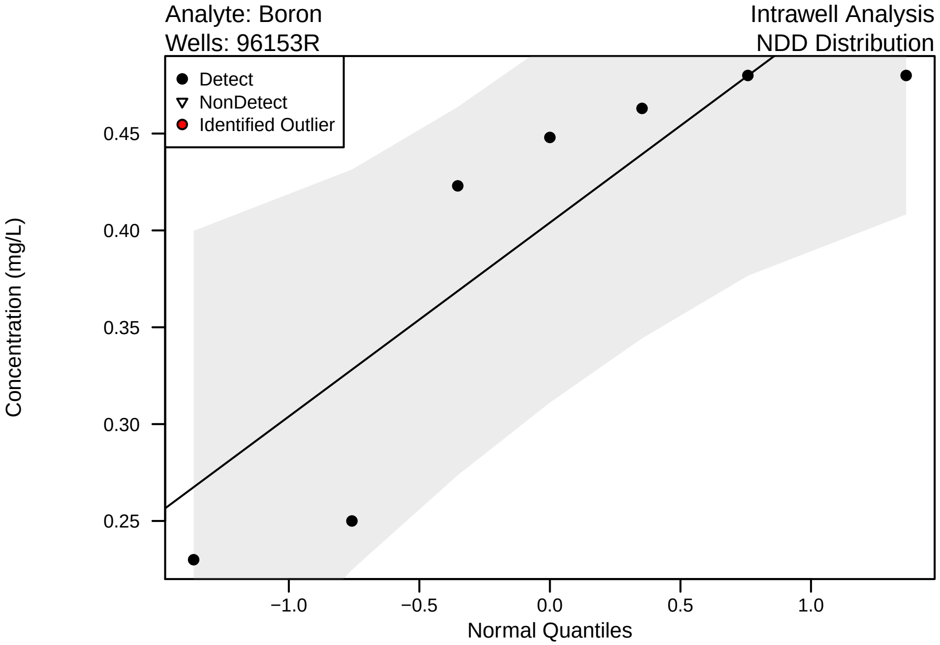
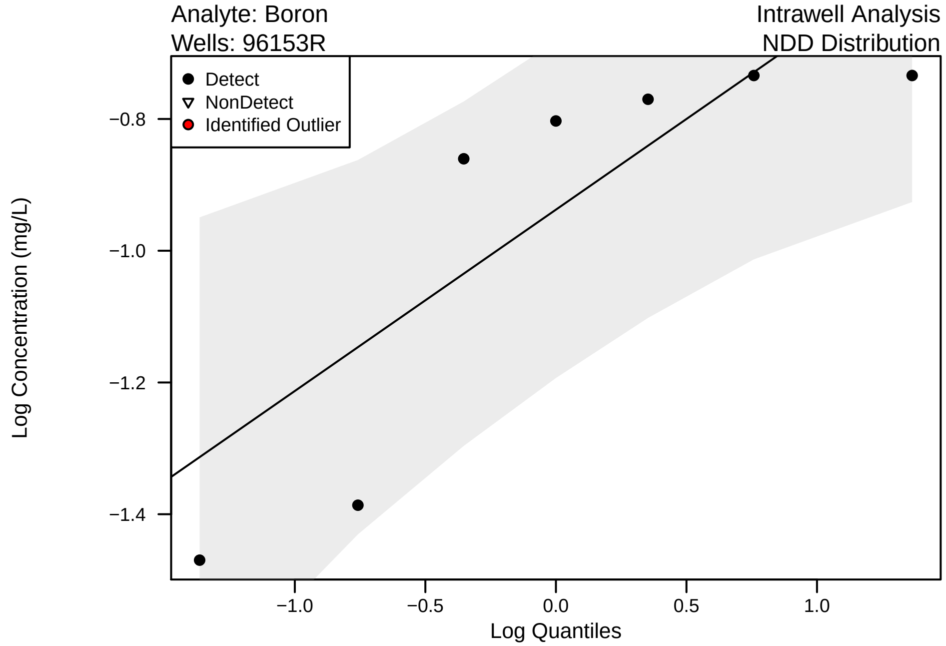
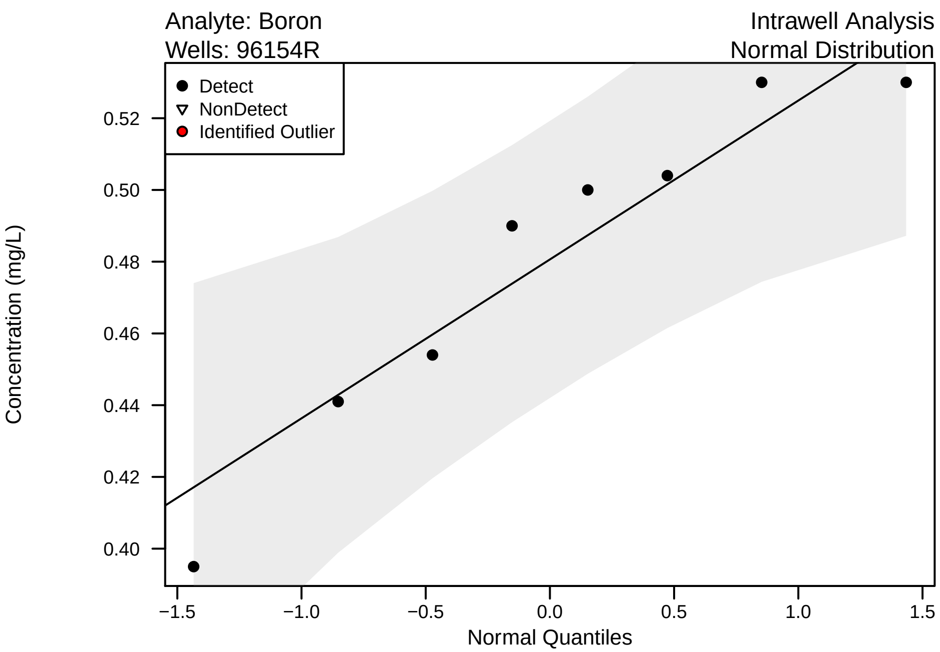
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS







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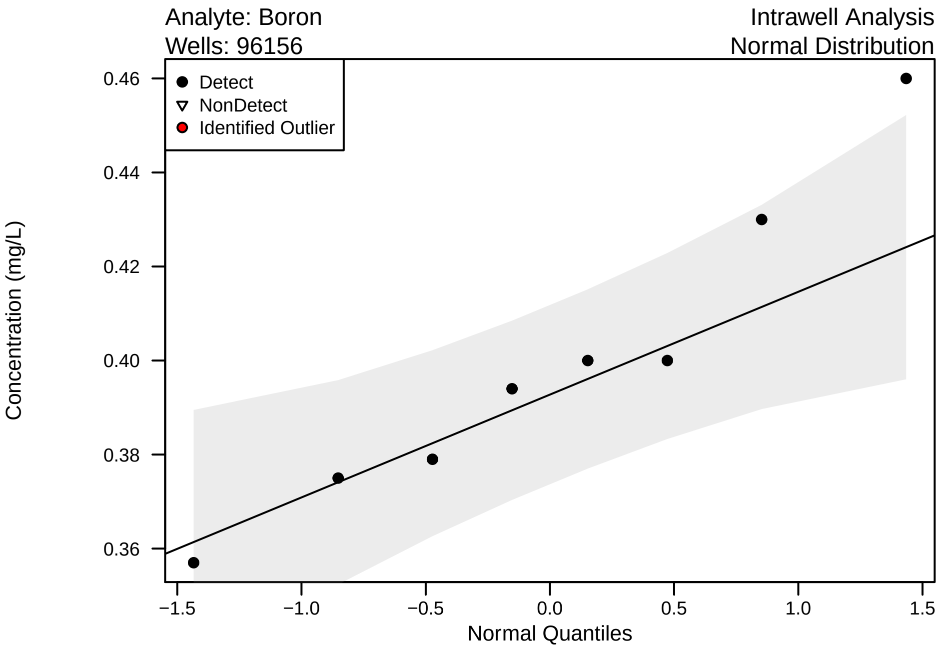
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



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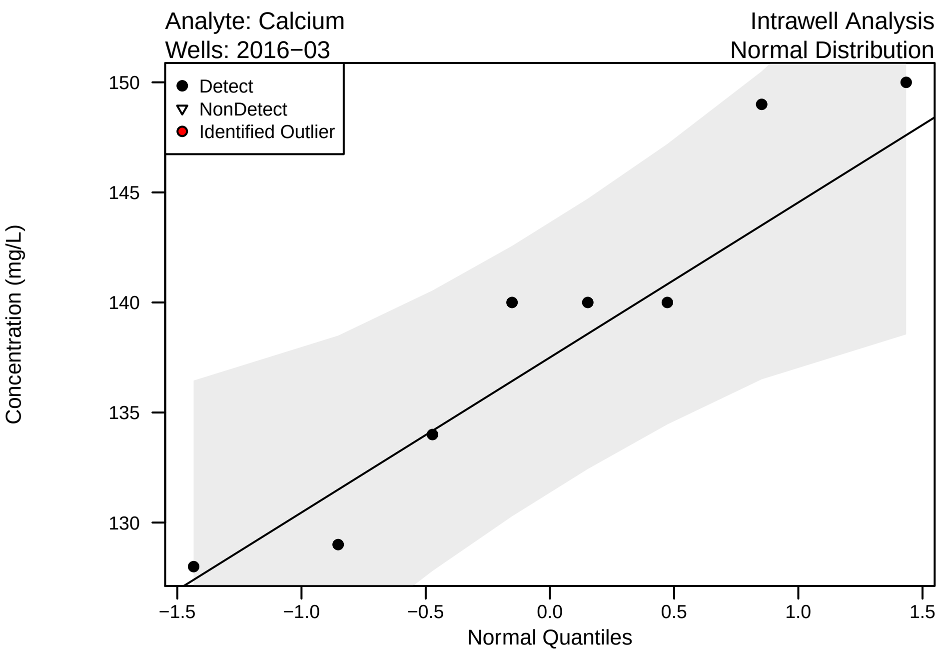

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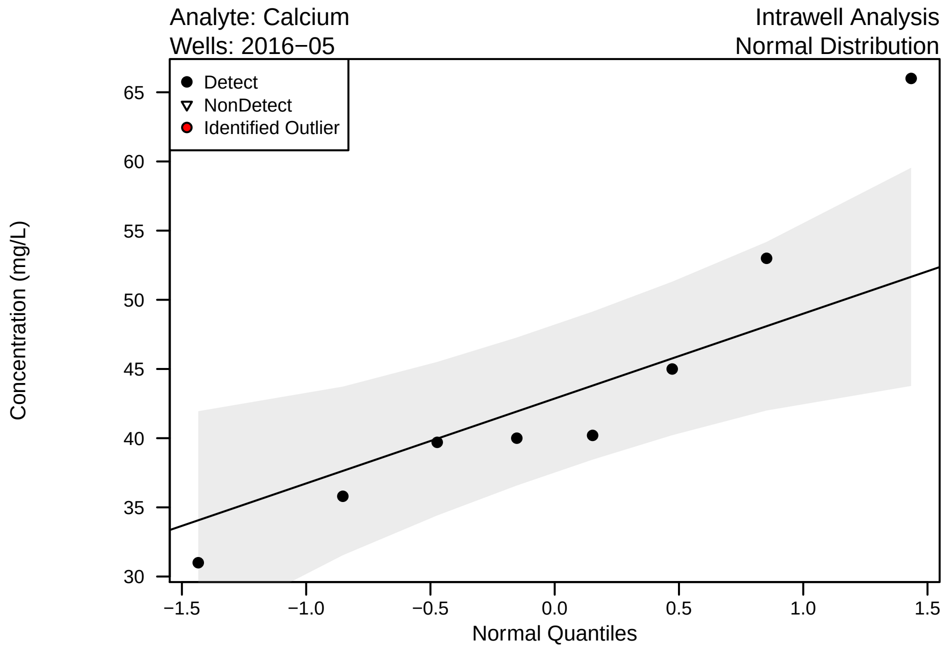
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



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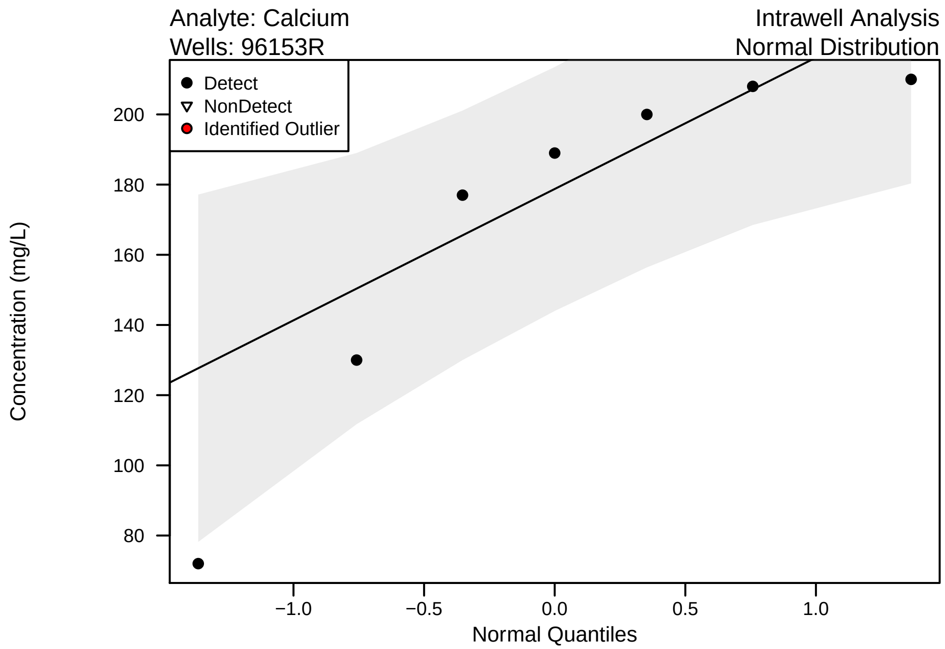

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QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS

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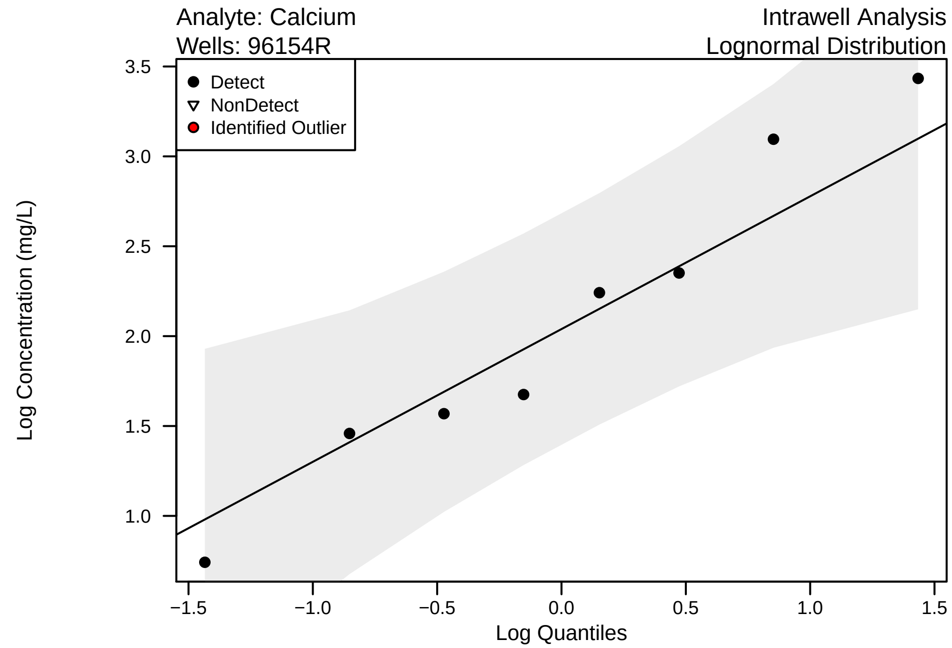

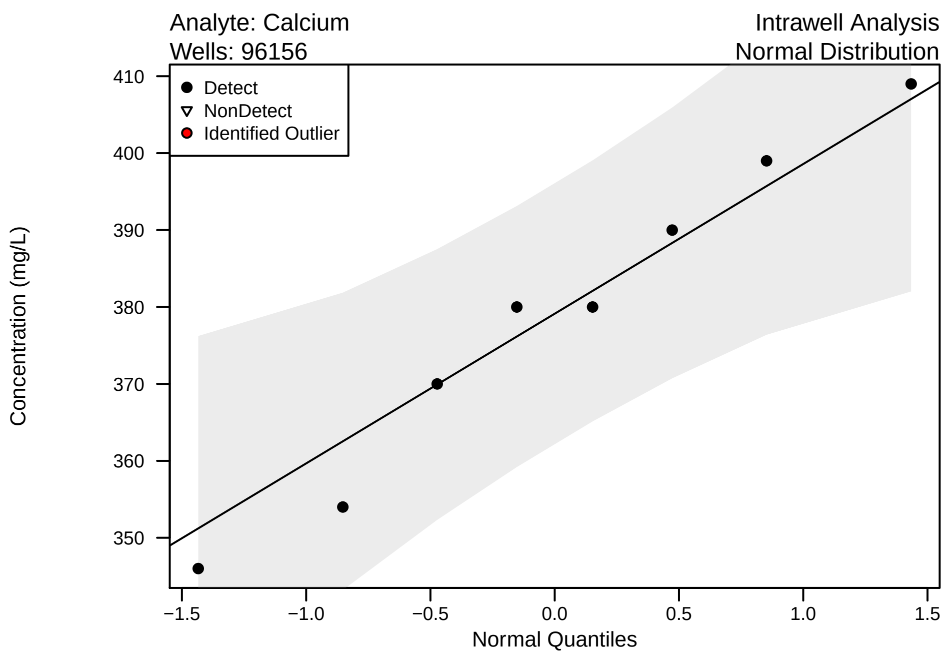

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QQ Plots of Upgradient Wells
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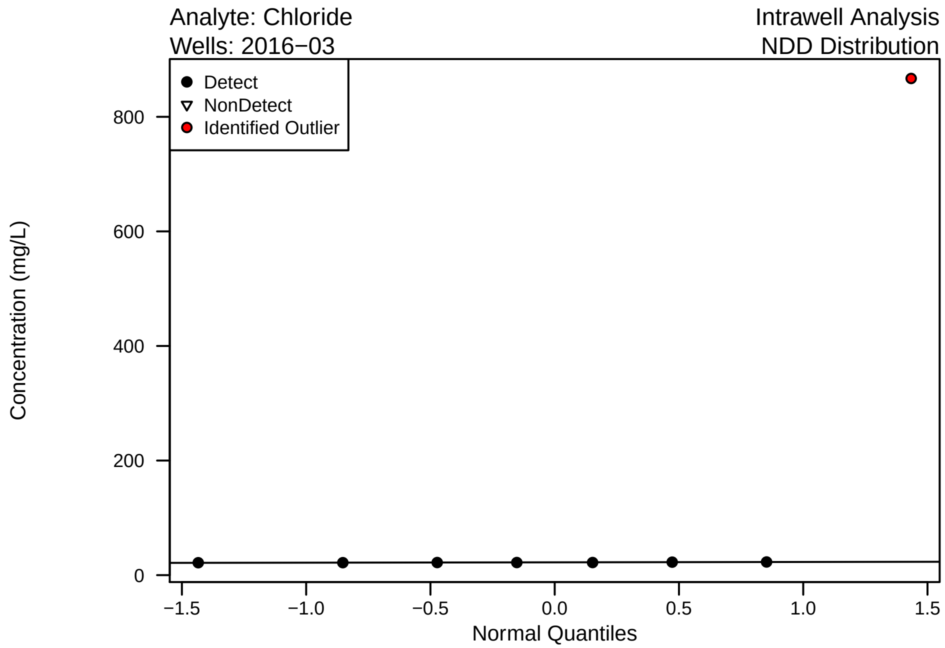

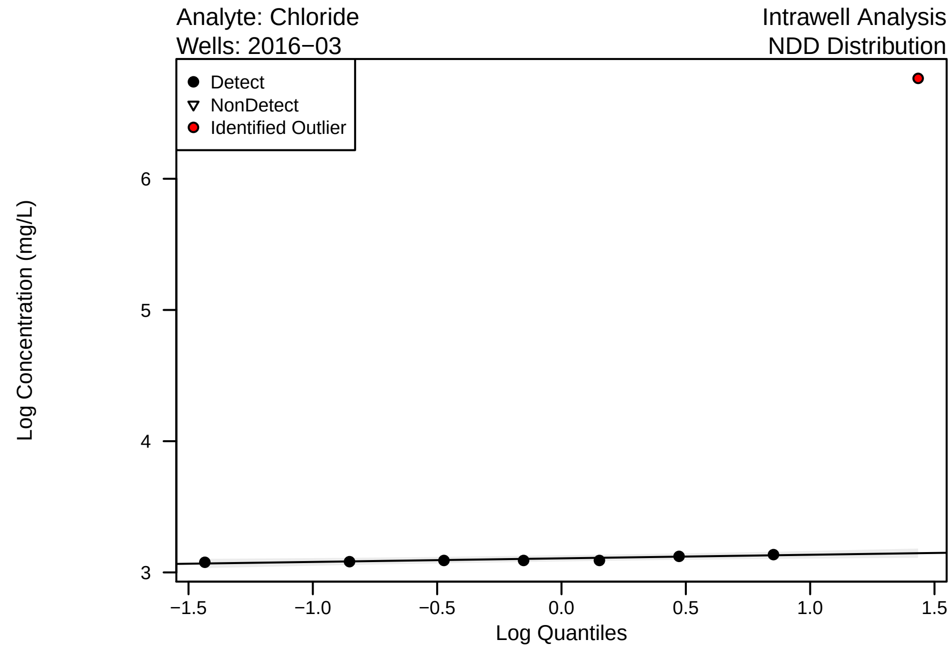

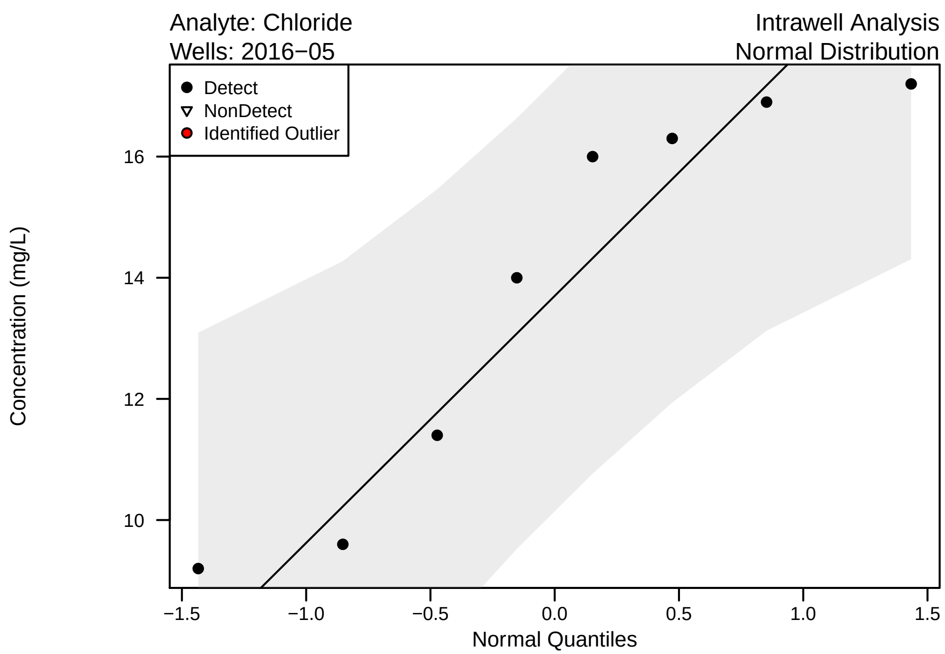

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QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
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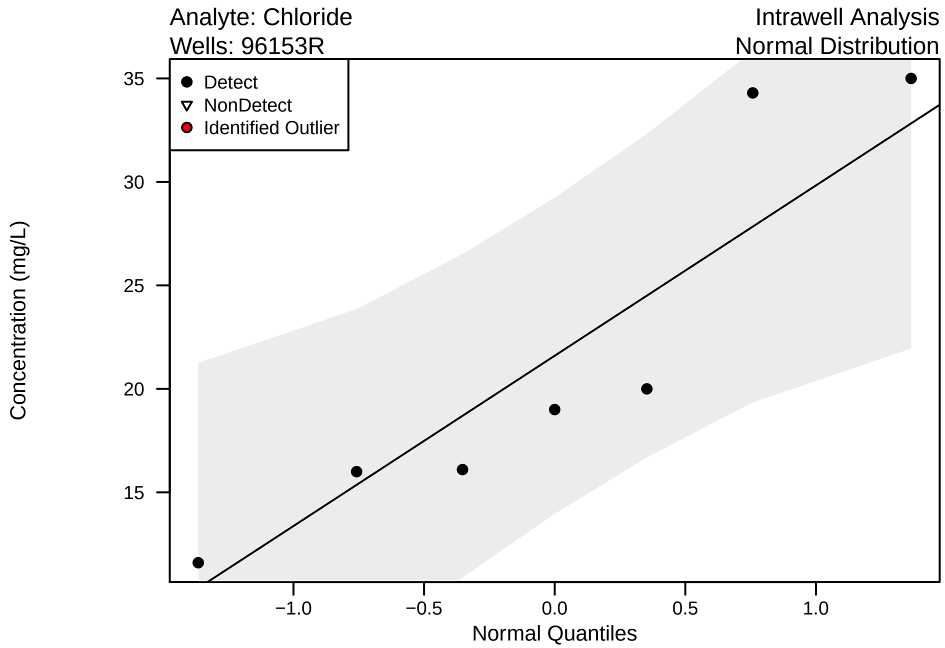

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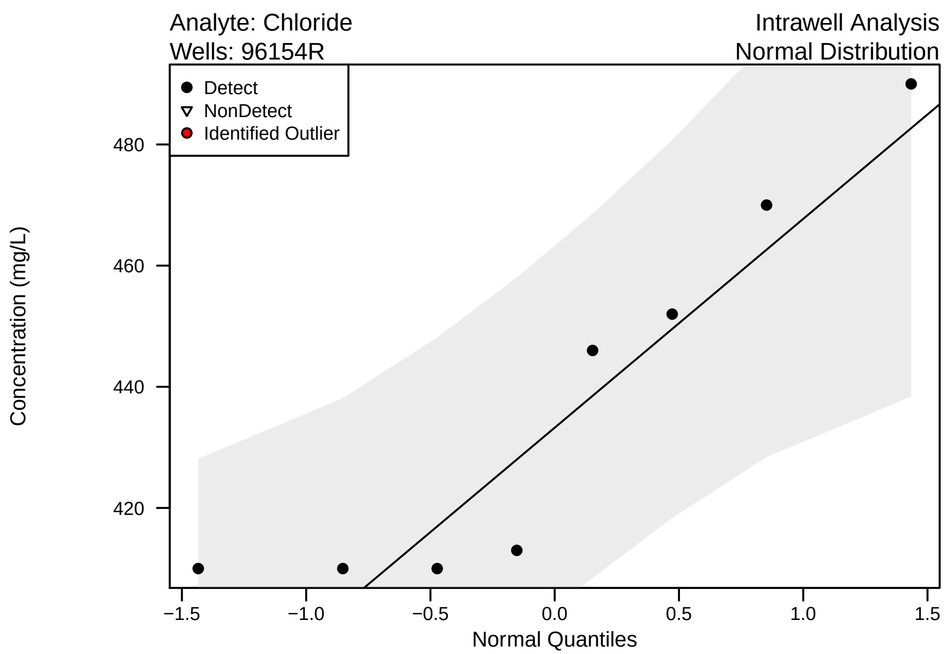

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Unit: Fly Ash Reservoir
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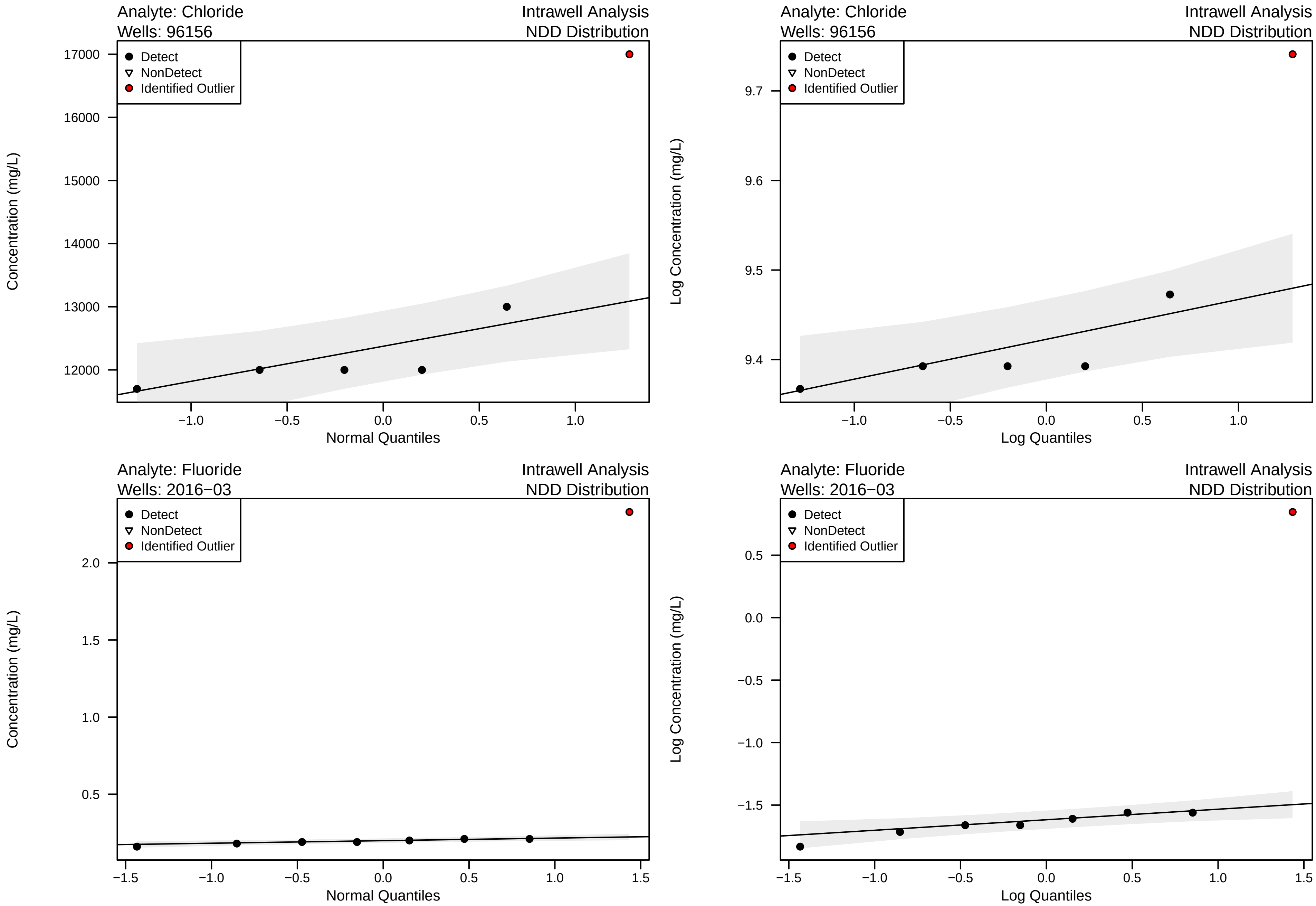
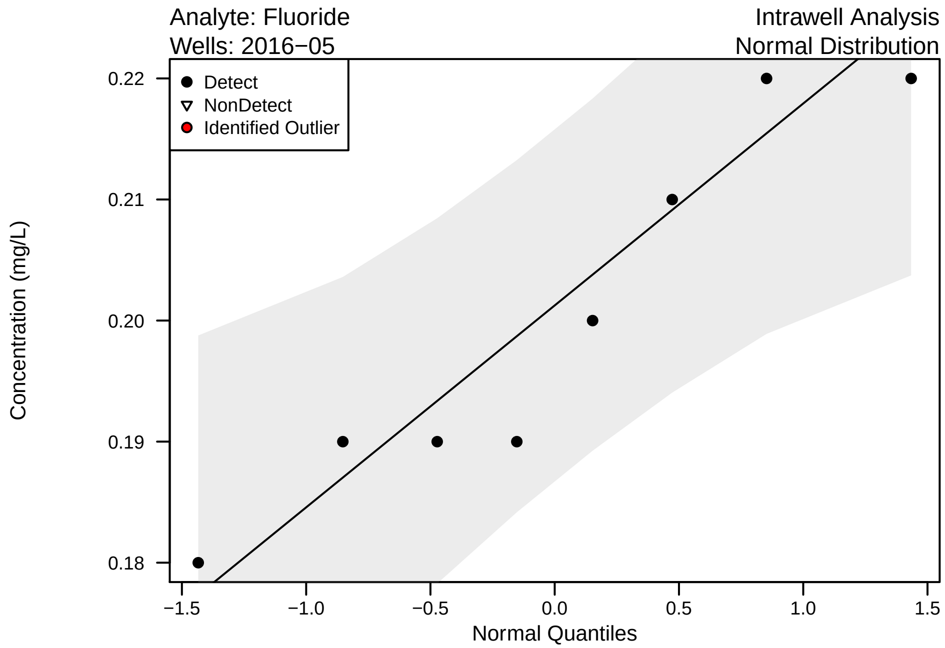


QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



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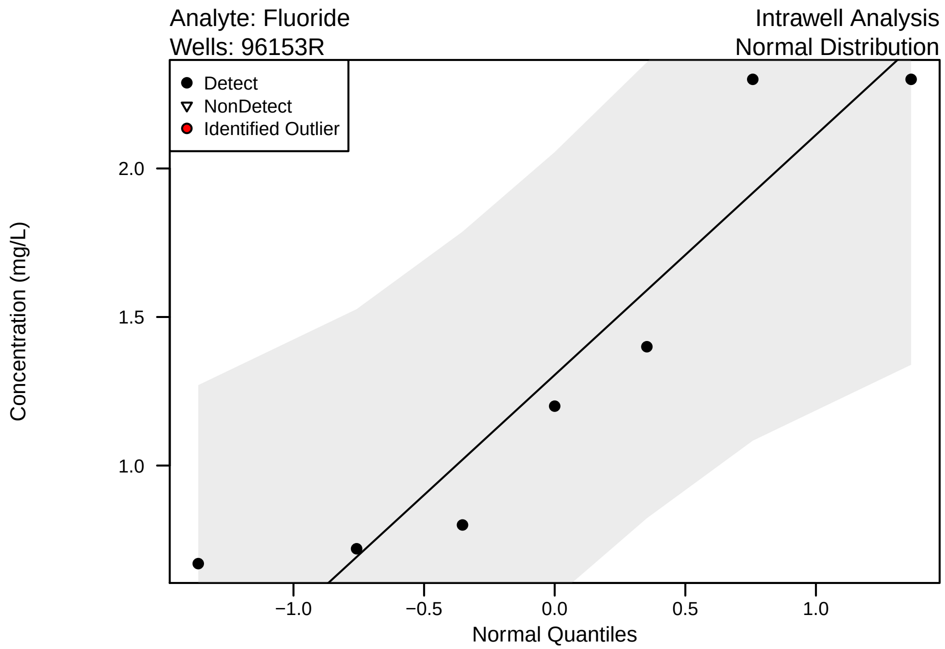

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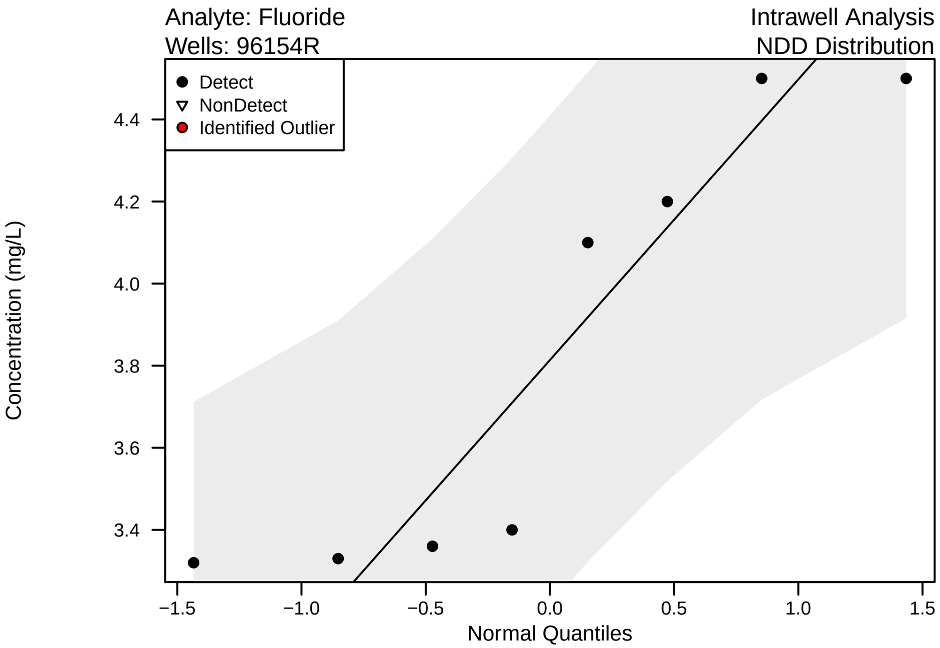
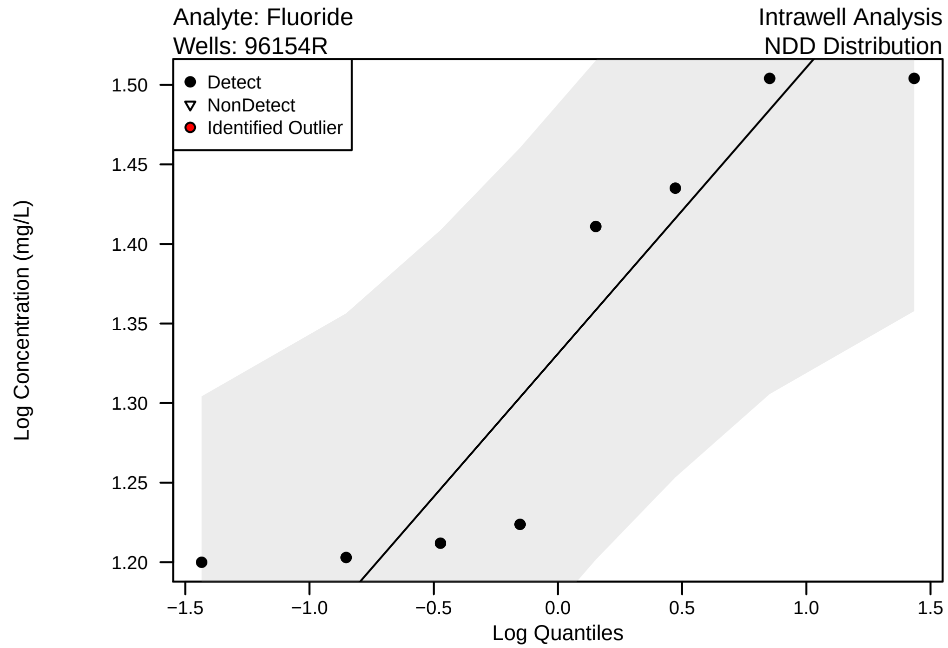
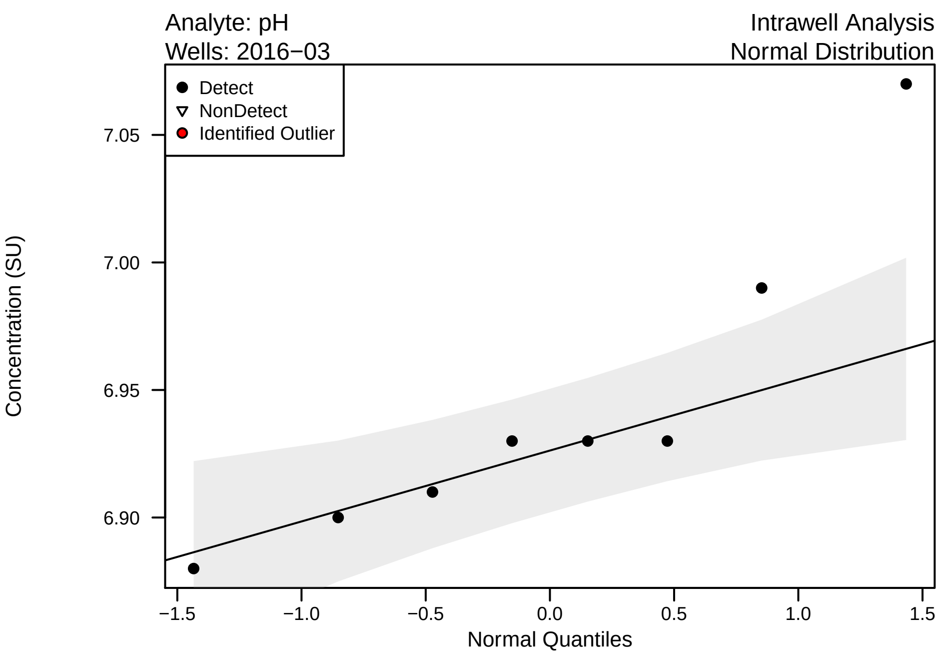
Unit: Fly Ash Reservoir
Geology: Morgantown SS







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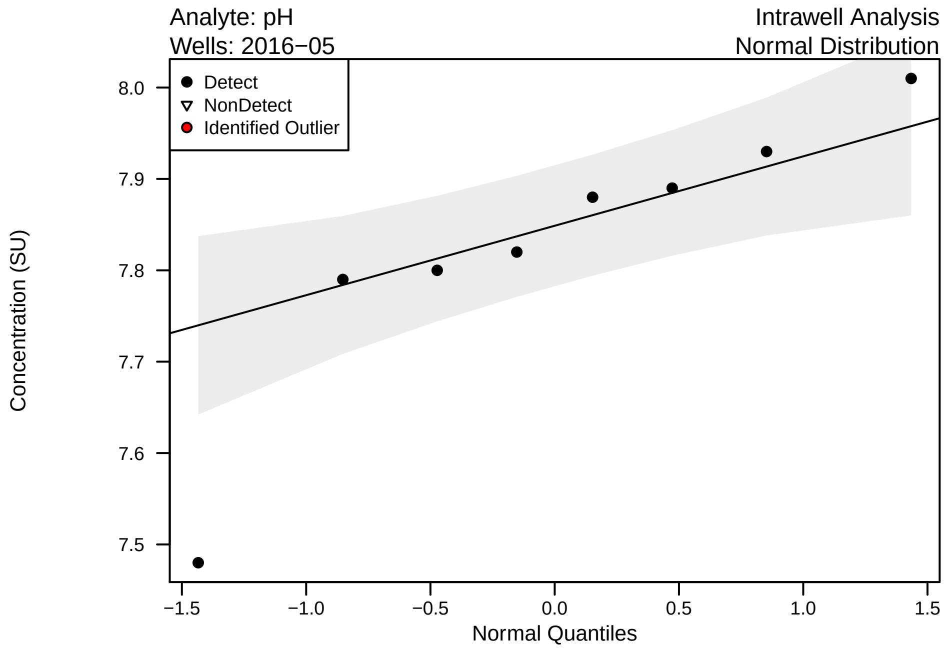
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



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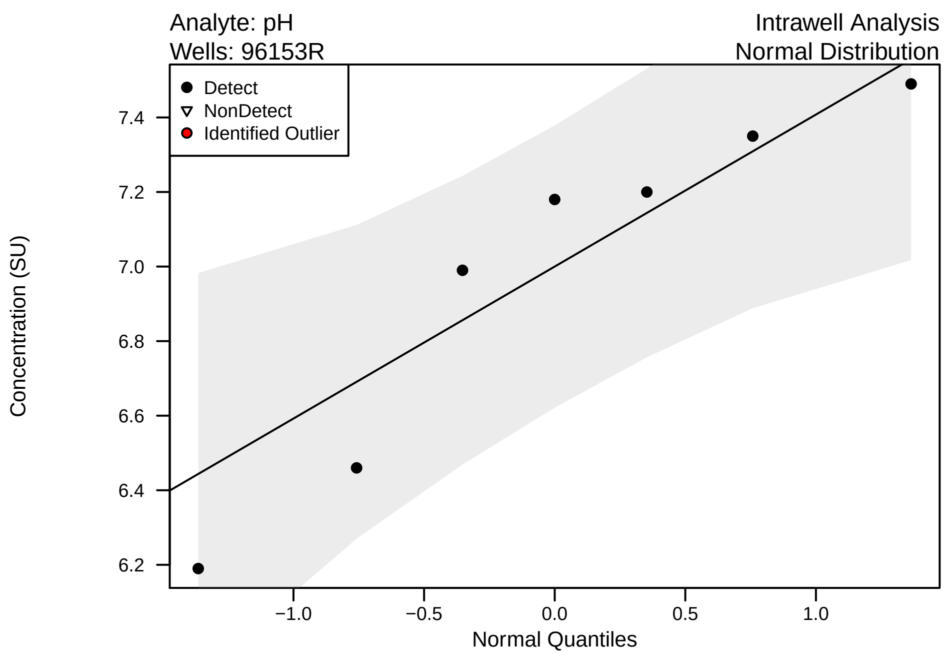

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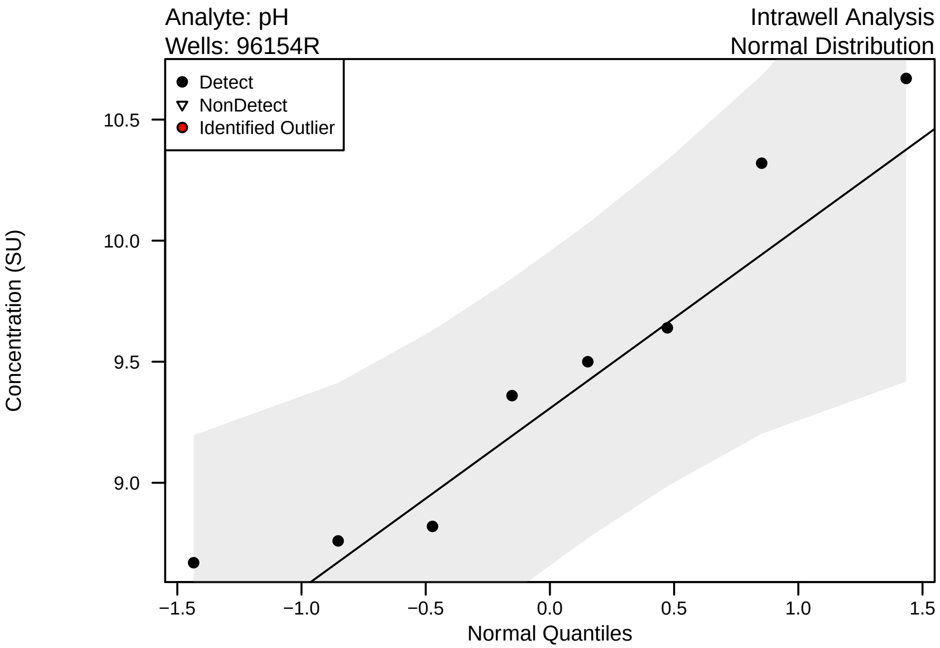

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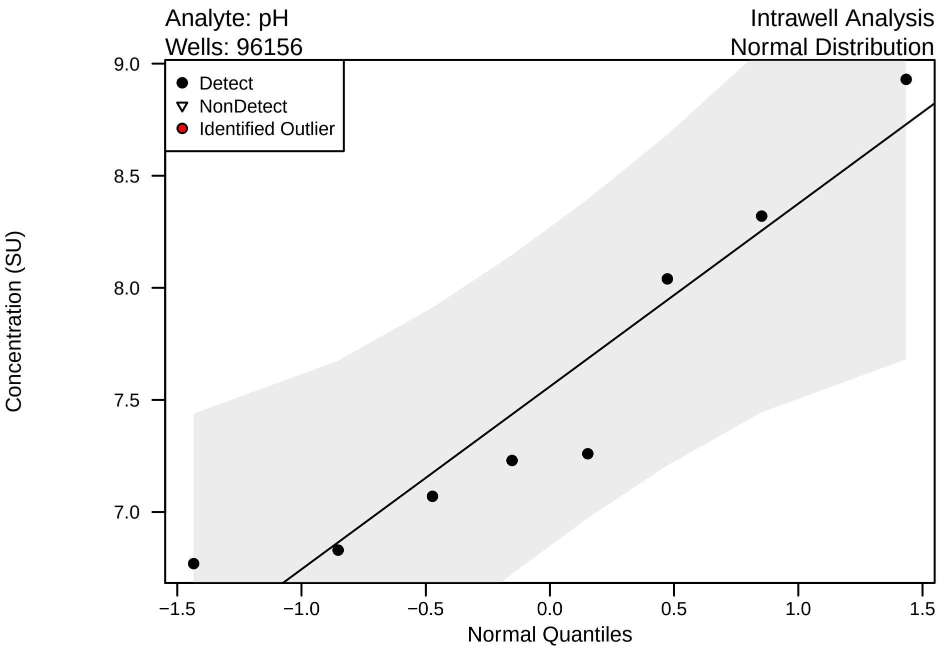

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QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
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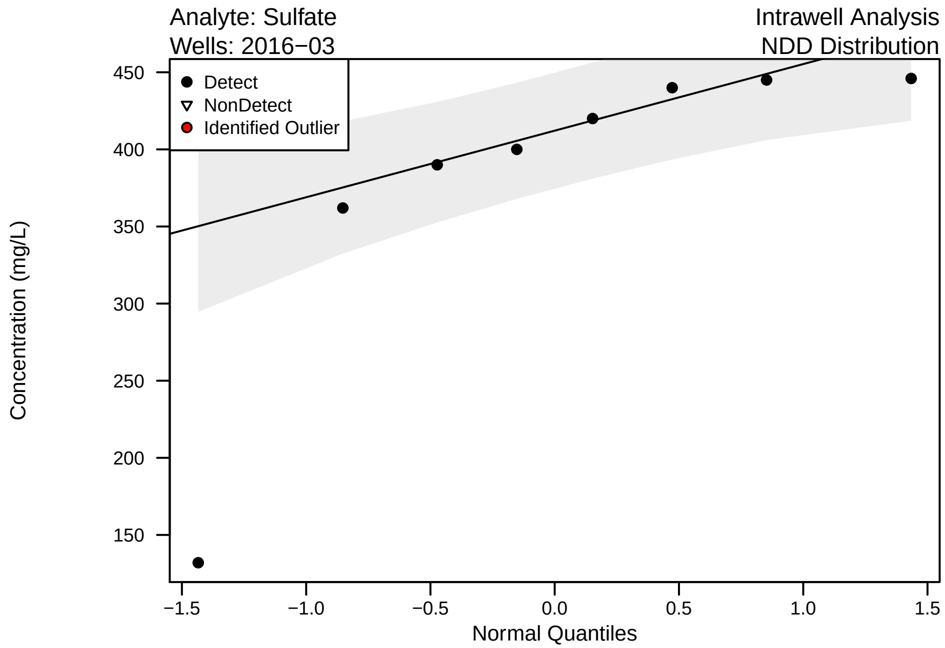

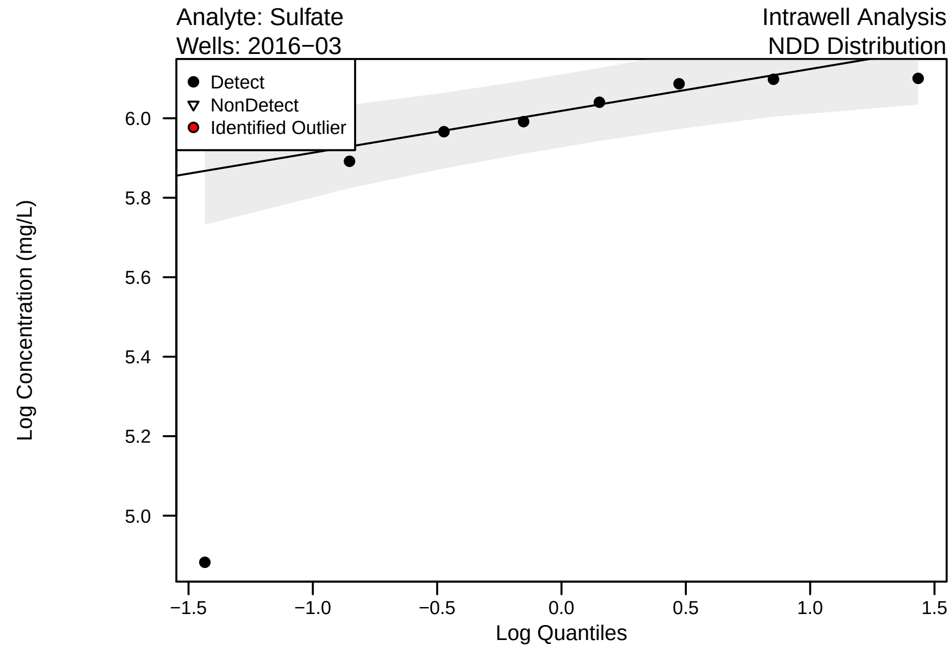

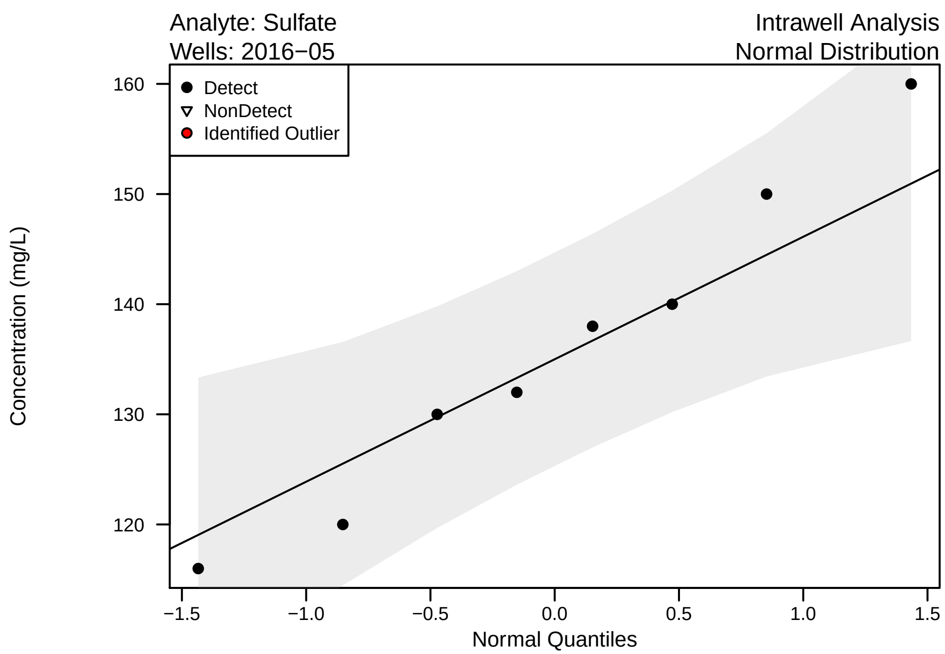

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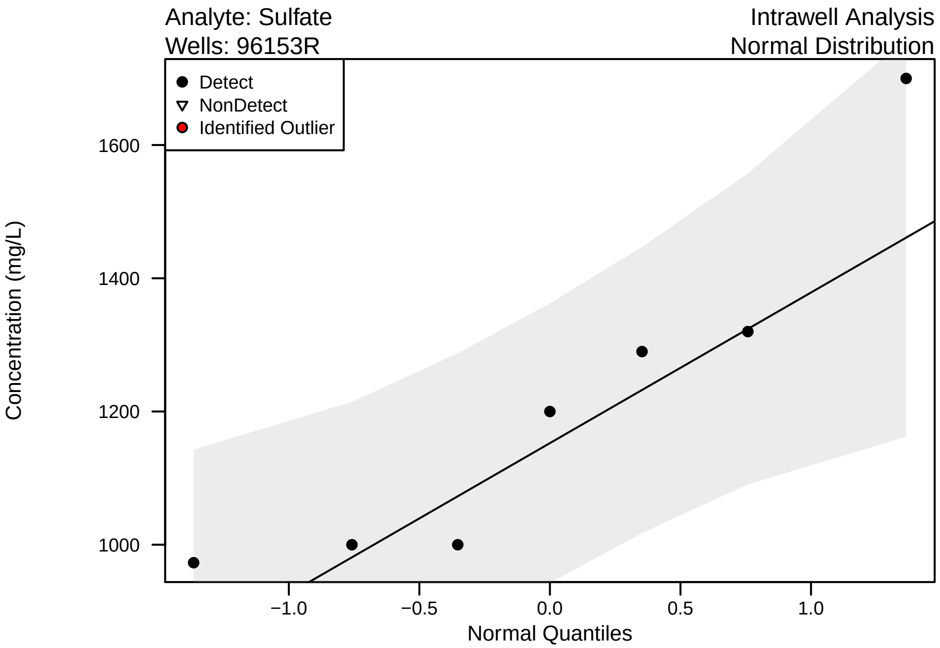
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



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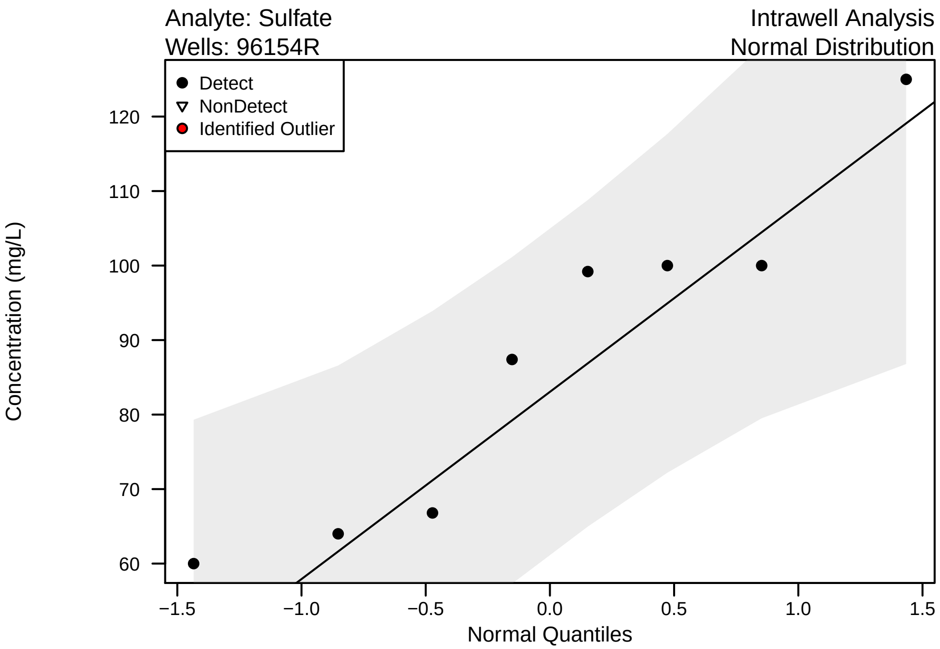

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QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
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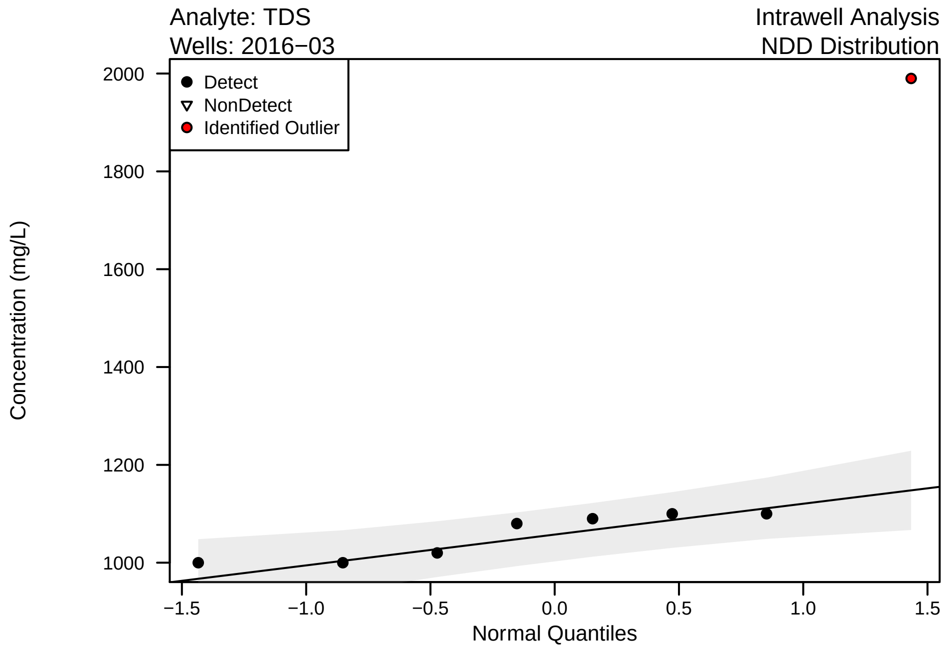

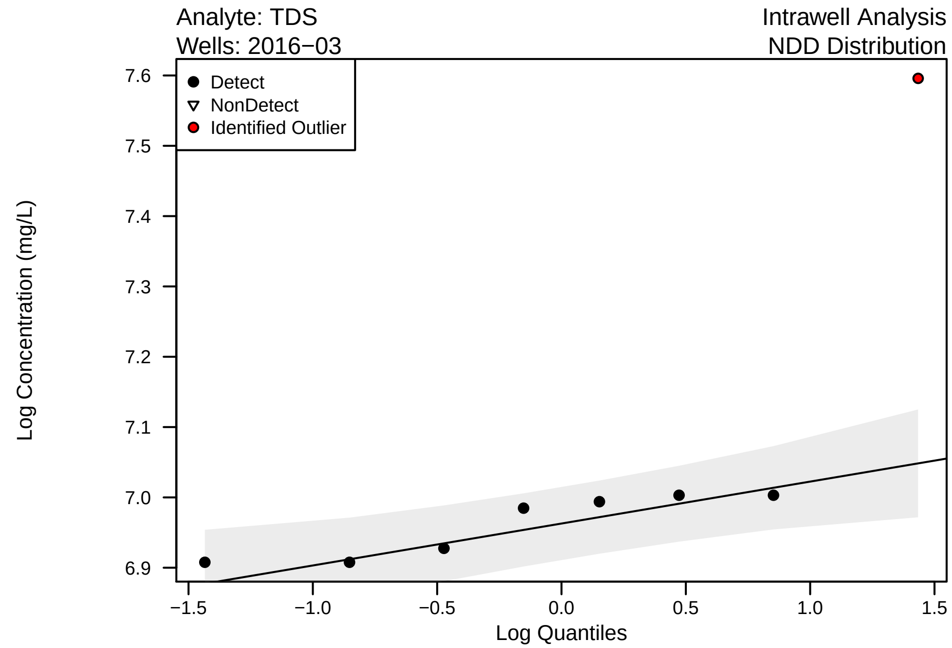

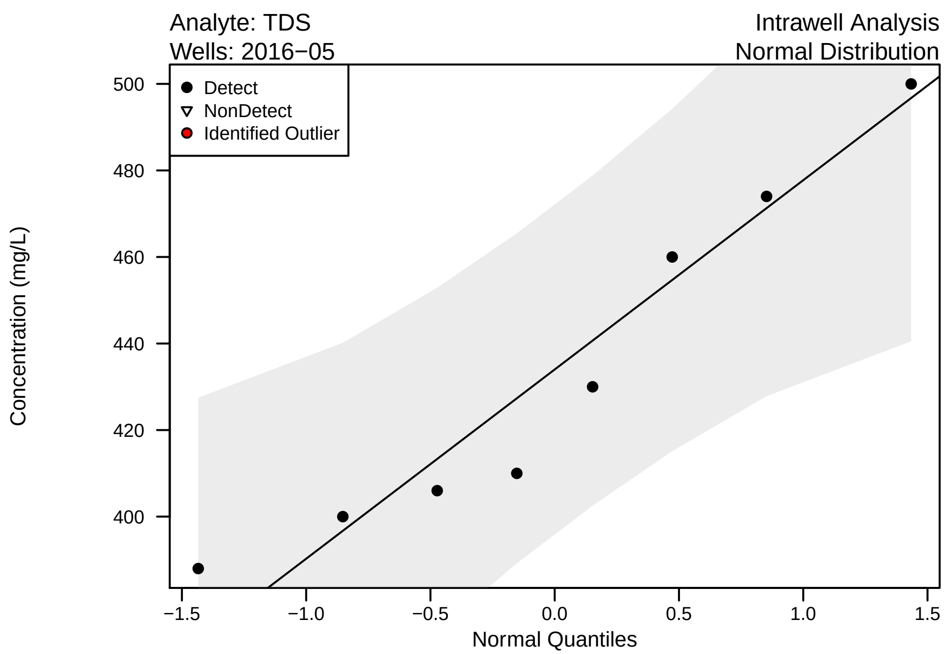

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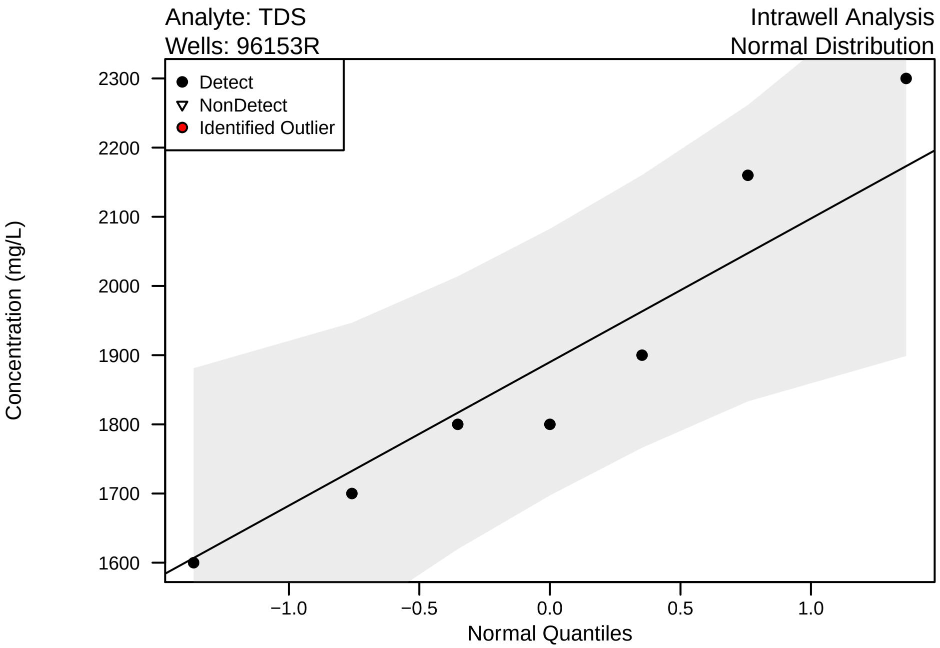
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



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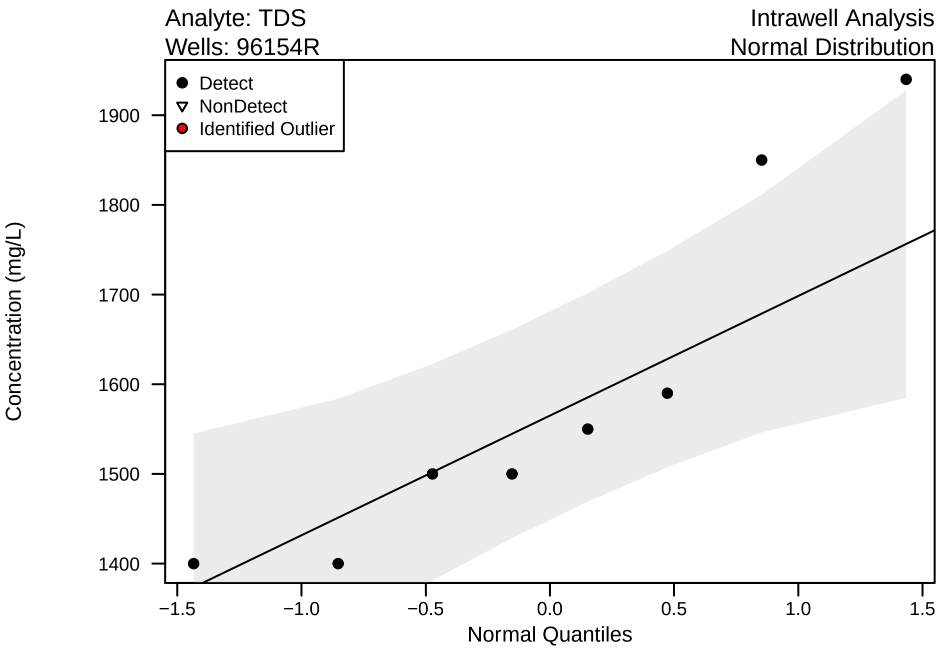

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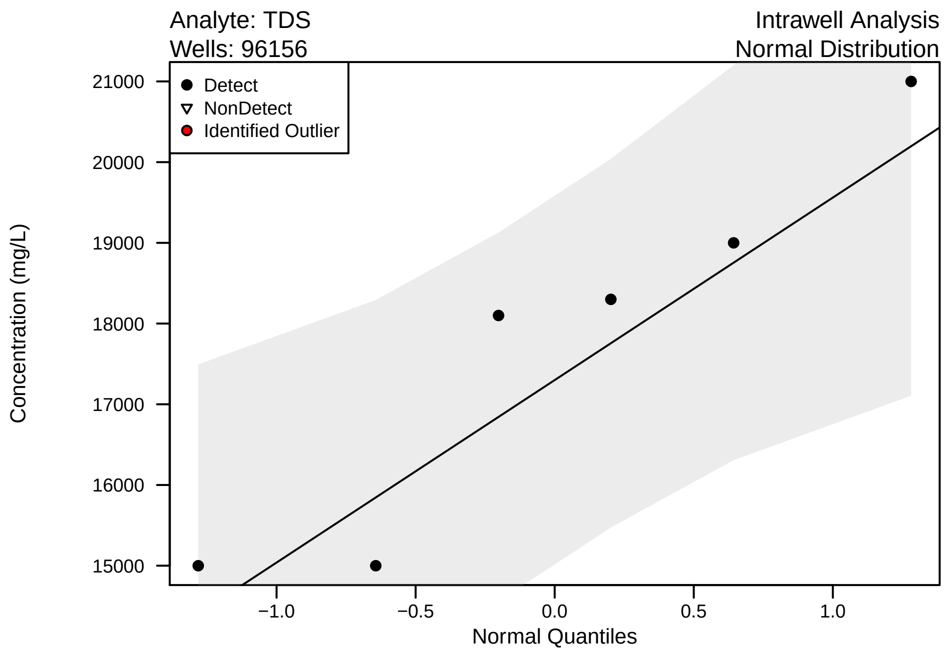
QQ Plots of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS



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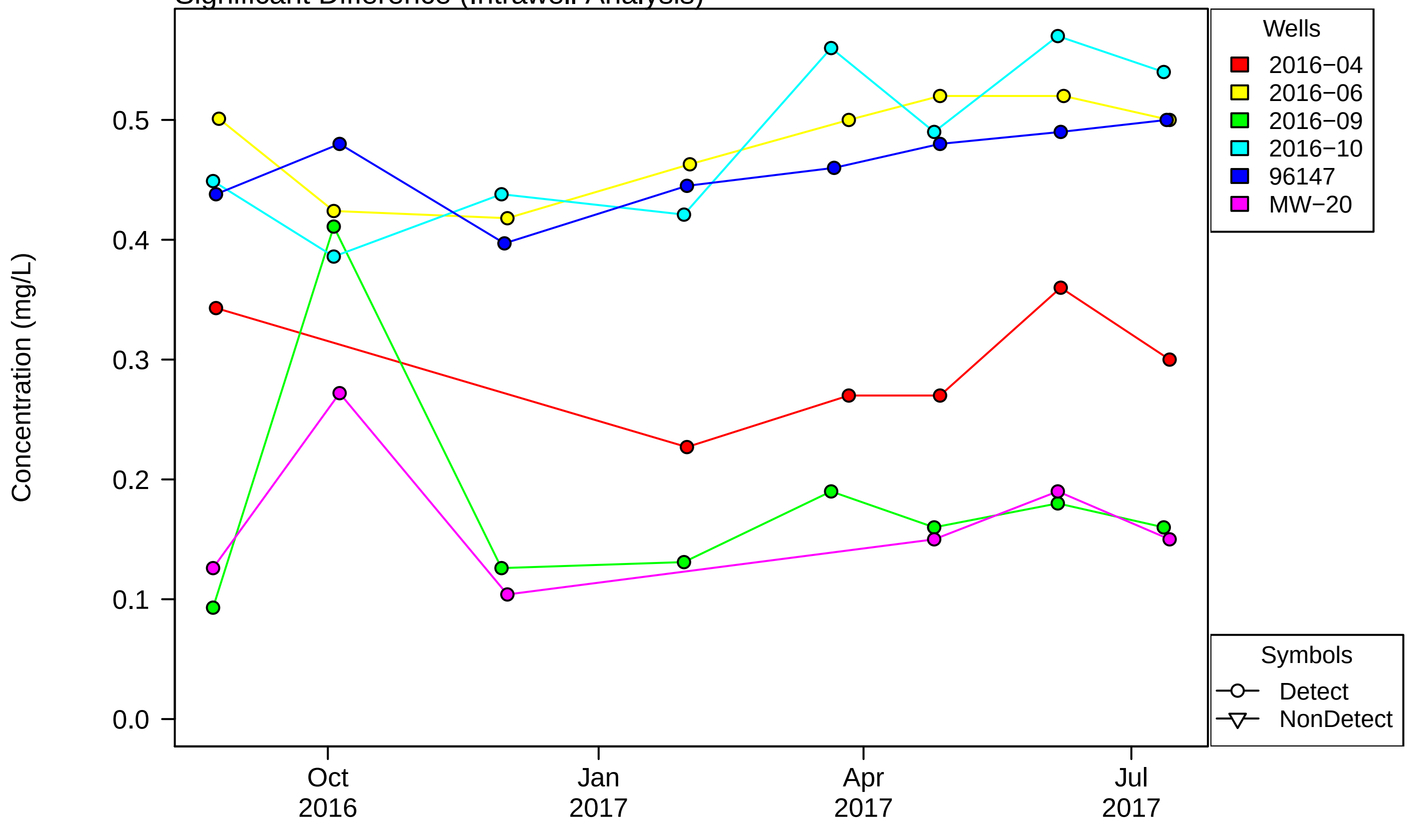
not Lognormal/NDD distribution.

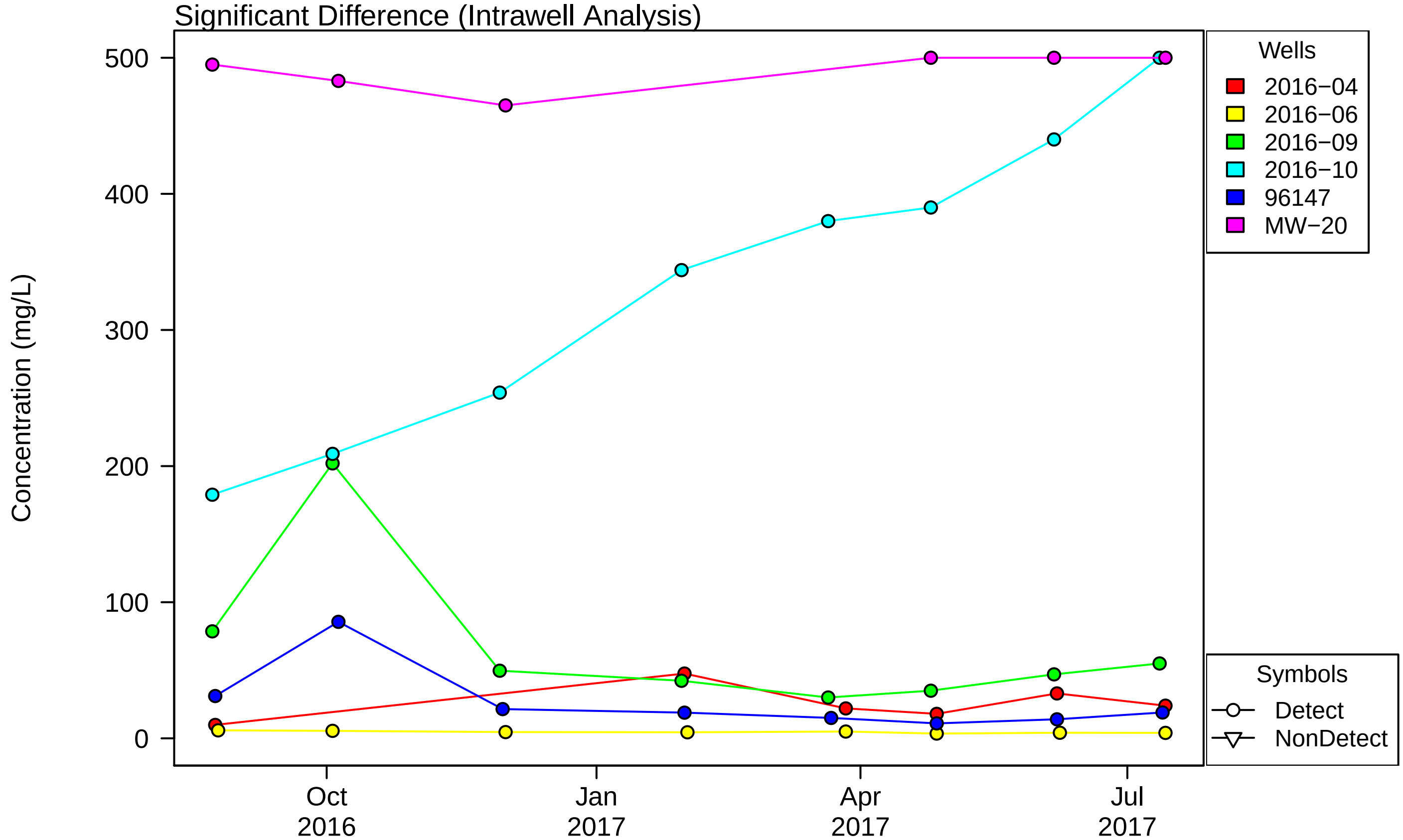
Figure A-3
Timeseries of Upgradient Wells

Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS

Chemical: Boron
Significant Difference (Intrawell Analysis)

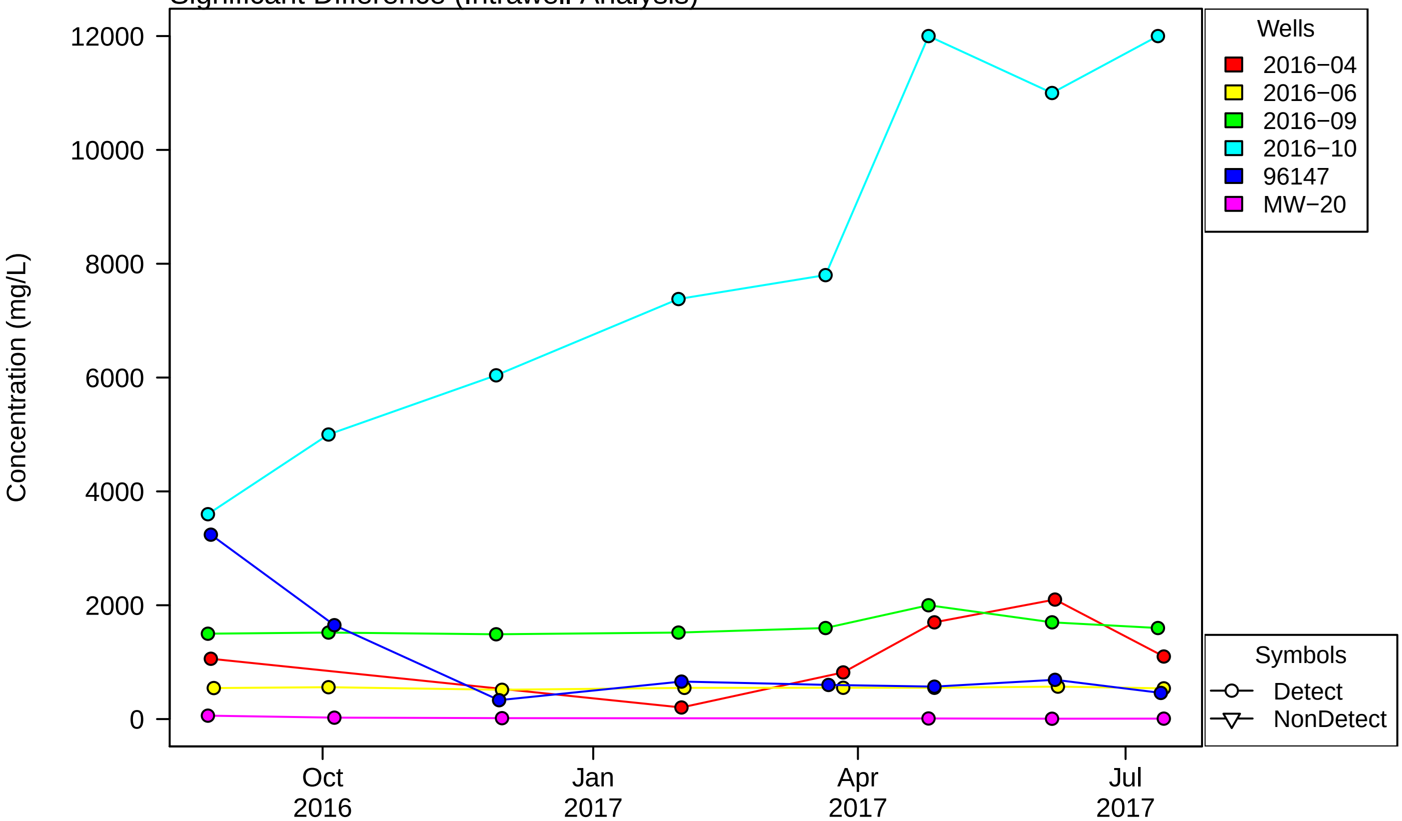


Chemical: Calcium
Significant Difference (Intrawell Analysis)

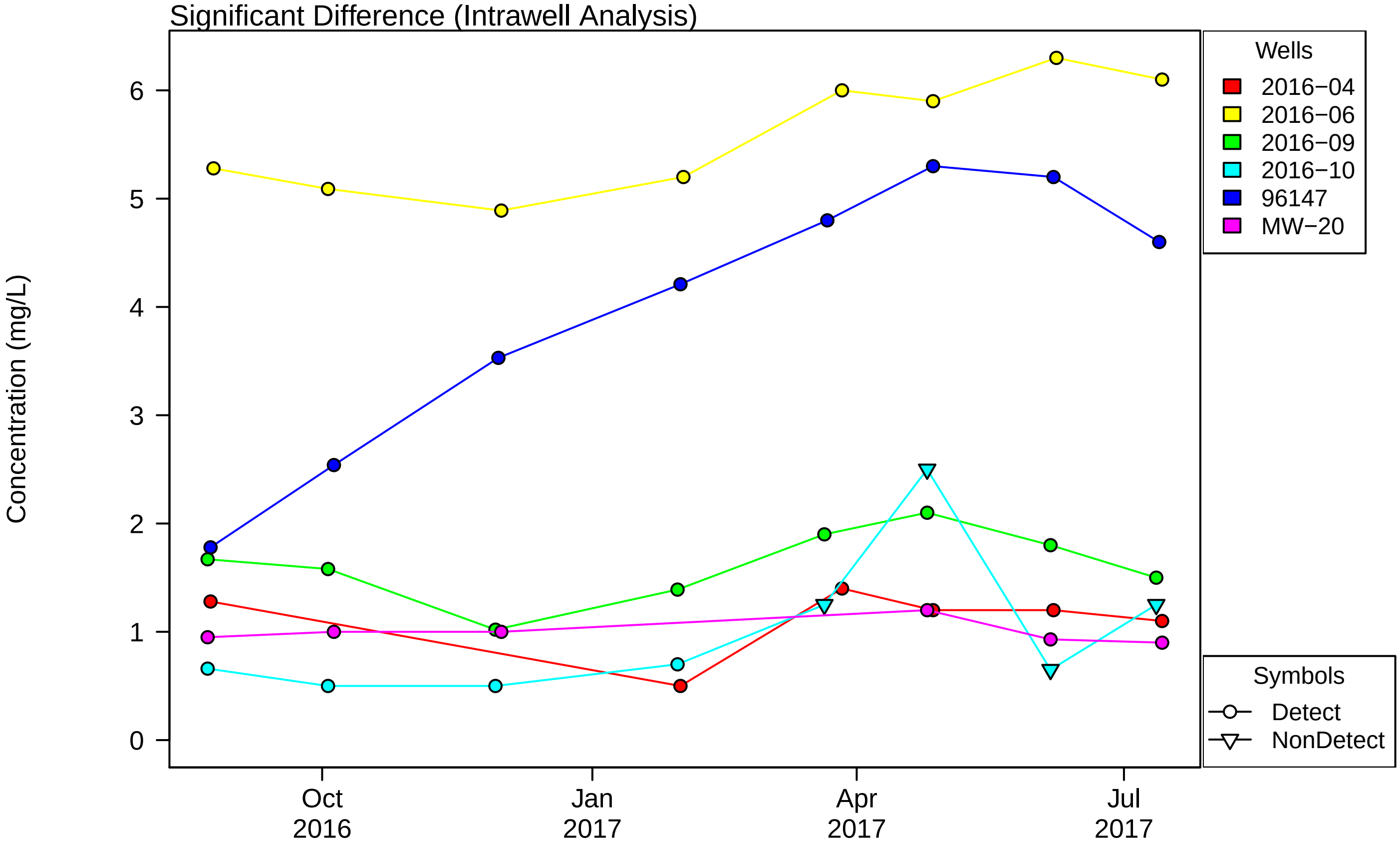


Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS

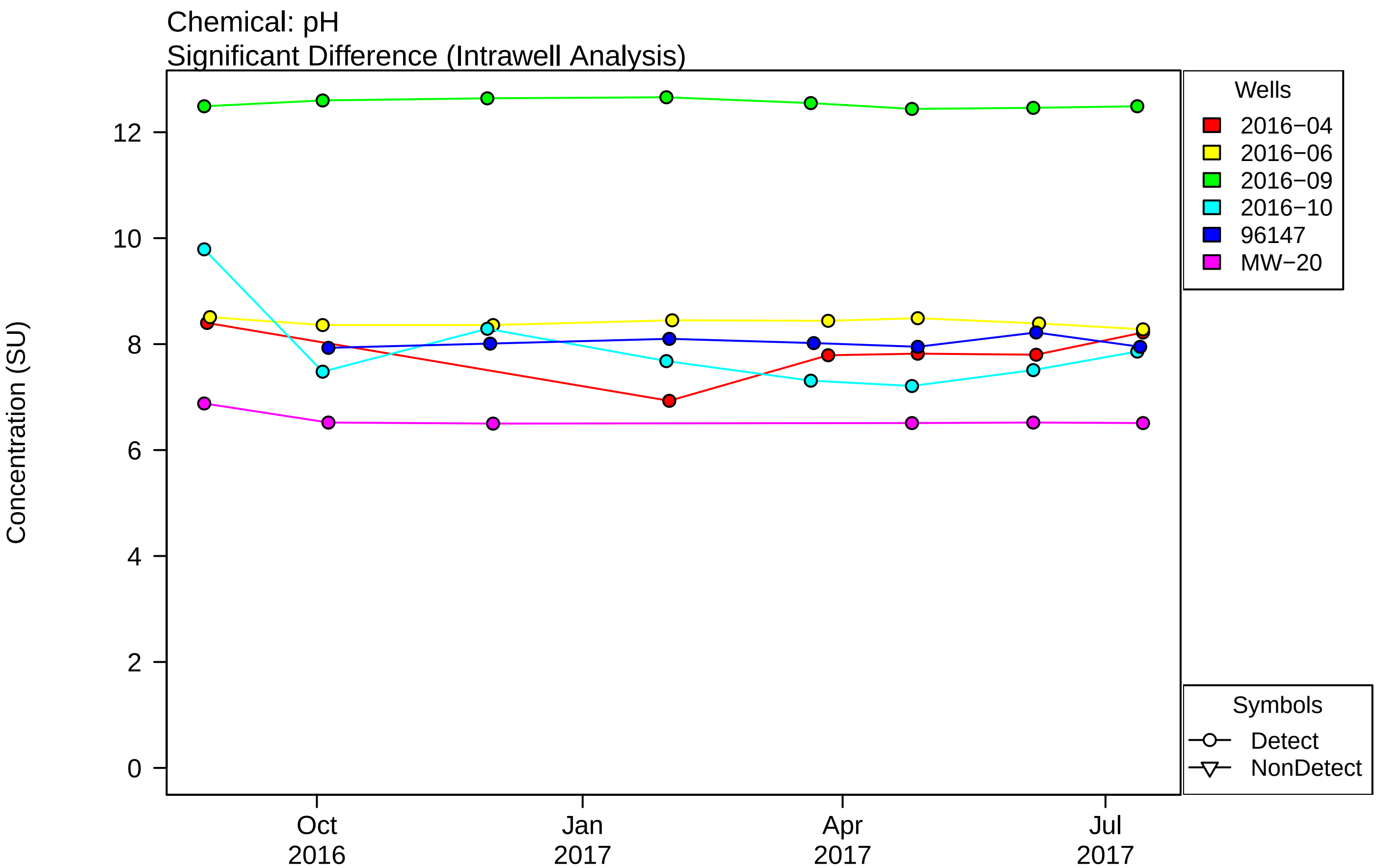
Chemical: Chloride
Significant Difference (Intrawell Analysis)

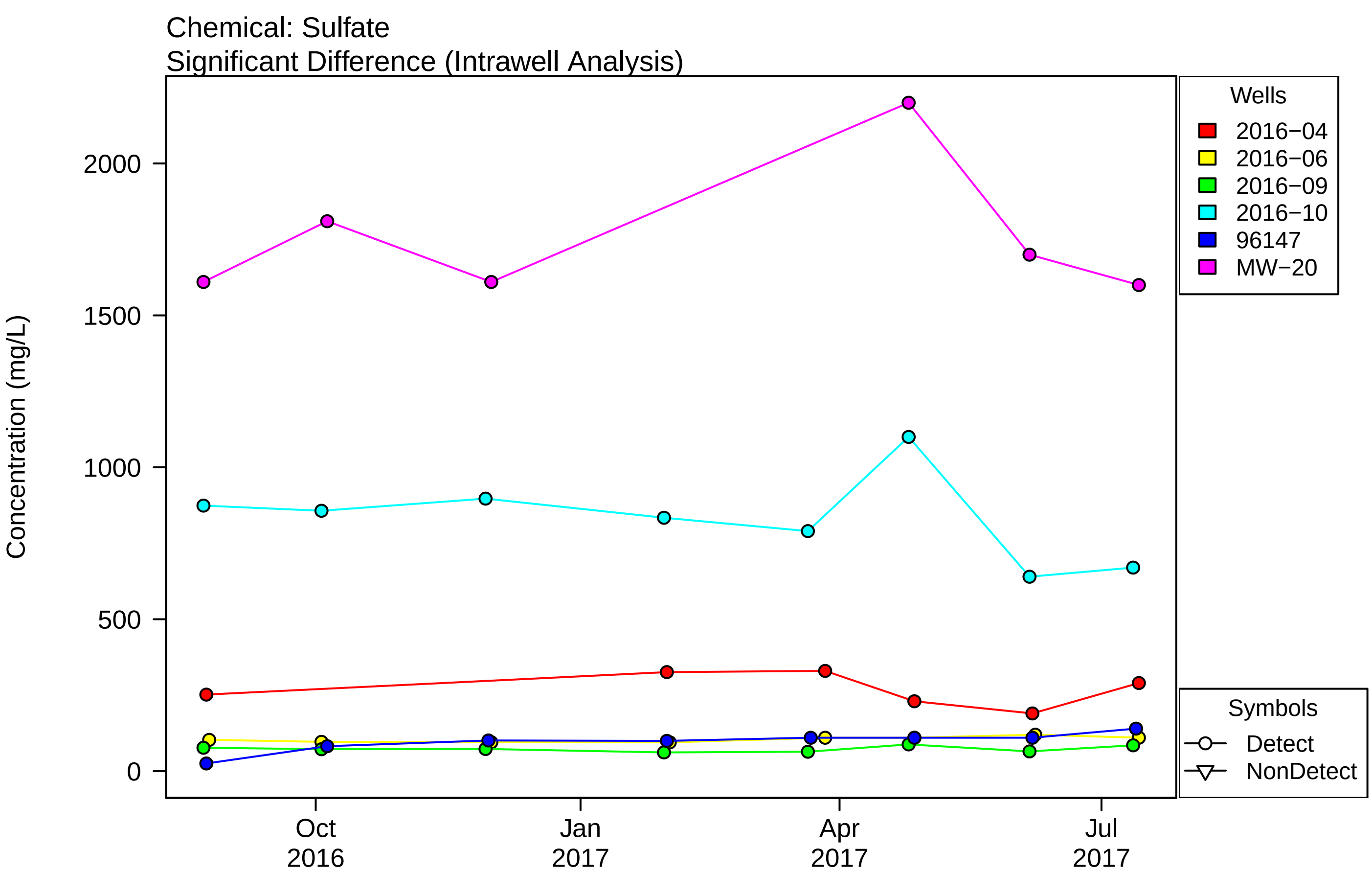


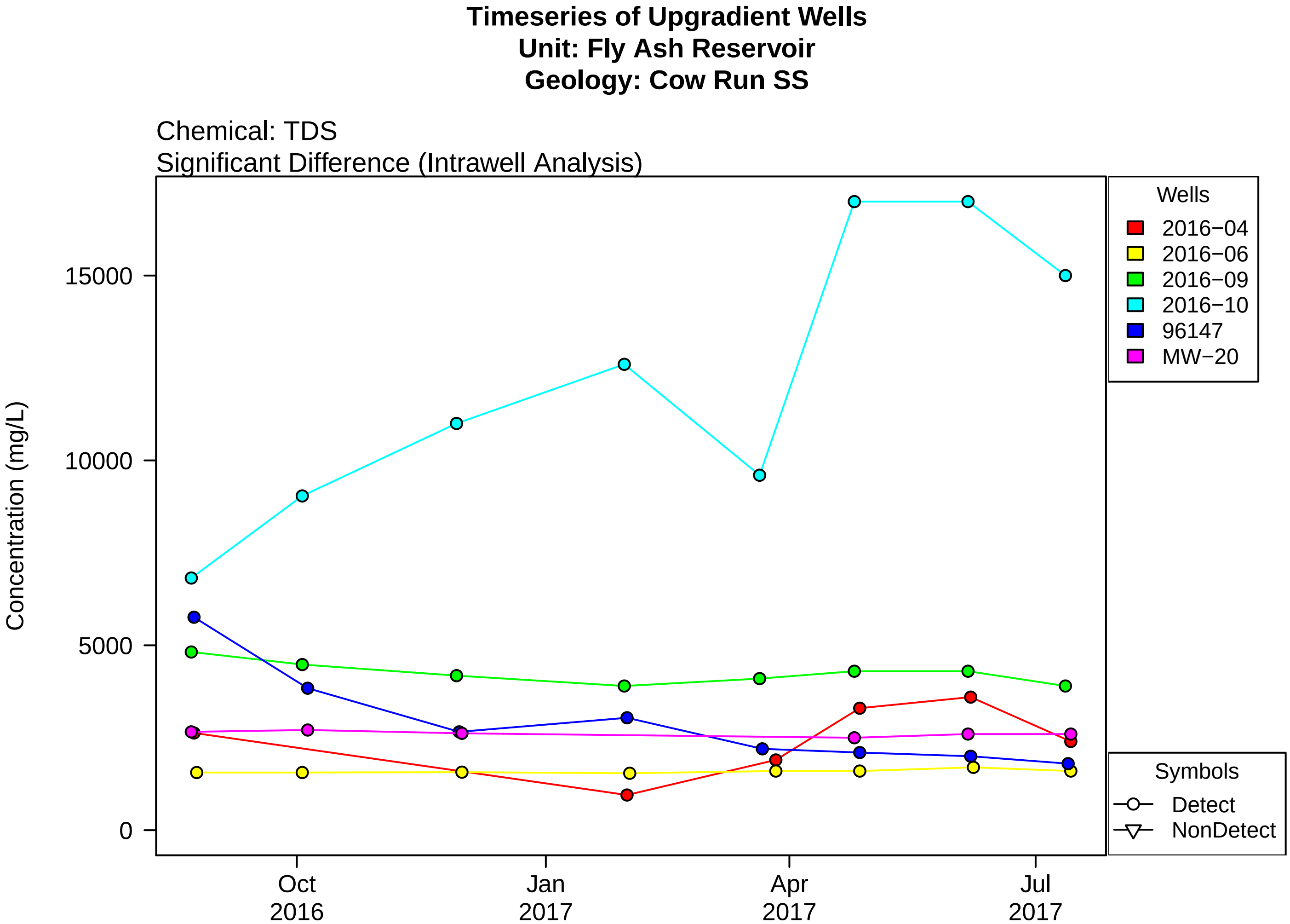
Chemical: Fluoride
Significant Difference (Intrawell Analysis)



Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS



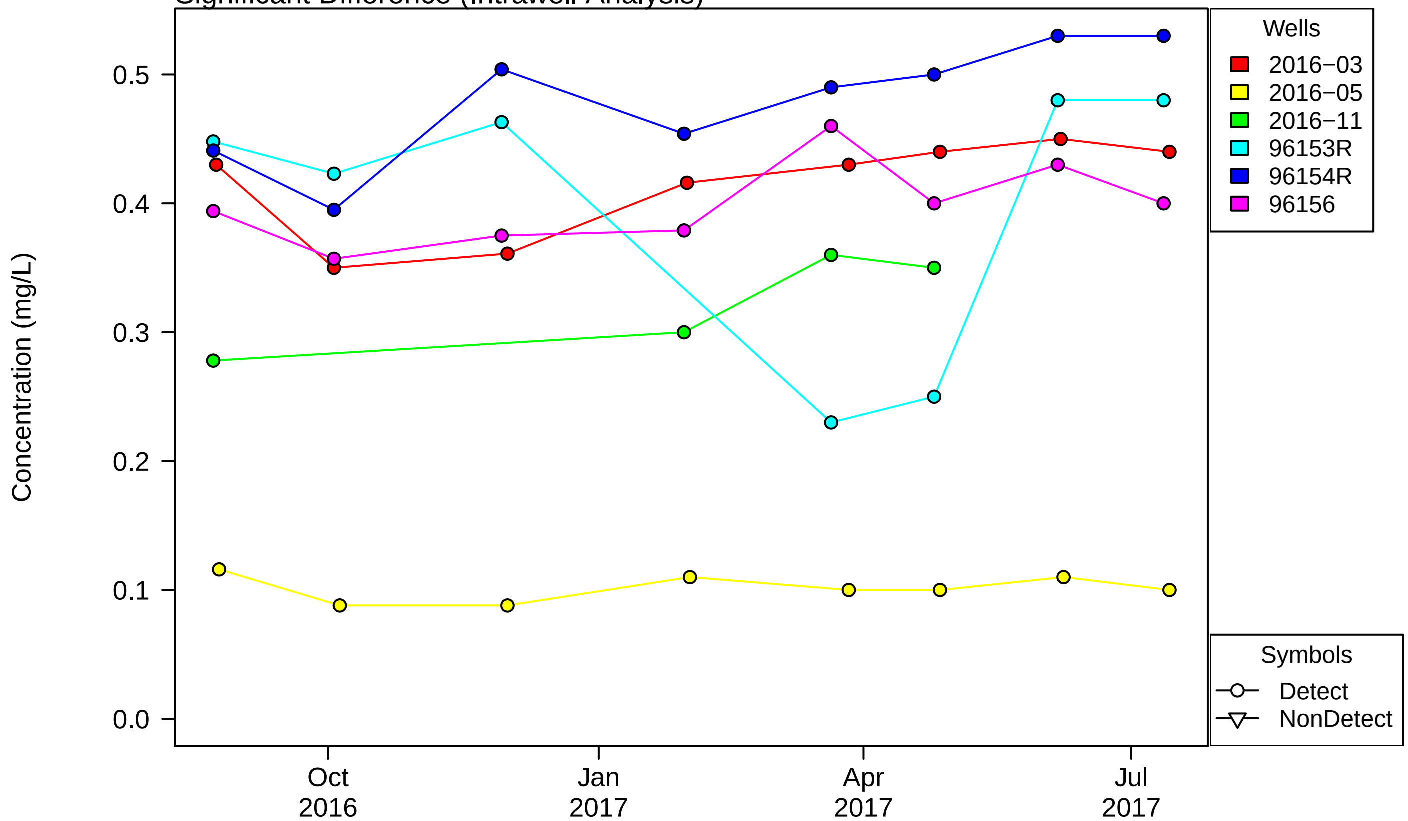




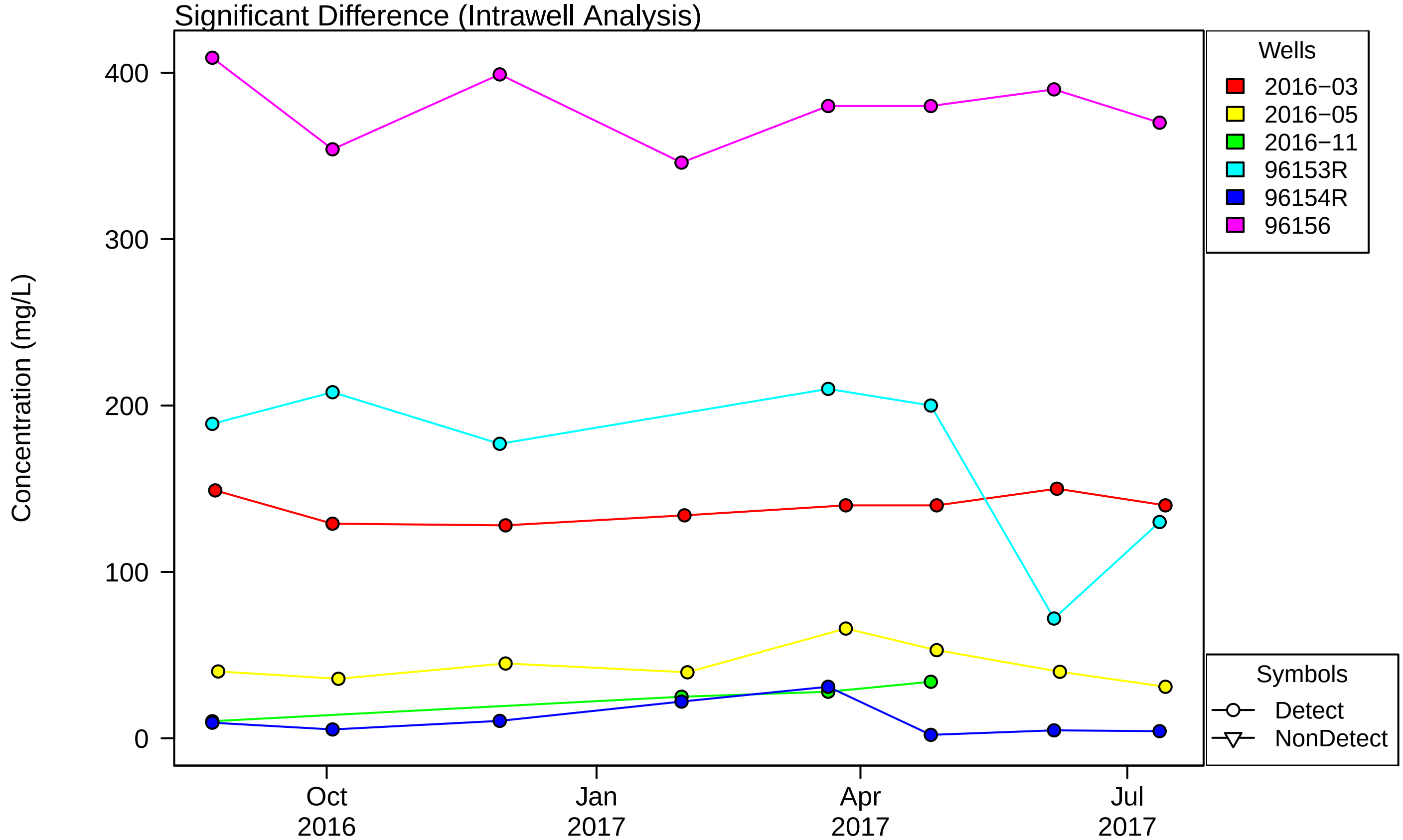
Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Cow Run SS
Chemical: TDS
Significant Difference (Intrawell Analysis)
Concentration (mg/L)
15000
10000
5000
0
Oct 2016
Jan 2017
Apr 2017
Jul 2017
Wells
2016−04
2016−06
2016−09
2016−10
96147
MW−20
Symbols
Detect
NonDetect

Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS

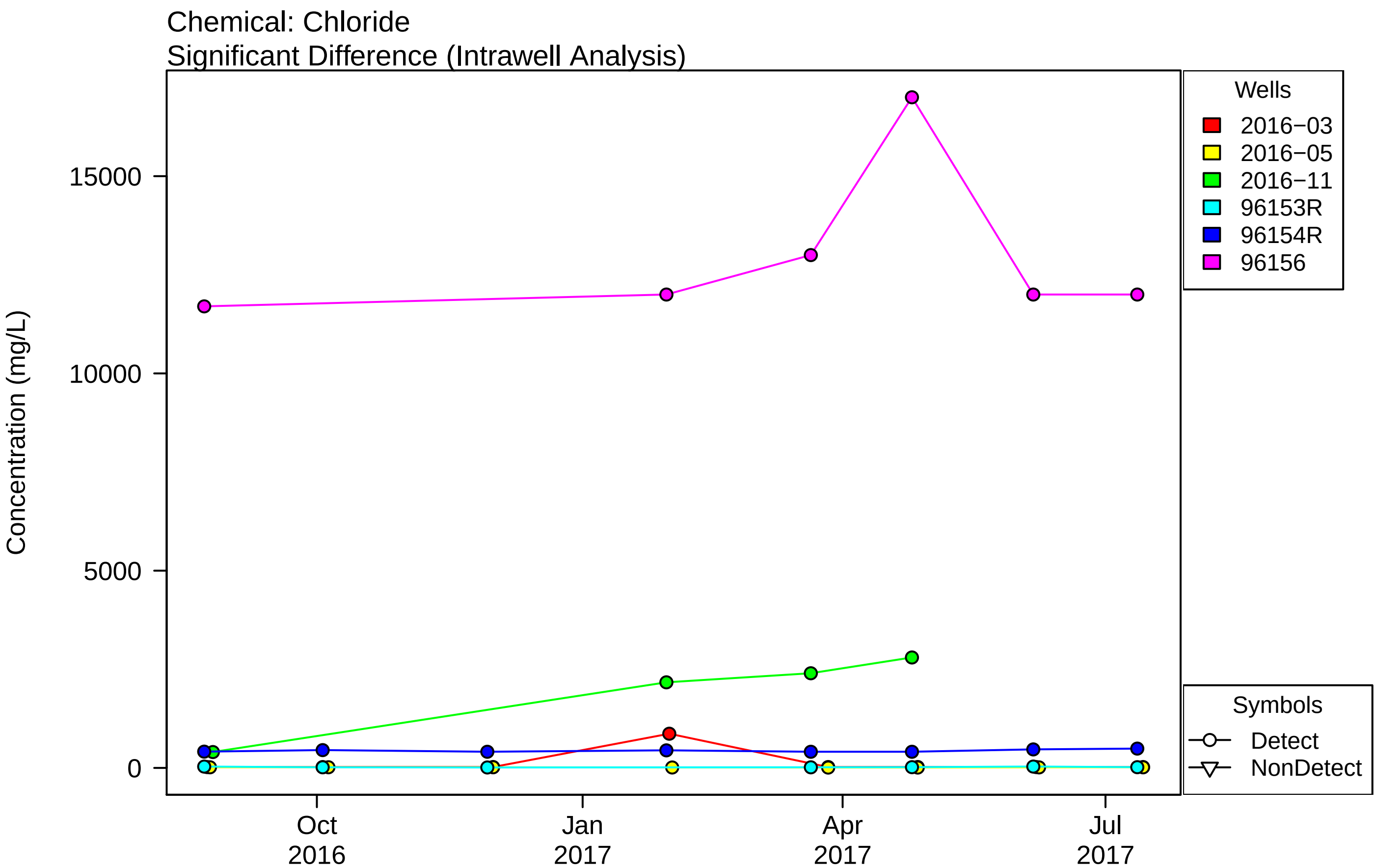
Chemical: Boron
Significant Difference (Intrawell Analysis)

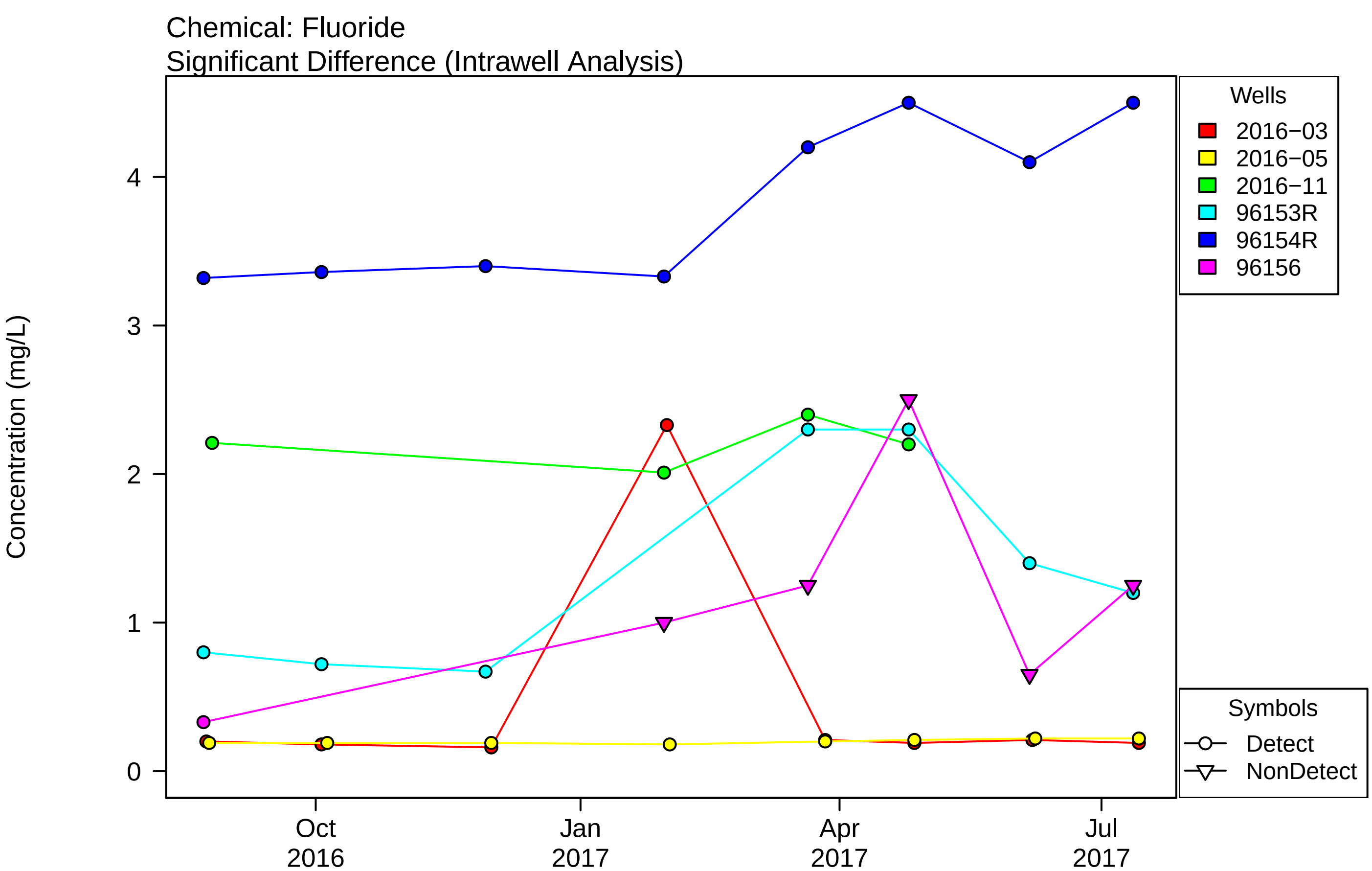


Chemical: Calcium
Significant Difference (Intrawell Analysis)

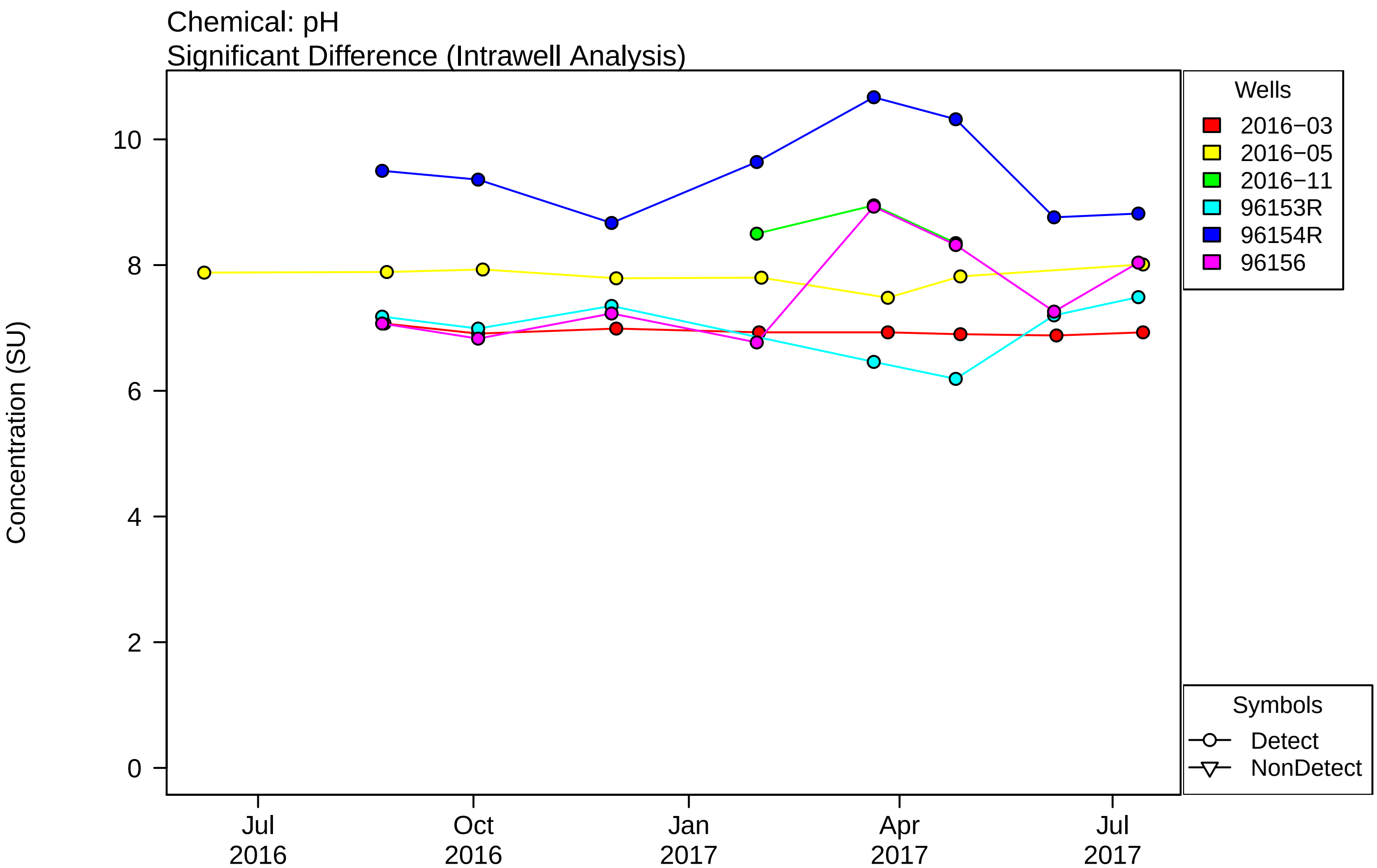


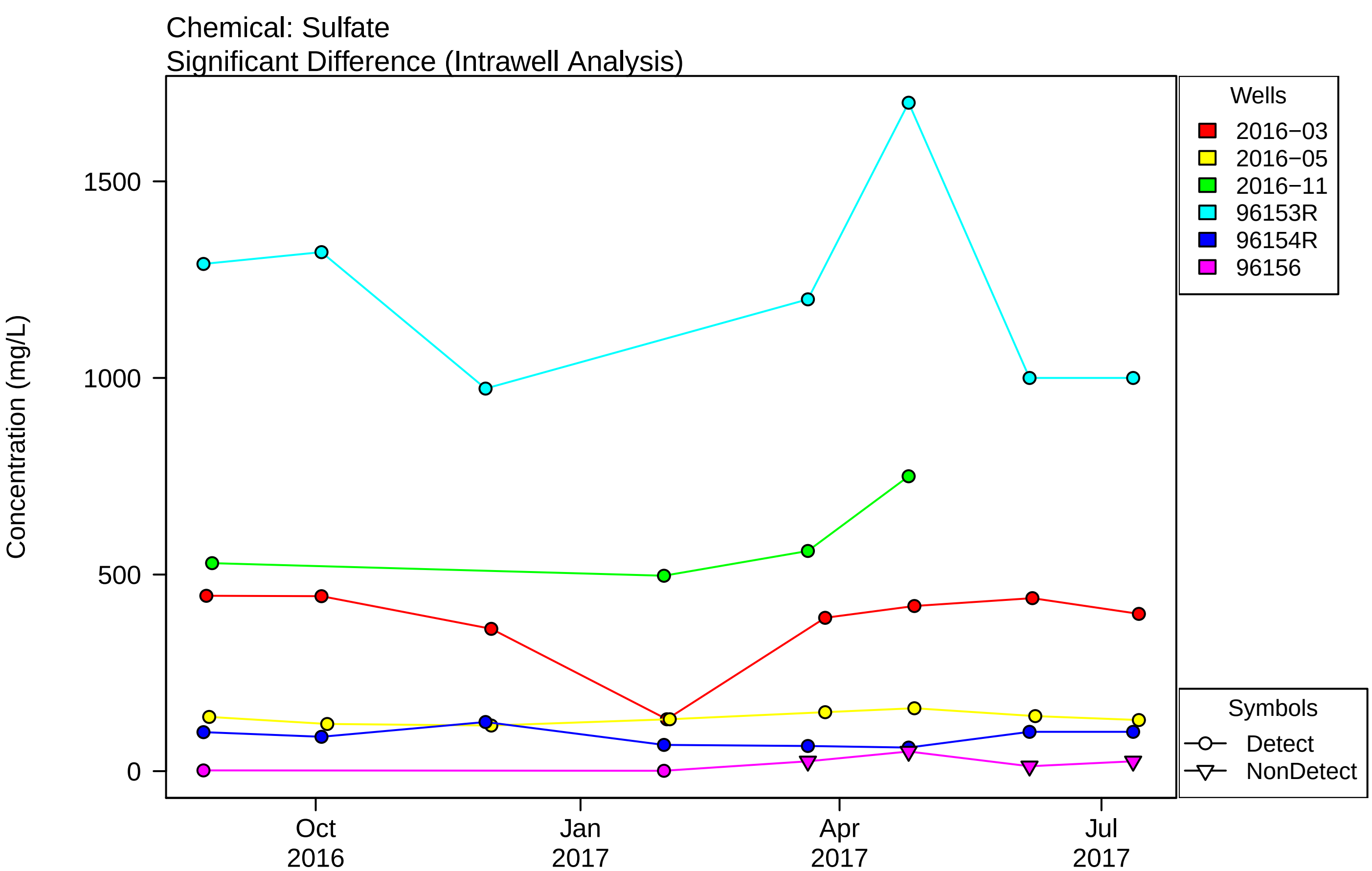
Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS





Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS





Timeseries of Upgradient Wells
Unit: Fly Ash Reservoir
Geology: Morgantown SS

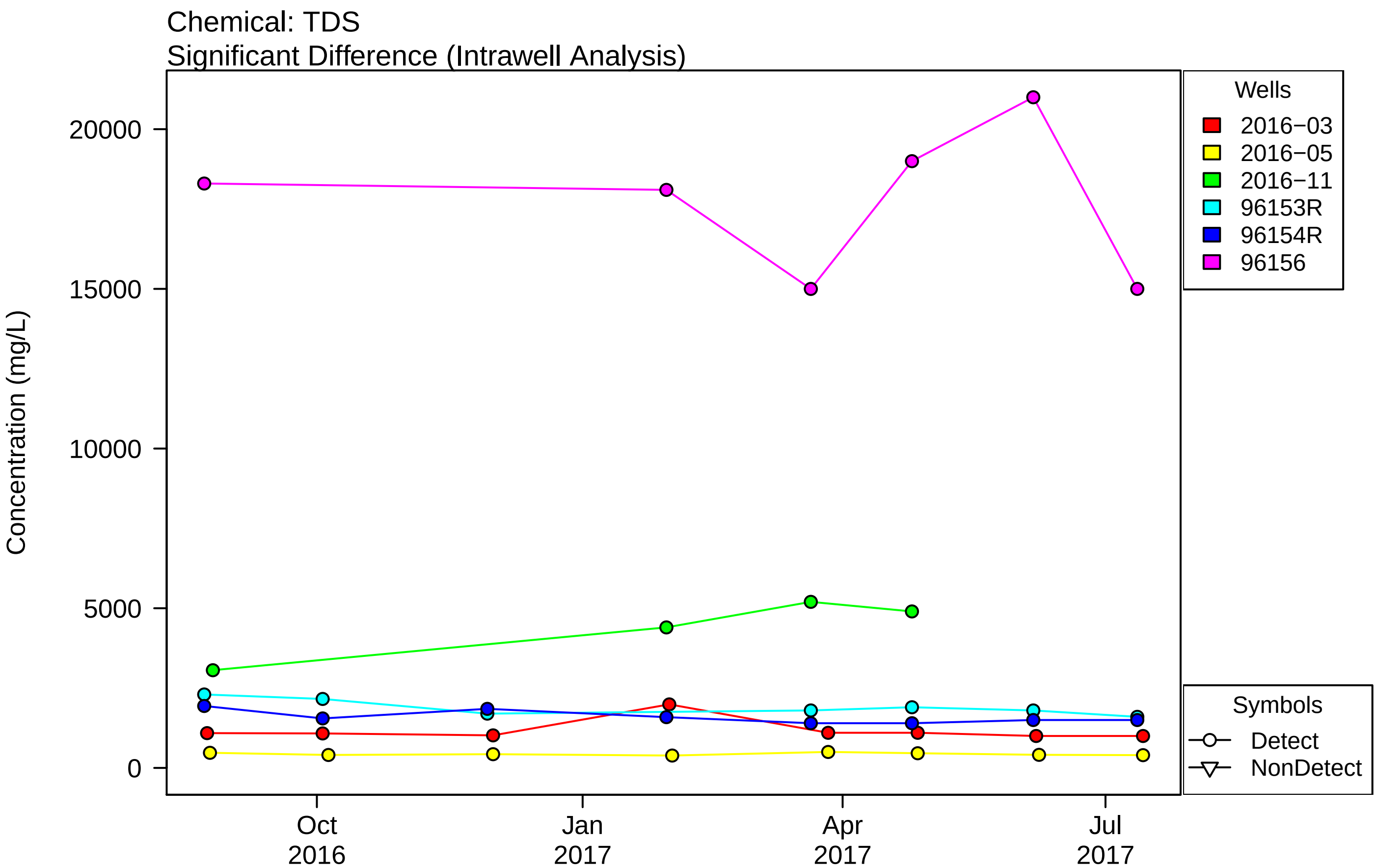
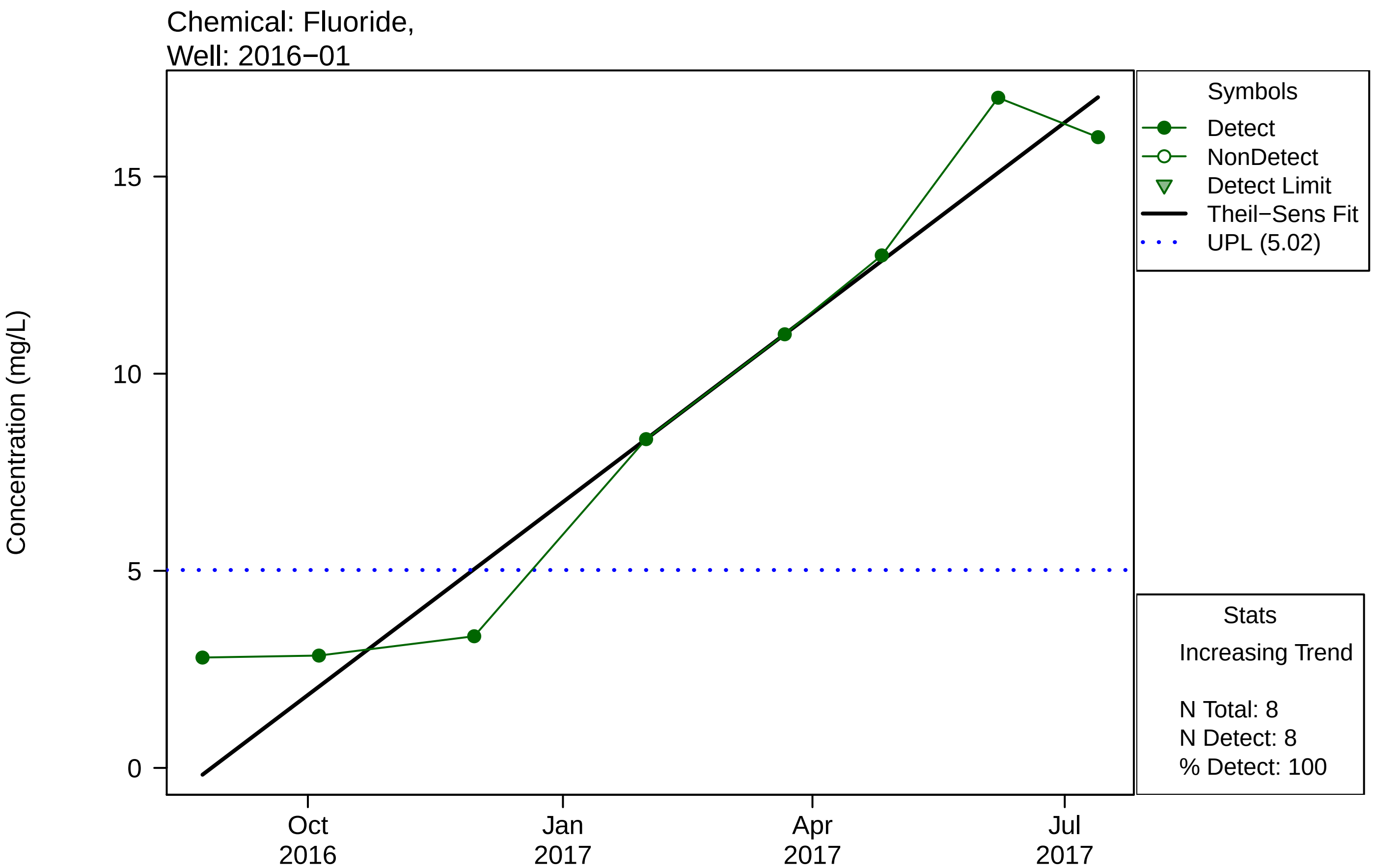


Figure A-4
Trend Analysis of Downgradient Wells with Exceedances

Trend Analysis of Downgradient Wells with Exceedances
Unit: Fly Ash Reservoir
Geology: Morgantown SS



Attachment B
Tables

Table B-1: Kruskal-Wallis Test Comparison of Upgradient Wells, Fly Ash Reservoir

Analyte	Geology	N	Num Detects	Percent Detects	DF	KW Statistic	p-value	Conclusion	UPL Type
Boron	Cow Run SS	44	44	100%	5	33.4	<0.001	Significant Difference	Intrawell
Calcium	Cow Run SS	44	44	100%	5	38.8	<0.001	Significant Difference	Intrawell
Chloride	Cow Run SS	44	44	100%	5	35.1	<0.001	Significant Difference	Intrawell
Fluoride	Cow Run SS	44	40	91%	5	31.3	<0.001	Significant Difference	Intrawell
pH	Cow Run SS	43	43	100%	5	34.7	<0.001	Significant Difference	Intrawell
Sulfate	Cow Run SS	44	44	100%	5	39	<0.001	Significant Difference	Intrawell
TDS	Cow Run SS	44	44	100%	5	35.9	<0.001	Significant Difference	Intrawell
Boron	Morgantown SS	43	43	100%	5	29.5	<0.001	Significant Difference	Intrawell
Calcium	Morgantown SS	43	43	100%	5	39.3	<0.001	Significant Difference	Intrawell
Chloride	Morgantown SS	41	41	100%	5	34.7	<0.001	Significant Difference	Intrawell
Fluoride	Morgantown SS	41	36	88%	5	31.2	<0.001	Significant Difference	Intrawell
pH	Morgantown SS	43	43	100%	5	31.4	<0.001	Significant Difference	Intrawell
Sulfate	Morgantown SS	41	37	90%	5	37.6	<0.001	Significant Difference	Intrawell
TDS	Morgantown SS	41	41	100%	5	36.2	<0.001	Significant Difference	Intrawell

Notes

N: number of data points

DF: Degrees of Freedom

statistic: Kruskal Wallis test statistic

p-value: P-values below 0.05 indicate that the median concentrations in the upgradient wells are significantly different from each other and the upgra

p-value: P-values equal or above 0.05 indicate that the median concentrations in the upgradient wells are not significantly different from each other a

UPL: upper prediction limit

TDS: Total dissolved solids

Table B-2: Descriptive Statistics for Upgradient Wells, Fly Ash Reservoir

Geology	Analyte	Well	Units	N	Num Detects	Percent Detects	Min ND	Max ND	Min Detect	Median	Mean	Max Detect	SD	CV	Distribution
Cow Run SS	Boron	2016-04	mg/L	6	6	100%			0.227	0.285	0.295	0.36	0.0499	0.169002685	Normal
Cow Run SS	Boron	2016-06	mg/L	8	8	100%			0.418	0.5	0.481	0.52	0.0409	0.085060253	Normal
Cow Run SS	Boron	2016-09	mg/L	8	8	100%			0.093	0.16	0.181	0.411	0.0979	0.539930602	Lognormal
Cow Run SS	Boron	2016-10	mg/L	8	8	100%			0.386	0.47	0.482	0.57	0.0689	0.142992325	Normal
Cow Run SS	Boron	96147	mg/L	8	8	100%			0.397	0.47	0.461	0.5	0.0337	0.073134302	Normal
Cow Run SS	Boron	MW-20	mg/L	6	6	100%			0.104	0.15	0.165	0.272	0.0596	0.360529874	Normal
Cow Run SS	Calcium	2016-04	mg/L	6	6	100%			9.88	23	25.7	47.6	13.1	0.509094007	Normal
Cow Run SS	Calcium	2016-06	mg/L	8	8	100%			3.5	4.53	4.63	5.87	0.796	0.171999214	Normal
Cow Run SS	Calcium	2016-09	mg/L	8	8	100%			30	48.4	67.4	202	56.3	0.835002479	Lognormal
Cow Run SS	Calcium	2016-10	mg/L	8	8	100%			179	362	337	500	113	0.336694862	Normal
Cow Run SS	Calcium	96147	mg/L	8	8	100%			11	19	27	85.6	24.4	0.904596814	Lognormal
Cow Run SS	Calcium	MW-20	mg/L	6	6	100%			465	498	490	500	14.1	0.028796018	NDD
Cow Run SS	Chloride	2016-04	mg/L	6	6	100%			204	1080	1160	2100	666	0.572224283	Normal
Cow Run SS	Chloride	2016-06	mg/L	8	8	100%			515	549	547	570	16	0.029249329	Normal
Cow Run SS	Chloride	2016-09	mg/L	8	8	100%			1490	1560	1620	2000	170	0.105308404	NDD
Cow Run SS	Chloride	2016-10	mg/L	8	8	100%			3600	7590	8100	12000	3240	0.400036401	Normal
Cow Run SS	Chloride	96147	mg/L	8	8	100%			332	630	1030	3240	981	0.956503766	Lognormal
Cow Run SS	Chloride	MW-20	mg/L	6	6	100%			6.5	13.7	21.2	60.1	20.2	0.9516079	Lognormal
Cow Run SS	Fluoride	2016-04	mg/L	6	6	100%			0.5	1.2	1.11	1.4	0.317	0.284415379	NDD
Cow Run SS	Fluoride	2016-06	mg/L	8	8	100%			4.89	5.59	5.6	6.3	0.537	0.09592664	Normal
Cow Run SS	Fluoride	2016-09	mg/L	8	8	100%			1.02	1.62	1.62	2.1	0.332	0.205075282	Normal
Cow Run SS	Fluoride	2016-10	mg/L	8	4	50%	1.3	5	0.5	0.68	1	0.7	0.676	0.675604996	Lognormal
Cow Run SS	Fluoride	96147	mg/L	8	8	100%			1.78	4.4	4	5.3	1.28	0.320204884	Normal
Cow Run SS	Fluoride	MW-20	mg/L	6	6	100%			0.9	0.975	0.997	1.2	0.107	0.107440658	Normal
Cow Run SS	pH	2016-04	SU	6	6	100%			6.93	7.81	7.83	8.4	0.508	0.064886515	Normal
Cow Run SS	pH	2016-06	SU	8	8	100%			8.28	8.41	8.41	8.51	0.0767	0.009122284	Normal
Cow Run SS	pH	2016-09	SU	8	8	100%			12.44	12.5	12.5	12.66	0.0841	0.006704369	Normal
Cow Run SS	pH	2016-10	SU	8	8	100%			7.21	7.6	7.89	9.79	0.839	0.106307781	NDD
Cow Run SS	pH	96147	SU	7	7	100%			7.93	8.01	8.03	8.22	0.103	0.012885804	Normal
Cow Run SS	pH	MW-20	SU	6	6	100%			6.5	6.52	6.57	6.88	0.15	0.022883615	NDD
Cow Run SS	Sulfate	2016-04	mg/L	6	6	100%			190	271	270	330	55.6	0.206197365	Normal
Cow Run SS	Sulfate	2016-06	mg/L	8	8	100%			94.8	106	105	120	9.09	0.086622697	Normal
Cow Run SS	Sulfate	2016-09	mg/L	8	8	100%			61.7	72.6	73.2	88	9.7	0.132424213	Normal
Cow Run SS	Sulfate	2016-10	mg/L	8	8	100%			640	846	833	1100	143	0.171820045	Normal
Cow Run SS	Sulfate	96147	mg/L	8	8	100%			25.3	106	97.2	140	33.3	0.341951405	Normal
Cow Run SS	Sulfate	MW-20	mg/L	6	6	100%			1600	1660	1760	2200	232	0.132446462	NDD
Cow Run SS	TDS	2016-04	mg/L	6	6	100%			952	2520	2460	3600	962	0.390393179	Normal
Cow Run SS	TDS	2016-06	mg/L	8	8	100%			1540	1580	1590	1700	49.4	0.031049301	Lognormal
Cow Run SS	TDS	2016-09	mg/L	8	8	100%			3900	4240	4250	4820	306	0.072025779	Normal
Cow Run SS	TDS	2016-10	mg/L	8	8	100%			6820	11800	12300	17000	3800	0.310173031	Normal
Cow Run SS	TDS	96147	mg/L	8	8	100%			1800	2430	2920	5760	1320	0.452918187	Lognormal
Cow Run SS	TDS	MW-20	mg/L	6	6	100%			2500	2610	2620	2710	70.4	0.026904871	Normal
Morgantown SS	Boron	2016-03	mg/L	8	8	100%			0.35	0.43	0.415	0.45	0.0379	0.091457908	NDD
Morgantown SS	Boron	2016-05	mg/L	8	8	100%			0.088	0.1	0.102	0.116	0.0102	0.100335183	Normal
Morgantown SS	Boron	2016-11	mg/L	4	4	100%			0.278	0.325	0.322	0.36	0.0394	0.122240906	Normal
Morgantown SS	Boron	96153R	mg/L	7	7	100%			0.23	0.448	0.396	0.48	0.109	0.274318881	NDD
Morgantown SS	Boron	96154R	mg/L	8	8	100%			0.395	0.495	0.481	0.53	0.0471	0.097919095	Normal
Morgantown SS	Boron	96156	mg/L	8	8	100%			0.357	0.397	0.399	0.46	0.0326	0.081674464	Normal

Geology	Analyte	Well	Units	N	Num Detects	Percent Detects	Min ND	Max ND	Min Detect	Median	Mean	Max Detect	SD	CV	Distribution
Morgantown SS	Calcium	2016-03	mg/L	8	8	100%			128	140	139	150	8.19	0.059024972	Normal
Morgantown SS	Calcium	2016-05	mg/L	8	8	100%			31	40.1	43.8	66	11	0.251512431	Normal
Morgantown SS	Calcium	2016-11	mg/L	4	4	100%			10.3	26.5	24.3	34	10.1	0.414013313	Normal
Morgantown SS	Calcium	96153R	mg/L	7	7	100%			72	189	169	210	50.9	0.300526452	Normal
Morgantown SS	Calcium	96154R	mg/L	8	8	100%			2.1	7.38	11.2	31	10.1	0.906193716	Lognormal
Morgantown SS	Calcium	96156	mg/L	8	8	100%			346	380	378	409	21.4	0.056629551	Normal
Morgantown SS	Chloride	2016-03	mg/L	8	8	100%			21.7	22	128	867	299	2.337643077	NDD
Morgantown SS	Chloride	2016-05	mg/L	8	8	100%			9.2	15	13.8	17.2	3.31	0.239674541	Normal
Morgantown SS	Chloride	2016-11	mg/L	4	4	100%			403	2280	1940	2800	1060	0.545123972	Normal
Morgantown SS	Chloride	96153R	mg/L	7	7	100%			11.6	19	21.7	35	9.23	0.425286587	Normal
Morgantown SS	Chloride	96154R	mg/L	8	8	100%			410	430	438	490	31.5	0.072073289	Normal
Morgantown SS	Chloride	96156	mg/L	6	6	100%			11700	12000	13000	17000	2030	0.157024706	NDD
Morgantown SS	Fluoride	2016-03	mg/L	8	8	100%			0.16	0.195	0.459	2.33	0.756	1.648560876	NDD
Morgantown SS	Fluoride	2016-05	mg/L	8	8	100%			0.18	0.195	0.2	0.22	0.0151	0.075592895	Normal
Morgantown SS	Fluoride	2016-11	mg/L	4	4	100%			2.01	2.2	2.2	2.4	0.159	0.072230913	Normal
Morgantown SS	Fluoride	96153R	mg/L	7	7	100%			0.67	1.2	1.34	2.3	0.706	0.526363506	Normal
Morgantown SS	Fluoride	96154R	mg/L	8	8	100%			3.32	3.75	3.84	4.5	0.538	0.14003836	NDD
Morgantown SS	Fluoride	96156	mg/L	6	1	17%	1.3	5	0.33	1.12	1.16	0.33	0.747	0.641693087	Normal
Morgantown SS	pH	2016-03	SU	8	8	100%			6.88	6.93	6.94	7.07	0.0607	0.008736223	Normal
Morgantown SS	pH	2016-05	SU	8	8	100%			7.48	7.85	7.82	8.01	0.157	0.020113664	Normal
Morgantown SS	pH	2016-11	SU	4	4	100%			8.35	8.72	9.51	12.23	1.83	0.19277611	Lognormal
Morgantown SS	pH	96153R	SU	7	7	100%			6.19	7.18	6.98	7.49	0.48	0.068708188	Normal
Morgantown SS	pH	96154R	SU	8	8	100%			8.67	9.43	9.47	10.67	0.734	0.077524871	Normal
Morgantown SS	pH	96156	SU	8	8	100%			6.77	7.24	7.56	8.93	0.782	0.103491933	Normal
Morgantown SS	Sulfate	2016-03	mg/L	8	8	100%			132	410	379	446	104	0.274847229	NDD
Morgantown SS	Sulfate	2016-05	mg/L	8	8	100%			116	135	136	160	14.6	0.107816288	Normal
Morgantown SS	Sulfate	2016-11	mg/L	4	4	100%			497	544	584	750	114	0.194548482	Normal
Morgantown SS	Sulfate	96153R	mg/L	7	7	100%			973	1200	1210	1700	259	0.213869887	Normal
Morgantown SS	Sulfate	96154R	mg/L	8	8	100%			60	93.3	87.8	125	22.7	0.258000051	Normal
Morgantown SS	Sulfate	96156	mg/L	6	2	33%	25	100	1	18.8	19.2	1.9	18.4	0.956257916	Normal
Morgantown SS	TDS	2016-03	mg/L	8	8	100%			1000	1080	1170	1990	333	0.284141497	NDD
Morgantown SS	TDS	2016-05	mg/L	8	8	100%			388	420	434	500	40.1	0.092592951	Normal
Morgantown SS	TDS	2016-11	mg/L	4	4	100%			3060	4650	4390	5200	946	0.215507888	Normal
Morgantown SS	TDS	96153R	mg/L	7	7	100%			1600	1800	1890	2300	251	0.132392505	Normal
Morgantown SS	TDS	96154R	mg/L	8	8	100%			1400	1520	1590	1940	200	0.12570699	Normal
Morgantown SS	TDS	96156	mg/L	6	6	100%			15000	18200	17700	21000	2350	0.132664693	Normal

Notes

Pooled well indicates that the summary statistics were produced for the pooled upgradient wells based on the Kruskal-Wallis test (Table B-1).
mg/L: milligrams per liter
SU: Standard units
TDS: Total dissolved solids
N: number of data points
Min ND: The minimum non-detected value
Max ND: The maximum non-detected value
SD: Standard Deviation
CV: Coefficient of Variation (standard deviation divided by the mean)
Normal: the data fit a normal distribution
Lognormal: the data fit a lognormal distribution
NDD: No discernible distribution

Table B-3: Potential Outliers in Upgradient Wells, Fly Ash Reservoir

Well	Sample	Geology	Date	Analyte	RL	Units	Detect	Concentration	UPL Type	Distribution	Statistical Outlier	Visual Outlier	Normal Outlier	Log Statistical Outlier	Log Visual Outlier	Lognormal Outlier	Statistical and Visual Outlier	Notes	Final Outlier Determination
2016-09	2016-09-20161003-01	Cow Run SS	10/3/2016	Boron		mg/L	TRUE	0.411	Single Well	Lognormal	X	X	X	X	X	X	0	There is no indication of sample collection or lab QC problems based on a review of the field and lab documents. This result is within 2x -3x the other 7 values measured for this well. Therefore this result was retained in the dataset.	Not an outlier
MW-20	MW-20-20161005-01	Cow Run SS	10/5/2016	Boron		mg/L	TRUE	0.272	Single Well	Normal		X							
2016-09	2016-09-20161003-01	Cow Run SS	10/3/2016	Calcium		mg/L	TRUE	202	Single Well	Lognormal	X	X	X		X				
96147	96147-20161005-01	Cow Run SS	10/5/2016	Calcium		mg/L	TRUE	85.6	Single Well	Lognormal	X	X	X		X				
2016-06	2016-06-20170608-01	Cow Run SS	6/8/2017	Chloride		mg/L	TRUE	570	Single Well	Normal		X			X				
2016-09	2016-09-20170425-01	Cow Run SS	4/25/2017	Chloride		mg/L	TRUE	2000	Single Well	NDD		X			X				
96147	96147-20160824-01	Cow Run SS	8/24/2016	Chloride		mg/L	TRUE	3240	Single Well	Lognormal		X			X				
96147	96147-20161005-01	Cow Run SS	10/5/2016	Chloride		mg/L	TRUE	1650	Single Well	Lognormal		X			X				
MW-20	MW-20-20160823-01	Cow Run SS	8/23/2016	Chloride		mg/L	TRUE	60.1	Single Well	Lognormal	X	X	X						
MW-20	MW20-20170425-01	Cow Run SS	4/25/2017	Fluoride		mg/L	TRUE	1.2	Single Well	Normal	X	X	X	X	X	X	0	There is no indication of sample collection or lab QC problems based on a review of field and lab documentation. This result is within 0.3mg/L of the other 5 values measured for this well, and was retained in the dataset.	Not an outlier
2016-10	2016-10-20160823-01	Cow Run SS	8/23/2016	pH		SU	TRUE	9.79	Single Well	NDD		X			X				
MW-20	MW-20-20160823-01	Cow Run SS	8/23/2016	pH		SU	TRUE	6.88	Single Well	NDD	X	X	X	X	X	X	0	This value is within 0.3 standard units of the other 5 results, and thus is very similar to the rest of the pH results and was retained in the dataset.	Not an outlier
2016-10	2016-10-20170425-01	Cow Run SS	4/25/2017	Sulfate		mg/L	TRUE	1100	Single Well	Normal		X							
96147	96147-20170713-01	Cow Run SS	7/13/2017	Sulfate		mg/L	TRUE	140	Single Well	Normal		X			X				
MW-20	MW20-20170425-01	Cow Run SS	4/25/2017	Sulfate		mg/L	TRUE	2200	Single Well	NDD	X	X	X		X		0	MW-20 is the most upgradient well in the network, so it is unlikely to be impacted by Gavin facility operations. Sources of acid mine drainage associated with historical coal mining likely contribute sulfate to MW-20. Sulfate could also be released in the Cow Run sandstone through the oxidation of naturally occuring pyrite. The field and lab documentation do not suggest any QA issues. Based on these lines of evidence and assessment monitoring completed at well 94136, this value was retained in the dataset	Not an outlier
2016-06	2016-06-20170608-01	Cow Run SS	6/8/2017	TDS		mg/L	TRUE	1700	Single Well	Lognormal	X	X	X	X	X	X	0	TDS in this well is relatively stable in this well over time. The value is at the low end of TDS concentrations in other background wells. This value was retained in the dataset	Not an outlier
2016-09	2016-09-20160823-01	Cow Run SS	8/23/2016	TDS		mg/L	TRUE	4820	Single Well	Normal		X							
96147	96147-20160824-01	Cow Run SS	8/24/2016	TDS		mg/L	TRUE	5760	Single Well	Lognormal		X							
96156	96156-20170321-01	Morgantown SS	3/21/2017	Boron		mg/L	TRUE	0.46	Single Well	Normal		X			X				
2016-05	2016-05-20170327-01	Morgantown SS	3/27/2017	Calcium		mg/L	TRUE	66	Single Well	Normal		X			X				
96154R	96154-R-20170130-01	Morgantown SS	1/30/2017	Calcium		mg/L	TRUE	22.1	Single Well	Lognormal		X							
96154R	96154R-20170321-01	Morgantown SS	3/21/2017	Calcium		mg/L	TRUE	31	Single Well	Lognormal		X							
2016-03	2016-03-20170131-01	Morgantown SS	1/31/2017	Chloride		mg/L	TRUE	867	Single Well	NDD	X	X	X	X	X	X	0	Chloride is relatively stable in this well over time. The value is within the same range of concentrations of chloride in other background wells. This value was retained in the dataset	Not an outlier
96156	96156-20170321-01	Morgantown SS	3/21/2017	Chloride		mg/L	TRUE	13000	Single Well	NDD	X			X					

Well	Sample	Geology	Date	Analyte	RL	Units	Detect	Concentration	UPL Type	Distribution	Statistical Outlier	Visual Outlier	Normal Outlier	Log Statistical Outlier	Log Visual Outlier	Lognormal Outlier	Statistical and Visual Outlier	Notes	Final Outlier Determination
96156	96156-20170425-01	Morgantown SS	4/25/2017	Chloride		mg/L	TRUE	17000	Single Well	NDD	X	X	X	X	X	X	0	A review of laboratory documentation indicates there were no data quality issues. Field records indicate a relatively high turbidity value (72.5 NTU) in the April 2017 sample, however there is no correlation between turbidity and chloride at this well over the 8 sampling rounds, thus this value was retained in the dataset.	Not an outlier
2016-03	2016-03-20170131-01	Morgantown SS	1/31/2017	Fluoride		mg/L	TRUE	2.33	Single Well	NDD	X	X	X	X	X	X	0	The value is within the same range of concentrations of fluoride in other background wells. This value was retained in the dataset	Not an outlier
96153R	96153 R-20170425-01	Morgantown SS	4/25/2017	Fluoride		mg/L	TRUE	2.3	Single Well	Normal	X			X					
96154R	96154R-20170712-01	Morgantown SS	7/12/2017	Fluoride		mg/L	TRUE	4.5	Single Well	NDD	X			X					
2016-03	2016-03-20160824-01	Morgantown SS	8/24/2016	pH		SU	TRUE	7.07	Single Well	Normal		X			X				
2016-03	2016-03-20161201-01	Morgantown SS	12/1/2016	pH		SU	TRUE	6.99	Single Well	Normal		X			X				
2016-10	2016-11-20160823-01	Morgantown SS	8/23/2016	pH		SU	TRUE	12.23	Single Well	Lognormal							X	pH value of 12.23 was removed based on visual inspe	Outlier
2016-03	2016-03-20170131-01	Morgantown SS	1/31/2017	TDS		mg/L	TRUE	1990	Single Well	NDD	X	X	X	X	X	X	0	TDS is relatively stable in this well over time. The value is within the same range of concentrations of chloride in other background wells. This value was retained in the dataset	Not an outlier
96154R	96154-R-20160823-01	Morgantown SS	8/23/2016	TDS		mg/L	TRUE	1940	Single Well	Normal		X							
96154R	96154-R-20161129-01	Morgantown SS	11/29/2016	TDS		mg/L	TRUE	1850	Single Well	Normal		X			X				

Notes
RL: Reporting Limit
UPL: Upper prediction limit
NDD: No Discernible Distribution
SU: Standard units
mg/L: milligrams per liter
Outlier tests were performed on detected data only.
Statistical outliers were determined using a Dixon's test for N < 25 and with Rosner's test for N > 25.
Visual outliers were identified if they fall above the confidence envelope on the QQ plot.
Data points were considered potential outliers if they were both statistical and visual outliers.
NDD wells had data points considered as potential outliers if they were either a normal or lognormal outlier.
[Blank] data distribution indicates that the well data did not have enough detected data points for outlier analysis.
Lognormally distributed data was first log-transformed before visual and statistical outlier tests were performed.
Normal data distribution indicates that the well data was directly used for statistical and visual outlier tests.
NDD indicates that the both untransformed and transformed data were examined with statistical and visual outlier tests.
0 indicates that the data point was a statistical and visual outlier but was retained after review by the hydrogeologist

Table B-4: Mann Kendall Test for Trends in Upgradient Wells, Fly Ash Reservoir

Analyte	Geology	UPL Type	Well	N	Num Detects	Percent Detects	p-value	tau	Conclusion
Boron	Cow Run SS	Intrawell	2016-04	6	6	100%	0.444	0.276	Stable, No Trend
Boron	Cow Run SS	Intrawell	2016-06	8	8	100%	0.209	0.371	Stable, No Trend
Boron	Cow Run SS	Intrawell	2016-09	8	8	100%	0.383	0.255	Stable, No Trend
Boron	Cow Run SS	Intrawell	2016-10	8	8	100%	0.109	0.5	Stable, No Trend
Boron	Cow Run SS	Intrawell	96147	8	8	100%	0.0178	0.691	Increasing Trend
Boron	Cow Run SS	Intrawell	MW-20	6	6	100%	0.702	0.138	Stable, No Trend
Calcium	Cow Run SS	Intrawell	2016-04	6	6	100%	0.719	0.2	Stable, No Trend
Calcium	Cow Run SS	Intrawell	2016-06	8	8	100%	0.0141	-0.714	Decreasing Trend
Calcium	Cow Run SS	Intrawell	2016-09	8	8	100%	0.399	-0.286	Stable, No Trend
Calcium	Cow Run SS	Intrawell	2016-10	8	8	100%	<0.001	1	Increasing Trend
Calcium	Cow Run SS	Intrawell	96147	8	8	100%	0.061	-0.571	Stable, No Trend
Calcium	Cow Run SS	Intrawell	MW-20	6	6	100%	0.227	0.447	Stable, No Trend
Chloride	Cow Run SS	Intrawell	2016-04	6	6	100%	0.272	0.467	Stable, No Trend
Chloride	Cow Run SS	Intrawell	2016-06	8	8	100%	0.533	0.182	Stable, No Trend
Chloride	Cow Run SS	Intrawell	2016-09	8	8	100%	0.0444	0.593	Increasing Trend
Chloride	Cow Run SS	Intrawell	2016-10	8	8	100%	0.00183	0.909	Increasing Trend
Chloride	Cow Run SS	Intrawell	96147	8	8	100%	0.179	-0.429	Stable, No Trend
Chloride	Cow Run SS	Intrawell	MW-20	6	6	100%	0.0167	-0.867	Decreasing Trend
Fluoride	Cow Run SS	Intrawell	2016-04	6	6	100%	0.444	-0.276	Stable, No Trend
Fluoride	Cow Run SS	Intrawell	2016-06	8	8	100%	0.061	0.571	Stable, No Trend
Fluoride	Cow Run SS	Intrawell	2016-09	8	8	100%	0.72	0.143	Stable, No Trend
Fluoride	Cow Run SS	Intrawell	2016-10	8	4	50%			Insufficient Data
Fluoride	Cow Run SS	Intrawell	96147	8	8	100%	0.0141	0.714	Increasing Trend
Fluoride	Cow Run SS	Intrawell	MW-20	6	6	100%	0.444	-0.276	Stable, No Trend
pH	Cow Run SS	Intrawell	2016-04	6	6	100%	0.719	0.2	Stable, No Trend
pH	Cow Run SS	Intrawell	2016-06	8	8	100%	0.383	-0.255	Stable, No Trend
pH	Cow Run SS	Intrawell	2016-09	8	8	100%	0.383	-0.255	Stable, No Trend
pH	Cow Run SS	Intrawell	2016-10	8	8	100%	0.399	-0.286	Stable, No Trend
pH	Cow Run SS	Intrawell	96147	7	7	100%	0.543	0.195	Stable, No Trend
pH	Cow Run SS	Intrawell	MW-20	6	6	100%	0.33	-0.358	Stable, No Trend
Sulfate	Cow Run SS	Intrawell	2016-04	6	6	100%	0.719	-0.2	Stable, No Trend

Analyte	Geology	UPL Type	Well	N	Num Detects	Percent Detects	p-value	tau	Conclusion
Sulfate	Cow Run SS	Intrawell	2016-06	8	8	100%	0.161	0.416	Stable, No Trend
Sulfate	Cow Run SS	Intrawell	2016-09	8	8	100%	0.905	0.0714	Stable, No Trend
Sulfate	Cow Run SS	Intrawell	2016-10	8	8	100%	0.179	-0.429	Stable, No Trend
Sulfate	Cow Run SS	Intrawell	96147	8	8	100%	0.0034	0.869	Increasing Trend
Sulfate	Cow Run SS	Intrawell	MW-20	6	6	100%	0.702	-0.138	Stable, No Trend
TDS	Cow Run SS	Intrawell	2016-04	6	6	100%	0.469	0.333	Stable, No Trend
TDS	Cow Run SS	Intrawell	2016-06	8	8	100%	0.04	0.617	Increasing Trend
TDS	Cow Run SS	Intrawell	2016-09	8	8	100%	0.132	-0.445	Stable, No Trend
TDS	Cow Run SS	Intrawell	2016-10	8	8	100%	0.0178	0.691	Increasing Trend
TDS	Cow Run SS	Intrawell	96147	8	8	100%	<0.001	-0.929	Decreasing Trend
TDS	Cow Run SS	Intrawell	MW-20	6	6	100%	0.126	-0.552	Stable, No Trend
Boron	Morgantown SS	Intrawell	2016-03	8	8	100%	0.0237	0.667	Increasing Trend
Boron	Morgantown SS	Intrawell	2016-05	8	8	100%	0.897	0.0394	Stable, No Trend
Boron	Morgantown SS	Intrawell	2016-11	4	4	100%			Insufficient Data
Boron	Morgantown SS	Intrawell	96153R	7	7	100%	0.362	0.293	Stable, No Trend
Boron	Morgantown SS	Intrawell	96154R	8	8	100%	0.0178	0.691	Increasing Trend
Boron	Morgantown SS	Intrawell	96156	8	8	100%	0.105	0.473	Stable, No Trend
Calcium	Morgantown SS	Intrawell	2016-03	8	8	100%	0.252	0.34	Stable, No Trend
Calcium	Morgantown SS	Intrawell	2016-05	8	8	100%	0.905	-0.0714	Stable, No Trend
Calcium	Morgantown SS	Intrawell	2016-11	4	4	100%			Insufficient Data
Calcium	Morgantown SS	Intrawell	96153R	7	7	100%	0.381	-0.333	Stable, No Trend
Calcium	Morgantown SS	Intrawell	96154R	8	8	100%	0.548	-0.214	Stable, No Trend
Calcium	Morgantown SS	Intrawell	96156	8	8	100%	0.533	-0.182	Stable, No Trend
Chloride	Morgantown SS	Intrawell	2016-03	8	8	100%	0.373	0.265	Stable, No Trend
Chloride	Morgantown SS	Intrawell	2016-05	8	8	100%	0.399	-0.286	Stable, No Trend
Chloride	Morgantown SS	Intrawell	2016-11	4	4	100%			Insufficient Data
Chloride	Morgantown SS	Intrawell	96153R	7	7	100%	0.773	0.143	Stable, No Trend
Chloride	Morgantown SS	Intrawell	96154R	8	8	100%	0.373	0.265	Stable, No Trend
Chloride	Morgantown SS	Intrawell	96156	6	6	100%	0.421	0.298	Stable, No Trend
Fluoride	Morgantown SS	Intrawell	2016-03	8	8	100%	0.802	0.0741	Stable, No Trend
Fluoride	Morgantown SS	Intrawell	2016-05	8	8	100%	0.0208	0.694	Increasing Trend
Fluoride	Morgantown SS	Intrawell	2016-11	4	4	100%			Insufficient Data
Fluoride	Morgantown SS	Intrawell	96153R	7	7	100%	0.543	0.195	Stable, No Trend

Analyte	Geology	UPL Type	Well	N	Num Detects	Percent Detects	p-value	tau	Conclusion
Fluoride	Morgantown SS	Intrawell	96154R	8	8	100%	0.0178	0.691	Increasing Trend
Fluoride	Morgantown SS	Intrawell	96156	6	1	17%			Insufficient Data
pH	Morgantown SS	Intrawell	2016-03	8	8	100%	0.0978	-0.491	Stable, No Trend
pH	Morgantown SS	Intrawell	2016-05	8	8	100%	1	0	Stable, No Trend
pH	Morgantown SS	Intrawell	2016-11	3	3	100%			Insufficient Data
pH	Morgantown SS	Intrawell	96153R	7	7	100%	0.773	0.143	Stable, No Trend
pH	Morgantown SS	Intrawell	96154R	8	8	100%	1	0	Stable, No Trend
pH	Morgantown SS	Intrawell	96156	8	8	100%	0.275	0.357	Stable, No Trend
Sulfate	Morgantown SS	Intrawell	2016-03	8	8	100%	0.72	-0.143	Stable, No Trend
Sulfate	Morgantown SS	Intrawell	2016-05	8	8	100%	0.548	0.214	Stable, No Trend
Sulfate	Morgantown SS	Intrawell	2016-11	4	4	100%			Insufficient Data
Sulfate	Morgantown SS	Intrawell	96153R	7	7	100%	0.543	-0.195	Stable, No Trend
Sulfate	Morgantown SS	Intrawell	96154R	8	8	100%	0.708	-0.109	Stable, No Trend
Sulfate	Morgantown SS	Intrawell	96156	6	2	33%			Insufficient Data
TDS	Morgantown SS	Intrawell	2016-03	8	8	100%	0.315	-0.296	Stable, No Trend
TDS	Morgantown SS	Intrawell	2016-05	8	8	100%	0.548	-0.214	Stable, No Trend
TDS	Morgantown SS	Intrawell	2016-11	4	4	100%			Insufficient Data
TDS	Morgantown SS	Intrawell	96153R	7	7	100%	0.0683	-0.586	Stable, No Trend
TDS	Morgantown SS	Intrawell	96154R	8	8	100%	0.0785	-0.519	Stable, No Trend
TDS	Morgantown SS	Intrawell	96156	6	6	100%	1	0	Stable, No Trend

Notes

UPL: Upper prediction limit

TDS: Total dissolved solids

N: number of data points

tau: Kendall's tau statistic

p-value: A two-sided p-value describing the probability of the H0 being true (a=0.05)

Trend tests were performed only if the upgradient dataset met the minium data quality criteria (ERM 2017).

Table B-5: Calculated UPLs for Upgradient Datasets, Fly Ash Reservoir

Analyte	Geology	UPL Type	Trend	Well	N	Num Detects	Percent Detects	LPL	UPL	Units	ND Adjustment	Transformation	Alpha	Method	Final LPL	Final UPL	Notes
Boron	Cow Run SS	Single well	Stable, No Trend	2016-04	6	6	100%		0.443	mg/L	None	No	0.0025	Param Intra 1 of 2			
Boron	Cow Run SS	Single well	Stable, No Trend	2016-06	8	8	100%		0.583	mg/L	None	No	0.0025	Param Intra 1 of 2			
Boron	Cow Run SS	Single well	Stable, No Trend	2016-09	8	8	100%		0.486	mg/L	None	ln(x)	0.0025	Param Intra 1 of 2			
Boron	Cow Run SS	Single well	Stable, No Trend	2016-10	8	8	100%		0.653	mg/L	None	No	0.0025	Param Intra 1 of 2		X	
Boron	Cow Run SS	Single well	Increasing Trend	96147	8	8	100%		0.542	mg/L	None	No	0.0025	NP Detrended UPL			
Boron	Cow Run SS	Single well	Stable, No Trend	MW-20	6	6	100%		0.342	mg/L	None	No	0.0025	Param Intra 1 of 2			
Calcium	Cow Run SS	Single well	Stable, No Trend	2016-04	6	6	100%		64.6	mg/L	None	No	0.0025	Param Intra 1 of 2			
Calcium	Cow Run SS	Single well	Decreasing Trend	2016-06	8	8	100%		4.84	mg/L	None	No	0.0025	NP Detrended UPL			
Calcium	Cow Run SS	Single well	Stable, No Trend	2016-09	8	8	100%		246	mg/L	None	ln(x)	0.0025	Param Intra 1 of 2			
Calcium	Cow Run SS	Single well	Increasing Trend	2016-10	8	8	100%		511	mg/L	None	No	0.0025	NP Detrended UPL			
Calcium	Cow Run SS	Single well	Stable, No Trend	96147	8	8	100%		106	mg/L	None	ln(x)	0.0025	Param Intra 1 of 2			
Calcium	Cow Run SS	Single well	Stable, No Trend	MW-20	6	6	100%		532	mg/L	None	No	0.0025	Param Intra 1 of 2		X	
Chloride	Cow Run SS	Single well	Stable, No Trend	2016-04	6	6	100%		3140	mg/L	None	No	0.0025	Param Intra 1 of 2			
Chloride	Cow Run SS	Single well	Stable, No Trend	2016-06	8	8	100%		587	mg/L	None	No	0.0025	Param Intra 1 of 2			
Chloride	Cow Run SS	Single well	Increasing Trend	2016-09	8	8	100%		1980	mg/L	None	No	0.0025	NP Detrended UPL			
Chloride	Cow Run SS	Single well	Increasing Trend	2016-10	8	8	100%		13900	mg/L	None	No	0.0025	NP Detrended UPL		X	
Chloride	Cow Run SS	Single well	Stable, No Trend	96147	8	8	100%		4850	mg/L	None	ln(x)	0.0025	Param Intra 1 of 2			
Chloride	Cow Run SS	Single well	Decreasing Trend	MW-20	6	6	100%		23.5	mg/L	None	No	0.0025	NP Detrended UPL			
Fluoride	Cow Run SS	Single well	Stable, No Trend	2016-04	6	6	100%		2.05	mg/L	None	No	0.0025	Param Intra 1 of 2			
Fluoride	Cow Run SS	Single well	Stable, No Trend	2016-06	8	8	100%		6.93	mg/L	None	No	0.0025	Param Intra 1 of 2			
Fluoride	Cow Run SS	Single well	Stable, No Trend	2016-09	8	8	100%		2.45	mg/L	None	No	0.0025	Param Intra 1 of 2			
Fluoride	Cow Run SS	Single well	Insufficient Data	2016-10	8	4	50%		5	mg/L				<5 Detects, Max RL used			<5 Detected values
Fluoride	Cow Run SS	Single well	Increasing Trend	96147	8	8	100%		6.96	mg/L	None	No	0.0025	NP Detrended UPL		X	
Fluoride	Cow Run SS	Single well	Stable, No Trend	MW-20	6	6	100%		1.31	mg/L	None	No	0.0025	Param Intra 1 of 2			
pH	Cow Run SS	Single well	Stable, No Trend	2016-04	6	6	100%	6.32	9.33	SU	None	No	0.00125	Param Intra 1 of 2			
pH	Cow Run SS	Single well	Stable, No Trend	2016-06	8	8	100%	8.22	8.6	SU	None	No	0.00125	Param Intra 1 of 2			
pH	Cow Run SS	Single well	Stable, No Trend	2016-09	8	8	100%	12.3	12.8	SU	None	No	0.00125	Param Intra 1 of 2		X	
pH	Cow Run SS	Single well	Stable, No Trend	2016-10	8	8	100%	5.8	9.98	SU	None	No	0.00125	Param Intra 1 of 2			
pH	Cow Run SS	Single well	Stable, No Trend	96147	7	7	100%	7.74	8.31	SU	None	No	0.00125	Param Intra 1 of 2			
pH	Cow Run SS	Single well	Stable, No Trend	MW-20	6	6	100%	6.5	6.88	SU	None	No	0.0714	NP Intra (normality) 1 of 2	X		
Sulfate	Cow Run SS	Single well	Stable, No Trend	2016-04	6	6	100%		435	mg/L	None	No	0.0025	Param Intra 1 of 2			
Sulfate	Cow Run SS	Single well	Stable, No Trend	2016-06	8	8	100%		128	mg/L	None	No	0.0025	Param Intra 1 of 2			
Sulfate	Cow Run SS	Single well	Stable, No Trend	2016-09	8	8	100%		97.4	mg/L	None	No	0.0025	Param Intra 1 of 2			
Sulfate	Cow Run SS	Single well	Stable, No Trend	2016-10	8	8	100%		1190	mg/L	None	No	0.0025	Param Intra 1 of 2			
Sulfate	Cow Run SS	Single well	Increasing Trend	96147	8	8	100%		171	mg/L	None	No	0.0025	NP Detrended UPL			
Sulfate	Cow Run SS	Single well	Stable, No Trend	MW-20	6	6	100%		2440	mg/L	None	No	0.0025	Param Intra 1 of 2		X	
TDS	Cow Run SS	Single well	Stable, No Trend	2016-04	6	6	100%		5320	mg/L	None	No	0.0025	Param Intra 1 of 2			
TDS	Cow Run SS	Single well	Increasing Trend	2016-06	8	8	100%		1690	mg/L	None	No	0.0025	NP Detrended UPL			
TDS	Cow Run SS	Single well	Stable, No Trend	2016-09	8	8	100%		5010	mg/L	None	No	0.0025	Param Intra 1 of 2			
TDS	Cow Run SS	Single well	Increasing Trend	2016-10	8	8	100%		22600	mg/L	None	No	0.0025	NP Detrended UPL		X	
TDS	Cow Run SS	Single well	Decreasing Trend	96147	8	8	100%		2840	mg/L	None	No	0.0025	NP Detrended UPL			

Analyte	Geology	UPL Type	Trend	Well	N	Num Detects	Percent Detects	LPL	UPL	Units	ND Adjustment	Transformation	Alpha	Method	Final LPL	Final UPL	Notes
TDS	Cow Run SS	Single well	Stable, No Trend	MW-20	6	6	100%		2820	mg/L	None	No	0.0025	Param Intra 1 of 2			
Boron	Morgantown SS	Single well	Increasing Trend	2016-03	8	8	100%		0.514	mg/L	None	No	0.00167	NP Detrended UPL			
Boron	Morgantown SS	Single well	Stable, No Trend	2016-05	8	8	100%		0.129	mg/L	None	No	0.00167	Param Intra 1 of 2			
Boron	Morgantown SS	Single well	Insufficient Data	2016-11	4	4	100%		0.36	mg/L				<5 Detects, Max Detect used			<5 Detected values
Boron	Morgantown SS	Single well	Stable, No Trend	96153R	7	7	100%		0.723	mg/L	None	No	0.00167	Param Intra 1 of 2		X	
Boron	Morgantown SS	Single well	Increasing Trend	96154R	8	8	100%		0.577	mg/L	None	No	0.00167	NP Detrended UPL			
Boron	Morgantown SS	Single well	Stable, No Trend	96156	8	8	100%		0.488	mg/L	None	No	0.00167	Param Intra 1 of 2			
Calcium	Morgantown SS	Single well	Stable, No Trend	2016-03	8	8	100%		161	mg/L	None	No	0.00167	Param Intra 1 of 2			
Calcium	Morgantown SS	Single well	Stable, No Trend	2016-05	8	8	100%		73.8	mg/L	None	No	0.00167	Param Intra 1 of 2			
Calcium	Morgantown SS	Single well	Insufficient Data	2016-11	4	4	100%		34	mg/L				<5 Detects, Max Detect used			<5 Detected values
Calcium	Morgantown SS	Single well	Stable, No Trend	96153R	7	7	100%		322	mg/L	None	No	0.00167	Param Intra 1 of 2			
Calcium	Morgantown SS	Single well	Stable, No Trend	96154R	8	8	100%		38.8	mg/L	None	No	0.00167	Param Intra 1 of 2			
Calcium	Morgantown SS	Single well	Stable, No Trend	96156	8	8	100%		437	mg/L	None	No	0.00167	Param Intra 1 of 2		X	
Chloride	Morgantown SS	Single well	Stable, No Trend	2016-03	8	8	100%		867	mg/L	None	No	0.0222	NP Intra (normality) 1 of 2			
Chloride	Morgantown SS	Single well	Stable, No Trend	2016-05	8	8	100%		22.8	mg/L	None	No	0.00167	Param Intra 1 of 2			
Chloride	Morgantown SS	Single well	Insufficient Data	2016-11	4	4	100%		2800	mg/L				<5 Detects, Max Detect used			<5 Detected values
Chloride	Morgantown SS	Single well	Stable, No Trend	96153R	7	7	100%		49.5	mg/L	None	No	0.00167	Param Intra 1 of 2			
Chloride	Morgantown SS	Single well	Stable, No Trend	96154R	8	8	100%		523	mg/L	None	No	0.00167	Param Intra 1 of 2			
Chloride	Morgantown SS	Single well	Stable, No Trend	96156	6	6	100%		17000	mg/L	None	No	0.0357	NP Intra (normality) 1 of 2		X	
Fluoride	Morgantown SS	Single well	Stable, No Trend	2016-03	8	8	100%		2.33	mg/L	None	No	0.0222	NP Intra (normality) 1 of 2			
Fluoride	Morgantown SS	Single well	Increasing Trend	2016-05	8	8	100%		0.234	mg/L	None	No	0.00167	NP Detrended UPL			
Fluoride	Morgantown SS	Single well	Insufficient Data	2016-11	4	4	100%		2.4	mg/L				<5 Detects, Max Detect used			<5 Detected values
Fluoride	Morgantown SS	Single well	Stable, No Trend	96153R	7	7	100%		3.46	mg/L	None	No	0.00167	Param Intra 1 of 2			
Fluoride	Morgantown SS	Single well	Increasing Trend	96154R	8	8	100%		5.02	mg/L	None	No	0.00167	NP Detrended UPL		X	
Fluoride	Morgantown SS	Single well	Insufficient Data	96156	6	1	17%		5	mg/L				<5 Detects, Max RL used			<5 Detected values, <50 Percent Detects
pH	Morgantown SS	Single well	Stable, No Trend	2016-03	8	8	100%	6.78	7.11	SU	None	No	0.000836	Param Intra 1 of 2	X		
pH	Morgantown SS	Single well	Stable, No Trend	2016-05	8	8	100%	7.4	8.25	SU	None	No	0.000836	Param Intra 1 of 2			
pH	Morgantown SS	Single well	Insufficient Data	2016-11	3	3	100%	8.35	8.95	SU				<5 Detects, Max Detect used			<5 Detected values
pH	Morgantown SS	Single well	Stable, No Trend	96153R	7	7	100%	5.54	8.42	SU	None	No	0.000836	Param Intra 1 of 2			
pH	Morgantown SS	Single well	Stable, No Trend	96154R	8	8	100%	7.47	11.5	SU	None	No	0.000836	Param Intra 1 of 2		X	
pH	Morgantown SS	Single well	Stable, No Trend	96156	8	8	100%	5.43	9.68	SU	None	No	0.000836	Param Intra 1 of 2			
Sulfate	Morgantown SS	Single well	Stable, No Trend	2016-03	8	8	100%		446	mg/L	None	No	0.0222	NP Intra (normality) 1 of 2			
Sulfate	Morgantown SS	Single well	Stable, No Trend	2016-05	8	8	100%		176	mg/L	None	No	0.00167	Param Intra 1 of 2			
Sulfate	Morgantown SS	Single well	Insufficient Data	2016-11	4	4	100%		750	mg/L				<5 Detects, Max Detect used			<5 Detected values
Sulfate	Morgantown SS	Single well	Stable, No Trend	96153R	7	7	100%		1990	mg/L	None	No	0.00167	Param Intra 1 of 2		X	
Sulfate	Morgantown SS	Single well	Stable, No Trend	96154R	8	8	100%		149	mg/L	None	No	0.00167	Param Intra 1 of 2			
Sulfate	Morgantown SS	Single well	Insufficient Data	96156	6	2	33%		100	mg/L				<5 Detects, Max RL used			<5 Detected values, <50 Percent Detects
TDS	Morgantown SS	Single well	Stable, No Trend	2016-03	8	8	100%		1990	mg/L	None	No	0.0222	NP Intra (normality) 1 of 2			
TDS	Morgantown SS	Single well	Stable, No Trend	2016-05	8	8	100%		543	mg/L	None	No	0.00167	Param Intra 1 of 2			
TDS	Morgantown SS	Single well	Insufficient Data	2016-11	4	4	100%		5200	mg/L				<5 Detects, Max Detect used			<5 Detected values
TDS	Morgantown SS	Single well	Stable, No Trend	96153R	7	7	100%		2650	mg/L	None	No	0.00167	Param Intra 1 of 2			

Analyte	Geology	UPL Type	Trend	Well	N	Num Detects	Percent Detects	LPL	UPL	Units	ND Adjustment	Transformation	Alpha	Method	Final LPL	Final UPL	Notes
TDS	Morgantown SS	Single well	Stable, No Trend	96154R	8	8	100%		2140	mg/L	None	No	0.00167	Param Intra 1 of 2			
TDS	Morgantown SS	Single well	Stable, No Trend	96156	6	6	100%		25500	mg/L	None	No	0.00167	Param Intra 1 of 2		X	

Notes

N: number of data points
UPL: upper prediction limit
LPL: Lower prediction limit. These were only calculated for pH
UPLs were constructed with a site wide false positive rate of 0.1 and a 1 of 2 retesting.
UPLs were calculated using Sanitas Software.
ND: Nondetect
mg/L: milligrams per liter
SU: Standard units

Table B-6: Comparison of Downgradient Wells to UPLs, Fly Ash Reservoir

Analyte	Well	Geology	LPL	UPL	Units	Recent Date	Observation	Qualifier	Obs > UPL	Notes	Mann Kendall P-value	Mann Kendall tau
Boron	2016-02	Cow Run SS		0.653	mg/L	7/13/2017	0.53					
Boron	2016-08	Cow Run SS		0.653	mg/L	6/7/2017	0.32					
Calcium	2016-02	Cow Run SS		532	mg/L	7/13/2017	480					
Calcium	2016-08	Cow Run SS		532	mg/L	6/7/2017	140					
Chloride	2016-02	Cow Run SS		13900	mg/L	7/13/2017	10000					
Chloride	2016-08	Cow Run SS		13900	mg/L	6/7/2017	1200					
Fluoride	2016-02	Cow Run SS		6.96	mg/L	7/13/2017	5	ND				
Fluoride	2016-08	Cow Run SS		6.96	mg/L	6/7/2017	2.3					
pH	2016-02	Cow Run SS	6.5	12.8	SU	7/13/2017	7.09					
pH	2016-08	Cow Run SS	6.5	12.8	SU	6/7/2017	12.42					
Sulfate	2016-02	Cow Run SS		2440	mg/L	7/13/2017	240					
Sulfate	2016-08	Cow Run SS		2440	mg/L	6/7/2017	89					
TDS	2016-02	Cow Run SS		22600	mg/L	7/13/2017	17000					
TDS	2016-08	Cow Run SS		22600	mg/L	6/7/2017	3000					
Boron	2016-01	Morgantown SS		0.723	mg/L	7/13/2017	0.35					
Boron	2016-07	Morgantown SS		0.723	mg/L	8/10/2017	0.44					
Calcium	2016-01	Morgantown SS		437	mg/L	7/13/2017	8.6					
Calcium	2016-07	Morgantown SS		437	mg/L	8/10/2017	41					
Chloride	2016-01	Morgantown SS		17000	mg/L	7/13/2017	210					
Chloride	2016-07	Morgantown SS		17000	mg/L	8/10/2017	1200					
Fluoride	2016-01	Morgantown SS		5.02	mg/L	7/13/2017	16		X	Trend Test: Increasing Trend	<0.001	0.929
Fluoride	2016-07	Morgantown SS		5.02	mg/L	8/10/2017	2.6					
pH	2016-01	Morgantown SS	6.78	11.5	SU	7/13/2017	11.03					
pH	2016-07	Morgantown SS	6.78	11.5	SU	8/10/2017	9.1					
Sulfate	2016-01	Morgantown SS		1990	mg/L	7/13/2017	150					
Sulfate	2016-07	Morgantown SS		1990	mg/L	8/10/2017	77					
TDS	2016-01	Morgantown SS		25500	mg/L	7/13/2017	950					
TDS	2016-07	Morgantown SS		25500	mg/L	8/10/2017	2500					

Notes

LPL: Lower Prediction Limit
UPL: Upper Prediction Limit
mg/L: milligrams per liter
Obs > UPL: the observation is greater than the UPL
ND: Not detected
SU: Standard units
tau: Kendall's tau statistic
p-value: A two-sided p-value describing the probability of the H0 being true (a=0.05)
Exceed 'X' indicates that the most recent observed value is higher than the UPL (or out of range of the LPL and UPL in the case of pH.)
Exceed 'X0' indicates that the two most recent values are higher than the UPL, but the upgradient well is 100% ND.
Exceed '0' indicated that the most recent observed value is higher than the UPL, but is not scored as an SSI due to Double Quantification Rule (ERM 2017).

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APPENDIX B FLY ASH RESERVOIR FIRST SEMIANNUAL SAMPLING EVENT OF 2018 ALTERNATE SOURCE DEMONSTRATION REPORT

Gavin Fly Ash Reservoir

Gavin Power, LLC

First Semiannual Sampling Event of 2018
Alternate Source Demonstration

10.12.2018

Project No.: 0402270

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Acronyms and Abbreviations

CCR	Coal Combustion Residuals
CCR Rule	Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments
CCR Unit	Bottom Ash Complex CCR Surface Impoundment
CFR	Code of Federal Regulations
FAR	Fly Ash Reservoir
Gavin	Gavin Power, LLC
LPL	Lower prediction limit
NETL	National Energy Technology Laboratory
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
Plant	General James M. Gavin Power Plant
RWL	Residual Waste Landfill
SSI	Statistically significant increase
UPL	Upper prediction limit
USEPA	United States Environmental Protection Agency
USEPA Guidance	Solid Waste Disposal Facility Criteria Technical Manual, EPA 530-R-93-017
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 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 Fly Ash Reservoir CCR Surface Impoundment (the "CCR Unit") at the General James M. Gavin Power Plant (the "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 in accordance with 40 CFR § 257.94. Statistically significant increases (SSIs) over background concentrations in downgradient monitoring wells for Appendix III constituents for the first half of 2018 (January–June) were detected and are detailed in this 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 statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality" (40 CFR § 257.94(e)(2)). If it can be demonstrated that the SSIs are 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 Alternate Source Demonstration (ASD) must be made in writing, and the accuracy of the information must be verified through certification by a qualified Professional Engineer.

The CCR Rule and the regulatory preamble do not contain requirements or reference agency guidance for a successful ASD. However, EPA previously issued guidance for conducting ASDs under the regulatory program governing Municipal Solid Waste Landfills (MSWLFs), upon which EPA modeled the groundwater monitoring provisions of the CCR Rule (80 Fed. Reg. 21302, 21396 (Apr. 17, 2015)). Because of the substantial similarity between the language governing ASDs in the CCR Rule and the MSWLF regulations, EPA's guidance document provides a useful framework for ASDs under the CCR Rule.

EPA's guidance document, "Solid Waste Disposal Facility Criteria Technical Manual, EPA 530-R-93-017, Subpart E" (Nov. 1993) ("EPA Guidance"), lays out six lines of evidence that should be pursued in a demonstration that an SSI resulted from a source other than the regulated disposal unit:

1. An alternative source exists.

2. 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 ground water could not have resulted from the unit given the waste constituents and concentrations in the unit leachate and wastes, and 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 addresses each of these lines of evidence for the SSIs detected in the groundwater beneath the Fly Ash Reservoir.

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 Fly Ash Reservoir (FAR) is one of three CCR units at the Plant that are subject to regulation under the CCR Rule. The FAR is approximately 300 acres and is located about 2.5 miles northwest of the Plant (Figure 1-2). From the mid-1970s until January 1995, fly ash was sluiced from the Plant to the former Stingy Run stream valley. The settled CCR materials were retained behind the Stingy Run Fly Ash Dam in the unlined FAR.

A Groundwater Monitoring Network Evaluation was performed to provide an assessment of the compliance of the groundwater monitoring network with 40 CFR § 257.91. The evaluation identified an uppermost aquifer composed of sandstone and interbedded clayshale units, specifically the Morgantown Sandstone and Cow Run Sandstone, and indicated groundwater flows to the south and east (Geosyntec 2016). Consistent with the CCR Rule and the Groundwater Monitoring Plan developed for Gavin (ERM 2017), a prediction limit approach was used to identify potential impacts to groundwater. Upper prediction limits (UPLs) and lower prediction limits (LPLs) were established based on the upgradient groundwater data. The 2017 Annual Groundwater Monitoring and Corrective Action Report identified SSIs in the downgradient monitoring wells for the period from August 2016 to August 2017 (ERM 2018a). The SSIs identified in the 2017 Annual Groundwater Monitoring and Corrective Action Report were addressed in the Gavin Fly Ash Reservoir Alternate Source Demonstration Report (ERM 2018b). More recently, and relevant to this report, data collected in the FAR from the first semiannual groundwater sampling event of 2018 were compared to the UPLs and LPLs, and SSIs were identified in the Cow Run Sandstone and the Morgantown Sandstone as summarized in Table 1-1 and Table 1-2.

Table 1-1: Statistically Significant Increases in FAR Cow Run Monitoring Wells

Analyte	2016-02	2016-08	96149
Boron	ϕ	ϕ	ϕ
Calcium	X	ϕ	ϕ
Chloride	X	ϕ	ϕ
Fluoride	ϕ	ϕ	ϕ
pH	ϕ	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ	ϕ
Notes: ϕ = No SSI, X = SSI *Results are for the downgradient wells sampled from 19 March to 6 April 2018.*			

Table 1-2: Statistically Significant Increases in FAR Morgantown Monitoring Wells

Analyte	2016-01	2016-07	96160
Boron	ϕ	ϕ	ϕ
Calcium	ϕ	ϕ	ϕ
Chloride	ϕ	ϕ	ϕ
Fluoride	X	ϕ	ϕ
pH	X	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ	ϕ
Notes: ϕ = No SSI, X = SSI *Results are for the downgradient wells sampled from 19 March to 6 April 2018.*			

This ASD continues to identify alternate sources for the calcium, chloride, fluoride, and pH SSIs. Supporting information and additional discussion of each of the lines of evidence discussed in Section 1.1 are presented in subsequent sections of this report.

2. HYDROGEOLOGIC INTERPRETATION

A detailed interpretation of hydrogeological conditions can be found in the previous Fly Ash Reservoir Alternate Source Demonstration (ERM 2018b). Key conclusions from this analysis include the following:

- A region of lower hydraulic pressure within the aquifer exists under the southeastern portion of the Fly Ash Reservoir (FAR), and extends southeastward under the Residual Waste Landfill (RWL) as shown on Figures 2-1 and 2-2. This area of lower hydraulic pressure is located under portions of the FAR and RWL that have received CCR materials that act to reduce infiltration due to their lower permeability. The forested and pastured areas surrounding the FAR and RWL are more permeable and have higher infiltration than the fine compacted material in the FAR and RWL. Groundwater flows from the areas of higher pressure surrounding the FAR and RWL to areas of lower pressure within the FAR and RWL.
- On the western side of the FAR, groundwater flows from west to east, toward the groundwater trough, and then turns to the southeast and flows toward the Ohio River.

- On the northeastern boundary of the FAR, groundwater flows from north to south, and then turns to the southeast and flows toward the Ohio River.

3. DESCRIPTION OF ALTERNATE SOURCES

3.1 Sources of Fluoride

An SSI in fluoride at the FAR Morgantown Monitoring Well was identified in the previous FAR Alternate Source Demonstration (ERM 2018b). Both naturally occurring and anthropogenic sources of fluoride were evaluated here as alternate sources of the SSI.

Two naturally occurring sources of fluoride likely contributed to elevated fluoride in groundwater below the FAR: 1) mobilization of fluoride from naturally occurring rocks and minerals, and 2) naturally occurring brine.

Fluorite and apatite are naturally occurring minerals known to release fluoride to Ohio's groundwater. Fluoride concentrations in Ohio groundwater correlate with groundwater depth. Deeper groundwater typically has a longer travel time in the subsurface, providing longer contact time and greater leaching of fluoride from rocks and minerals to groundwater (OEPA 2012a). The groundwater velocity within the Morgantown Sandstone is estimated to be approximately 0.2 feet per year (ERM 2017). This relatively low velocity suggests groundwater within the Morgantown Sandstone could have a long contact time with the aquifer materials, which would facilitate the leaching of naturally occurring fluoride. A comparison of fluoride concentrations in the FAR and the RWL by geologic unit (ERM 2018b) shows generally higher fluoride concentrations in the deeper rock formations (Connellsville, Morgantown, and Cow Run) and lower concentrations in the shallower alluvial aquifer. This pattern of higher fluoride concentration with greater depth is consistent with statewide patterns in fluoride concentration reported by the Ohio Environmental Protection Agency (OEPA) (2012a) and indicates the concentration of fluoride is related to the age of groundwater underlying the Plant.

Naturally occurring brines in the Appalachian Basin are known to contain fluoride at concentrations as high as 33 mg/L (Kelly 1973, and Poth 1962). Some of the brines exist close to the land surface. For example, brine was discovered at the land surface approximately 10 miles south of the Plant in Gallipolis, Ohio and was used 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 presence of brine in the region, both in the subsurface and at the land surface, indicates the potential for naturally occurring brine to contribute Appendix III constituents to shallow groundwater at the Plant.

Human activities that could also contribute fluoride to groundwater include agricultural run-off, infiltration of fertilizers, and discharges from septic systems (OEPA 2012a). Given the presence of agricultural land to the north and west of the Plant, it is possible that use of fertilizer is a contributing source of fluoride. Other regional activities with the potential to influence the concentration of Appendix III constituents in groundwater include:

- The drilling of oil and gas wells, which could allow brines from deeper strata to migrate upward to shallower water-bearing rock strata (OEPA 2003);
- Over-pumping water supply wells, which allows the upward migration of brines that naturally occur in deeper rock strata (Ohio River Valley Water Sanitation Commission 1984); and
- The use of brine on roadways for ice and dust control (OEPA 2012b).

To account for natural and anthropogenic sources of fluoride on a regional scale, background groundwater data were obtained from the United States Geological Survey (USGS) National Water

Information System database (USGS 2018), and brine data were obtained from the National Energy Technology Laboratory (NETL) (NETL 2015). Background groundwater and brine data are discussed further in Section 5.

3.2 Sources of Calcium and Chloride

Two sources of calcium and chloride likely contributed to elevated concentrations of these elements in groundwater below the FAR: 1) naturally occurring brine and 2) local road deicing practices.

Naturally occurring brines in the Appalachian Basin bedrock are known to be rich in calcium and chloride, and exist at depths of 300 to 500 feet below the ground surface (Ohio River Valley Water Sanitation Commission 1984). The presence of brine in the region, both in the subsurface and at the land surface, indicates the potential for naturally occurring brine to contribute calcium and chloride to shallow bedrock groundwater underlying the Plant. To account for natural sources of calcium and chloride on a regional scale, brine data were obtained from the NETL (NETL 2015). The brine data are discussed further in Section 5.

Human activities that could contribute calcium and chloride to groundwater include the use of brine and road salt on roadways for deicing and dust control (OEPA 2012a). On 9 August 2018 ERM spoke with Mr. Mark Kirkhart of the Ohio Department of Transportation (ODOT) regarding road deicing practices in Gallia County. Mr. Kirkhart provided the following information:

- ODOT is responsible for treating all state roads, including State Road 554 which is located northwest, north, and northeast of the FAR, (i.e. hydraulically upgradient of the Plant).
- Deicing materials used by the ODOT include sodium chloride and calcium chloride.
- Road salting activities start around Thanksgiving and run until April each year.
- Typical application rates are 250 pounds per lane per mile, and the frequency of application depends on the frequency and duration of storm events.

Recent research has identified that road salting practices have the potential to contribute chloride to groundwater in fractured rock aquifers located near the land surface (Vitale et al. 2017). Given the proximity of the Conemaugh group rocks to the land surface near State Road 554, there is a potential for road salt dissolved in rainwater and snowmelt to migrate through natural fractures in the Morgantown and Cow Run sandstone. Considering Morgantown (Figure 2-1) and Cow Run (Figure 2-2) groundwater generally flows from north to south in the FAR, dissolved calcium and chloride from road salt applied to state highway 554 located north, northeast, and northwest is a likely source of elevated chloride and calcium concentrations in Well 2016-02.

3.3 Elevated pH

A pH value above the UPL was identified at Well 2016-01 for a sample collected in March 2018. As discussed in Section 7 of this document, neither the regional hydrogeological conditions nor the seepage and discharge from the FAR is a likely source of elevated pH in the groundwater. Based on a review of the boring log and well construction diagram prepared for Well 2016-01, a likely source for the elevated pH of the sample was improper well construction. This improper well construction could have enabled contact between the screened interval and the cement-bentonite grout used during well construction.

Impacts on groundwater quality caused by cement-based grout are typically associated with groundwater pH values above 10, and, in low-permeability formations, the impacts of grout materials may persist for longer than 18 months due to the slower rate of flushing of the well screen by moving groundwater (Pohlmann and Alduino 1992; Barcelona et al. 1988). Based on the elevated pH values observed at this well between August 2016 and March 2018, it appears that incorrect well construction methods have influenced the quality of groundwater collected from this well, and thus the alternate source of the elevated pH is cement used during well construction.

4. HYDRAULIC CONNECTIONS TO THE ALTERNATE SOURCES

The regional bedrock geology near the Plant includes Pennsylvanian age (299 to 311 million years old) sedimentary rocks from the Monongahela and Conemaugh Groups. These sedimentary rocks consist primarily of shale and siltstone, with minor amounts of mudstone, sandstone, and incidental amounts of limestone and coal (USGS 2005). As shown in Figure 4-1, regional groundwater flow near and surrounding the FAR occurs primarily within fractured sedimentary rocks of the Monongahela Group and the Conemaugh Group, which contains the Morgantown and the Cow Run Sandstone (USGS 1981; USGS 2016). These sedimentary rock groups extend west of the FAR, where agricultural activities, road salting activities, and surficial brine could contribute fluoride, chloride, and calcium to surface water runoff prior to infiltration into the underlying aquifers. Septic systems could also contribute fluorinated and chlorinated water directly to the subsurface. As shown in Figure 4-2, regional groundwater flows through the fractured bedrock from the north and west, under the FAR, to the south and east toward the Ohio River. While migrating through the fractured bedrock, groundwater also has the potential to interact with fluoride-, chloride-, and calcium-containing minerals. Based on these considerations, the fractured rocks of the Monongahela and Conemaugh Groups, including the Morgantown Sandstone and Cow Run Sandstone, are hydraulically connected to potential alternate sources of fluoride, calcium, and chloride.

As described in Section 3.3, the source of the elevated pH in Well 2016-01 appears to be cement-bentonite grout used during well construction. Given that the cement-bentonite grout was injected into the borehole during construction, concrete may have penetrated the sand pack or fractures within the bedrock immediately surrounding the well screen, and groundwater migrating through these fractures and the sand pack could come into contact with the cement. Thus, the alternate source of elevated pH (cement-bentonite grout) is hydraulically connected with groundwater entering Well 2016-01.

5. CONSTITUENTS ARE PRESENT AT THE ALTERNATE SOURCES OR ALONG FLOW PATHS

5.1 Fluoride, Calcium, and Chloride Alternate Sources along Flow Path

Regional background groundwater data from the USGS National Water Information System database (USGS 2018) and regional brine data from the NETL NATCARB Brine Database (NETL 2015) were reviewed to evaluate regional concentrations of fluoride, calcium, and chloride in groundwater and/or naturally occurring brine.

5.1.1 Fluoride

Figure 5-1 shows the distribution of fluoride in groundwater within Conemaugh and Monongahela Group aquifers surrounding the Gavin Plant. The maximum fluoride value is associated with a groundwater sample collected by the USGS from a monitoring well located approximately 1.2 miles southeast of the Plant, across the Ohio River in West Virginia. This sample is unlikely to be impacted by Plant operations, because the Ohio River is the regional discharge boundary for groundwater, and thus it is unlikely that groundwater from the Plant could cross under the river and continue to flow eastward toward the USGS monitoring well.

These results indicate fluoride is naturally present in Monongahela and Conemaugh background groundwater. As described in Section 3, the fractured bedrock aquifers could be the alternate source or they could act as the flow path from an alternate source. Although results from March 2017 through July

2017 were above background, the concentration of fluoride at Well 2016-01 has declined since June 2017, and the March 2018 result was below the regional background value of 8.8 milligrams per liter (Figure 5-4).

5.1.2 Calcium and Chloride

As shown in Figure 5-2 and Figure 5-3, brine with elevated levels of calcium and chloride is present throughout the region surrounding the Gavin Plant. The data show brine throughout the region has calcium and chloride concentrations significantly above the FAR background (UPL) values. As described in Section 3, brine is commonly found at relatively shallow depths or at the land surface, and the fractured bedrock aquifers of the Monongahela and Conemaugh rocks could act as the flow pathways where brine could mix with groundwater.

As discussed in Section 3.2, deicing materials used by the ODOT on state roads surrounding the Gavin Plant include sodium chloride and calcium chloride. Both the Morgantown and Cow Run Sandstones are relatively close to the land surface northwest of the FAR (Figure 4-2), and thus calcium and chloride released during deicing operations may infiltrate into bedrock near the roadway and migrate under the FAR. Additional evaluation of this potential migration pathway is provided in Section 6.

5.2 pH Alternate Source along Flow Path

Cement mixtures are strongly basic and can have a pH between 12 and 13 (Portland Cement Association 2018). Groundwater that entered the well screen of Well 2016-01 likely contacted uncured cement, and the elevated pH has persisted 2 years after well installation due to the naturally low groundwater velocity of the Morgantown formation, and the limited flushing of the well screen interval. Thus, the alternate source (cement-bentonite grout) is along the flow path of groundwater entering Well 2016-01.

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

6.1 Fluoride

As described in Sections 4 and 5, groundwater with dissolved fluoride flows from upgradient recharge areas via the Morgantown Sandstone and migrates under the FAR. The regional background concentration of fluoride is higher than the fluoride concentration measured in Well 2016-01 in March 2018, which demonstrates regional background could be the alternate source.

The piper diagram is a graphical procedure commonly used in groundwater studies to interpret sources of dissolved constituents in water and evaluate the potential for mixing of waters from different sources (Piper 1944). The Morgantown piper diagram (Figure 6-1) plots upgradient monitoring Wells 96153R, 96154R, 96156, 96152, 96148, 2016-11, 2016-03, and 2016-05 in the same general area on the piper diagram as downgradient Wells 96160, 2016-01, and 2016-07. The similarity in geochemical signatures shows the groundwater beneath and downgradient of the FAR likely originated from the same source as the upgradient groundwater, and thus the Morgantown groundwater under the FAR is hydraulically connected to the upgradient alternate source.

6.2 Calcium and Chloride

As described in Sections 4 and 5, regional concentrations of calcium and chloride in brine within the Monongahela and Conemaugh bedrock are higher than in Well 2016-02, which demonstrates that naturally occurring brine could be an alternate source. As described in Section 3, calcium chloride and sodium chloride are applied to state highways near the Plant to deice state highways during the winter months. Figure 4-2 shows how rainwater or snowmelt with dissolved calcium and chloride from the road salt can infiltrate into the underlying aquifers. Groundwater with these dissolved constituents then flows in the Cow Run sandstone under the FAR and eventually discharges to the Ohio River (Figure 4.2).

Recent calcium and chloride solute concentrations in the Cow Run sandstone and a potential groundwater flow pathway from Highway 554 are shown in Figure 5-5 and Figure 5-6. In general, calcium and chloride are present in upgradient groundwater at similar or higher concentrations compared to results from Well 2016-02, which is consistent with a connection between Well 2016-02 and upgradient sources, whether they are road salt, brine, or both.

As shown in the Cow Run piper diagram (Figure 6-2), upgradient monitoring Wells 2016-09, 2016-10, 2016-06, 2016-04, and 96147 plot in the same general area on the piper diagram as downgradient Wells 2016-08, 2016-02, and 96149. The similarity in geochemical signatures shows the groundwater beneath and downgradient of the FAR likely originated from the same source as the upgradient groundwater, and thus the Cow Run groundwater under the FAR is hydraulically connected to the upgradient alternate source.

6.3 pH

As discussed in Section 5, the pH of groundwater at monitoring Well 2016-01 is consistent with the typical pH of cement used for well construction.

7. A RELEASE FROM THE FLY ASH RESERVOIR IS NOT SUPPORTED AS THE SOURCE

7.1 Piper Diagrams

As seen in Figures 6-1 and 6-2, the discharge and seepage results plot in the upper portion of the piper diagram, which represents a high calcium and sulfate fingerprint. The discharge and seepage results represent FAR water which has been in contact with CCR within the FAR. Specifically, the discharge samples are collected from standing water within the FAR. The seepage samples represent FAR water collected from the engineered collection system at the toe of the dam. With the exception of MW-20, which is an upgradient well and only coincidentally has a signature similar to the leachate, the groundwater and leachate chemical signatures are distinct. If water in contact with fly ash (e.g., seepage water or discharge water) were released from the FAR and mixed with groundwater, the signature of the resulting mixture would become more like the discharge and seepage signatures (i.e., plot higher in the diamond portion of the piper diagram). Based on the data presented in Figures 6-1 and 6-2, it is clear that groundwater in the Morgantown Sandstone and Cow Run Sandstone has not mixed with FAR discharge or seepage because they plot in distinct regions on the piper diagram, and thus the FAR could not be the source of the constituents detected in Wells 2016-01 and 2016-02.

7.2 Leachate Constituents vs Groundwater Constituents

If the FAR had a release and seepage or discharge mixed with groundwater, the concentrations of individual analytes in the resulting mixture would depend on the volume of the release, and the initial concentrations in each. In order for a release to result in an increase in the concentration of an analyte in groundwater, the concentration of the analyte in the seepage or discharge would need to be higher than in groundwater. At the FAR, the opposite conditions exist: the concentration of fluoride, calcium, and chloride are lower in discharge and seepage than in groundwater, as summarized in Table 7-1.

Table 7-1: Comparison of Discharge, Seepage and Groundwater Results

Analyte	Units	FAR Discharge (1998–2018)		FAR Seepage (2012–2018)		Well 2016-01 (2016–2018)		Well 2016-02 (2016–2018)	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Fluoride	mg/L	0.35	0.88	0.15	0.24	2.8	17	-	-
Calcium	mg/L	71.5	190	82	340	-	-	400	850
Chloride	mg/L	1.9	21	0.83	12.9	-	-	10500	14000

The concentrations of fluoride, calcium, and chloride in FAR discharge and seepage are all less than the concentrations in groundwater. Because the groundwater fluoride, calcium, and chloride concentrations are already greater than the leachate fluoride, calcium, and chloride concentrations, it is unlikely that FAR seepage or discharge are the source of the increased concentrations which resulted in SSIs for these analytes.

8. ALTERNATE SOURCE DATA ARE HISTORICALLY CONSISTENT WITH HYDROGEOLOGIC CONDITIONS

This report provides background groundwater quality for the fractured sedimentary bedrock aquifers found within and beyond the boundary of the FAR. The patterns of regional groundwater flow through fractured rock near the FAR were established after the last deglaciation, which occurred approximately 14,000 years ago (Hansen 2017). The estimated groundwater velocity for the Morgantown Sandstone and Cow Run Sandstone is 0.2 feet per year and 0.01 feet per year (ERM 2017), respectively, which 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 hydrogeological conditions and findings of the monitoring program.

The elevated pH that has been observed at Well 2016-01 since it was constructed in March 2016 is consistent with the errors that likely occurred during well construction, and the use of concrete to build the well. In addition, the persistence of the elevated pH is consistent with the low groundwater velocities of the Morgantown Sandstone and expected low rate of flushing of the monitoring well screen interval.

9. CONCLUSIONS

Between January and June 2018, SSIs were detected in the downgradient monitoring wells of the FAR. In response to the SSIs, this Alternate Source Demonstration was prepared in accordance with 40 CFR 257.94(e)(2).

All SSIs in the downgradient FAR monitoring wells have been demonstrated to result from alternate sources that include regional background, naturally occurring brine, local road salting practices, and concrete from improper well construction. Table 9-1 summarizes the six lines of evidence of an ASD for each of the SSIs.

Table 9-1: FAR Alternate Source Demonstration Summary

Line of Evidence	Fluoride	Calcium	Chloride	pH
Alternate source	Fluoride is present in background groundwater and can be attributed to regional sources such as naturally occurring brine or fluoride-bearing minerals. In addition, the March 2018 result from Well 2016-01 showed fluoride was within the range of regional values.	Calcium is present in regional sources such as naturally occurring brine and is applied to the surface of state highways during deicing practices	Chloride is present in regional sources such as naturally occurring brine and is applied to the surface of state highways during deicing practices	Elevated pH is due to improper well construction
Hydraulic connection	Regional groundwater flows under the FAR	Regional groundwater flows under the FAR	Regional groundwater flows under the FAR	Cement from well construction is in contact with groundwater
Constituent present at source or along flow path	Fluoride is present along flow path	Calcium is present along flow path	Chloride is present along flow path	Cement is likely located in or near the well screen
Constituent distribution more strongly linked to alternate source	Fluoride in FAR groundwater is within the range of regional values	Calcium in FAR groundwater is within the range of regional brine concentrations	Chloride in FAR groundwater is within the range of regional brine concentrations	The observed pH levels are consistent with the expected pH of groundwater in contact with cement
Constituent could not have resulted from the FAR	Piper diagrams show different chemical fingerprints between groundwater and FAR seepage and discharge. The concentrations in FAR seepage and discharge concentrations are lower than in groundwater.	Piper diagrams show different chemical fingerprints between groundwater and FAR seepage and discharge. The concentrations in FAR seepage and discharge concentrations are lower than in groundwater.	Piper diagrams show different chemical fingerprints between groundwater and FAR seepage and discharge. The concentrations in FAR seepage and discharge concentrations are lower than in groundwater.	Piper diagrams show different chemical fingerprints between FAR leachate and groundwater
Data are historically consistent with hydrogeological conditions	Groundwater velocities suggest there is ample time for upgradient fluoride to migrate to the Plant	Groundwater velocities suggest there is ample time for upgradient calcium to migrate to the Plant	Groundwater velocities suggest there is ample time for upgradient chloride to migrate to the Plant	Timing of well installation is consistent with likely impacts from cement

The FAR was not the source of the SSIs identified in the first semiannual groundwater sampling event of 2018 and thus the Plant will continue to conduct Detection Monitoring in accordance with 40 CFR § 257.94(e)(2). The second semiannual sampling event for 2018 is planned to be performed before 31 December 2018.

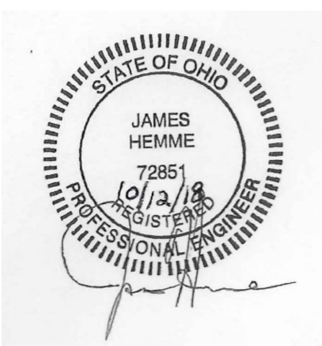
PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I or an agent under my review has prepared this Alternate Source Demonstration Report for the Fly Ash Reservoir in accordance with 40 CFR § 257.94(e). 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: ____10/12/2018___________



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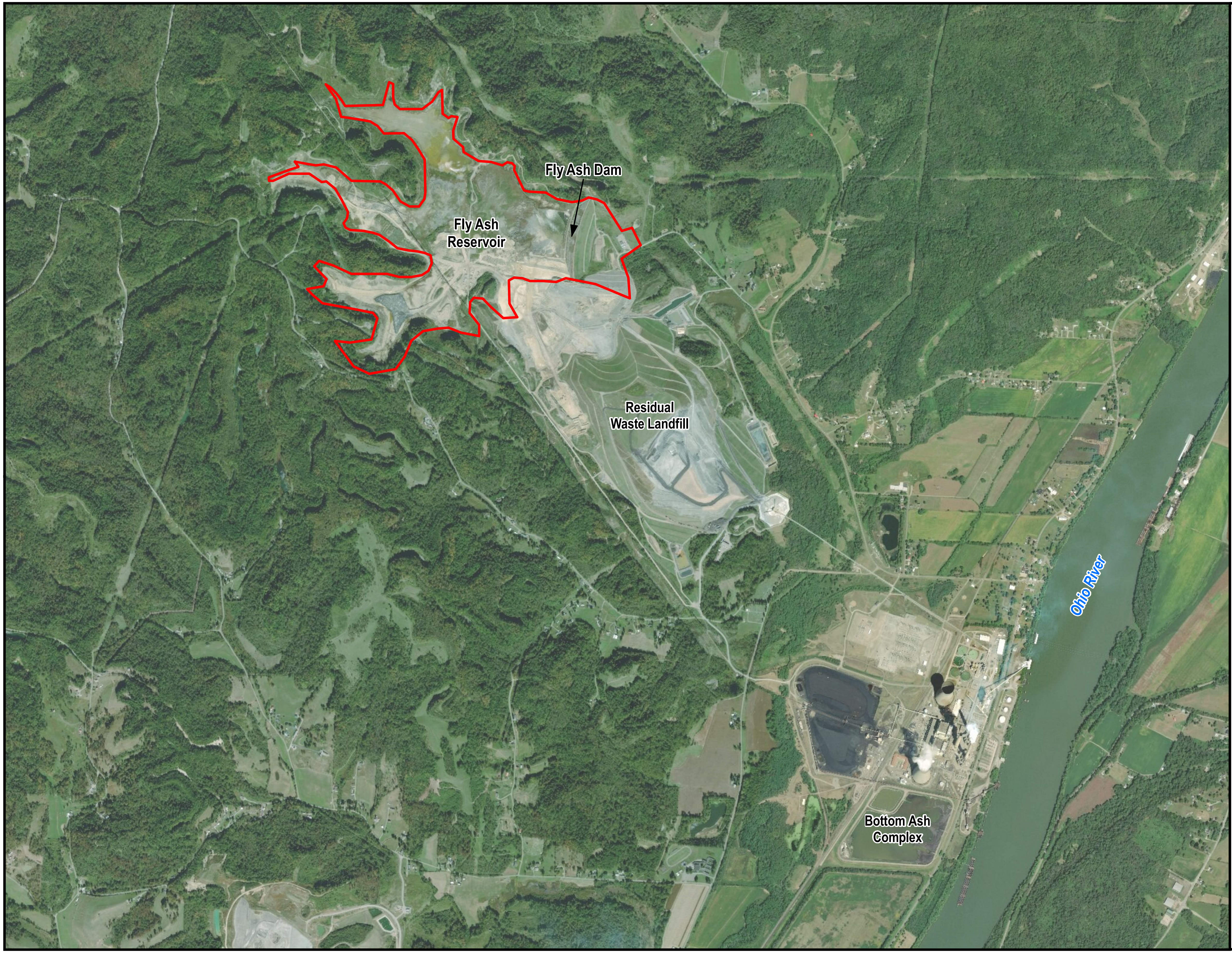
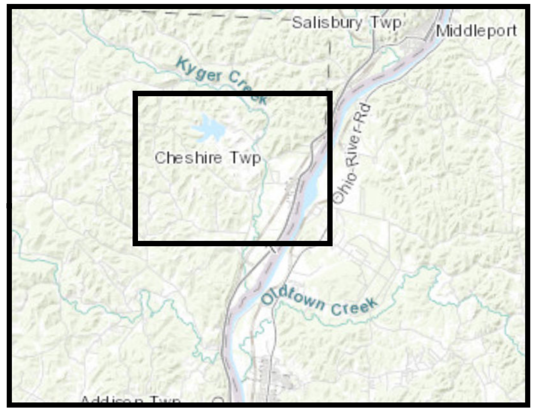
FIGURES

Figure 1-1: Gavin Plant Location
Fly Ash Reservoir Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio





0 550 1,100 2,200 3,300
Feet

Figure 1-2: Fly Ash Reservoir Location
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

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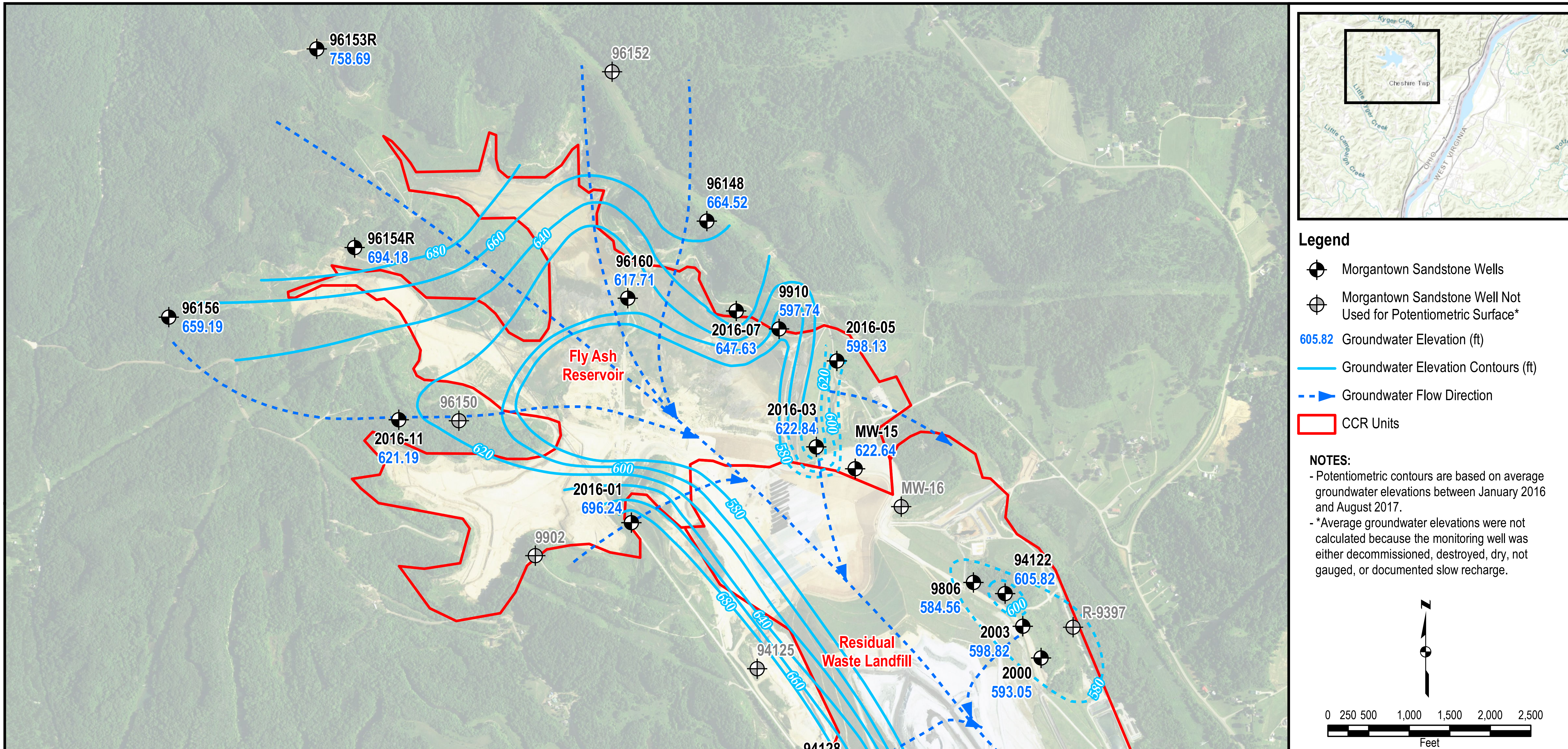
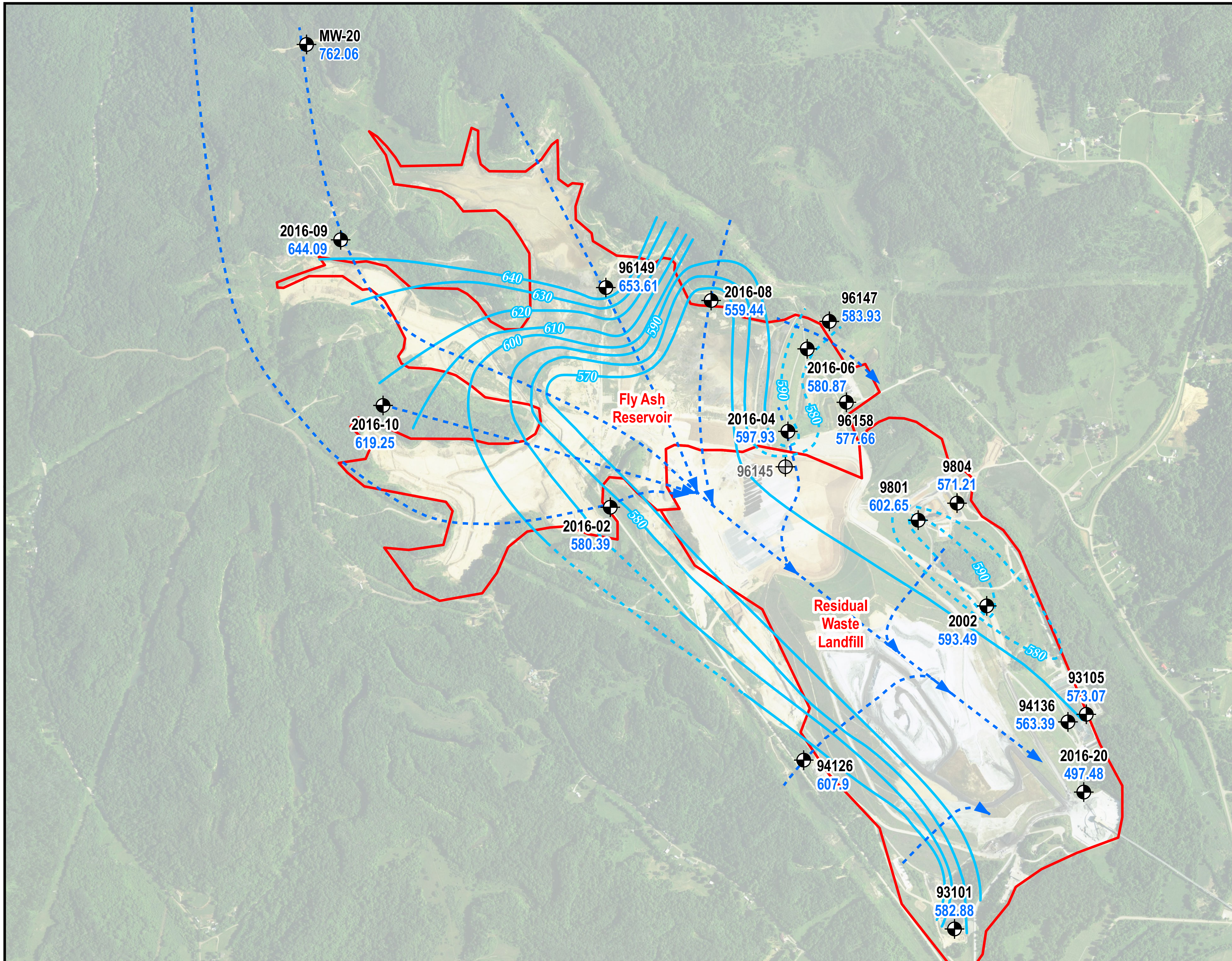
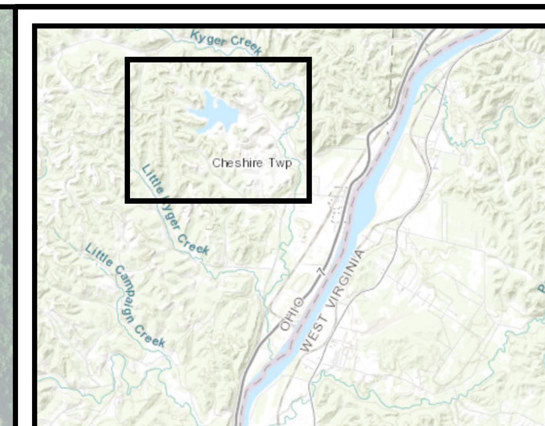


Figure 2-1: Morgantown Potentiometric Surface Map
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Chesire, Ohio

ERM





Legend

- Cow Run Sandstone Wells
- Cow Run Sandstone Well Not Used for Potentiometric Surface*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contours (ft)
- Groundwater Flow Direction
- CCR Units

NOTES:

- Potentiometric contours are based on average groundwater elevations between January 2016 and August 2017.
- *Average groundwater elevations were not calculated because the monitoring well was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

N

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

Feet

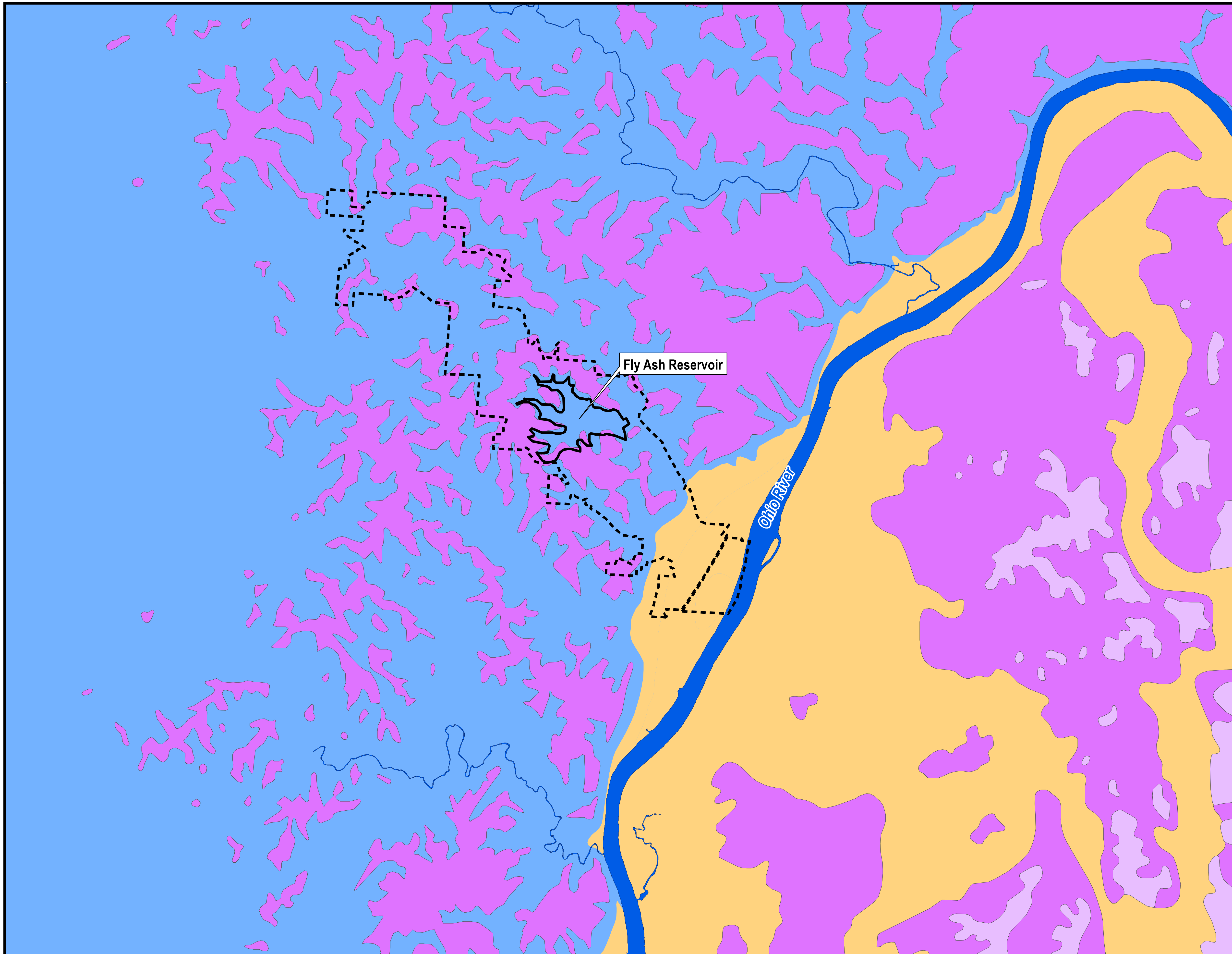
Figure 2-2: Cow Run Potentiometric Surface Map

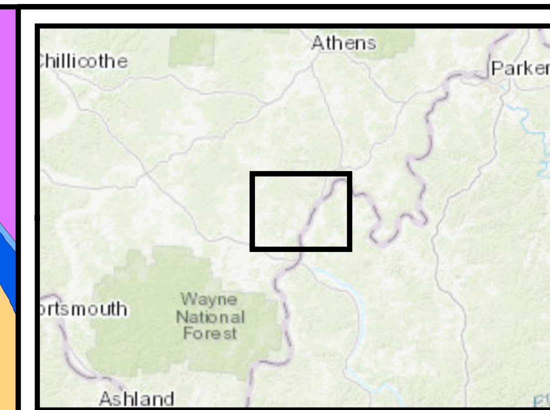
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration

Gavin Generating Station

Cheshire, Ohio

ERM





Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Conemaugh Group

Monongahela Group

Dunkard 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 4-1: Sedimentary and Alluvial Aquifers

First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration

Gavin Generating Station

Cheshire, Ohio

ERM

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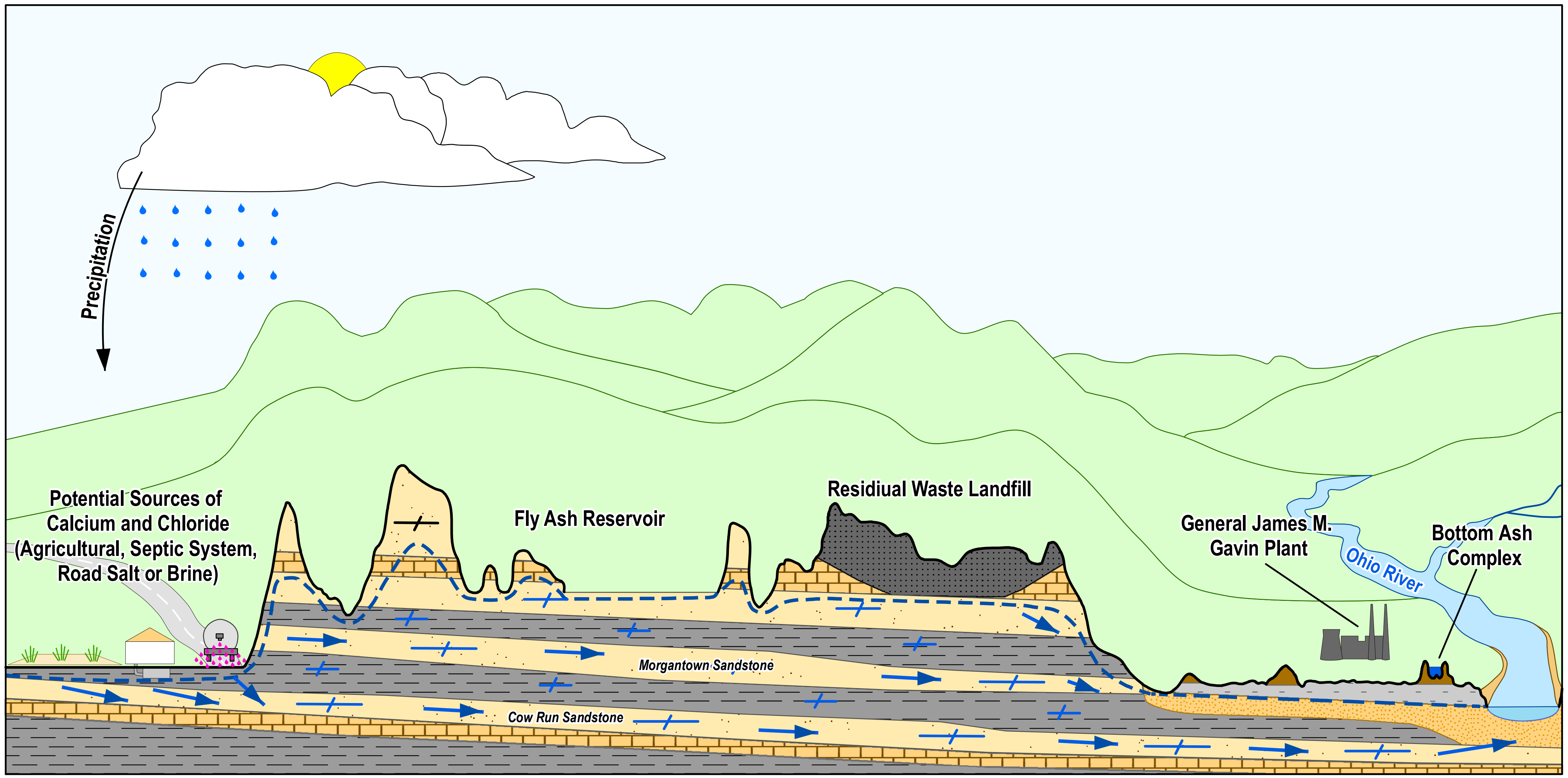
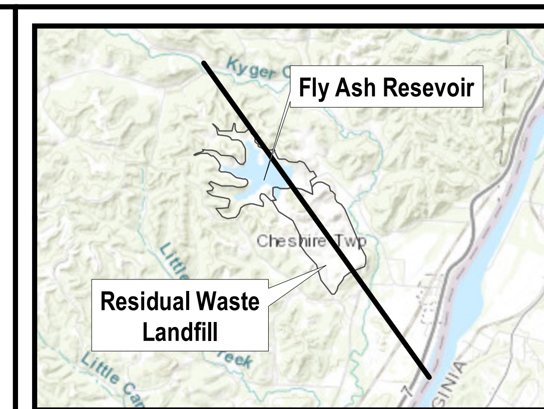




Legend

- Groundwater Flow Direction
- Water Table
- Saturated Fractures
- Unsaturated Fractures
- Deicing Fluid Application
- FGD Material
- Interbedded Silt/Clay
- Course Sand Deposits
- Fractured Limestone
- Fractured Shale
- Fill
- Sand
- Sandstone

NOTES:

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

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

Figure 4-2: Regional Groundwater Flow Patterns
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

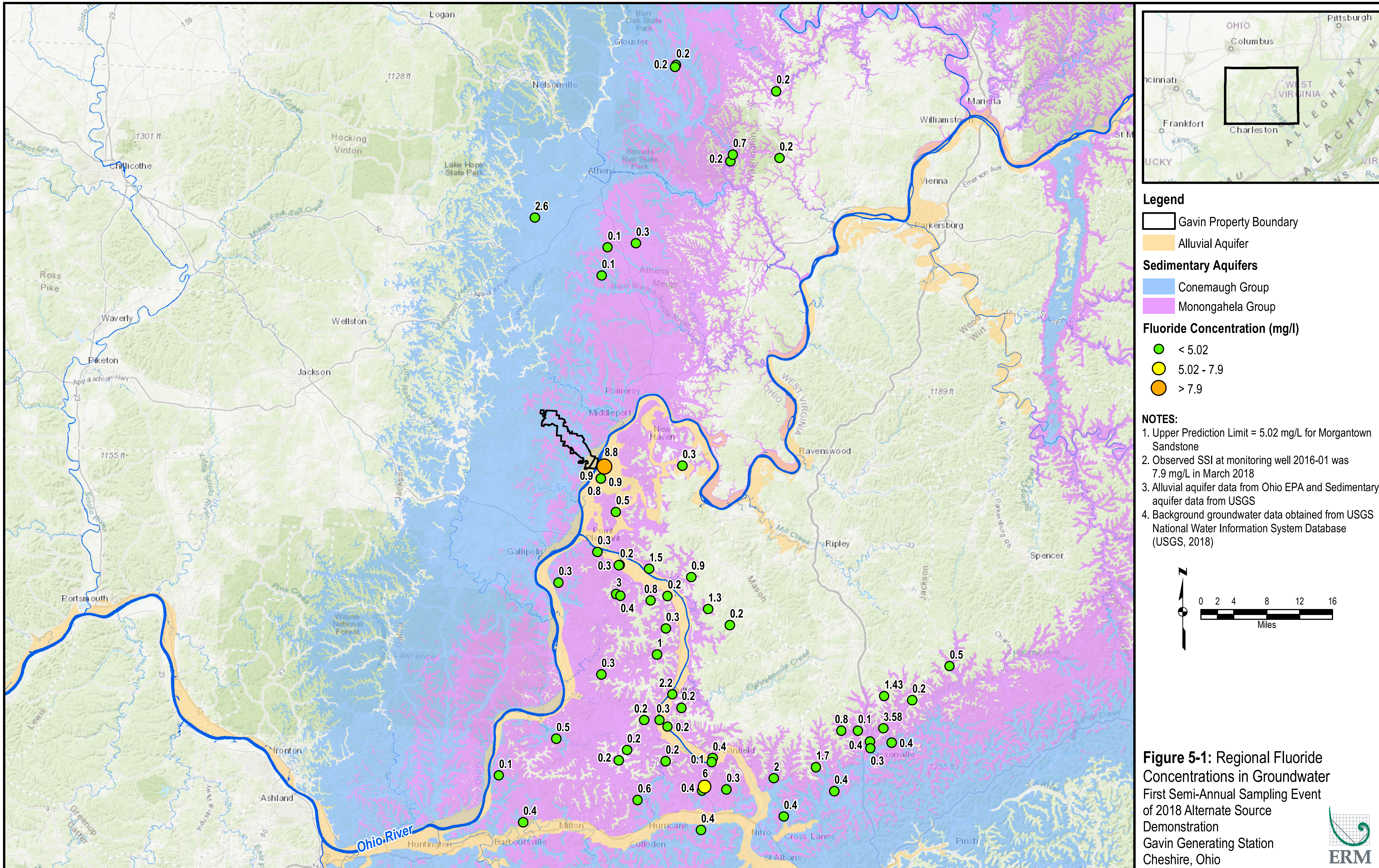
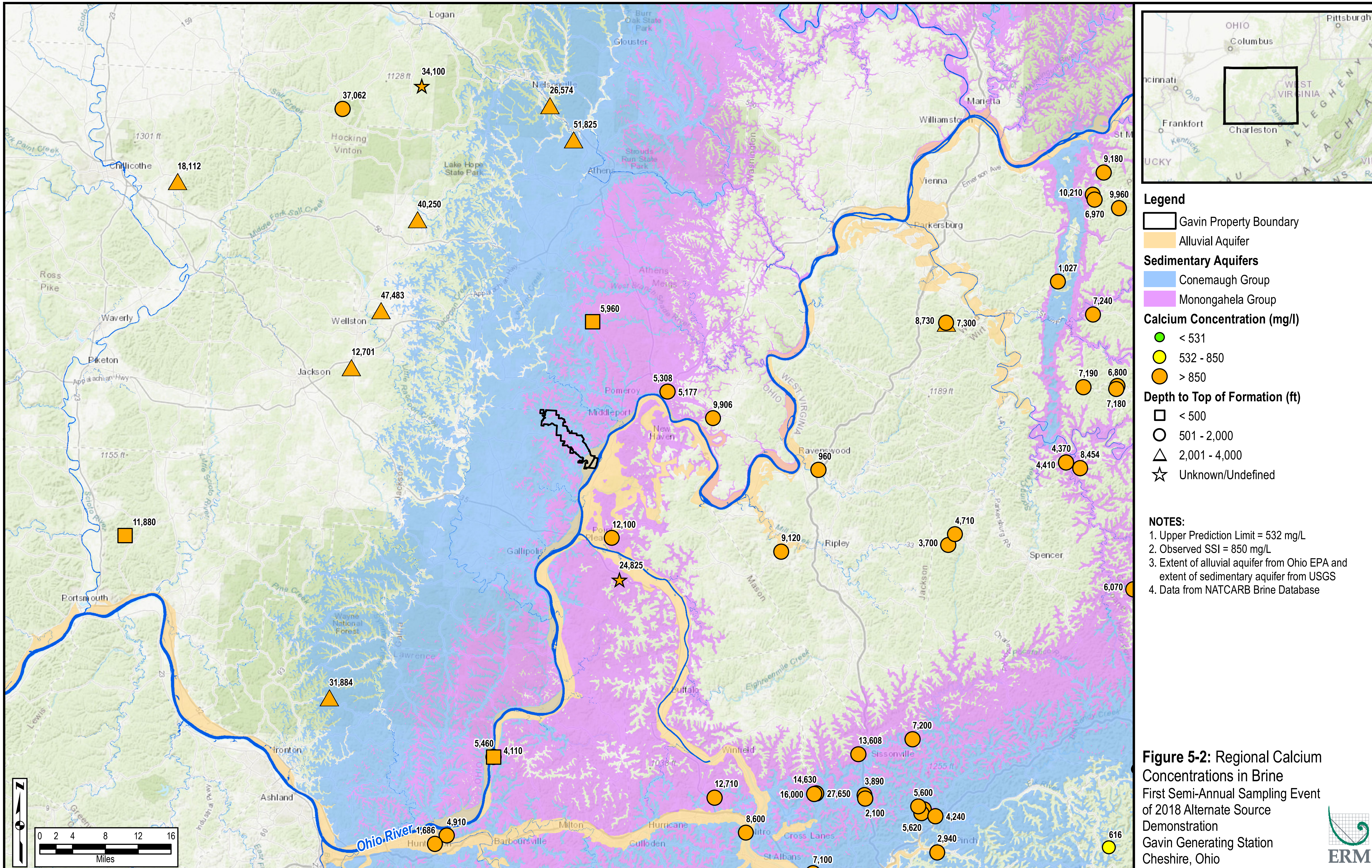


Figure 5-1: Regional Fluoride Concentrations in Groundwater
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio



Legend

- Gavin Property Boundary
- Alluvial Aquifer

Sedimentary Aquifers

- Conemaugh Group
- Monongahela Group

Calcium Concentration (mg/l)

- < 531
- 532 - 850
- > 850

Depth to Top of Formation (ft)

- < 500
- 501 - 2,000
- 2,001 - 4,000
- Unknown/Undefined

NOTES:

1. Upper Prediction Limit = 532 mg/L
2. Observed SSI = 850 mg/L
3. Extent of alluvial aquifer from Ohio EPA and extent of sedimentary aquifer from USGS
4. Data from NATCARB Brine Database

Figure 5-2: Regional Calcium Concentrations in Brine
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

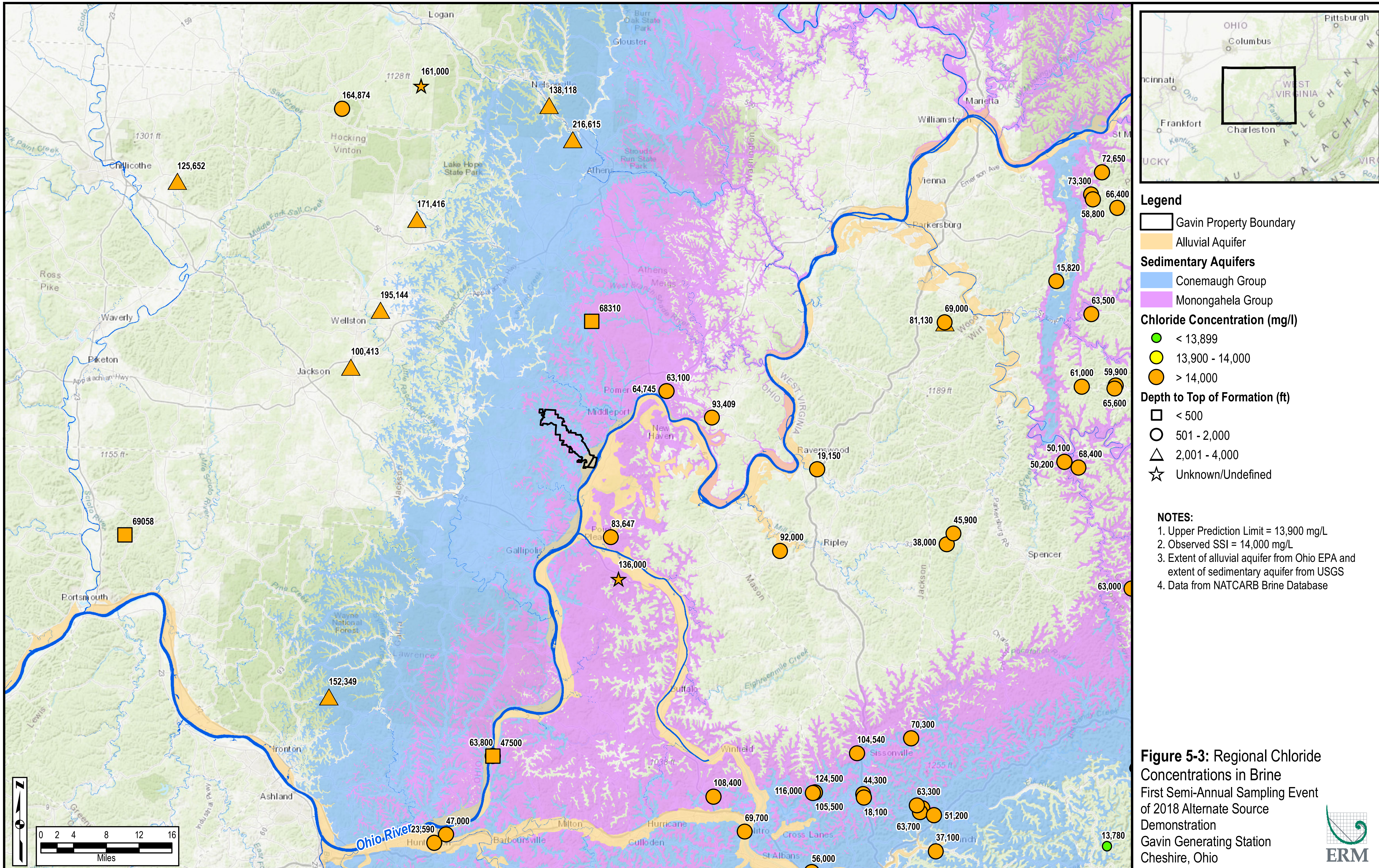
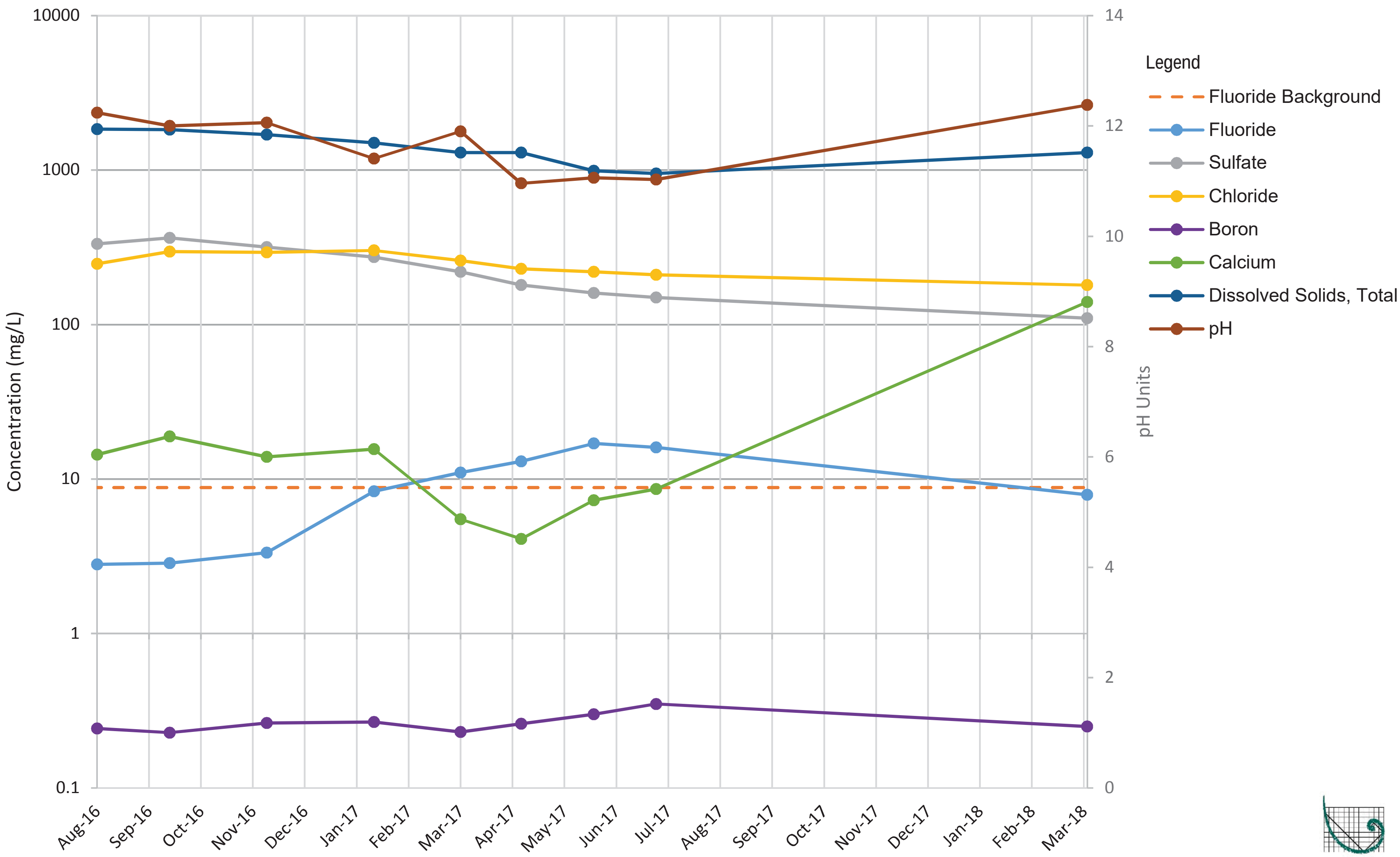


Figure 5-3: Regional Chloride Concentrations in Brine
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

Figure 5-4: Analytical Results for Morgantown Sandstone Monitoring Well 2016-01
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Chesire, Ohio



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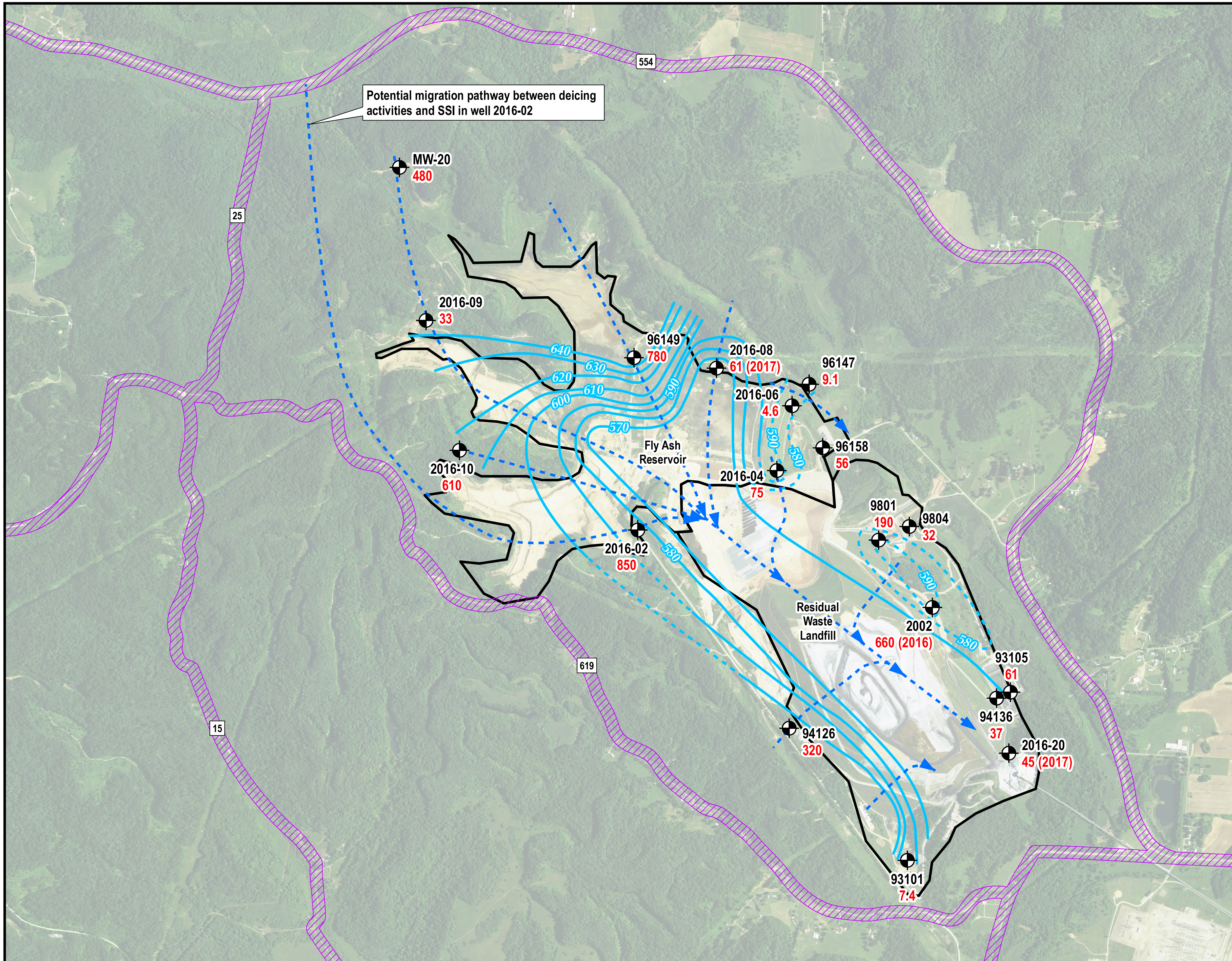
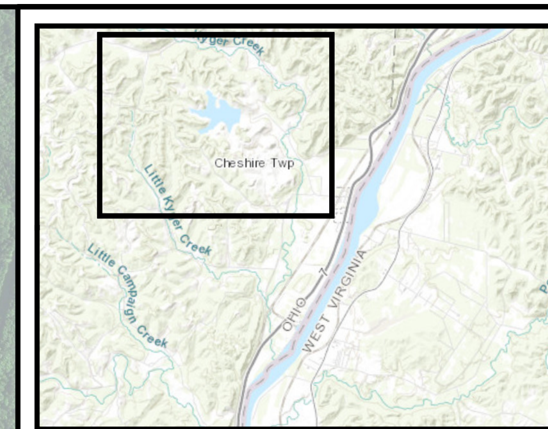




Legend

- 190 Most Recent Calcium Concentration (mg/L)
- Groundwater Elevation Contours (ft)
- Groundwater Flow Direction
- Area of Road Salt Application
- CCR Units

NOTES:

- Most recent concentration data is from February to May 2018 unless noted otherwise.

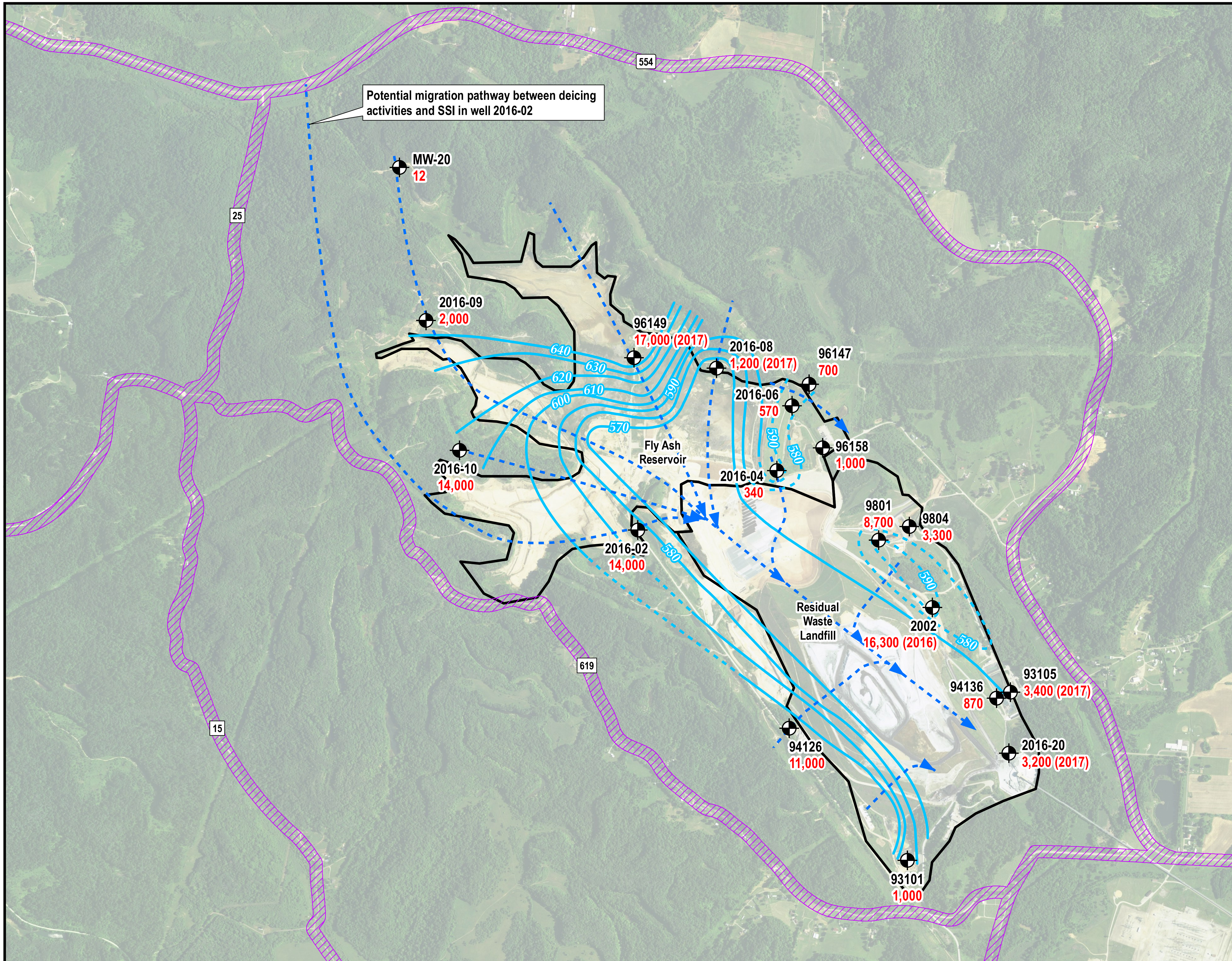
0 250500 1,000 1,500 2,000 2,500

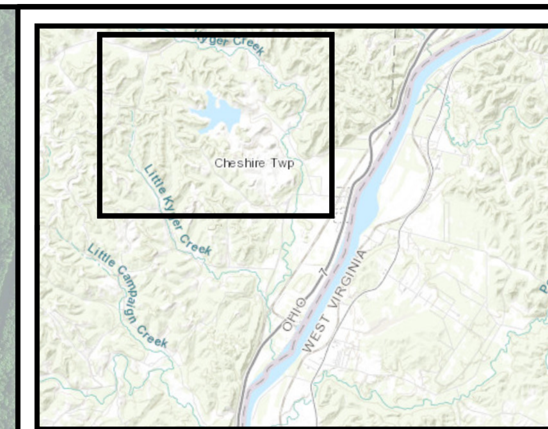
Feet

Figure 5-5: Most Recent Calcium Concentrations in the Cow Run Sandstone

First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- 540 Most Recent Chloride Concentration (mg/L)
- Groundwater Elevation Contours (ft)
- Groundwater Flow Direction
- Area of Road Salt Application
- CCR Units

NOTES:

- Most recent concentration data is from February to May 2018 unless noted otherwise.

N

0 250500 1,000 1,500 2,000 2,500

Feet

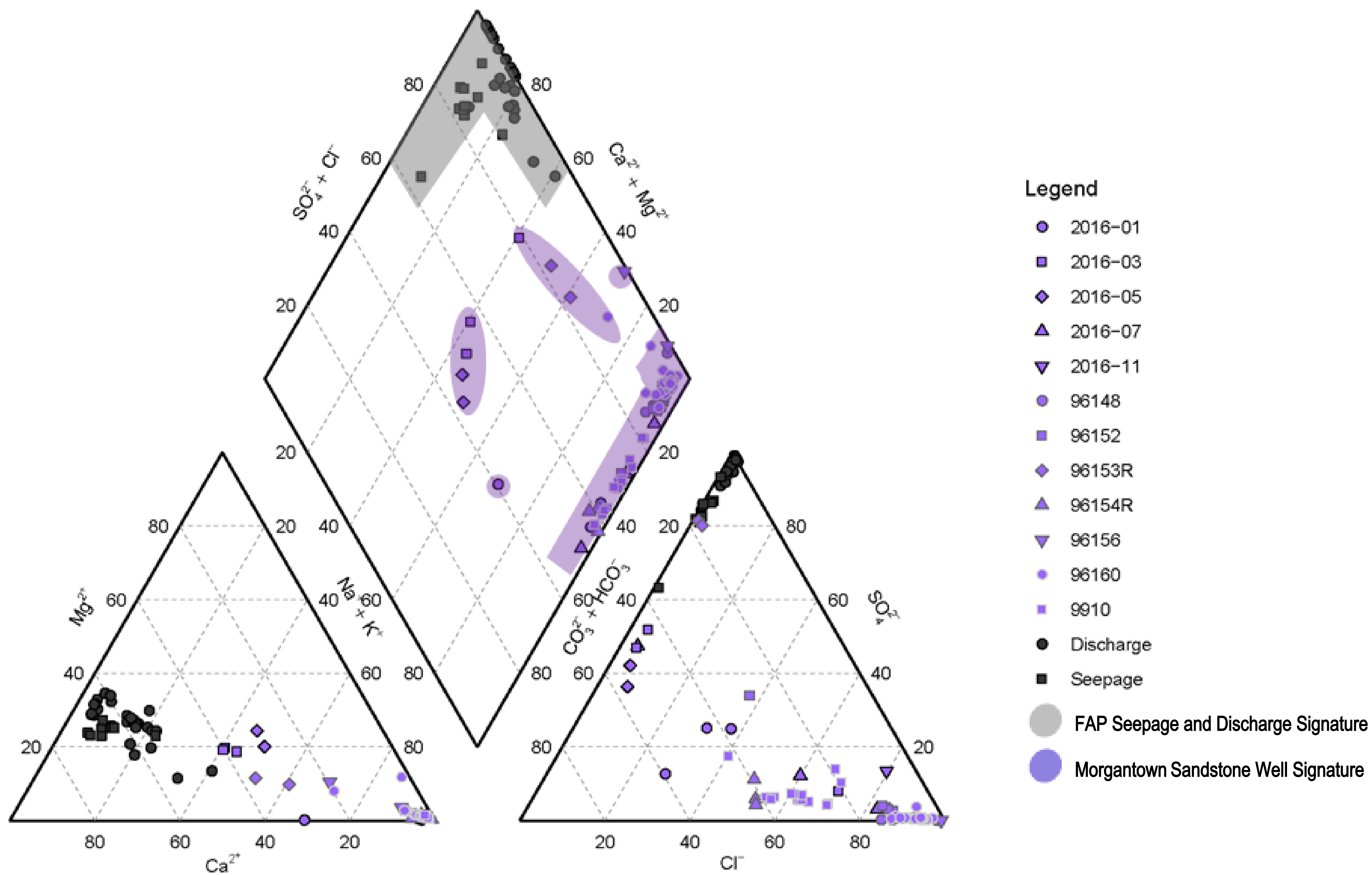
Figure 5-6: Most Recent Chloride Concentrations in the Cow Run Sandstone

First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration

Gavin Generating Station

Cheshire, Ohio

ERM



NOTES:

1. Data Range: 05/12/1999 to 5/08/2018.
2. Only wells with complete data including all 8 piper diagram analytes are presented.

Figure 6-1: FAR Piper Diagram for the Morgantown Sandstone
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

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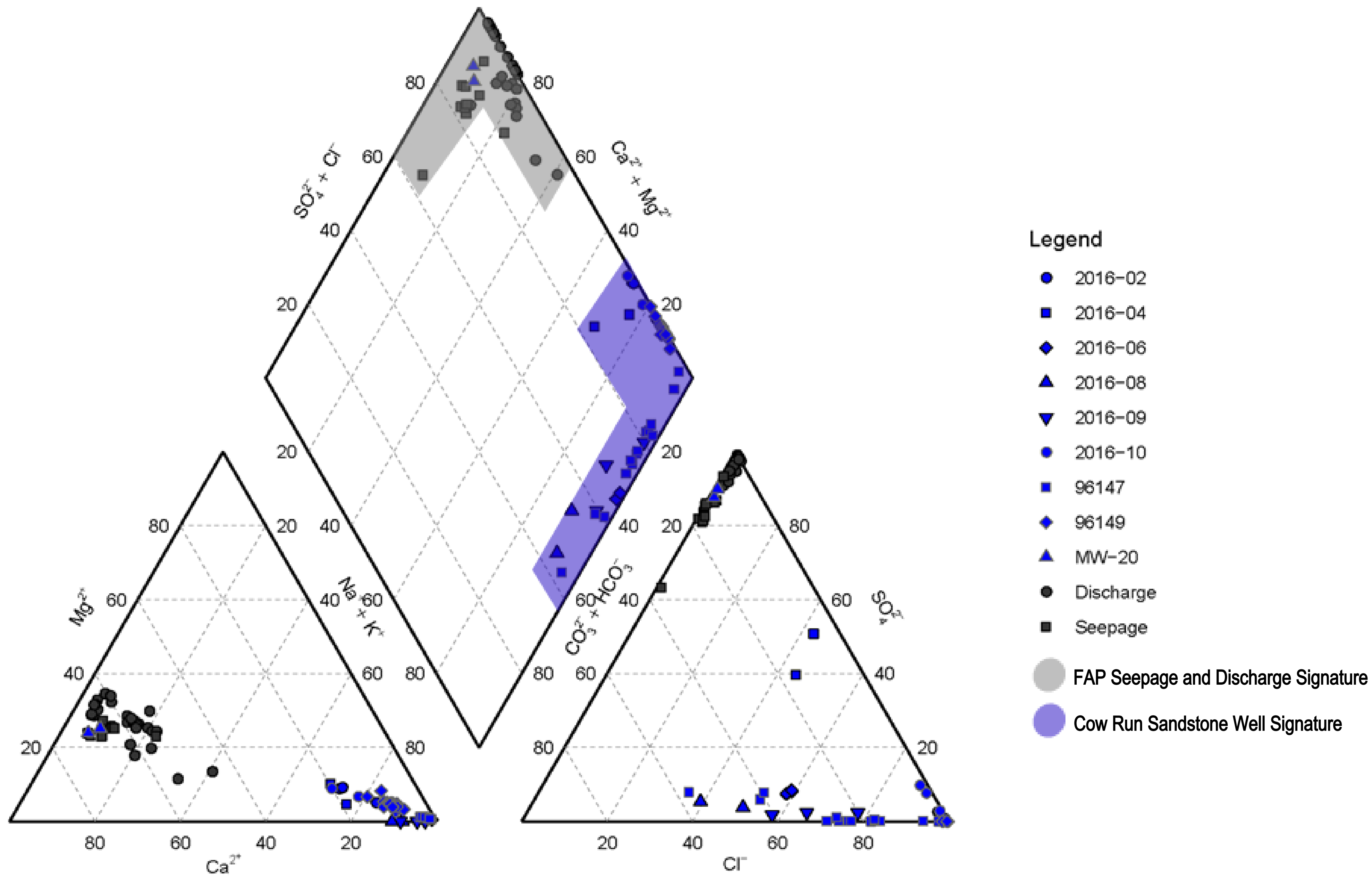

NOTES:
1. Data Range: 05/12/1999 to 5/08/2018.
2. Only wells with complete data including all 8 piper diagram analytes are presented.

Figure 6-2 FAR Piper Diagram for the Cow Run Sandstone
First Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
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Cheshire, Ohio

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APPENDIX C FLY ASH RESERVOIR SECOND SEMIANNUAL SAMPLING EVENT OF 2018 ALTERNATE SOURCE DEMONSTRATION REPORT

Gavin Fly Ash Reservoir

Gavin Power, LLC

Second Semiannual Sampling Event of 2018
Alternate Source Demonstration Report

Gavin Power Plant
Cheshire, Ohio

31 January 2019

Project No.: 0488799

The business of sustainability

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CONTENTS

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Acronyms and Abbreviations

CCR	Coal Combustion Residuals
CCR Rule	Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments
CCR Unit	Bottom Ash Complex CCR Surface Impoundment
CFR	Code of Federal Regulations
FAR	Fly Ash Reservoir
Gavin	Gavin Power, LLC
NETL	National Energy Technology Laboratory
ODOT	Ohio Department of Transportation
OEPA	Ohio Environmental Protection Agency
Plant	General James M. Gavin Power Plant
RWL	Residual Waste Landfill
SSI	Statistically significant increase
UPL	Upper prediction limit
USEPA	United States Environmental Protection Agency
USEPA Guidance	Solid Waste Disposal Facility Criteria Technical Manual, USEPA 530-R-93-017
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 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 Fly Ash Reservoir CCR Surface Impoundment ("FAR," or the "CCR Unit") at the General James M. Gavin Power Plant (the "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 FAR 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 half of 2018 (July–December) and are explained in this 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 statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality" (40 CFR § 257.94(e)(2)). If it can be 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 Alternate Source Demonstration (ASD) must be made in writing, and the accuracy of the information must be verified through certification by a qualified Professional Engineer (40 CF § 257.94(e)(2)).

The CCR Rule and the regulatory preamble do not contain requirements or reference agency guidance for a successful ASD. However, the United States Environmental Protection Agency (USEPA) previously issued guidance for conducting ASDs under the regulatory program governing Municipal Solid Waste Landfills (MSWLFs), upon which USEPA modeled the groundwater monitoring provisions of the CCR Rule (80 Fed. Reg. 21302, 21396 (Apr. 17, 2015)). Because of the substantial similarity between the language governing ASDs in the CCR Rule and the MSWLF regulations, USEPA's guidance document provides a useful framework for ASDs under the CCR Rule.

This guidance document, "Solid Waste Disposal Facility Criteria Technical Manual, USEPA 530-R-93-017, Subpart E" (Nov. 1993) ("USEPA Guidance"), lays out the six lines of evidence that should be addressed to determine whether an SSI resulted from a source other than the regulated disposal unit:

1. An alternative source exists.
2. 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 ground water could not have resulted from the unit given the waste constituents and concentrations in the unit leachate and wastes, and 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 the groundwater beneath the FAR.

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 FAR is one of three CCR units at the Plant that are subject to regulation under the CCR Rule. The FAR is approximately 300 acres and is located about 2.5 miles northwest of the Plant (Figure 1-2). From the mid-1970s until January 1995, fly ash was sluiced from the Plant to the former Stingy Run stream valley. The settled CCR materials were retained behind the Stingy Run Fly Ash Dam in the FAR.

A Groundwater Monitoring Network Evaluation was performed to provide an assessment of the compliance of the groundwater monitoring network with 40 CFR § 257.91. This evaluation identified an uppermost aquifer composed of sandstone and interbedded clayshale units, specifically the Morgantown Sandstone and Cow Run Sandstone, and indicated groundwater flows to the south and east (Geosyntec 2016). Consistent with the CCR Rule and the Groundwater Monitoring Plan developed for Gavin (ERM 2017), a prediction limit approach was used to identify potential impacts to groundwater. Upper prediction limits (UPLs) and lower prediction limits were established based on the upgradient groundwater data. The 2017 Annual Groundwater Monitoring and Corrective Action Report identified SSIs in the downgradient monitoring wells for the period from August 2016 to August 2017 (ERM 2018a). The SSIs identified in the 2017 Annual Groundwater Monitoring and Corrective Action Report were addressed in the Gavin FAR ASD Report (ERM 2018b). The SSIs identified for samples collected in March and April 2018 were addressed in the Gavin FAR First Semiannual Sampling Event of 2018 ASD Report (ERM 2018c). This ASD Report addresses SSIs for samples collected from the Cow Run and Morgantown monitoring wells in September and October 2018, as summarized in Table 1-1 and Table 1-2, respectively.

Table 1-1: SSIs in FAR Cow Run Monitoring Wells

Analyte	2016-02	2016-08
Boron	ϕ	ϕ
Calcium	X	ϕ
Chloride	X	ϕ
Fluoride	ϕ	ϕ
pH	ϕ	ϕ
Sulfate	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ
ϕ = No SSI; X = SSI *Results are for the downgradient wells sampled on 25 September 2018.*		

Table 1-2: SSIs in FAR Morgantown Monitoring Wells

Analyte	2016-01	2016-07	9910
Boron	ϕ	ϕ	ϕ
Calcium	ϕ	ϕ	ϕ
Chloride	ϕ	ϕ	ϕ
Fluoride	X	ϕ	ϕ
pH	X	ϕ	ϕ
Sulfate	ϕ	ϕ	ϕ
Total Dissolved Solids	ϕ	ϕ	ϕ
ϕ = No SSI; X = SSI *Results are for the downgradient wells sampled from on 25 September 2018 or 23 October 2018.*			

This ASD Report identifies alternate sources for the calcium, chloride, fluoride, and pH SSIs. Supporting information and discussion of each of the lines of evidence discussed in Section 1.1 are presented in subsequent sections of this report.

2. HYDROGEOLOGIC INTERPRETATION

A detailed interpretation of hydrogeological conditions can be found in the Gavin FAR ASD Report (ERM 2018b). Key conclusions from this analysis include the following:

- A region of lower hydraulic pressure than the surrounding areas exists within the portion of the aquifer under the southeastern portion of the FAR, and extends southeastward under the Residual Waste Landfill (RWL) as shown on Figures 2-1 and 2-2. This area of lower hydraulic pressure is located under portions of the FAR and RWL that have received CCR materials that act to reduce infiltration due to their lower permeability. The forested and pastured areas surrounding the FAR and RWL are more permeable and have higher infiltration than the fine compacted material in the FAR and RWL. Groundwater flows from the areas of higher pressure surrounding the FAR and RWL to areas of lower pressure within the FAR and RWL.
- On the western side of the FAR, groundwater flows from west to east, toward the groundwater trough, and then turns to the southeast and flows toward the Ohio River.
- On the northeastern boundary of the FAR, groundwater flows from north to south, and then turns to the southeast and flows toward the Ohio River.

3. DESCRIPTION OF ALTERNATE SOURCES

3.1 Sources of Fluoride

An SSI in fluoride at the FAR Morgantown Monitoring Well was identified in previous Gavin FAR ASD Reports (ERM 2018b and ERM 2018c). The following is an evaluation of both naturally occurring and anthropogenic sources of fluoride as alternate sources of the SSI.

Two naturally occurring sources of fluoride likely contributed to elevated fluoride in groundwater below the FAR: (1) mobilization of fluoride from naturally occurring rocks and minerals, and (2) naturally occurring brine.

Fluorite and apatite are naturally occurring minerals known to release fluoride to Ohio's groundwater. Fluoride concentrations in Ohio groundwater correlate with groundwater depth. Deeper groundwater typically has a longer travel time in the subsurface, providing longer contact time and increased leaching of fluoride from rocks and minerals to groundwater (OEPA 2012a). Based on the depth and estimated groundwater velocity within the Morgantown Sandstone, groundwater in this aquifer may have sufficiently long travel times to facilitate the leaching of naturally occurring fluoride. A comparison of fluoride concentrations in the FAR and the RWL by geologic unit (ERM 2018b) shows generally higher fluoride concentrations in the deeper rock formations (Connellsville, Morgantown, and Cow Run) and lower concentrations in the shallower alluvial aquifer. This pattern of higher fluoride concentration with greater depth is consistent with statewide patterns in fluoride concentration reported by the Ohio Environmental Protection Agency (OEPA) and indicates that the concentration of fluoride is related to the age of groundwater underlying the Plant (OEPA 2012a).

Naturally occurring brines in the Appalachian Basin are known to contain fluoride at concentrations as high as 33 mg/L (Kelly 1973, and Poth 1962). Some of the brines exist close to the land surface. For example, brine was discovered at the land surface approximately 10 miles south of the Plant in Gallipolis, Ohio and was used 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 presence of naturally occurring brine in the region, both in the subsurface and at the land surface, indicates the potential for brine to contribute Appendix III constituents to shallow groundwater at the Plant.

Human activities that could also contribute fluoride to groundwater include agricultural run-off, infiltration of fertilizers, and discharges from septic systems (OEPA 2012a). Given the presence of agricultural land to the north and west of the Plant, fertilizer use is a potential contributing source of fluoride. Other regional activities with the potential to influence the concentration of Appendix III constituents in groundwater include:

- The drilling of oil and gas wells, which could allow brines from deeper strata to migrate upward to shallower water-bearing rock strata (OEPA 2003);
- Over-pumping water supply wells, which allows the upward migration of brines that naturally occur in deeper rock strata (ORANSCO 1984); and
- The use of brine on roadways for ice and dust control (OEPA 2012b).

To account for natural and anthropogenic sources of fluoride on a regional scale, background groundwater data were obtained from the United States Geological Survey (USGS) National Water Information System database (USGS 2018), and brine data were obtained from the National Energy Technology Laboratory (NETL) (NETL 2015). Background groundwater and brine data are discussed further in Section 5.

3.2 Sources of Calcium and Chloride

Two sources of calcium and chloride likely contributed to elevated concentrations of these elements in groundwater below the FAR: (1) naturally occurring brine and (2) local road deicing practices.

Naturally occurring brines in the Appalachian Basin bedrock are known to be rich in calcium and chloride, and exist at depths of 300 to 500 feet below the ground surface (ORANSCO 1984). The presence of brine in the region, both in the subsurface and at the land surface, indicates the potential for naturally occurring brine to contribute calcium and chloride to shallow bedrock groundwater underlying the Plant. To account for natural sources of calcium and chloride on a regional scale, brine data were obtained from the NETL (NETL 2015). The brine data are discussed further in Section 5.

Human activities that could contribute calcium and chloride to groundwater include the use of brine and road salt on roadways for deicing and dust control (OEPA 2012a). On 9 August 2018 ERM spoke with Mr. Mark Kirkhart of the Ohio Department of Transportation (ODOT) regarding road deicing practices in Gallia County. Mr. Kirkhart provided the following information:

- ODOT is responsible for treating all state roads, including State Road 554 which is located northwest, north, and northeast of the FAR, (i.e., hydraulically upgradient of the Plant).
- Deicing materials used by the ODOT include sodium chloride and calcium chloride.
- Road salting activities start around Thanksgiving and run until April each year.
- Typical application rates are 250 pounds per lane per mile, and the frequency of application depends on the frequency and duration of storm events.

Recent research has identified that road salting practices have the potential to contribute chloride to groundwater in fractured rock aquifers located near the land surface (Vitale et al. 2017). Given the proximity of the Conemaugh group rocks to the land surface near State Road 554, there is a potential for road salt dissolved in rainwater and snowmelt to migrate through natural fractures in the Morgantown and Cow Run sandstone. Considering Morgantown (Figure 2-1) and Cow Run (Figure 2-2) groundwater generally flows from north to south in the FAR, dissolved calcium and chloride from road salt applied to state Highway 554 located north, northeast, and northwest is a likely source of elevated chloride and calcium concentrations in Well 2016-02.

3.3 Elevated pH

A pH value above the UPL was identified at Well 2016-01 for a sample collected in September 2018. As discussed in Section 7 of this document, neither the regional hydrogeological conditions nor the seepage and discharge from the FAR are likely sources of elevated pH in the groundwater. Based on a review of the boring log and well construction diagram prepared for Well 2016-01, a likely source for the elevated pH of the sample was improper well construction. This improper well construction could have enabled contact between the screened interval and the cement-bentonite grout used during well construction.

Impacts on groundwater quality caused by cement-based grout are typically associated with groundwater pH values above 10, and, in low-permeability formations, the impacts of grout materials may persist for longer than 18 months due to the slower rate of flushing of the well screen by moving groundwater (Pohlmann and Alduino 1992, Barcelona et al. 1988). Based on the elevated pH values observed at this well between August 2016 and September 2018, it appears that incorrect well construction methods have influenced the quality of groundwater collected from this well, and thus the alternate source of the elevated pH is cement used during well construction.

4. HYDRAULIC CONNECTIONS TO THE ALTERNATE SOURCES

The regional bedrock geology near the Plant includes Pennsylvanian age (299 to 311 million years old) sedimentary rocks from the Monongahela and Conemaugh Groups. These sedimentary rocks consist primarily of shale and siltstone, with minor amounts of mudstone, sandstone, and incidental amounts of limestone and coal (USGS 2005). As shown on Figure 4-1, regional groundwater flow near and surrounding the FAR occurs primarily within fractured sedimentary rocks of the Monongahela Group and the Conemaugh Group, which contains the Morgantown and the Cow Run Sandstone (USGS 1981, USGS 2016). These sedimentary rock groups extend west of the FAR, where agricultural activities, road salting activities, and surficial brine could contribute fluoride, chloride, and calcium to surface water runoff prior to infiltration into the underlying aquifers. Septic systems could also contribute fluorinated and chlorinated water directly to the subsurface. As shown on Figure 4-2, regional groundwater flows through the fractured bedrock from the north and west, under the FAR, to the south and east toward the Ohio River. While migrating through the fractured bedrock, groundwater also has the potential to interact with fluoride-, chloride-, and calcium-containing minerals. Based on these considerations, the fractured rocks of the Monongahela and Conemaugh Groups, including the Morgantown Sandstone and Cow Run Sandstone, are hydraulically connected to the potential alternate sources of fluoride, calcium, and chloride.

As described in Section 3.3, the source of the elevated pH in Well 2016-01 appears to be cement-bentonite grout used during well construction. Given that the cement-bentonite grout was injected into the borehole during construction, concrete may have penetrated the sand pack or fractures within the bedrock immediately surrounding the well screen, and groundwater migrating through these fractures and the sand pack could come into contact with the cement. Thus, the alternate source of elevated pH (cement-bentonite grout) is hydraulically connected with groundwater entering Well 2016-01.

5. CONSTITUENTS ARE PRESENT AT THE ALTERNATE SOURCES OR ALONG FLOW PATHS

5.1 Fluoride, Calcium, and Chloride Alternate Sources Along Flow Path

Regional background groundwater data from the USGS National Water Information System database (USGS 2018) and regional brine data from the NETL NATCARB Brine Database (NETL 2015) were reviewed to evaluate regional concentrations of fluoride, calcium, and chloride in groundwater and/or naturally occurring brine.

5.1.1 Fluoride

Figure 5-1 shows the distribution of fluoride in groundwater within the Conemaugh and Monongahela Group aquifers surrounding the Gavin Plant. The maximum fluoride value is associated with a groundwater sample collected by the USGS from a monitoring well approximately 1.2 miles southeast of the Plant, across the Ohio River in West Virginia. This sample is unlikely to be impacted by Plant operations, because the Ohio River is the regional discharge boundary for groundwater, and thus it is unlikely that groundwater from the Plant could cross under the river and continue to flow eastward toward the USGS monitoring well.

These results indicate fluoride is naturally present in Monongahela and Conemaugh background groundwater. As described in Section 3, the fractured bedrock aquifers could be the alternate source, or they could act as the flow path from an alternate source. Although results from March 2017 through July 2017 were above background, the concentration of fluoride at monitoring Well 2016-01 has declined since June 2017, and the September 2018 result (5.8 mg/L) was below the regional background value of 8.8 milligrams per liter (Figure 5-4). In short, fluoride is present at the alternate source.

5.1.2 Calcium and Chloride

As shown on Figure 5-2 and Figure 5-3, brine with elevated levels of calcium and chloride is present throughout the region surrounding the Gavin Plant. The data show brine throughout the region has calcium and chloride concentrations significantly above the FAR UPL values. As described in Section 3, brine is commonly found at relatively shallow depths or at the land surface, and the fractured bedrock aquifers of the Monongahela and Conemaugh rocks could act as the flow pathways where brine could mix with groundwater.

As discussed in Section 3.2, deicing materials used by the ODOT on state roads surrounding the Gavin Plant include sodium chloride and calcium chloride. Both the Morgantown and Cow Run Sandstones are relatively close to the land surface northwest of the FAR (Figure 4-2), and thus calcium and chloride released during deicing operations may infiltrate into bedrock near the roadway and migrate under the FAR. Additional evaluation of this potential migration pathway is provided in Section 6. But in short, calcium and chloride are present at the alternate sources.

5.2 pH Alternate Source Along Flow Path

Cement mixtures are strongly basic and can have a pH between 12 and 13 (Portland Cement Association 2018). Groundwater that entered the well screen of Well 2016-01 likely contacted uncured cement, and the elevated pH has persisted 2 years after well installation due to the naturally low groundwater velocity of the Morgantown formation, and the limited flushing of the well screen interval. Thus, the alternate source (cement-bentonite grout) is along the flow path of groundwater entering Well 2016-01.

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

6.1 Fluoride

As described in Sections 4 and 5, groundwater with dissolved fluoride flows from upgradient recharge areas via the Morgantown Sandstone and migrates under the FAR. The regional background concentration of fluoride is higher than the fluoride concentration measured in Well 2016-01 in September 2018, which supports the conclusion that regional background is the alternate source of fluoride.

The piper diagram is a graphical procedure commonly used in groundwater studies to interpret sources of dissolved constituents in water and evaluate the potential for mixing of waters from different sources (Piper 1944). The Morgantown piper diagram (Figure 6-1) plots upgradient monitoring wells (96153R, 96154R, 96156, 96152, 96148, 2016-11, 2016-03, and 2016-05) in the same general area on the piper diagram as downgradient wells (2016-01 and 2016-07). The similarity in geochemical signatures shows that the groundwater beneath and downgradient of the FAR likely originated from the same source as the upgradient groundwater, and thus the fluoride in the Morgantown groundwater under the FAR is hydraulically connected to the upgradient alternate source.

6.2 Calcium and Chloride

As described in Sections 4 and 5, regional concentrations of calcium and chloride in brine within the Monongahela and Conemaugh bedrock are higher than in Well 2016-02, which demonstrates that naturally occurring brine could be an alternate source. As described in Section 3, calcium chloride and sodium chloride are applied to state highways near the Plant to deice state highways during the winter months. Figure 4-2 shows how rainwater or snowmelt with dissolved calcium and chloride from the road salt can infiltrate into the underlying aquifers. Groundwater with these dissolved constituents then flows in the Cow Run sandstone under the FAR and eventually discharges to the Ohio River (Figure 4-2).

Recent calcium and chloride solute concentrations in the Cow Run sandstone and a potential groundwater flow pathway from Highway 554 are shown on Figure 5-5 and Figure 5-6. In general, calcium and chloride are present in upgradient groundwater at similar or higher concentrations compared to results from Well 2016-02, which is consistent with a connection between Well 2016-02 and upgradient sources, whether they are road salt, brine, or both.

As shown in the Cow Run piper diagram (Figure 6-2), upgradient monitoring wells (2016-09, 2016-10, 2016-06, 2016-04, and 96147) plot in the same general area on the piper diagram as downgradient wells (2016-08 and 2016-02). The similarity in geochemical signatures shows the groundwater beneath and downgradient of the FAR likely originated from the same source as the upgradient groundwater, and thus the calcium and chloride in the Cow Run groundwater under the FAR is hydraulically connected to the upgradient alternate sources.

6.3 pH

As discussed in Section 5, the pH of the groundwater detected at monitoring Well 2016-01 is consistent with the typical pH of cement used for well construction.

7. A RELEASE FROM THE FAR IS NOT SUPPORTED AS THE SOURCE

7.1 Piper Diagrams

As seen on Figures 6-1 and 6-2, the discharge and seepage results plot in the upper portion of the piper diagram, which represents a high calcium and sulfate fingerprint, while the groundwater is represented by the combination of sodium, potassium, and chloride. The discharge and seepage results represent water that has been in contact with CCR within the FAR. Specifically, the discharge samples are collected from standing water within the FAR. The seepage samples represent FAR water collected from the engineered collection system at the toe of the dam. With the exception of MW-20, which is an upgradient well and only coincidentally has a signature similar to the leachate, the groundwater and leachate chemical signatures are distinct. If water in contact with fly ash (e.g., seepage water or discharge water) were released from the FAR and mixed with groundwater, the signature of the resulting mixture would become more like the discharge and seepage signatures (i.e., plot higher in the diamond portion of the piper diagram). Based on the data presented on Figures 6-1 and 6-2, it is clear that groundwater in the Morgantown Sandstone and Cow Run Sandstone has not mixed with FAR discharge or seepage because they plot in distinct regions on the piper diagram, and thus the FAR is not the source of the constituents detected in Wells 2016-01 and 2016-02.

7.2 Leachate Constituents vs Groundwater Constituents

If the FAR had a release and seepage or discharge mixed with groundwater, the concentrations of individual analytes in the resulting mixture would depend on the volume and initial concentration of the release. In order for a release to result in an increase in the concentration of an analyte in groundwater, the concentration of the analyte in the seepage or discharge would need to be higher than the respective existing background concentrations in groundwater. However, at the FAR, the opposite conditions exist: the concentrations of fluoride, calcium, and chloride are lower in discharge and seepage than in groundwater, as summarized in Table 7-1.

Table 7-1: Comparison of Discharge, Seepage and Groundwater Results

Analyte	Units	FAR Discharge (1998–2018)		FAR Seepage (2012–2018)		Well 2016-01 (2016–2018)		Well 2016-02 (2016–2018)	
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Fluoride	mg/L	0.35	0.88	0.15	0.24	2.8	17	-	-
Calcium	mg/L	71.5	190	82	340	-	-	400	850
Chloride	mg/L	1.9	21	0.83	12.9	-	-	10,500	14,000

mg/L = milligrams per liter

The concentrations of fluoride, calcium, and chloride in FAR discharge and seepage are all less than the concentrations in groundwater. Because the groundwater fluoride, calcium, and chloride concentrations are already greater than the leachate fluoride, calcium, and chloride concentrations, it is unlikely that FAR seepage or discharge are the source of the increased concentrations which resulted in SSIs for these analytes.

8. ALTERNATE SOURCE DATA ARE HISTORICALLY CONSISTENT WITH HYDROGEOLOGIC CONDITIONS

This ASD Report provides background groundwater quality for the fractured sedimentary bedrock aquifers found within and beyond the boundary of the FAR. The patterns of regional groundwater flow through fractured rock near the FAR 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 for the Morgantown Sandstone and Cow Run Sandstone of 50 feet per year and 80 feet per year[1], respectively, which 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 hydrogeological conditions and findings of the monitoring program.

The elevated pH that has been observed at Well 2016-01 since it was constructed in March 2016 is consistent with the errors that likely occurred during well construction, and the use of concrete to build the well. In addition, the persistence of the elevated pH is consistent with the groundwater velocities of the Morgantown Sandstone and expected low rate of flushing of the monitoring well screen interval.

[1] The groundwater velocities presented in the ASD prepared for the first semiannual sampling event of 2018 were based on an estimated porosity of 30 percent. Based on observations of additional bedrock cores advanced in 2018, ERM has revised downward the estimated porosity, which has resulted in higher estimated groundwater velocities within the fractured bedrock aquifers.

9. CONCLUSIONS

The SSIs identified in this report for samples from monitoring wells located downgradient of the FAR were detected on 15 November 2018. 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 FAR monitoring wells have been determined to result from alternate sources that include regional background, naturally occurring brine, local road salting practices, and concrete from improper well construction. Table 9-1 summarizes the six lines of evidence of an ASD for each of the SSIs.

Table 9-1: FAR ASD Summary

Line of Evidence	Fluoride	Calcium	Chloride	pH
Alternate source	Fluoride is present in background groundwater and can be attributed to regional sources such as naturally occurring brine or fluoride-bearing minerals. In addition, the 2018 results from Well 2016-01 showed fluoride was within the range of regional values.	Calcium is present in regional sources such as naturally occurring brine and is applied to the surface of state highways during deicing practices.	Chloride is present in regional sources such as naturally occurring brine and is applied to the surface of state highways during deicing practices.	Elevated pH is due to improper well construction.
Hydraulic connection	Regional groundwater flows under the FAR.	Regional groundwater flows under the FAR.	Regional groundwater flows under the FAR.	Cement from well construction is in contact with groundwater.
Constituent present at source or along flow path	Fluoride is present along flow path.	Calcium is present along flow path.	Chloride is present along flow path.	Cement from well construction is likely located in or near the well screen.
Constituent distribution more strongly linked to alternate source	Fluoride in FAR groundwater is within the range of regional values.	Calcium in FAR groundwater is within the range of regional brine concentrations.	Chloride in FAR groundwater is within the range of regional brine concentrations.	The observed pH levels are consistent with the expected pH of groundwater in contact with cement.

Line of Evidence	Fluoride	Calcium	Chloride	pH
Constituent could not have resulted from the FAR	Piper diagrams show different chemical fingerprints between groundwater and FAR seepage and discharge. The concentrations in FAR seepage and discharge concentrations are lower than in groundwater.	Piper diagrams show different chemical fingerprints between groundwater and FAR seepage and discharge. The concentrations in FAR seepage and discharge concentrations are lower than in groundwater.	Piper diagrams show different chemical fingerprints between groundwater and FAR seepage and discharge. The concentrations in FAR seepage and discharge concentrations are lower than in groundwater.	Piper diagrams show different chemical fingerprints between FAR leachate and groundwater.
Data are historically consistent with hydrogeological conditions	Groundwater velocities suggest there is ample time for upgradient fluoride to migrate to the Plant.	Groundwater velocities suggest there is ample time for upgradient calcium to migrate to the Plant.	Groundwater velocities suggest there is ample time for upgradient chloride to migrate to the Plant.	Timing of well installation is consistent with likely impacts from cement.

In conclusion, the FAR was not the source of the SSIs identified in the second semiannual groundwater sampling event of 2018 and thus the Plant will continue detection monitoring at the FAR in accordance with 40 CFR § 257.94(e)(2). The first semiannual FAR sampling event for 2019 is planned to be performed in April and May 2019.

PROFESSIONAL ENGINEER CERTIFICATION

I hereby certify that I or an agent under my review has prepared this Alternate Source Demonstration Report for the Fly Ash Reservoir in accordance with 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: ____01/31/2019___________

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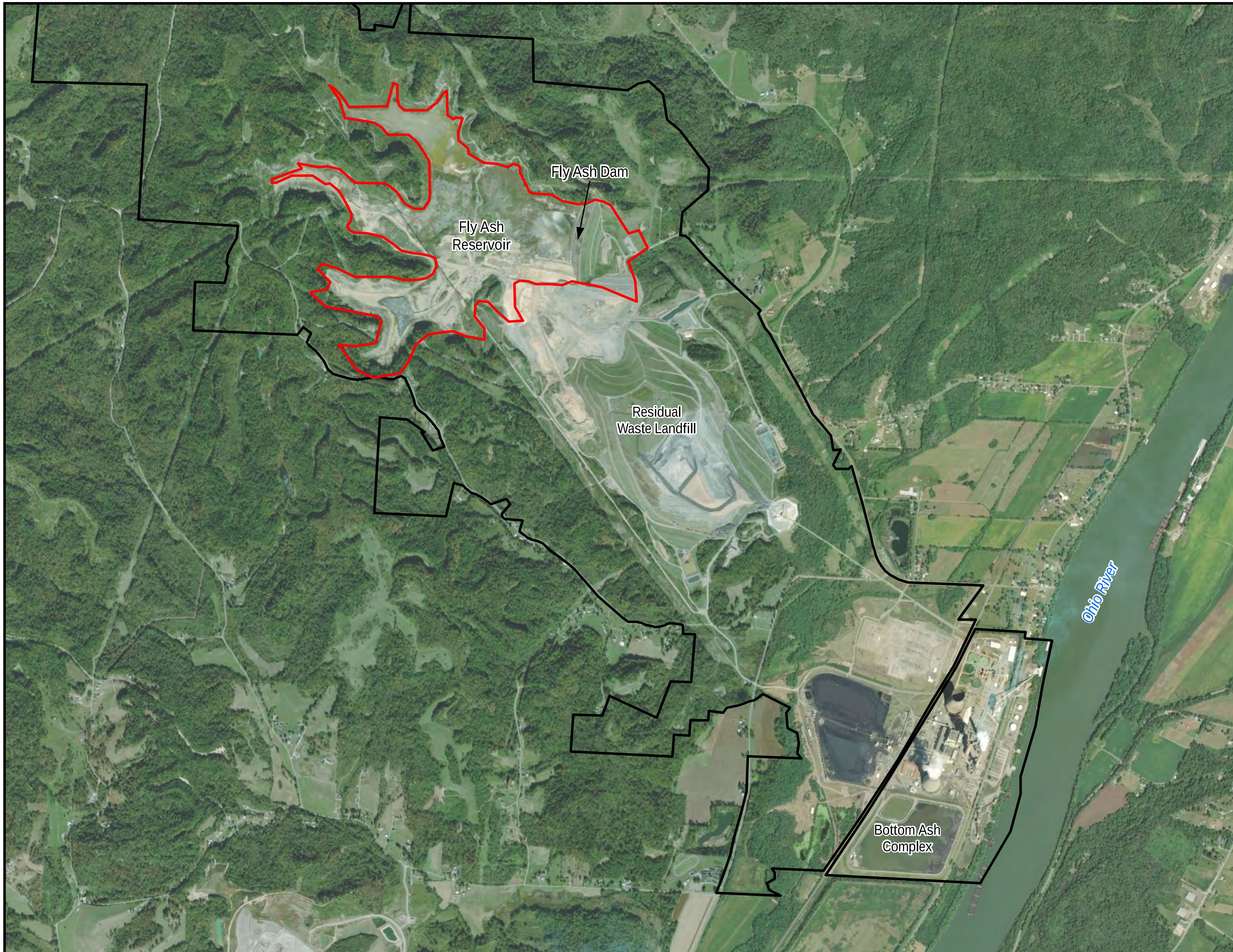
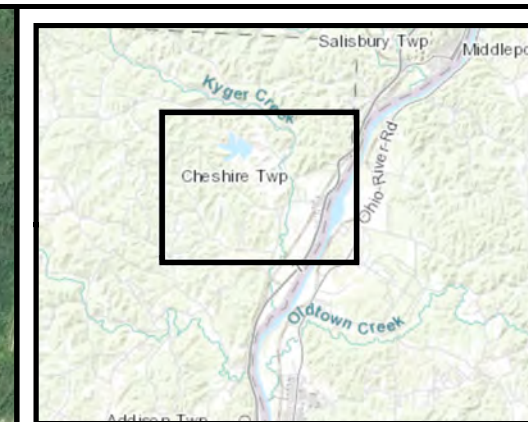
FIGURES

Figure 1-1: Gavin Plant Location
Fly Ash Reservoir Second Semi-Annual Sampling
Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- Fly Ash Reservoir
- Gavin Property Boundary

N

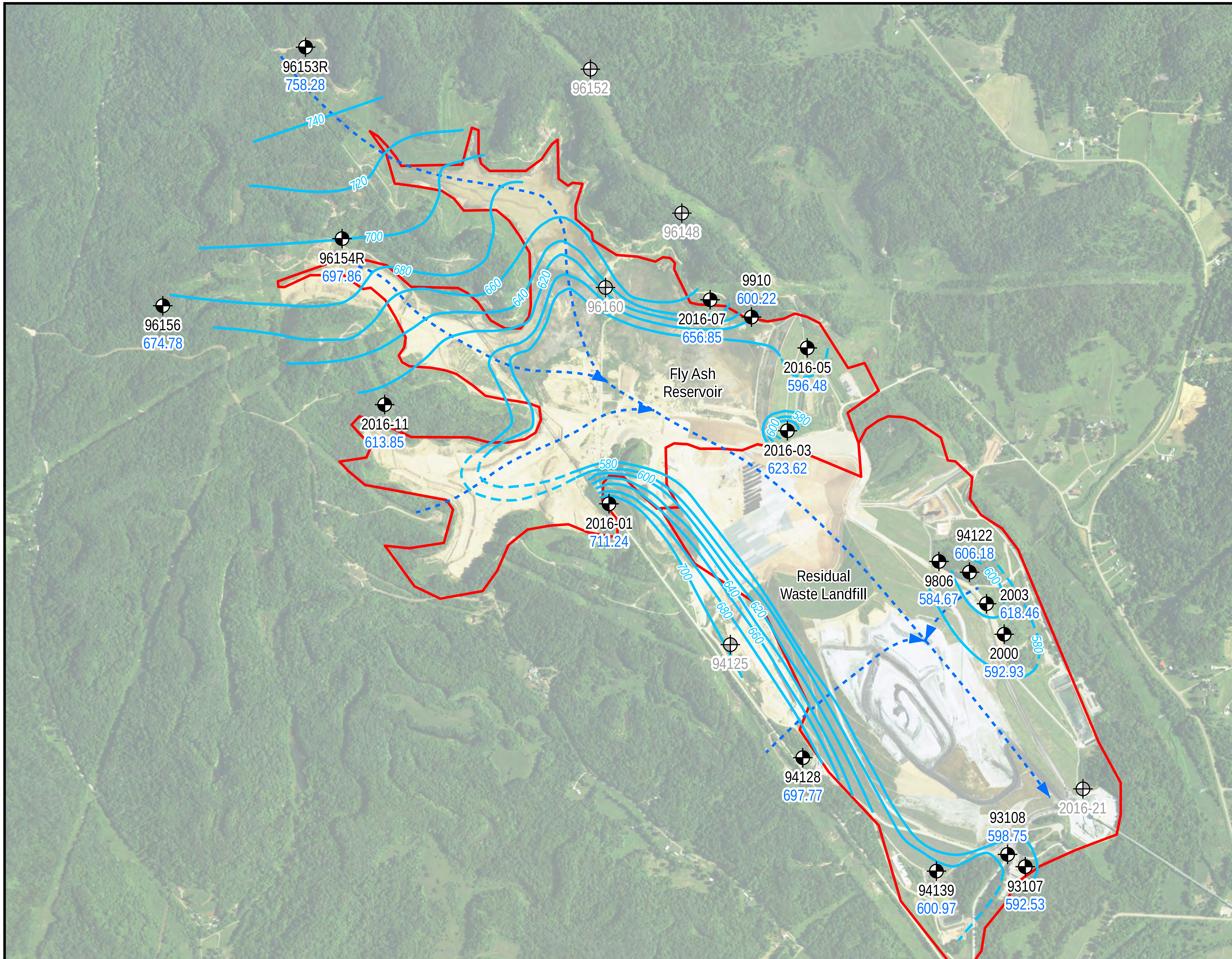
0 500 1,000 2,000 3,000 4,000
Feet

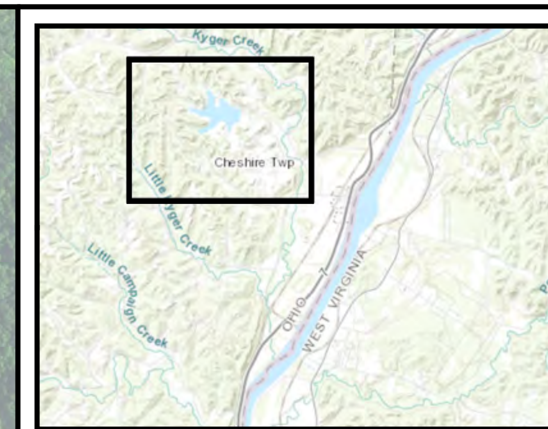
Figure 1-2: Fly Ash Reservoir Location

Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

Q:\Team\DMMV\Clients_F_K\Gavin\GavinPowerPlant\MXD\2018_FAR_ASD_Report\2nd_SemiAnnual_FAR\Figure1_2_FARLocation_20190114.mxd - Dana.Heusinkveld - 1/14/2019





Legend

- Morgantown Sandstone Well
- Morgantown Sandstone Well not included in potentiometric surface interpretation*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contour (ft) (Dashed where inferred)
- Groundwater Flow Direction
- CCR Unit

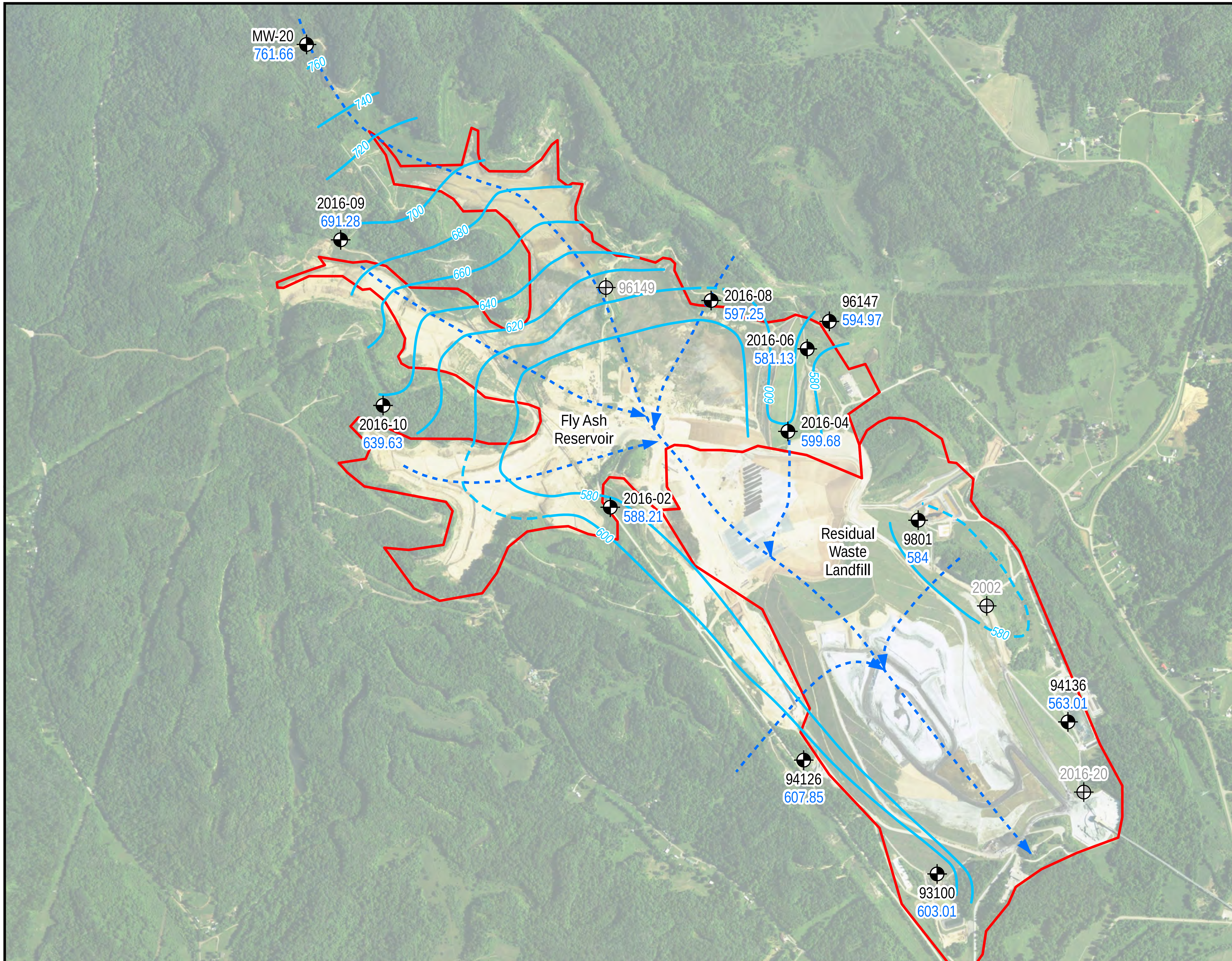
NOTES:
- * Monitoring Well not included in potentiometric surface interpretation because it was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

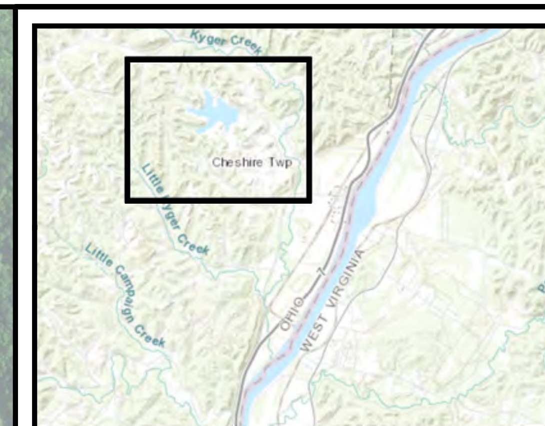
N

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

Figure 2-1: Morgantown Potentiometric Surface Map
Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Chesire, Ohio

ERM





Legend

- Cow Run Sandstone Well
- Cow Run Sandstone Well not included in potentiometric surface interpretation*
- 605.82 Groundwater Elevation (ft)
- Groundwater Elevation Contours (ft) (Dashed where inferred)
- Potential Groundwater Flow Direction
- CCR Unit

NOTES:
- * Monitoring Well not included in potentiometric surface interpretation because it was either decommissioned, destroyed, dry, not gauged, or documented slow recharge.

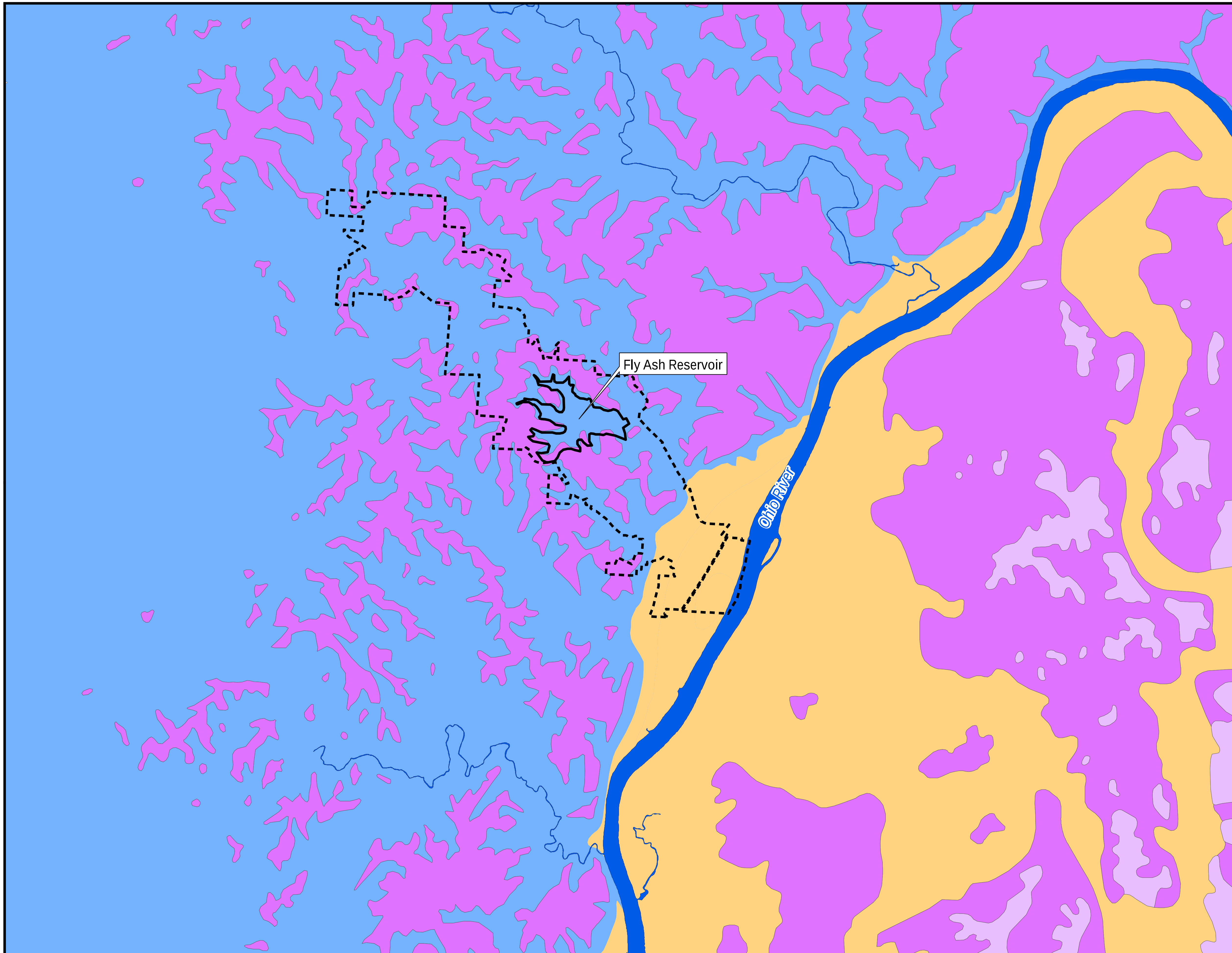
N

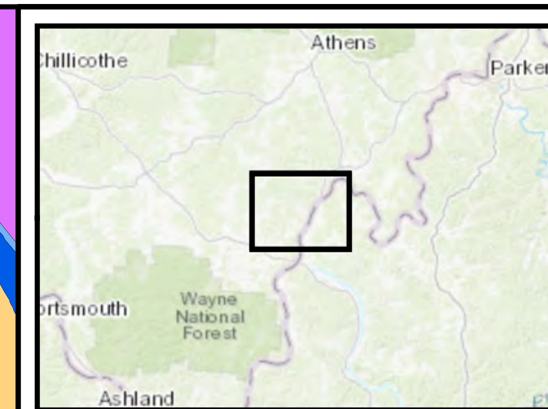
0 250 500 1,000 1,500 2,000
Feet

Figure 2-2: Cow Run Potentiometric Surface Map

Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

Gavin Property Boundary

Alluvial Aquifer

Sedimentary Aquifers

Conemaugh Group

Monongahela Group

Dunkard Group

NOTES:

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

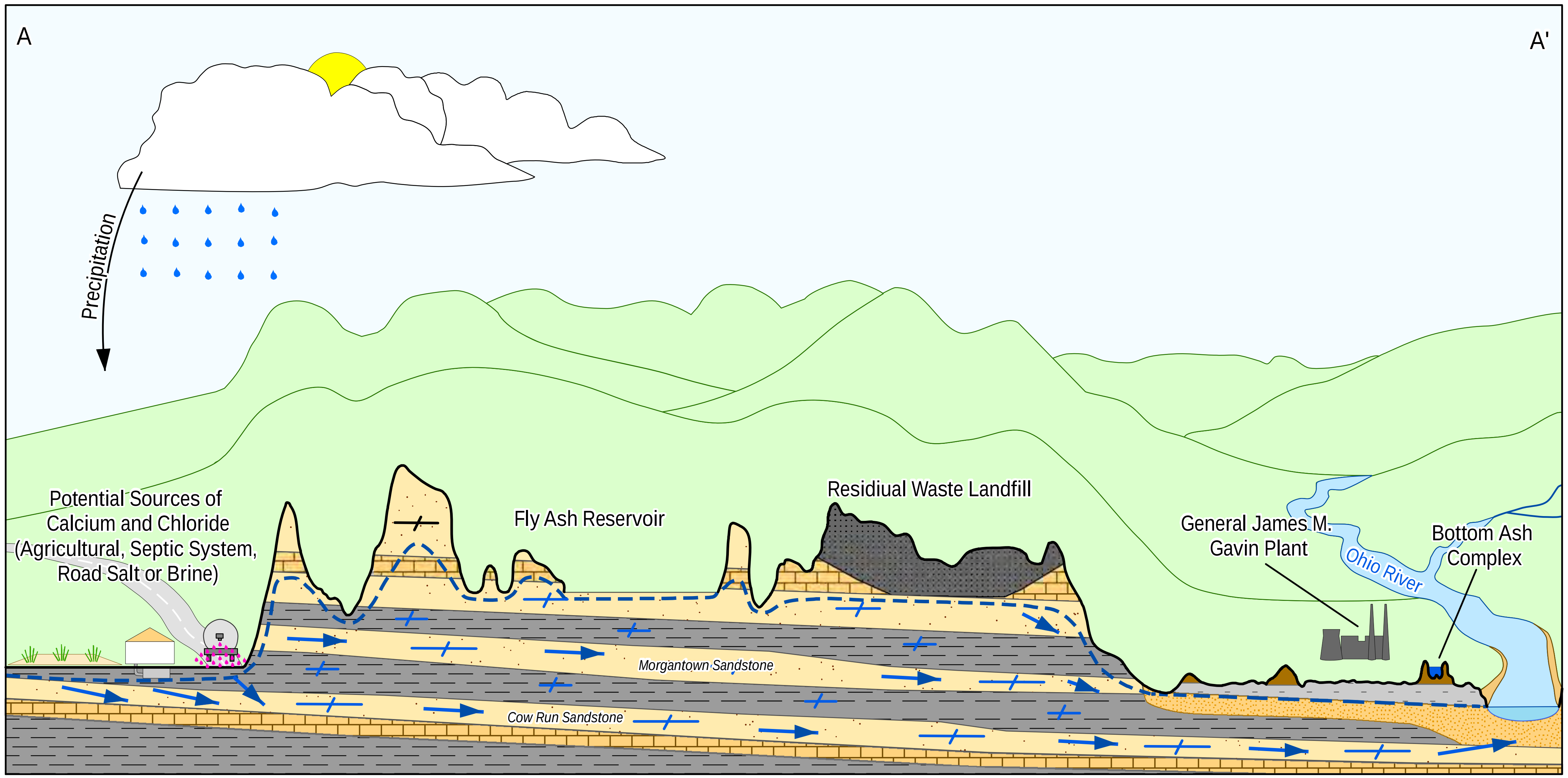
0 0.25 0.5 1 1.5 2
Miles

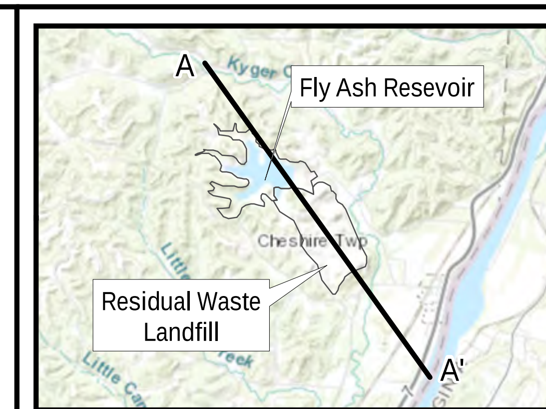
Figure 4-1: Sedimentary and Alluvial Aquifers

Second Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

Q:\Team\DMMV\Clients_F_K\Gavin\GavinPowerPlant\MXD\2018_FAR_ASD_Report\Figure4_1_SedimentaryAndAlluvialAquifers_20180611.mxd - Dana.Heusinkveld - 10/2/2018





Legend

- Groundwater Flow Direction
- Water Table
- Saturated Fractures
- Unsaturated Fractures
- Deicing Fluid Application
- FGD Material
- Fill
- Interbedded Silt/Clay
- Sand
- Course Sand Deposits
- Sandstone
- Fractured Limestone
- Fractured Shale

NOTES:

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

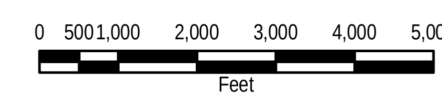


Figure 4-2: Regional Groundwater Flow Patterns

Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM

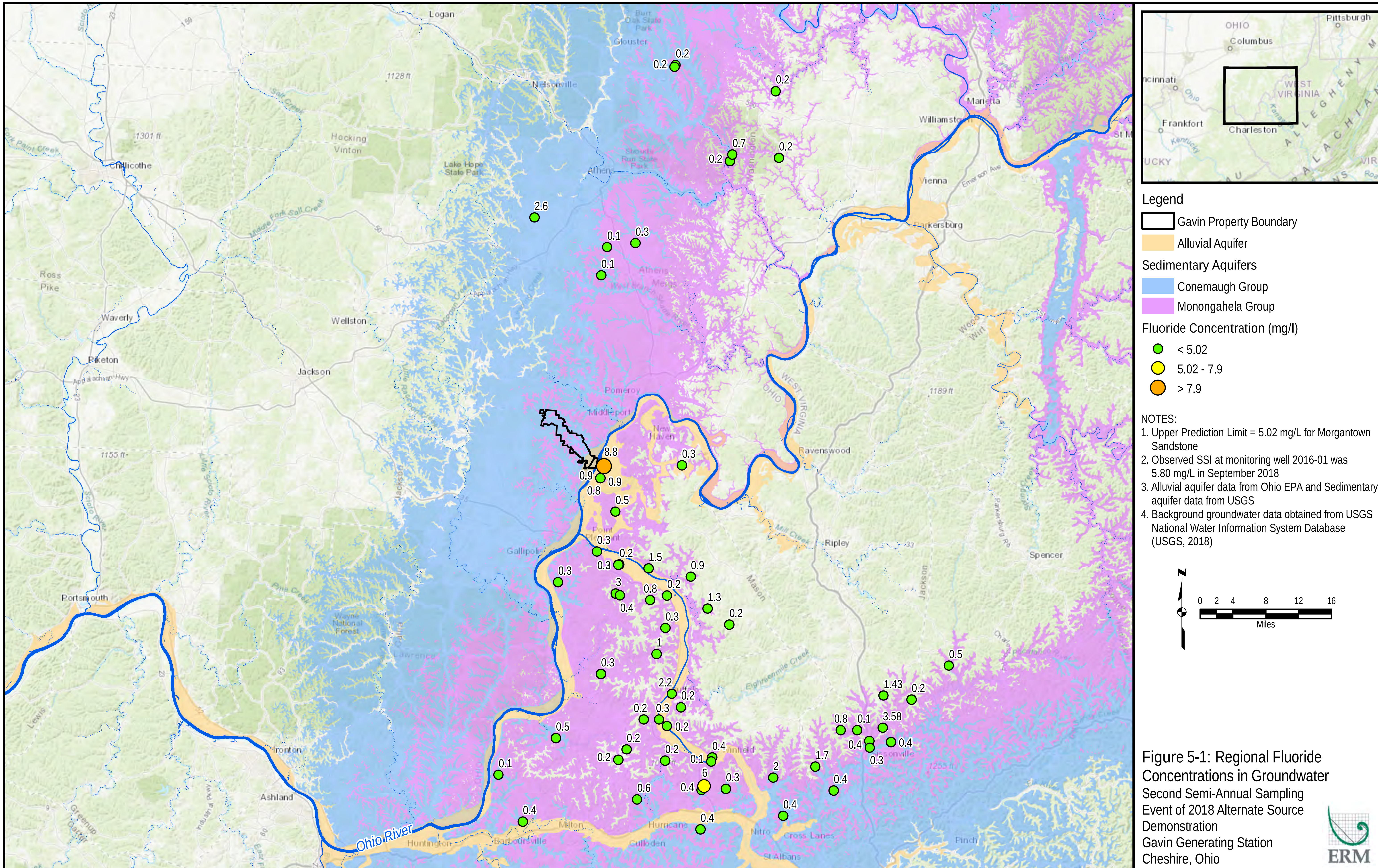


Figure 5-1: Regional Fluoride Concentrations in Groundwater
Second Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

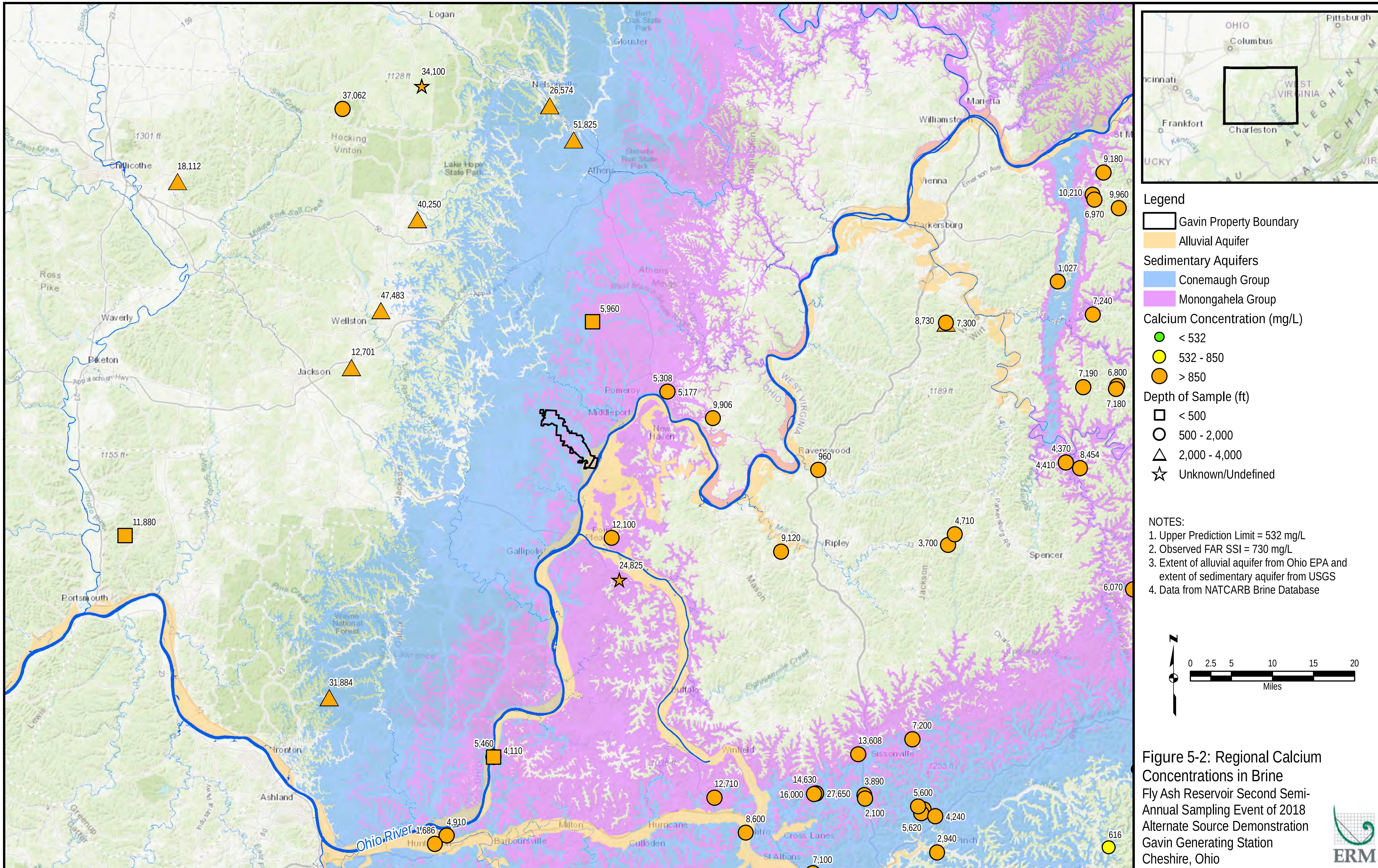


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Figure 5-2: Regional Calcium Concentrations in Brine
Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

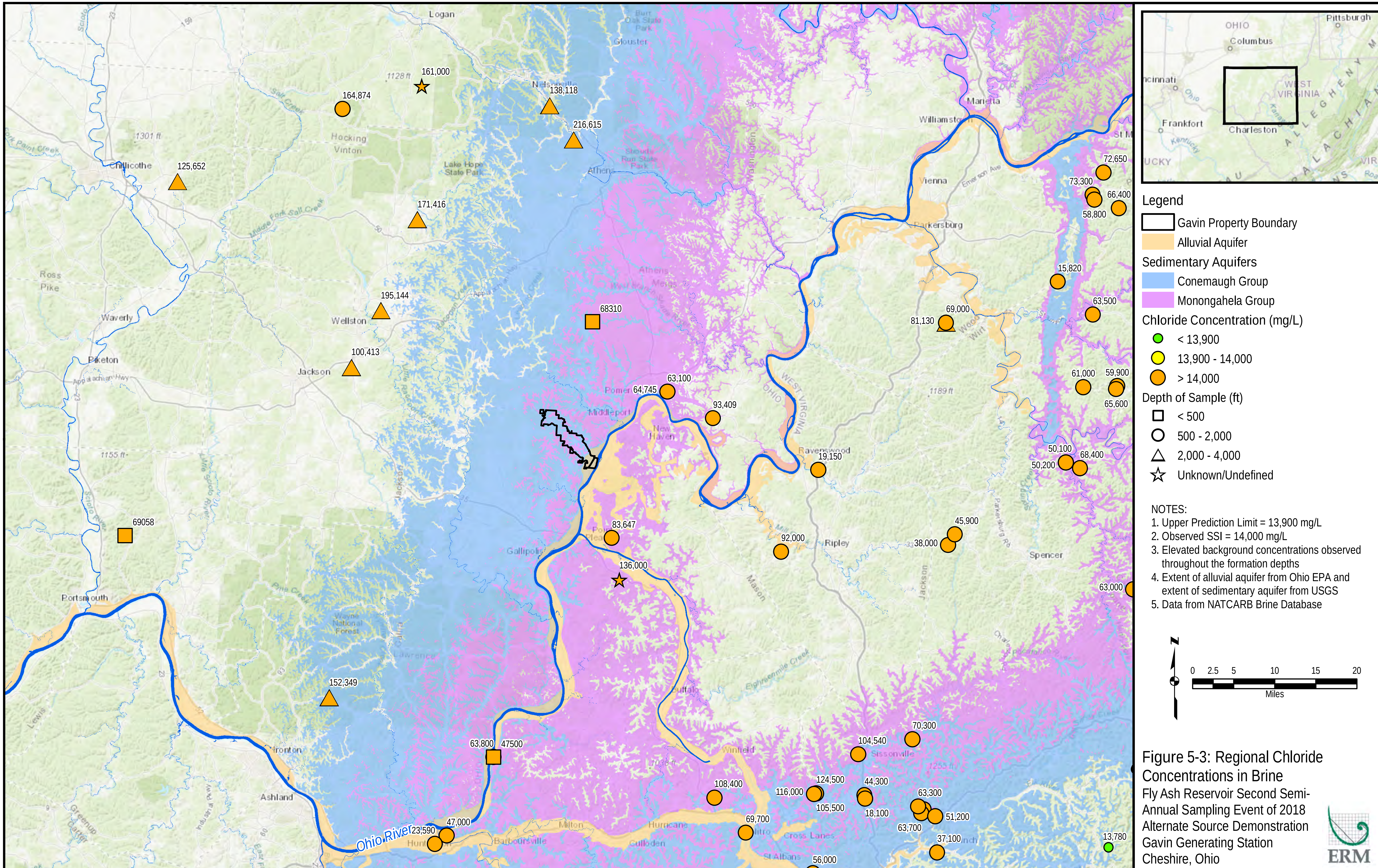


Figure 5-3: Regional Chloride Concentrations in Brine
Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

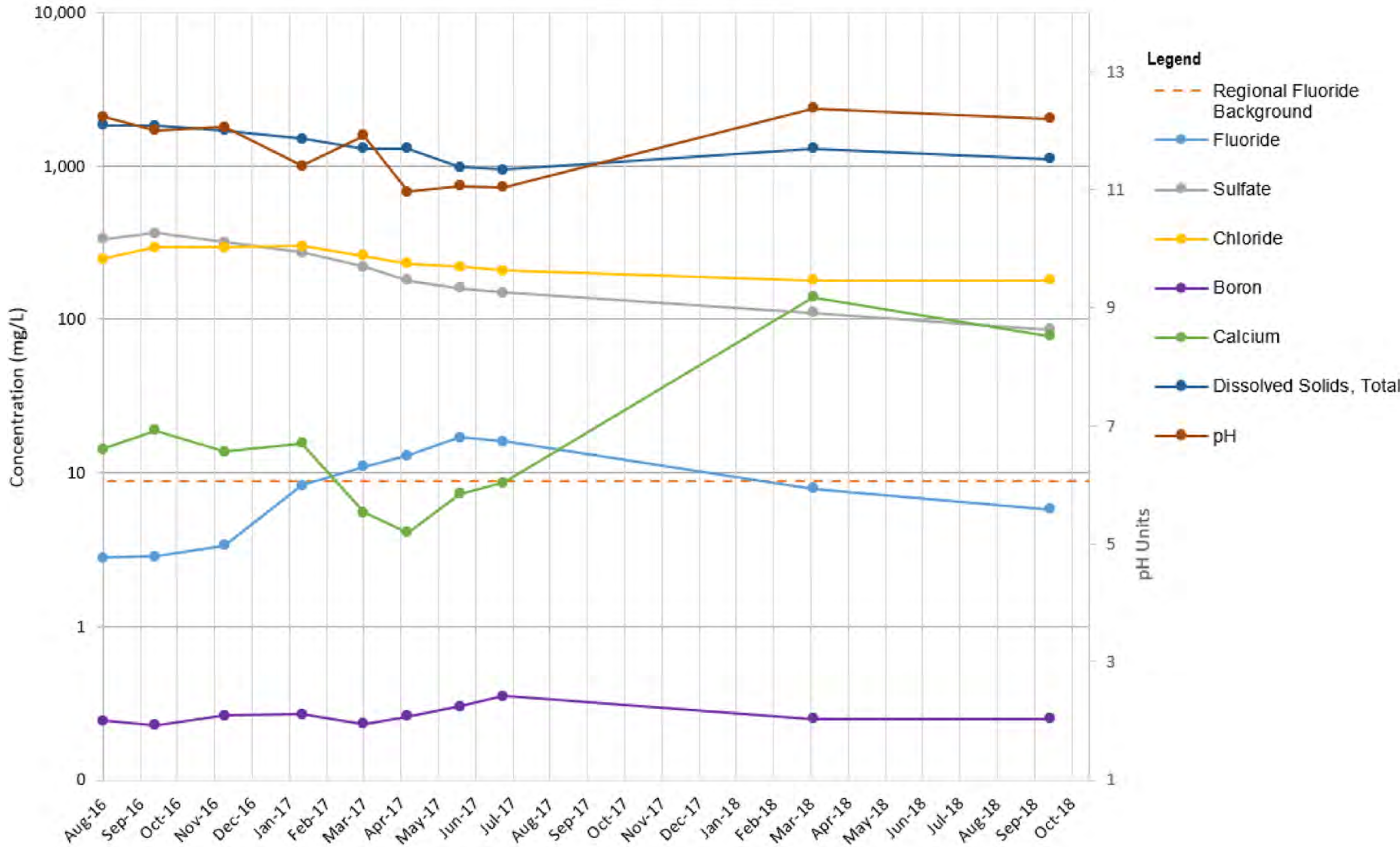
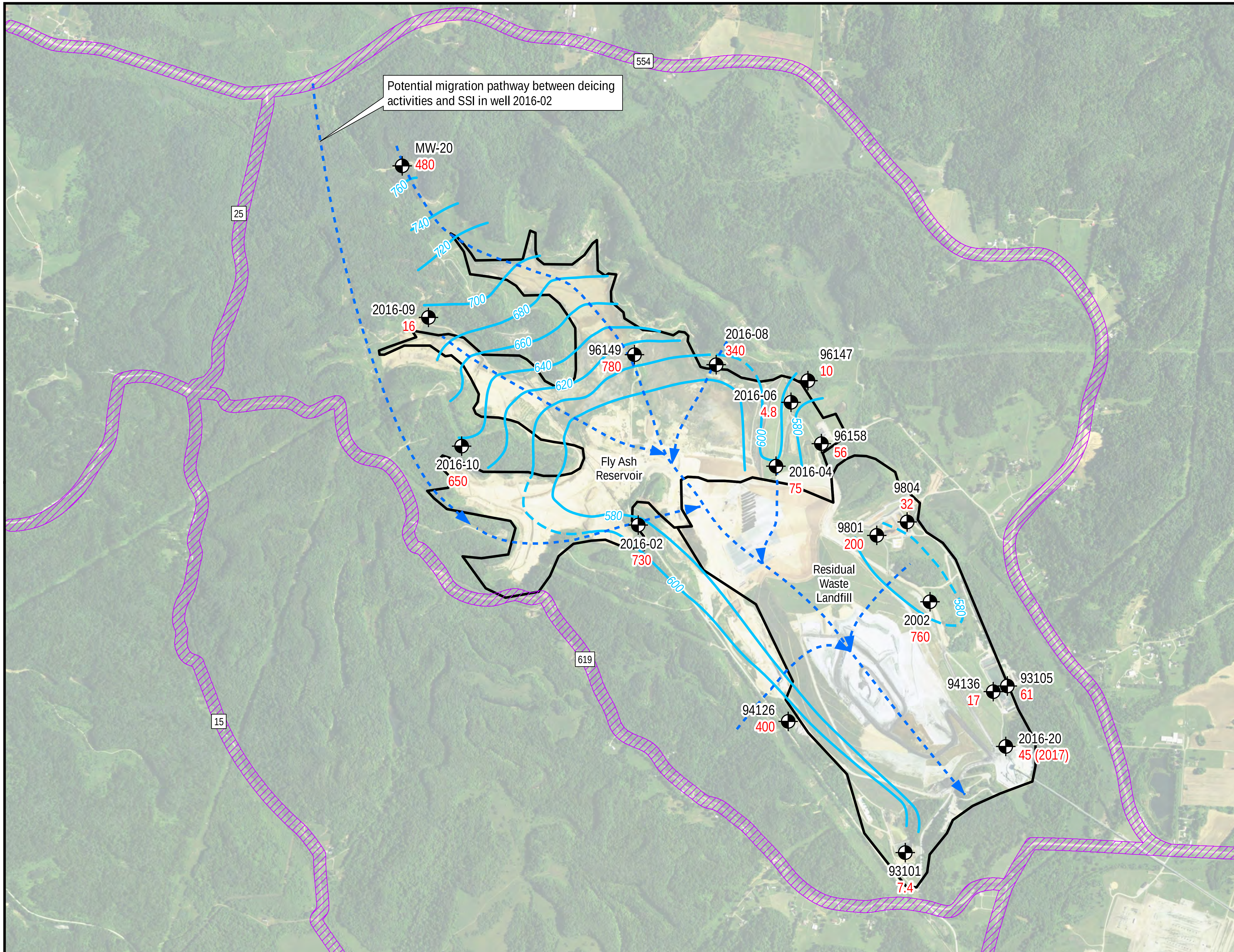
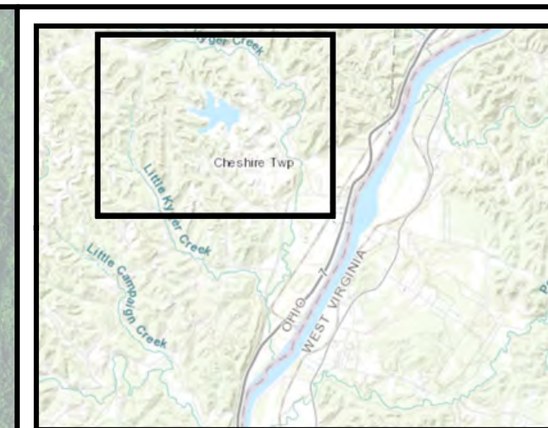


Figure 5-4: Analytical Results for Morgantown Sandstone Monitoring Well 2016-01
Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018 Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

- 190 Calcium Concentration (mg/L)
- Groundwater Flow Direction
- Area of Road Salt
- CCR Unit

NOTES:
- Concentration data is from February to October 2018 unless noted otherwise.

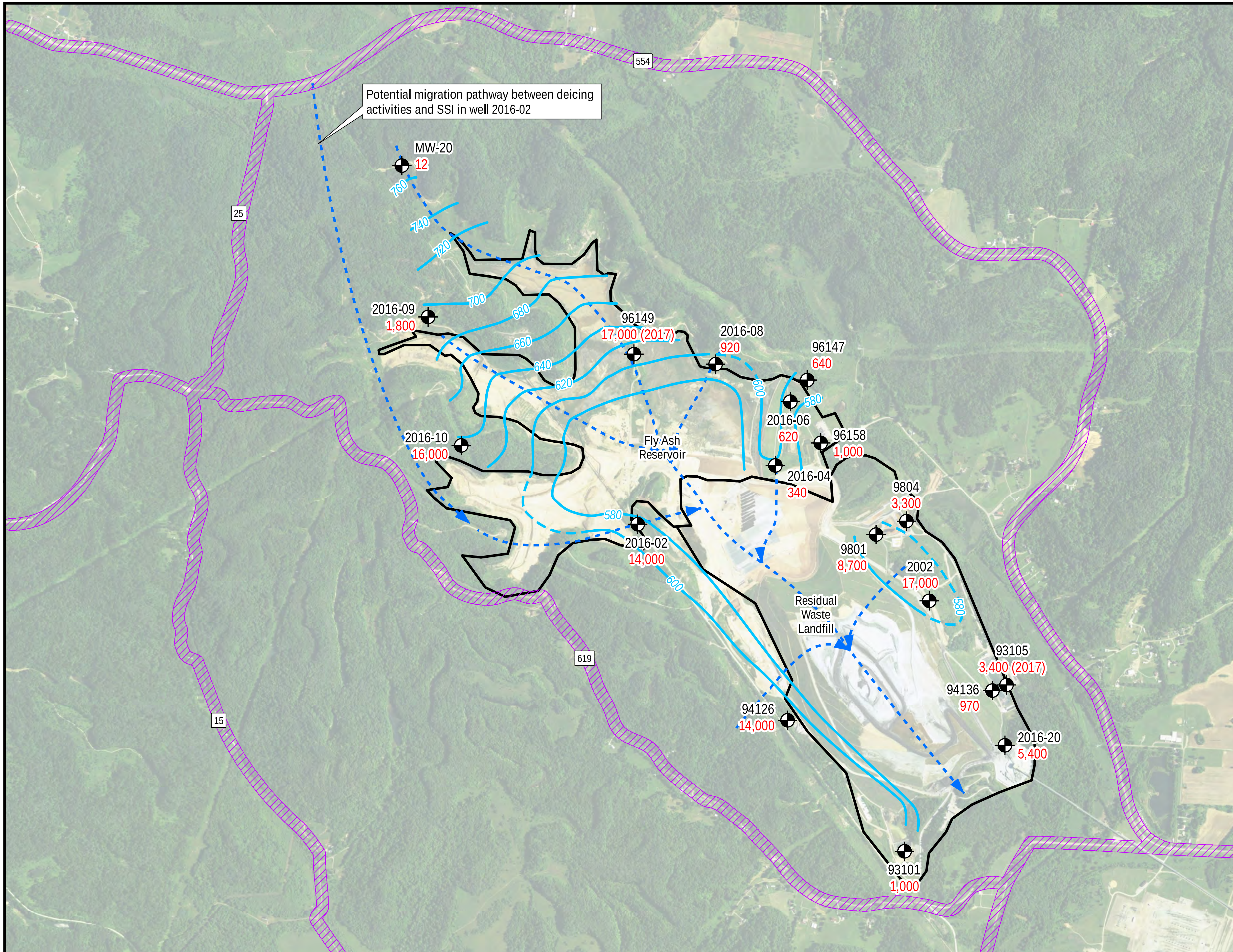
N

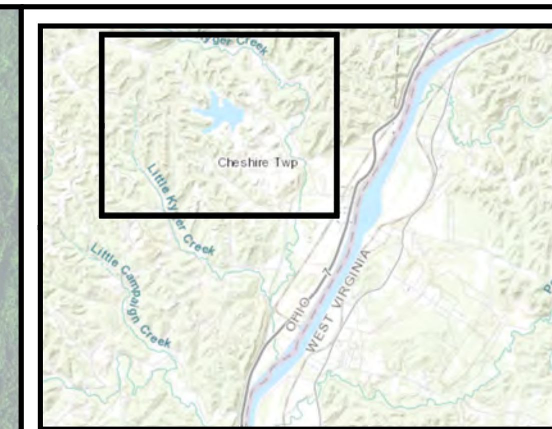
0 500 1,000 2,000 3,000
Feet

Figure 5-5: Calcium Concentrations in the Cow Run Sandstone

Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM





Legend

540	Chloride Concentration (mg/L)
	Groundwater Elevation Contour (ft) (Dashed where inferred)
	Groundwater Flow Direction
	Area of Road Salt Application
	CCR Unit

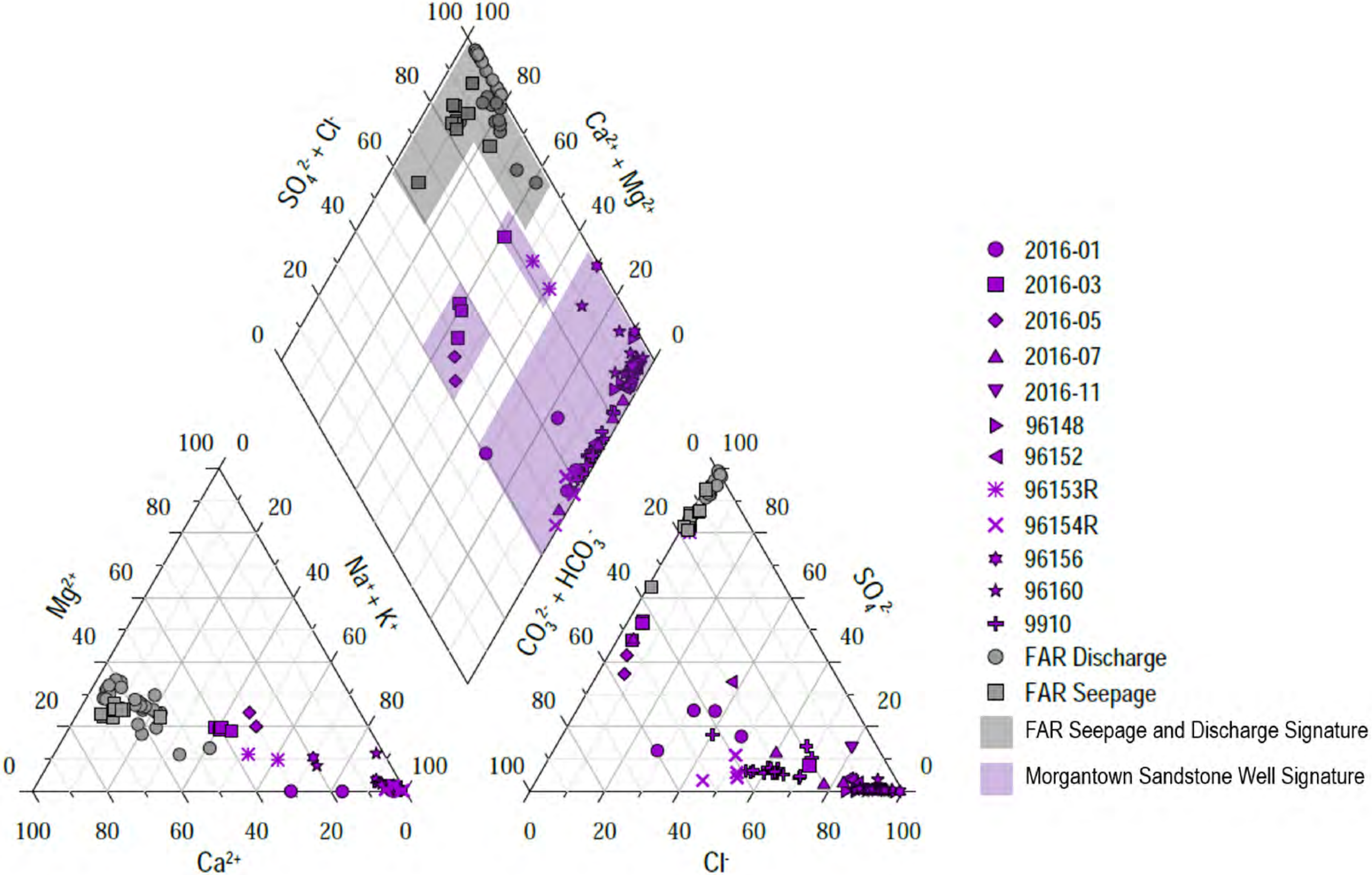
NOTES:
- Concentration data is from February to October 2018 unless noted otherwise.

N

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

Figure 5-6: Chloride Concentrations in the Cow Run Sandstone
Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

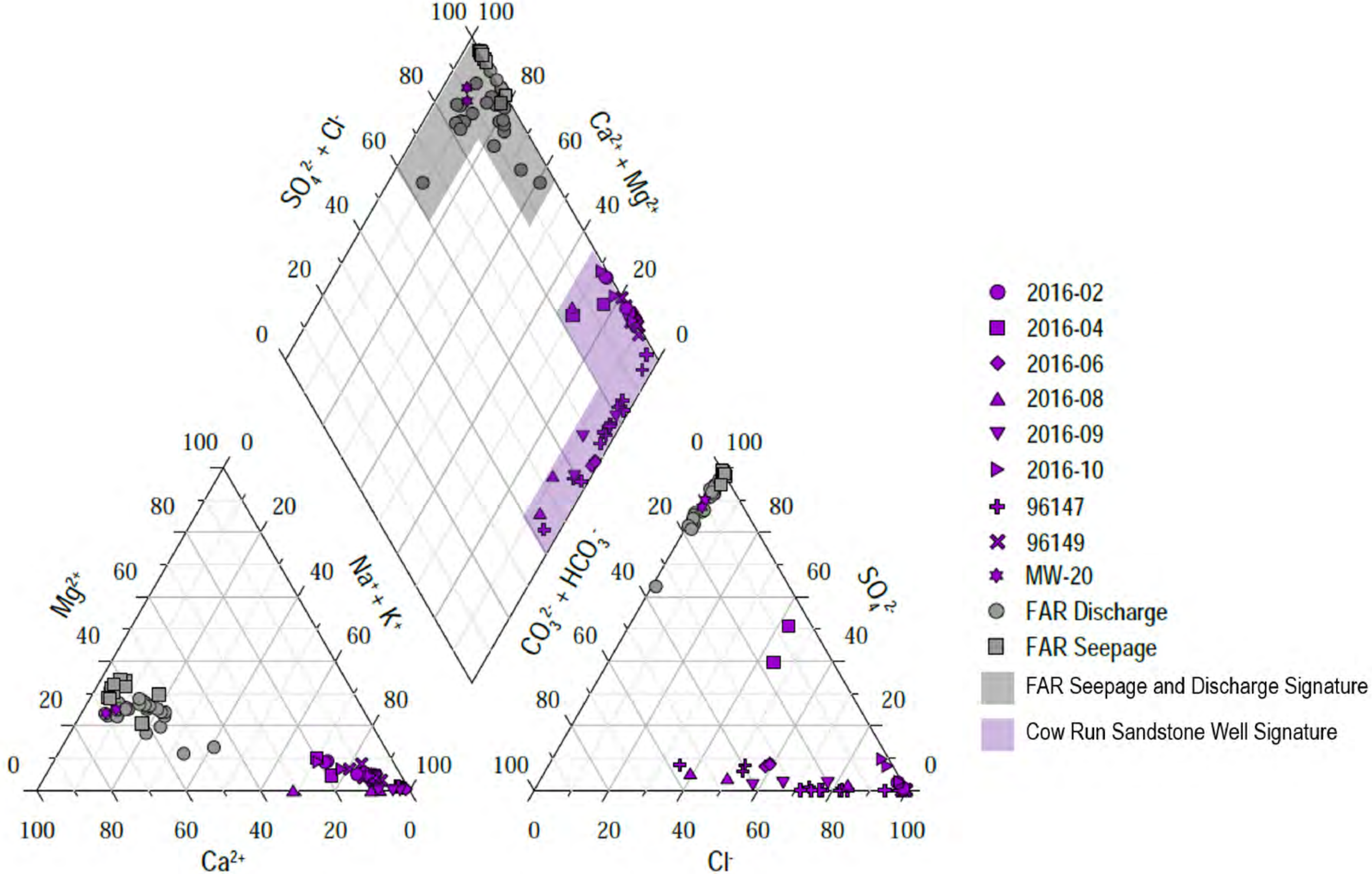
ERM



NOTES:
1. Data Range: May 1999 to September 2018
2. Only wells with complete data including all 8 piper diagram analytes are presented.

Figure 6-1: FAR Piper Diagram for the Morgantown Sandstone
Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

ERM



NOTES:
1. Data Range: May 1999 to September 2018
2. Only wells with complete data including all 8 piper diagram analytes are presented.

Figure 6-2: FAR Piper Diagram for the Cow Run Sandstone
Fly Ash Reservoir Second Semi-Annual Sampling Event of 2018
Alternate Source Demonstration
Gavin Generating Station
Cheshire, Ohio

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APPENDIX D ANALYTICAL SUMMARY

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

	Location ID	FEDERAL 6/8/2016 N 2016-05	FEDERAL 8/23/2016 N 2016-09	FEDERAL 8/23/2016 N 2016-10	FEDERAL 8/23/2016 N 2016-11	FEDERAL 8/23/2016 N 96153R
	Sample ID	2016-05-20170608-02	2016-09-20160823-01	2016-10-20160823-01	2016-11-20160823-01	96153-R-20160823-01
Analyte	Unit					
Antimony	mg/L		0.00076	0.00027	0.00533	0.00059
Arsenic	mg/L		0.0117	0.00323	0.0038	0.00237
Barium	mg/L		0.684	0.235	0.154	0.0315
Beryllium	mg/L		8.5E-05	8E-05	4E-05	0.000515
Boron	mg/L		0.093	0.449	0.278	0.448
Cadmium	mg/L		6E-05	4E-05	0.0002	8E-05
Calcium	mg/L		78.6	179	10.3	189
Chloride	mg/L		1500	3600		34.3
Chromium	mg/L		0.0455	0.0007	0.0349	0.0034
Cobalt	mg/L		0.00056	0.000699	0.000731	0.0234
Dissolved Solids, Total	mg/L		4820	6820		2300
Fluoride	mg/L		1.67	0.66		0.8
Lead	mg/L		0.00215	0.00143	0.00261	0.00648
Lithium	mg/L		0.561	0.138	0.593	0.096
Mercury	mg/L		1.2E-05	4E-06	8E-06	8E-06
Molybdenum	mg/L		0.18	0.0367	0.223	0.0126
pH, Field	SU	7.88	12.49	9.79	12.23	7.18
Radium-226/228	pCi/L		1.924	2.85	2.62	2.434
Selenium	mg/L		0.0042	0.001	0.0054	0.0009
Sulfate	mg/L		77.1	874		1290
Thallium	mg/L		7E-05	7E-05	0.000266	5E-05

Notes
FD - Field Duplicate
N - Normal Sample
mg/L = milligrams per liter
SU = Standard Units
pCi/L = Picocuries per liter

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		8/23/2016	8/23/2016	8/23/2016	8/24/2016	8/24/2016	8/24/2016
		N	N	N	N	N	N
	Location ID	96154R	96156	MW-20	2016-01	2016-02	2016-03
	Sample ID	96154-R-20160823-01	96156-20160823-01	MW-20-20160823-01	2016-01-20160824-01	2016-02-20160824-01	2016-03-20160824-01
Analyte	Unit						
Antimony	mg/L	0.00091	0.0001	4E-05	0.00092	0.0003	0.00096
Arsenic	mg/L	0.00644	0.0141	0.00938	0.0158	0.0149	0.00059
Barium	mg/L	0.13	16.2	0.0274	0.098	1.06	0.0321
Beryllium	mg/L	0.000546	0.0002	0.000234	3E-05	0.0002	1E-05
Boron	mg/L	0.441	0.394	0.126	0.243	0.396	0.43
Cadmium	mg/L	5E-05	0.00022	8E-05	7E-05	9E-05	0.00012
Calcium	mg/L	9.41	409	495	14.4	400	149
Chloride	mg/L	413	11700	60.1	247	10500	21.7
Chromium	mg/L	0.0022	0.0011	0.0028	0.0014	0.0013	0.0002
Cobalt	mg/L	0.00204	0.00194	0.128	0.000358	0.00279	0.000403
Dissolved Solids, Total	mg/L	1940	18300	2660	1840	17000	1090
Fluoride	mg/L	3.32	0.33	0.95	2.8	0.74	0.2
Lead	mg/L	0.00565	0.00236	0.000201	0.000671	0.00167	0.000324
Lithium	mg/L	0.08	0.269	0.174	0.435	0.171	0.03
Mercury	mg/L	2.5E-05	5E-06	5E-06	8E-06	4E-06	1.1E-05
Molybdenum	mg/L	0.0557	0.00987	0.0089	0.11	0.195	0.0154
pH, Field	SU	9.5	7.07	6.88	12.24	7.18	7.07
Radium-226/228	pCi/L	1.566	75.85	0.684	0.887	4.82	0.409
Selenium	mg/L	0.001	0.0006	0.0001	0.0011	0.0003	0.0002
Sulfate	mg/L	99.2	1.9	1610	333	228	446
Thallium	mg/L	6.4E-05	0.0005	0.000598	2E-05	0.000956	2E-05

Notes
FD - Field Duplicate
N - Normal Sample
mg/L = milligrams per liter
SU = Standard Units
pCi/L = Picocuries per liter

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 8/24/2016 N	FEDERAL 8/24/2016 N	FEDERAL 8/24/2016 N	FEDERAL 8/24/2016 N	FEDERAL 8/25/2016 N
	Location ID	2016-04	2016-07	2016-08	96147	2016-05
	Sample ID	2016-04-20160824-01	2016-07-20160824-01	2016-08-20160824-01	96147-20160824-01	2016-05-20160825-01
Analyte	Unit					
Antimony	mg/L	0.00116	0.00126	0.00134	0.00017	0.00015
Arsenic	mg/L	0.00421	0.00772	0.00795	0.00241	0.00078
Barium	mg/L	0.117	0.107	0.312	0.77	0.052
Beryllium	mg/L	4E-05	0.000368	4E-05	0.000155	0.000107
Boron	mg/L	0.343	0.313	0.318	0.438	0.116
Cadmium	mg/L	5E-05	7E-05	2E-05	0.00067	3E-05
Calcium	mg/L	9.88	13.3	33.8	31.1	40.2
Chloride	mg/L	1060	421	452	3240	16.3
Chromium	mg/L	0.0305	0.0015	0.0012	0.0013	0.0015
Cobalt	mg/L	0.000641	0.00105	0.000353	0.00113	0.00299
Dissolved Solids, Total	mg/L	2630	1740	2480	5760	474
Fluoride	mg/L	1.28	1.89	1.92	1.78	0.19
Lead	mg/L	0.000238	0.00336	0.000143	0.00737	0.00194
Lithium	mg/L	0.236	0.235	0.665	0.077	0.019
Mercury	mg/L	1.3E-05	1.2E-05	2.4E-05	4E-05	8E-06
Molybdenum	mg/L	0.0864	0.0808	0.121	0.00729	0.00109
pH, Field	SU	8.4	10.86	12.52		7.89
Radium-226/228	pCi/L	1.08	0.427	1.898	3.94	1.027
Selenium	mg/L	0.0021	0.0008	0.0028	0.0002	0.0005
Sulfate	mg/L	252	229	133	25.3	138
Thallium	mg/L	3E-05	8.4E-05	9E-05	8E-05	2E-05

Notes
FD - Field Duplicate
N - Normal Sample
mg/L = milligrams per liter
SU = Standard Units
pCi/L = Picocuries per liter

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

	Location ID	FEDERAL 8/25/2016 N 2016-06	FEDERAL 8/26/2016 N 2016-11	FEDERAL 10/3/2016 N 2016-03	FEDERAL 10/3/2016 N 2016-06	FEDERAL 10/3/2016 N 2016-09
	Sample ID	2016-06-20160825-01	2016-11-20160826-01	2016-03-20161003-01	2016-06-20161003-01	2016-09-20161003-01
Analyte	Unit					
Antimony	mg/L	0.00019		0.00041	0.00025	0.00087
Arsenic	mg/L	0.00225		0.00092	0.0023	0.0145
Barium	mg/L	0.0707		0.0383	0.0649	0.566
Beryllium	mg/L	0.000198		7.2E-05	0.000143	3E-05
Boron	mg/L	0.501		0.35	0.424	0.411
Cadmium	mg/L	1E-05		0.0001	2E-05	6E-05
Calcium	mg/L	5.87		129	5.51	202
Chloride	mg/L	545	403	21.8	560	1520
Chromium	mg/L	0.0092		0.0002	0.077	0.0371
Cobalt	mg/L	0.00208		0.000563	0.00283	0.000324
Dissolved Solids, Total	mg/L	1560	3060	1080	1560	4480
Fluoride	mg/L	5.28	2.21	0.18	5.09	1.58
Lead	mg/L	0.00371		0.000456	0.00151	0.000743
Lithium	mg/L	0.029		0.03	0.024	0.082
Mercury	mg/L	5E-06		4E-05	1.1E-05	4E-06
Molybdenum	mg/L	0.0595		0.00646	0.0952	0.155
pH, Field	SU	8.51		6.91	8.36	12.6
Radium-226/228	pCi/L	0.756		1.295	2.268	2.559
Selenium	mg/L	0.0003		0.0003	0.0002	0.0038
Sulfate	mg/L	103	529	445	96.5	72.2
Thallium	mg/L	3E-05		3E-05	2E-05	4E-05

Notes
FD - Field Duplicate
N - Normal Sample
mg/L = milligrams per liter
SU = Standard Units
pCi/L = Picocuries per liter

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 10/3/2016 N	FEDERAL 10/3/2016 N	FEDERAL 10/3/2016 N	FEDERAL 10/3/2016 N	FEDERAL 10/3/2016 N	FEDERAL 10/5/2016 N
	Location ID	2016-10	96153R	96154R	96156	9910	2016-01
	Sample ID	2016-10-20161003-01	96153-R-20161003-01	96154-R-20161003-01	96156-20161003-01	9910-20161003-01	2016-01-20161005-01
Analyte	Unit						
Antimony	mg/L	9E-05	0.00036	0.00098	0.00141		0.00091
Arsenic	mg/L	0.00281	0.00142	0.00668	0.0184		0.0188
Barium	mg/L	0.183	0.0901	0.115	17.4		0.0908
Beryllium	mg/L	0.0001	0.000196	0.000319	0.000129		8E-05
Boron	mg/L	0.386	0.423	0.395	0.357		0.228
Cadmium	mg/L	0.0001	0.0001	2E-05	0.00221		3E-05
Calcium	mg/L	209	208	5.34	354		18.9
Chloride	mg/L	5000	16.1	452			297
Chromium	mg/L	0.0003	0.0027	0.0057	0.0195		0.0023
Cobalt	mg/L	0.000869	0.0266	0.00176	0.00371		0.000396
Dissolved Solids, Total	mg/L	9040	2160	1550			1830
Fluoride	mg/L	0.5	0.72	3.36			2.85
Lead	mg/L	0.000325	0.00278	0.00371	0.0218		0.000487
Lithium	mg/L	0.142	0.081	0.054	0.252		0.317
Mercury	mg/L	5E-06	2E-06	1E-05	0.0002		7E-06
Molybdenum	mg/L	0.0128	0.0114	0.102	0.017		0.124
pH, Field	SU	7.48	6.99	9.36	6.83	7.58	12
Radium-226/228	pCi/L	2.5	1.963	1.434	41.96		2.58
Selenium	mg/L	0.0002	0.0005	0.001	0.0004		0.0015
Sulfate	mg/L	857	1320	87.4			364
Thallium	mg/L	0.0002	8E-05	0.000144	0.0002		4E-05

Notes
FD - Field Duplicate
N - Normal Sample
mg/L = milligrams per liter
SU = Standard Units
pCi/L = Picocuries per liter

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 10/5/2016 N	FEDERAL 10/5/2016 N	FEDERAL 10/5/2016 N	FEDERAL 10/5/2016 N	FEDERAL 10/5/2016 N	FEDERAL 10/5/2016 N
	Location ID	2016-02	2016-05	2016-07	2016-08	96147	MW-20
	Sample ID	2016-02-20161005-01	2016-05-20161005-01	2016-07-20161005-01	2016-08-20161005-01	96147-20161005-01	MW-20-20161005-01
Analyte	Unit						
Antimony	mg/L	0.0001	0.0001	0.00091	0.00083	0.0002	0.0002
Arsenic	mg/L	0.00732	0.00074	0.00705	0.00691	0.00906	0.01
Barium	mg/L	0.606	0.0432	0.141	0.279	0.929	0.0228
Beryllium	mg/L	8E-05	6E-05	0.00027	0.000182	0.00926	0.000265
Boron	mg/L	0.355	0.088	0.297	0.286	0.48	0.272
Cadmium	mg/L	0.00032	2E-05	8E-05	3E-05	0.00198	2E-05
Calcium	mg/L	313	35.8	11.5	48.9	85.6	483
Chloride	mg/L	9310	17.2	609	645	1650	25.2
Chromium	mg/L	0.0007	0.0012	0.0022	0.0033	0.0062	0.0018
Cobalt	mg/L	0.00171	0.00267	0.000905	0.00278	0.0255	0.134
Dissolved Solids, Total	mg/L	15900	406	1850	2660	3840	2710
Fluoride	mg/L	0.94	0.19	2.04	1.85	2.54	1
Lead	mg/L	0.00154	0.00137	0.00292	0.00216	0.0574	0.00013
Lithium	mg/L	0.141	0.016	0.193	0.6	0.075	0.171
Mercury	mg/L	1E-05	1E-05	1.7E-05	7E-06	0.00167	5E-06
Molybdenum	mg/L	0.107	0.00115	0.0841	0.0735	0.00114	0.00543
pH, Field	SU	7.16	7.93	10.56	12.41	7.93	6.52
Radium-226/228	pCi/L	7.68	0.703	3.077	2.97	5.469	1.494
Selenium	mg/L	0.0004	0.0005	0.001	0.0022	0.0013	0.0002
Sulfate	mg/L	351	120	235	126	82.1	1810
Thallium	mg/L	0.0002	0.0002	9E-05	7E-05	0.000836	0.00033

Notes
FD - Field Duplicate
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pCi/L = Picocuries per liter

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 11/29/2016 N	FEDERAL 11/29/2016 N	FEDERAL 11/29/2016 N	FEDERAL 11/29/2016 N	FEDERAL 11/29/2016 N
	Location ID	2016-09	2016-10	96153R	96154R	96156
	Sample ID	2016-09-20161129-01	2016-10-20161129-01	96153-R-20161129-01	96154-R-20161129-01	96156-20161129-01
Analyte	Unit					
Antimony	mg/L	0.00082	0.0002	0.00024	0.00046	0.00208
Arsenic	mg/L	0.0149	0.00304	0.0013	0.00409	0.0398
Barium	mg/L	0.49	0.162	0.136	0.219	17.7
Beryllium	mg/L	2E-05	0.0002	0.00019	0.000679	0.0003
Boron	mg/L	0.126	0.438	0.463	0.504	0.375
Cadmium	mg/L	4E-05	4E-05	2E-05	4E-05	0.00419
Calcium	mg/L	49.7	254	177	10.5	399
Chloride	mg/L	1490	6040	11.6	410	
Chromium	mg/L	0.0299	0.00461	0.00261	0.0121	0.0598
Cobalt	mg/L	0.000245	0.00198	0.00693	0.00443	0.00517
Dissolved Solids, Total	mg/L	4180	11000	1700	1850	
Fluoride	mg/L	1.02	0.5	0.67	3.4	
Lead	mg/L	0.000281	0.000492	0.00277	0.00967	0.0455
Lithium	mg/L	0.392	0.189	0.053	0.04	0.296
Mercury	mg/L	6E-06	2E-06	1.5E-05	3E-05	2.1E-05
Molybdenum	mg/L	0.149	0.0278	0.00812	0.0724	0.0225
pH, Field	SU	12.64	8.29	7.35	8.67	7.23
Radium-226/228	pCi/L	1.729	3.15	1.64	2.328	
Selenium	mg/L	0.0037	0.0005	0.0006	0.002	0.001
Sulfate	mg/L	73	897	973	125	
Thallium	mg/L	0.0002	5E-05	2E-05	0.000121	0.0002

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 11/30/2016 N	FEDERAL 11/30/2016 N	FEDERAL 11/30/2016 N	FEDERAL 11/30/2016 N	FEDERAL 11/30/2016 N
	Location ID	2016-01	2016-02	2016-07	2016-08	96147
	Sample ID	2016-01-20161130-01	2016-02-20161130-01	2016-07-20161130-01	2016-08-20161130-01	96147-20161130-01
Analyte	Unit					
Antimony	mg/L	0.00088	0.0005	0.00079	0.00095	5E-05
Arsenic	mg/L	0.0187	0.012	0.00666	0.00652	0.00467
Barium	mg/L	0.071	0.807	0.115	0.416	0.464
Beryllium	mg/L	3.5E-05	0.0002	0.000183	0.000123	0.00294
Boron	mg/L	0.263	0.406	0.348	0.294	0.397
Cadmium	mg/L	4E-05	5E-05	0.0001	5E-05	0.00022
Calcium	mg/L	13.9	348	8.2	57	21.5
Chloride	mg/L	294	8700	643	650	332
Chromium	mg/L	0.00159	0.000682	0.00163	0.00434	0.00233
Cobalt	mg/L	0.000326	0.00174	0.000573	0.00172	0.00586
Dissolved Solids, Total	mg/L	1700	15300	1900	2730	2660
Fluoride	mg/L	3.34	2	1.94	1.56	3.53
Lead	mg/L	0.000718	0.0002	0.00215	0.00207	0.0332
Lithium	mg/L	0.238	0.177	0.202	0.702	0.03
Mercury	mg/L	2.4E-05	1.5E-05	8E-06	3.7E-05	0.00013
Molybdenum	mg/L	0.137	0.203	0.0953	0.0982	0.0125
pH, Field	SU	12.06	7.06	10.61	12.59	8.01
Radium-226/228	pCi/L	0.562	8	2.17	2.005	4.8483
Selenium	mg/L	0.0013	0.0005	0.0007	0.0019	0.0006
Sulfate	mg/L	317	302	178	120	101
Thallium	mg/L	3E-05	0.0002	4E-05	5E-05	0.000267

Notes
FD - Field Duplicate
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

	Location ID	FEDERAL 12/1/2016 N 2016-03	FEDERAL 12/1/2016 N 2016-05	FEDERAL 12/1/2016 N 2016-06	FEDERAL 12/1/2016 N MW-20	FEDERAL 1/30/2017 N 2016-09
	Sample ID	2016-03-20161201-01	2016-05-20161201-01	2016-06-20161201-01	MW-20-20161201-01	2016-09-20170130-01
Analyte	Unit					
Antimony	mg/L	0.0004	8E-05	0.00023	0.0001	0.00078
Arsenic	mg/L	0.0007	0.00051	0.00195	0.00917	0.0144
Barium	mg/L	0.0256	0.0382	0.0525	0.0233	0.433
Beryllium	mg/L	1E-05	3.4E-05	3.4E-05	0.000276	2E-05
Boron	mg/L	0.361	0.088	0.418	0.104	0.131
Cadmium	mg/L	0.00016	1E-05	3E-05	4E-05	1E-05
Calcium	mg/L	128	45	4.6	465	42.3
Chloride	mg/L	22.7	16.9	515	16.4	1520
Chromium	mg/L	0.000162	0.000802	0.0205	0.00121	0.0256
Cobalt	mg/L	0.0005	0.00158	0.00156	0.143	0.000208
Dissolved Solids, Total	mg/L	1020	430	1570	2620	3900
Fluoride	mg/L	0.16	0.19	4.89	1	1.39
Lead	mg/L	0.000213	0.000848	0.00039	3E-05	0.000118
Lithium	mg/L	0.034	0.011	0.027	0.188	0.324
Mercury	mg/L	3.9E-05	1.7E-05	1.6E-05	5E-06	5E-06
Molybdenum	mg/L	0.00649	0.00231	0.0674	0.00249	0.137
pH, Field	SU	6.99	7.79	8.36	6.5	12.66
Radium-226/228	pCi/L	0.44	1.429	1.052	0.866	2.472
Selenium	mg/L	0.0001	0.0002	0.0003	0.0001	0.0029
Sulfate	mg/L	362	116	95.1	1610	61.7
Thallium	mg/L	2E-05	2E-05	2E-05	9E-05	4E-05

Notes
FD - Field Duplicate
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		1/30/2017	1/30/2017	1/30/2017	1/30/2017	1/31/2017
		N	N	N	N	N
Location ID		2016-10	2016-11	96154R	96156	2016-01
Sample ID		2016-10-20170130-01	2016-11-20170130-01	96154-R-20170130-01	96156-20170130-01	2016-01-20170131-01
Analyte	Unit					
Antimony	mg/L	0.00023	0.00068	0.00078	0.00022	0.00045
Arsenic	mg/L	0.00443	0.00586	0.00277	0.00202	0.00739
Barium	mg/L	0.339	0.681	0.194	14.8	0.0823
Beryllium	mg/L	1E-05	9.2E-05	0.000166	2E-05	0.000134
Boron	mg/L	0.421	0.3	0.454	0.379	0.267
Cadmium	mg/L	0.00026	0.00027	4E-05	0.0001	0.00017
Calcium	mg/L	344	25	22.1	346	15.6
Chloride	mg/L	7380	2170	446	12000	302
Chromium	mg/L	0.00983	0.00944	0.00249	0.000629	0.00139
Cobalt	mg/L	0.00275	0.00238	0.000799	0.00145	0.000893
Dissolved Solids, Total	mg/L	12600	4400	1590	18100	1500
Fluoride	mg/L	0.7	2.01	3.33	2	8.34
Lead	mg/L	0.00257	0.00424	0.0031	0.00115	0.00204
Lithium	mg/L	0.246	0.086	0.137	0.294	0.15
Mercury	mg/L	3E-06	8E-06	1.8E-05	1.1E-05	3.5E-05
Molybdenum	mg/L	0.0258	0.248	0.0692	0.0054	0.18
pH, Field	SU	7.68	8.5	9.64	6.77	11.41
Radium-226/228	pCi/L	2.304	2.041	1.762	122.3	0.938
Selenium	mg/L	0.0003	0.0007	0.0006	0.0001	0.0009
Sulfate	mg/L	834	497	66.8	1	273
Thallium	mg/L	8E-05	0.000105	0.000114	3E-05	5E-05

Notes
FD - Field Duplicate
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Analytical Data Summary
Fly Ash Reservoir
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		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		1/31/2017	1/31/2017	1/31/2017	1/31/2017	1/31/2017
		N	N	N	N	N
	Location ID	2016-02	2016-03	2016-04	2016-07	2016-08
	Sample ID	2016-02-20170131-01	2016-03-20170131-01	2016-04-20170131-01	2016-07-20170131-01	2016-08-20170131-01
Analyte	Unit					
Antimony	mg/L	7E-05	0.00026	0.00033	0.00045	0.00078
Arsenic	mg/L	0.00988	0.00063	0.00259	0.0042	0.00489
Barium	mg/L	0.752	0.0241	0.065	0.188	0.446
Beryllium	mg/L	1E-05	6E-06	2.2E-05	0.000428	5.9E-05
Boron	mg/L	0.457	0.416	0.227	0.365	0.279
Cadmium	mg/L	9E-06	6E-05	7E-05	8E-05	1E-05
Calcium	mg/L	358	134	47.6	9.9	80.6
Chloride	mg/L	9740	867	204	23.6	879
Chromium	mg/L	0.000832	0.000852	0.00651	0.00322	0.00374
Cobalt	mg/L	0.00114	0.000246	0.000173	0.00167	0.00095
Dissolved Solids, Total	mg/L	15700	1990	952	1000	2750
Fluoride	mg/L	0.9	2.33	0.5	0.18	2.03
Lead	mg/L	0.00121	0.000105	0.000454	0.00336	0.000987
Lithium	mg/L	0.221	0.031	0.035	0.163	0.652
Mercury	mg/L	4E-06	1.8E-05	7E-06	5E-05	9E-06
Molybdenum	mg/L	0.29	0.00523	0.0728	0.0689	0.102
pH, Field	SU	7.07	6.93	6.93	10.01	12.45
Radium-226/228	pCi/L	8.25	1.121	1.328	2.84	2.62
Selenium	mg/L	0.0001	0.0001	0.0007	0.0008	0.0012
Sulfate	mg/L	325	132	326	371	90.4
Thallium	mg/L	5.6E-05	2E-05	1E-05	6.1E-05	3E-05

Notes
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		FEDERAL 1/31/2017 N	FEDERAL 2/1/2017 N	FEDERAL 2/1/2017 N	FEDERAL 3/21/2017 N	FEDERAL 3/21/2017 N
	Location ID	96147	2016-05	2016-06	2016-09	2016-10
	Sample ID	96147-20170131-01	2016-05-20170201-01	2016-06-20170201-01	2016-09-20170321-02	2016-10-20170321-02
Analyte	Unit					
Antimony	mg/L	8E-05	4E-05	0.00026		
Arsenic	mg/L	0.00379	0.00028	0.00214		
Barium	mg/L	0.372	0.0331	0.0515		
Beryllium	mg/L	0.00206	8E-06	6.8E-05		
Boron	mg/L	0.445	0.11	0.463		
Cadmium	mg/L	0.00018	8E-06	4E-05		
Calcium	mg/L	18.9	39.7	4.45		
Chloride	mg/L	659	11.4	548		
Chromium	mg/L	0.00105	0.000582	0.0625		
Cobalt	mg/L	0.0028	0.000274	0.00106		
Dissolved Solids, Total	mg/L	3040	388	1540		
Fluoride	mg/L	4.21	0.18	5.2		
Lead	mg/L	0.0227	0.000206	0.000607		
Lithium	mg/L	0.034	0.012	0.034		
Mercury	mg/L	0.000206	5E-06	3E-06		
Molybdenum	mg/L	0.0179	0.00071	0.0804		
pH, Field	SU	8.1	7.8	8.45	12.55	7.31
Radium-226/228	pCi/L	9.87	0.40713	0.604		
Selenium	mg/L	0.0003	0.0001	0.0003		
Sulfate	mg/L	99.6	132	94.8		
Thallium	mg/L	0.000142	3E-05	2E-05		

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		3/21/2017	3/21/2017	3/21/2017	3/21/2017	3/21/2017	3/21/2017
		N	N	N	N	N	N
	Location ID	2016-11	96153R	96154R	96156	96153R	96154R
	Sample ID	2016-11-20170321-02	96153-R-20170321-02	96154-R-20170321-02	96156-20170321-02	96153R-20170321-01	96154R-20170321-01
Analyte	Unit						
Antimony	mg/L					0.00085 J	0.0014 J
Arsenic	mg/L					0.0044 J	0.0049 J
Barium	mg/L					0.061 JB	0.28 JB
Beryllium	mg/L					0.012	0.001 U
Boron	mg/L					0.23	0.49
Cadmium	mg/L					0.00036 J	0.001 U
Calcium	mg/L					210 B	31 B
Chloride	mg/L					16	410
Chromium	mg/L					0.0028 J	0.0051 J
Cobalt	mg/L					0.3	0.00095 J
Dissolved Solids, Total	mg/L					1800	1400
Fluoride	mg/L					2.3	4.2
Lead	mg/L					0.0014 J	0.0021 J
Lithium	mg/L					0.18	0.24
Mercury	mg/L					0.0002 U	0.0002 U
Molybdenum	mg/L					0.0065 J	0.09 J
pH, Field	SU	8.95	6.46	10.67	8.93		
Radium-226/228	pCi/L					0.764	1.21
Selenium	mg/L					0.0053 J	0.00096 J
Sulfate	mg/L					1200	64
Thallium	mg/L					0.001 U	0.001 U

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		FEDERAL 3/21/2017 N	FEDERAL 3/21/2017 N	FEDERAL 3/21/2017 N	FEDERAL 3/21/2017 N	FEDERAL 3/22/2017 FD
	Location ID	2016-09	96156	2016-10	2016-11	2016-02
	Sample ID	2016-09-20170321-01	96156-20170321-01	2016-10-20170321-01	2016-11-20170321-01	DUPE032217-20170322-01
Analyte	Unit					
Antimony	mg/L	0.0014 J	0.0025	0.002 U	0.002 U	0.00057 J
Arsenic	mg/L	0.026 J	0.0035 J	0.0037 J	0.0049 J	0.011 J
Barium	mg/L	0.42 JB	16 JB	0.17 JB	0.33 JB	0.95 JB
Beryllium	mg/L	0.001 U	0.00043 J	0.001 U	0.001 U	0.001 U
Boron	mg/L	0.19	0.46	0.56	0.36	0.54
Cadmium	mg/L	0.001 U	0.00043 J	0.001 U	0.00035 J	0.001 U
Calcium	mg/L	30 B	380 B	380 B	28 B	410 B
Chloride	mg/L	1600	13000	7800	2400	9600
Chromium	mg/L	0.027 J	0.0011 J	0.00071 J	0.037 J	0.0023 J
Cobalt	mg/L	0.00092 J	0.0021	0.0015	0.00076 J	0.0015
Dissolved Solids, Total	mg/L	4100	15000	9600	5200	14000
Fluoride	mg/L	1.9 J	2.5 U	2.5 U	2.4	0.94 J
Lead	mg/L	0.0021 J	0.0022 J	0.00056 J	0.0054 J	0.00053 J
Lithium	mg/L	0.23	0.22	0.21	0.08	0.13
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.19 J	0.0056 J	0.011 J	0.14 J	0.29 J
pH, Field	SU					
Radium-226/228	pCi/L	2.69	189	1.71	1.81	4.46
Selenium	mg/L	0.0051 J	0.0013 J	0.0015 J	0.003 J	0.0012 J
Sulfate	mg/L	64	50 U	790	560	330
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

Notes
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Analytical Data Summary
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		FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N
	Location ID	2016-01	2016-02	2016-07	2016-08	96147
	Sample ID	2016-01-20170322-02	2016-02-20170322-02	2016-07-20170322-02	2016-08-20170322-02	96147-20170322-02
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L					
Cadmium	mg/L					
Calcium	mg/L					
Chloride	mg/L					
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L					
Fluoride	mg/L					
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU	11.9	7.24	9.94	12.65	8.02
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L					
Thallium	mg/L					

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pCi/L = Picocuries per liter

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		FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N	FEDERAL 3/22/2017 N
	Location ID	2016-02	2016-01	2016-07	2016-08	96147
	Sample ID	2016-02 (39)-20170322-01	2016-01-20170322-01	2016-07-20170322-01	2016-08-20170322-01	96147-20170322-01
Analyte	Unit					
Antimony	mg/L	0.0016 J	0.0019 J	0.0015 J	0.0012 J	0.00097 J
Arsenic	mg/L	0.012 J	0.0055	0.016	0.0054	0.013
Barium	mg/L	1 JB	0.12 JB	0.83 JB	0.97 JB	0.43 JB
Beryllium	mg/L	0.001 U	0.001 U	0.0026	0.001 U	0.0032
Boron	mg/L	0.55	0.23	0.4	0.22	0.46
Cadmium	mg/L	0.001 U	0.00052 J	0.001 U	0.001 U	0.001 U
Calcium	mg/L	420 B	5.5 B	15 B	190 B	15 B
Chloride	mg/L	9600	260	1000	700	600
Chromium	mg/L	0.00078 J	0.01 J	0.063 J	0.011 J	0.077 J
Cobalt	mg/L	0.0018	0.0018	0.016	0.0024	0.017
Dissolved Solids, Total	mg/L	13000	1300	2300	2700	2200
Fluoride	mg/L	0.88 J	11	2.3	2	4.8
Lead	mg/L	0.00084 J	0.0062 J	0.031 J	0.0044 J	0.044 J
Lithium	mg/L	0.15	0.23 J	0.16	0.85	0.082
Mercury	mg/L	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.3 J	0.18 J	0.092 J	0.094 J	0.046 J
pH, Field	SU					
Radium-226/228	pCi/L	4.49	0.896	4.35	6.4	7.29
Selenium	mg/L	0.0025 J	0.0026 J	0.004 J	0.002 J	0.0024 J
Sulfate	mg/L	340	220	120	71	110
Thallium	mg/L	0.001 U	0.001 U	0.00052 J	0.001 U	0.00085 J

Notes
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Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		3/27/2017	3/27/2017	3/27/2017	3/27/2017	3/27/2017
		N	N	N	N	N
	Location ID	2016-03	2016-04	2016-05	2016-06	2016-05
	Sample ID	2016-03-20170327-02	2016-04-20170327-02	2016-05-20170327-02	2016-06-20170327-17	2016-05-20170327-01
Analyte	Unit					
Antimony	mg/L					0.002 U
Arsenic	mg/L					0.005 U
Barium	mg/L					0.049 JB
Beryllium	mg/L					0.001 U
Boron	mg/L					0.1
Cadmium	mg/L					0.001 U
Calcium	mg/L					66 B
Chloride	mg/L					9.2
Chromium	mg/L					0.0017 JB
Cobalt	mg/L					0.00042 J
Dissolved Solids, Total	mg/L					500
Fluoride	mg/L					0.2
Lead	mg/L					0.00036 J
Lithium	mg/L					0.011
Mercury	mg/L					0.0002 U
Molybdenum	mg/L					0.00064 J
pH, Field	SU	6.93	7.79	7.48	8.44	
Radium-226/228	pCi/L					0.365 U
Selenium	mg/L					0.005 U
Sulfate	mg/L					150
Thallium	mg/L					0.001 U

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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		3/27/2017	3/27/2017	3/27/2017	4/25/2017	4/25/2017
		N	N	N	N	N
	Location ID	2016-06	2016-03	2016-04	2016-09	2016-10
	Sample ID	2016-06-20170327-01	2016-03-20170327-01	2016-04-20170327-01	2016-09-20170425-02	2016-10-20170425-02
Analyte	Unit					
Antimony	mg/L	0.00047 JB	0.002 U	0.00067 JB		
Arsenic	mg/L	0.0034 J	0.00058 J	0.0054		
Barium	mg/L	0.068 JB	0.026 JB	0.14 JB		
Beryllium	mg/L	0.001 U	0.001 U	0.001 U		
Boron	mg/L	0.5	0.43	0.27		
Cadmium	mg/L	0.00061 J	0.001 U	0.001 U		
Calcium	mg/L	5 B	140 B	22 B		
Chloride	mg/L	550	22	820		
Chromium	mg/L	0.068 JB	0.00064 JB	0.0054 JB		
Cobalt	mg/L	0.0019	0.00029 J	0.00026 J		
Dissolved Solids, Total	mg/L	1600	1100	1900		
Fluoride	mg/L	6	0.21 J	1.4		
Lead	mg/L	0.0016 J	0.00026 J	0.00043 J		
Lithium	mg/L	0.034	0.029	0.044		
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U		
Molybdenum	mg/L	0.091 J	0.0049 J	0.12 J		
pH, Field	SU				12.44	7.21
Radium-226/228	pCi/L	0.381	0.456	1.51		
Selenium	mg/L	0.005 U	0.005 U	0.0026 J		
Sulfate	mg/L	110	390	330		
Thallium	mg/L	0.001 U	0.001 U	0.001 U		

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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N
	Location ID	2016-11	96153R	96154R	96156	MW-20	96153R
	Sample ID	2016-11-20170425-02	96153-R-20170425-02	96154-R-20170425-02	96156-20170425-02	MW-20-20170425-02	96153 R-20170425-01
Analyte	Unit						
Antimony	mg/L						0.002 U
Arsenic	mg/L						0.005 U
Barium	mg/L						0.027
Beryllium	mg/L						0.0048
Boron	mg/L						0.25
Cadmium	mg/L						0.00024 J
Calcium	mg/L						200
Chloride	mg/L						20
Chromium	mg/L						0.002 U
Cobalt	mg/L						0.29
Dissolved Solids, Total	mg/L						1900 J
Fluoride	mg/L						2.3
Lead	mg/L						0.001 U
Lithium	mg/L						0.2
Mercury	mg/L						0.0002 U
Molybdenum	mg/L						0.0042 J
pH, Field	SU	8.35	6.19	10.32	8.32	6.51	
Radium-226/228	pCi/L						0.926
Selenium	mg/L						0.0017 J
Sulfate	mg/L						1700
Thallium	mg/L						0.001 U

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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N	FEDERAL 4/25/2017 N
	Location ID	MW-20	96154R	2016-09	96156	2016-10	2016-11
	Sample ID	MW20-20170425-01	96154 R-20170425-01	2016-09-20170425-01	96156-20170425-01	2016-10-20170425-01	2016-11-20170425-01
Analyte	Unit						
Antimony	mg/L	0.002 U	0.0014 J	0.0012 J	0.002 U	0.002 U	0.00081 J
Arsenic	mg/L	0.0048 J	0.0093	0.016	0.0042 J	0.0025 J	0.0022 J
Barium	mg/L	0.025	0.067	0.52	16	0.17	0.41
Beryllium	mg/L	0.00032 J	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Boron	mg/L	0.15 J	0.5	0.16 J	0.4	0.49	0.35
Cadmium	mg/L	0.001 U	0.001 U	0.001 U	0.00027 J	0.001 U	0.001 U
Calcium	mg/L	500	2.1	35	380	390	34
Chloride	mg/L	11	410	2000	17000	12000	2800
Chromium	mg/L	0.002 U	0.002 U	0.025	0.002 U	0.002 U	0.002 U
Cobalt	mg/L	0.13	0.00037 J	0.00032 J	0.0016	0.0013	0.0013
Dissolved Solids, Total	mg/L	2500 J	1400 J	4300 J	19000 J	17000 J	4900 J
Fluoride	mg/L	1.2	4.5	2.1 J	5 U	5 U	2.2 J
Lead	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Lithium	mg/L	0.16	0.19	0.3	0.25	0.23	0.074
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L	0.0016 J	0.093	0.17	0.0073 J	0.015	0.14
pH, Field	SU						
Radium-226/228	pCi/L	0.594	0.894	2.29	189	2.19	1.56
Selenium	mg/L	0.005 U	0.005 U	0.0029 J	0.005 U	0.005 U	0.005 U
Sulfate	mg/L	2200	60	88 J	100 U	1100	750
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		4/26/2017	4/26/2017	4/26/2017	4/26/2017	4/26/2017	4/27/2017
		FD	N	N	N	N	N
	Location ID	2016-02	2016-01	2016-02	2016-02	2016-01	2016-03
	Sample ID	DUPE 042617	2016-01-20170426-02	2016-02-20170426-02	2016-02-20170426-01	2016-01-20170426-01	2016-03-20170427-02
Analyte	Unit						
Antimony	mg/L	0.002 U			0.002 U	0.00085 J	
Arsenic	mg/L	0.0093			0.0097	0.0051	
Barium	mg/L	0.84			0.83	0.071	
Beryllium	mg/L	0.001 U			0.001 U	0.001 U	
Boron	mg/L	0.52			0.51	0.26	
Cadmium	mg/L	0.001 U			0.001 U	0.001 U	
Calcium	mg/L	360			360	4.1	
Chloride	mg/L	15000			13000	230	
Chromium	mg/L	0.002 U			0.002 U	0.0015 J	
Cobalt	mg/L	0.0016			0.0017	0.00066 J	
Dissolved Solids, Total	mg/L	18000 J			100 J	1300 J	
Fluoride	mg/L	5 U			5 U	13 J	
Lead	mg/L	0.001 U			0.001 U	0.00093 J	
Lithium	mg/L	0.16			0.17	0.23 J	
Mercury	mg/L	0.0002 U			0.0002 U	0.0002 U	
Molybdenum	mg/L	0.3			0.3	0.18	
pH, Field	SU		10.96	7.09			6.9
Radium-226/228	pCi/L	7.99			6.63	1.44	
Selenium	mg/L	0.005 U			0.005 U	0.0015 J	
Sulfate	mg/L	300			280	180 J	
Thallium	mg/L	0.001 U			0.001 U	0.001 U	

Notes
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Analytical Data Summary
Fly Ash Reservoir
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		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		4/27/2017	4/27/2017	4/27/2017	4/27/2017	4/27/2017
		N	N	N	N	N
	Location ID	2016-04	2016-05	2016-06	2016-07	2016-08
	Sample ID	2016-04-20170427-02	2016-05-20170427-02	2016-06-20170427-02	2016-07-20170427-02	2016-08-20170427-02
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L					
Cadmium	mg/L					
Calcium	mg/L					
Chloride	mg/L					
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L					
Fluoride	mg/L					
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU	7.82	7.82	8.49	9.44	12.35
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L					
Thallium	mg/L					

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Analytical Data Summary
Fly Ash Reservoir
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		FEDERAL 4/27/2017 N	FEDERAL 4/27/2017 N	FEDERAL 4/27/2017 N	FEDERAL 4/27/2017 N	FEDERAL 4/27/2017 N	FEDERAL 4/27/2017 N
	Location ID	96147	2016-08	2016-07	96147	2016-03	2016-04
	Sample ID	96147-20170427-02	2016-08-20170427-01	2016-07-20170427-01	96147-20170427-01	2016-03-20170427-01	2016-04-20170427-01
Analyte	Unit						
Antimony	mg/L		0.0051	0.0024	0.0012 J	0.002 U	0.00087 J
Arsenic	mg/L		0.0075	0.0034 J	0.0042 J	0.001 J	0.0044 J
Barium	mg/L		0.7	0.7	0.18	0.024	0.16
Beryllium	mg/L		0.001 U	0.00091 J	0.001 U	0.001 U	0.001 U
Boron	mg/L		0.28 B	0.42 B	0.48 B	0.44 B	0.27 B
Cadmium	mg/L		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Calcium	mg/L		140	25	11	140	18
Chloride	mg/L		890	1900	570	23	1700
Chromium	mg/L		0.0027	0.011	0.002 U	0.002 U	0.0027
Cobalt	mg/L		0.00039 J	0.0028	0.00066 J	0.00055 J	0.001 U
Dissolved Solids, Total	mg/L		2900 J	3900 J	2100 J	1100 J	3300 J
Fluoride	mg/L		1.8 J	1.6	5.3	0.19 J	1.2
Lead	mg/L		0.001 U	0.0054	0.00081 J	0.001 U	0.001 U
Lithium	mg/L		0.75	0.062	0.034	0.034	0.072
Mercury	mg/L		0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L		0.12	0.056	0.05	0.0043 J	0.11
pH, Field	SU	7.95					
Radium-226/228	pCi/L		5.53	12.7	4.65	0.541	1.27
Selenium	mg/L		0.0022 J	0.0015 J	0.005 U	0.005 U	0.0022 J
Sulfate	mg/L		70	99	110	420	230
Thallium	mg/L		0.001 U	0.001 U	0.001 U	0.001 U	0.001 U

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Fly Ash Reservoir
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	Location ID	FEDERAL 4/27/2017 N 2016-05	FEDERAL 4/27/2017 N 2016-06	FEDERAL 6/6/2017 N 2016-09	FEDERAL 6/6/2017 N 2016-10	FEDERAL 6/6/2017 N 96153R
	Sample ID	2016-05-20170427-01	2016-06-20170427-01	2016-09-20170606-02	2016-10-20170606-02	96153-R-20170606-02
Analyte	Unit					
Antimony	mg/L	0.00072 J	0.00078 J			
Arsenic	mg/L	0.005 U	0.0017 J			
Barium	mg/L	0.043	0.05			
Beryllium	mg/L	0.001 U	0.001 U			
Boron	mg/L	0.1 JB	0.52 B			
Cadmium	mg/L	0.001 U	0.001 U			
Calcium	mg/L	53	3.5			
Chloride	mg/L	9.6	550			
Chromium	mg/L	0.002 U	0.022			
Cobalt	mg/L	0.00028 J	0.00068 J			
Dissolved Solids, Total	mg/L	460 J	1600 J			
Fluoride	mg/L	0.21	5.9			
Lead	mg/L	0.001 U	0.001 U			
Lithium	mg/L	0.013	0.032			
Mercury	mg/L	0.0002 U	0.0002 U			
Molybdenum	mg/L	0.01 U	0.076			
pH, Field	SU			12.46	7.51	7.2
Radium-226/228	pCi/L	0.0784 U	0.395			
Selenium	mg/L	0.005 U	0.005 U			
Sulfate	mg/L	160	110			
Thallium	mg/L	0.001 U	0.001 U			

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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 6/6/2017 N	FEDERAL 6/6/2017 N	FEDERAL 6/6/2017 N	FEDERAL 6/6/2017 N	FEDERAL 6/6/2017 N	FEDERAL 6/6/2017 N
	Location ID	96154R	96156	MW-20	96153R	MW-20	96154R
	Sample ID	96154-R-20170606-02	96156-20170606-02	MW-20-20170606-02	96153R-20170606-01	MW20-20170606-01	96154R-20170606-01
Analyte	Unit						
Antimony	mg/L				0.00057 J	0.002 U	0.002 U
Arsenic	mg/L				0.005 U	0.0086	0.0022 J
Barium	mg/L				0.037	0.027	0.12
Beryllium	mg/L				0.00038 J	0.00055 J	0.001 UJ
Boron	mg/L				0.48 B	0.19 B	0.53 B
Cadmium	mg/L				0.001 U	0.001 U	0.001 U
Calcium	mg/L				72	500	4.8
Chloride	mg/L				35	6.5	470
Chromium	mg/L				0.002 U	0.0018 J	0.0078 J
Cobalt	mg/L				0.012	0.13	0.00042 J
Dissolved Solids, Total	mg/L				1800	2600	1500
Fluoride	mg/L				1.4	0.93	4.1
Lead	mg/L				0.00045 J	0.001 U	0.00077 J
Lithium	mg/L				0.069	0.16	0.048
Mercury	mg/L				0.0002 U	0.0002 U	0.0002 U
Molybdenum	mg/L				0.02	0.002 J	0.1
pH, Field	SU	8.76	7.26	6.52			
Radium-226/228	pCi/L				0.607	0.425	0.655
Selenium	mg/L				0.0014 J	0.005 U	0.005 U
Sulfate	mg/L				1000	1700	100
Thallium	mg/L				0.001 U	0.001 U	0.001 U

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Analytical Data Summary
Fly Ash Reservoir
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		FEDERAL 6/6/2017 N	FEDERAL 6/6/2017 N	FEDERAL 6/6/2017 N	FEDERAL 6/7/2017 FD	FEDERAL 6/7/2017 N
	Location ID	2016-09	96156	2016-10	2016-02	2016-01
	Sample ID	2016-09-20170606-01	96156-20170606-01	2016-10-20170606-01	DUPE -01060717-20170607-01	2016-01-20170607-02
Analyte	Unit					
Antimony	mg/L	0.02 U	0.0017 J	0.02 U	0.01 U	
Arsenic	mg/L	0.016 J	0.0043 J	0.05 U	0.0057	
Barium	mg/L	0.53	16	0.25	0.87	
Beryllium	mg/L	0.001 UJ	0.001 UJ	0.001 UJ	0.005 U	
Boron	mg/L	0.18 B	0.43 B	0.57 B	0.57	
Cadmium	mg/L	0.01 U	0.00088 J	0.01 U	0.005 U	
Calcium	mg/L	47	390	440	400	
Chloride	mg/L	1700	12000	11000	19000	
Chromium	mg/L	0.029 J	0.0077 J	0.02 U	0.0012 J	
Cobalt	mg/L	0.01 U	0.0015	0.0069 J	0.0029	
Dissolved Solids, Total	mg/L	4300	21000	17000	13000	
Fluoride	mg/L	1.8	1.3 U	1.3 U	5 U	
Lead	mg/L	0.001	0.0055	0.001 U	0.00048 J	
Lithium	mg/L	0.27	0.25	0.29	0.17	
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	
Molybdenum	mg/L	0.17	0.017	0.011 J	0.23	
pH, Field	SU					11.06
Radium-226/228	pCi/L	3.76	138	3.93	5.93	
Selenium	mg/L	0.05 U	0.00091 J	0.05 U	0.025 U	
Sulfate	mg/L	65	25 U	640	720	
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U	

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		FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N
	Location ID	2016-02	2016-03	2016-04	2016-08	96147
	Sample ID	2016-02-20170607-02	2016-03-20170607-02	2016-04-20170607-02	2016-08-20170607-02	96147-20170607-02
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L					
Cadmium	mg/L					
Calcium	mg/L					
Chloride	mg/L					
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L					
Fluoride	mg/L					
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU	7.21	6.88	7.8	12.42	8.22
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L					
Thallium	mg/L					

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Analytical Data Summary
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		FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N	FEDERAL 6/7/2017 N
	Location ID	2016-02	2016-01	2016-08	96147	2016-03
	Sample ID	2016-02(39)-20170607-01	2016-01-20170607-01	2016-08-20170607-01	96147-20170607-01	2016-03-20170607-01
Analyte	Unit					
Antimony	mg/L	0.01 U	0.00068 J	0.0013 J	0.0011 J	0.002 U
Arsenic	mg/L	0.009 J	0.0043 J	0.014	0.013	0.00082 J
Barium	mg/L	0.88	0.094	0.76	0.34	0.026
Beryllium	mg/L	0.001 U	0.00032 J	0.005 U	0.0027 J	0.001 U
Boron	mg/L	0.62	0.3	0.32	0.49	0.45
Cadmium	mg/L	0.005 U	0.0003 J	0.001 U	0.00057 J	0.001 U
Calcium	mg/L	380	7.3 J	140	14	150
Chloride	mg/L	11000	220	1200 J	690 J	22 J
Chromium	mg/L	0.01 U	0.0037	0.015 J	0.071 J	0.002 U
Cobalt	mg/L	0.0029 J	0.00072 J	0.0037	0.018	0.00019 J
Dissolved Solids, Total	mg/L	16000	990	3000	2000	1000
Fluoride	mg/L	5 U	17	2.3 J	5.2 J	0.21 J
Lead	mg/L	0.00066 J	0.0029	0.006	0.051	0.001 U
Lithium	mg/L	0.17	0.25 J	0.64	0.084	0.029
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002	0.0002 U
Molybdenum	mg/L	0.28	0.16	0.14	0.053	0.004 J
pH, Field	SU					
Radium-226/228	pCi/L	5.73	0.578	2.43	4.72	0.59
Selenium	mg/L	0.025 U	0.00094 J	0.0043 J	0.0027 J	0.005 U
Sulfate	mg/L	380	160 J	89 J	110 J	440 J
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001	0.001 U

Notes
FD - Field Duplicate
N - Normal Sample
mg/L = milligrams per liter
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pCi/L = Picocuries per liter

Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		6/7/2017	6/8/2017	6/8/2017	6/8/2017	7/12/2017
		N	N	N	N	N
	Location ID	2016-04	2016-06	2016-05	2016-06	2016-09
	Sample ID	2016-04-20170607-01	2016-06-20170608-02	2016-05-20170608-01	2016-06-20170608-01	2016-09-20170712-02
Analyte	Unit					
Antimony	mg/L	0.002 U		0.00067 J	0.002 U	
Arsenic	mg/L	0.0019 J		0.00088 J	0.0026 J	
Barium	mg/L	0.41		0.044 B	0.064 B	
Beryllium	mg/L	0.001 U		0.00067 J	0.00035 J	
Boron	mg/L	0.36		0.11	0.52	
Cadmium	mg/L	0.001 U		0.001 U	0.001 U	
Calcium	mg/L	33		40	4.1	
Chloride	mg/L	2100 J		14	570	
Chromium	mg/L	0.002 U		0.0033	0.058 J	
Cobalt	mg/L	0.001 U		0.0011	0.0038	
Dissolved Solids, Total	mg/L	3600		410	1700	
Fluoride	mg/L	1.2 J		0.22	6.3	
Lead	mg/L	0.001 U		0.0012	0.0013	
Lithium	mg/L	0.066		0.012	0.031	
Mercury	mg/L	0.0002 U		0.0002 U	0.0002 U	
Molybdenum	mg/L	0.051		0.0012 J	0.074	
pH, Field	SU		8.39			12.49
Radium-226/228	pCi/L	1.19		0.0846 U	0.362 U	
Selenium	mg/L	0.005 U		0.005 U	0.005 U	
Sulfate	mg/L	190 J		140	120	
Thallium	mg/L	0.001 U		0.001 U	0.001 U	

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 7/12/2017 N	FEDERAL 7/12/2017 N	FEDERAL 7/12/2017 N	FEDERAL 7/12/2017 N	FEDERAL 7/12/2017 N	FEDERAL 7/12/2017 N
	Location ID	2016-10	96153R	96154R	96156	96153R	96154R
	Sample ID	2016-10-20170712-02	96153-R-20170712-02	96154-R-20170712-02	96156-20170712-02	96153R-20170712-01	96154R-20170712-01
Analyte	Unit						
Antimony	mg/L					0.002 U	0.0006 JB
Arsenic	mg/L					0.005 U	0.0025 J
Barium	mg/L					0.03	0.11
Beryllium	mg/L					0.001 U	0.001 U
Boron	mg/L					0.48 B	0.53 B
Cadmium	mg/L					0.001 U	0.001 U
Calcium	mg/L					130	4.3
Chloride	mg/L					19	490
Chromium	mg/L					0.002 U	0.0013 J
Cobalt	mg/L					0.0063	0.00022 J
Dissolved Solids, Total	mg/L					1600 J	1500 J
Fluoride	mg/L					1.2	4.5
Lead	mg/L					0.001 U	0.00048 J
Lithium	mg/L					0.054	0.049
Mercury	mg/L					0.0002 U	0.0002 U
Molybdenum	mg/L					0.0068 J	0.1
pH, Field	SU	7.86	7.49	8.82	8.04		
Radium-226/228	pCi/L					0.702	0.577
Selenium	mg/L					0.001 JB	0.005 U
Sulfate	mg/L					1000	100
Thallium	mg/L					0.001 U	0.001 U

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 7/12/2017 N	FEDERAL 7/12/2017 N	FEDERAL 7/12/2017 N	FEDERAL 7/13/2017 FD	FEDERAL 7/13/2017 N	FEDERAL 7/13/2017 N
	Location ID	2016-09	96156	2016-10	2016-02	2016-01	2016-02
	Sample ID	2016-09-20170712-01	96156-20170712-01	2016-10-20170712-01	DUPE FAR 071317	2016-01-20170713-02	2016-02-20170713-02
Analyte	Unit						
Antimony	mg/L	0.001 JB	0.0012 JB	0.002 U	0.002 U		
Arsenic	mg/L	0.016	0.0036 J	0.0039 J	0.012 J		
Barium	mg/L	0.52	15	0.24	1.4		
Beryllium	mg/L	0.001 U	0.001 U	0.001 U	0.00039 J		
Boron	mg/L	0.16 B	0.4 B	0.54 B	0.52		
Cadmium	mg/L	0.001 U	0.0015	0.001 U	0.00025 J		
Calcium	mg/L	55	370	500	490		
Chloride	mg/L	1600	12000	12000	11000		
Chromium	mg/L	0.025	0.016	0.0011 J	0.0014 J		
Cobalt	mg/L	0.00071 J	0.0017	0.0046	0.0026		
Dissolved Solids, Total	mg/L	3900 J	15000 J	15000 J	19000 J		
Fluoride	mg/L	1.5 J	2.5 U	2.5 U	5 U		
Lead	mg/L	0.00068 J	0.0033	0.001 U	0.00088 J		
Lithium	mg/L	0.25	0.23	0.29	0.19		
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U		
Molybdenum	mg/L	0.16	0.0086 J	0.016	0.15		
pH, Field	SU					11.03	7.09
Radium-226/228	pCi/L	2.61 J	119 J	4.91 J	6.97 J		
Selenium	mg/L	0.0034 JB	0.0011 JB	0.0014 JB	0.0022 J		
Sulfate	mg/L	85	50 U	670	200		
Thallium	mg/L	0.001 U	0.001 U	0.001 U	0.001 U		

Notes
FD - Field Duplicate
N - Normal Sample
mg/L = milligrams per liter
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pCi/L = Picocuries per liter

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Analytical Data Summary
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		FEDERAL 7/13/2017 N	FEDERAL 7/13/2017 N	FEDERAL 7/13/2017 N	FEDERAL 7/13/2017 N	FEDERAL 7/14/2017 N
	Location ID	96147	96147	2016-02	2016-01	2016-03
	Sample ID	96147-20170713-01	96147-20170713-02	2016-02 (39)-20170713-01	2016-01-20170713-01	2016-03-20170714-02
Analyte	Unit					
Antimony	mg/L	0.001 J		0.002 U	0.002 U	
Arsenic	mg/L	0.021		0.011 J	0.0061	
Barium	mg/L	0.64		1.4	0.094	
Beryllium	mg/L	0.0075		0.001 U	0.00037 J	
Boron	mg/L	0.5		0.53	0.35	
Cadmium	mg/L	0.00036 J		0.001 U	0.0003 J	
Calcium	mg/L	19		480	8.6	
Chloride	mg/L	460		10000	210	
Chromium	mg/L	0.13		0.002 U	0.0048	
Cobalt	mg/L	0.037		0.0025	0.001	
Dissolved Solids, Total	mg/L	1800 J		17000 J	950 J	
Fluoride	mg/L	4.6		5 U	16	
Lead	mg/L	0.088		0.00047 J	0.0036	
Lithium	mg/L	0.15		0.19	0.25	
Mercury	mg/L	0.00027		0.0002 U	0.0002 U	
Molybdenum	mg/L	0.04		0.14	0.15	
pH, Field	SU		7.95			6.93
Radium-226/228	pCi/L	12 J		7.5 J	0.482	
Selenium	mg/L	0.0089		0.0016 J	0.0024 J	
Sulfate	mg/L	140		240	150	
Thallium	mg/L	0.0013		0.001 U	0.001 U	

Notes
FD - Field Duplicate
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		7/14/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017	7/14/2017
		N	N	N	N	N	N
	Location ID	2016-04	2016-05	2016-06	MW-20	MW-20	2016-03
	Sample ID	2016-04-20170714-02	2016-05-20170714-02	2016-06-20170714-02	MW-20-20170714-02	MW20-20170714-01	2016-03-20170714-01
Analyte	Unit						
Antimony	mg/L					0.002 U	0.002 U
Arsenic	mg/L					0.013	0.00088 J
Barium	mg/L					0.029	0.025
Beryllium	mg/L					0.00088 J	0.001 U
Boron	mg/L					0.15	0.44
Cadmium	mg/L					0.001 U	0.001 U
Calcium	mg/L					500	140
Chloride	mg/L					8.2 J	22
Chromium	mg/L					0.0025	0.002 U
Cobalt	mg/L					0.14	0.00034 J
Dissolved Solids, Total	mg/L					2600 J	1000 J
Fluoride	mg/L					0.9	0.19 J
Lead	mg/L					0.00089 J	0.001 U
Lithium	mg/L					0.16	0.034
Mercury	mg/L					0.0002 U	0.0002 U
Molybdenum	mg/L					0.0027 J	0.0038 J
pH, Field	SU	8.22	8.01	8.28	6.51		
Radium-226/228	pCi/L					0.73	1.02
Selenium	mg/L					0.0015 J	0.005 U
Sulfate	mg/L					1600	400
Thallium	mg/L					0.001 U	0.001 U

Notes
FD - Field Duplicate
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		7/14/2017	7/14/2017	7/14/2017	8/10/2017	8/10/2017
		N	N	N	N	N
	Location ID	2016-04	2016-05	2016-06	2016-07	2016-07
	Sample ID	2016-04-20170714-01	2016-05-20170714-01	2016-06-20170714-01	2016-07-20170810-02	2016-07-20170810-01
Analyte	Unit					
Antimony	mg/L	0.00097 J	0.002 U	0.002 U		0.0017 JB
Arsenic	mg/L	0.0039 J	0.00079 J	0.0024 J		0.016
Barium	mg/L	0.24	0.038	0.059		1.3
Beryllium	mg/L	0.00038 J	0.001 U	0.001 U		0.0028
Boron	mg/L	0.3	0.1	0.5		0.44
Cadmium	mg/L	0.001 U	0.001 U	0.001 U		0.00059 J
Calcium	mg/L	24	31	4		41
Chloride	mg/L	1100	16	540		1200
Chromium	mg/L	0.0016 J	0.0025	0.062		0.059
Cobalt	mg/L	0.00027 J	0.00088 J	0.0018		0.015
Dissolved Solids, Total	mg/L	2400 J	400 J	1600 J		2500 J
Fluoride	mg/L	1.1	0.22	6.1		2.6
Lead	mg/L	0.00055 J	0.00077 J	0.00083 J		0.036 B
Lithium	mg/L	0.066	0.014	0.032		0.19
Mercury	mg/L	0.0002 U	0.0002 U	0.0002 U		0.0002 U
Molybdenum	mg/L	0.093	0.01 U	0.073		0.11 B
pH, Field	SU				9.1	
Radium-226/228	pCi/L	1.21	0.575	0.651		8.09 J
Selenium	mg/L	0.0032 J	0.005 U	0.001 J		0.0052
Sulfate	mg/L	290	130	110		77
Thallium	mg/L	0.001 U	0.001 U	0.001 U		0.00066 J

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

	Location ID	FEDERAL 3/19/2018 N 2016-01	FEDERAL 3/19/2018 N 2016-01	FEDERAL 3/19/2018 N 2016-02	FEDERAL 3/19/2018 N 2016-02	FEDERAL 3/21/2018 N 2016-03
	Sample ID	2016-01_20180319-01	2016-01-WG-20180319-02	2016-02_20180319-01	2016-02-WG-20180319-02	2016-03_20180321-01
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L	0.25		0.47		0.43
Cadmium	mg/L					
Calcium	mg/L	140		850		140
Chloride	mg/L	180		14000		24
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L	1300		20000		1100
Fluoride	mg/L	7.9		2.5		0.24
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU		12.38		7.11	
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L	110		120		400
Thallium	mg/L					

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL	FEDERAL	FEDERAL	FEDERAL	FEDERAL
		3/21/2018	3/22/2018	3/22/2018	3/22/2018	3/22/2018
		N	N	N	N	N
	Location ID	2016-03	2016-04	2016-04	2016-06	2016-06
	Sample ID	2016-03-WG-20180321-02	2016-04_20180322-01	2016-04-WG-20180322-02	2016-06_20180322-01	2016-06-WG-20180322-02
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L		0.35		0.49	
Cadmium	mg/L					
Calcium	mg/L		75		4.6	
Chloride	mg/L		340		570	
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L		1300		1500	
Fluoride	mg/L		0.42		5.7	
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU	7.03		7.75		8.43
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L		410		110	
Thallium	mg/L					

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

Location ID		FEDERAL 3/22/2018 FD 2016-09	FEDERAL 3/22/2018 N 2016-09	FEDERAL 3/22/2018 N 2016-09	FEDERAL 3/22/2018 N 96154R
Sample ID		DUPLICATE (2016-09)_20180322-01	2016-09_20180322-01	2016-09-WG-20180322-02	96154R_20180322-01
Analyte	Unit				
Antimony	mg/L				
Arsenic	mg/L				
Barium	mg/L				
Beryllium	mg/L				
Boron	mg/L	0.22	0.22		0.53
Cadmium	mg/L				
Calcium	mg/L	33	33		2.9
Chloride	mg/L	2000	2000		470
Chromium	mg/L				
Cobalt	mg/L				
Dissolved Solids, Total	mg/L	3900	3700		1500
Fluoride	mg/L	1.9	1.9		3.9
Lead	mg/L				
Lithium	mg/L				
Mercury	mg/L				
Molybdenum	mg/L				
pH, Field	SU			12.59	
Radium-226/228	pCi/L				
Selenium	mg/L				
Sulfate	mg/L	83	81		51
Thallium	mg/L				

Notes
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 3/22/2018 N	FEDERAL 3/22/2018 N	FEDERAL 3/22/2018 N	FEDERAL 3/26/2018 N	FEDERAL 3/26/2018 N
	Location ID	96154R	96153R	96153R	MW-20	MW-20
	Sample ID	96154R-WG-20180322-02	96153R_20180322-01	96153R-WG-20180322-02	MW-20_20180326-01	MW-20-WG-20180326-02
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L		0.51		0.16	
Cadmium	mg/L					
Calcium	mg/L		140		480	
Chloride	mg/L		26		12	
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L		1600		2600	
Fluoride	mg/L		1.1		1	
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU	9.85		7.14		6.56
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L		1000		1700	
Thallium	mg/L					

Notes
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Analytical Data Summary
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Gavin Power Plant

		FEDERAL 3/26/2018 N	FEDERAL 3/26/2018 N	FEDERAL 3/28/2018 N	FEDERAL 3/28/2018 N	FEDERAL 4/5/2018 N
	Location ID	96156	96156	96147	96147	2016-07
	Sample ID	96156_20180326-01	96156-WG-20180326-02	96147_20180328-01	96147-WG-20180328-02	2016-07_20180405-01
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L	0.41		0.48		0.45
Cadmium	mg/L					
Calcium	mg/L	400		9.1		12
Chloride	mg/L	13000		700		1200
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L	19000		2200		2300
Fluoride	mg/L	5		4.6		2.8
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU		7.4		7.99	
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L	100		140		60
Thallium	mg/L					

Notes
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N - Normal Sample
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Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 4/5/2018 N	FEDERAL 4/6/2018 N	FEDERAL 4/6/2018 N	FEDERAL 9/11/2018 N	FEDERAL 9/11/2018 N
	Location ID	2016-07	2016-10	2016-10	2016-04	2016-04
	Sample ID	2016-07-WG-20180405-02	2016-10_20180406-01	2016-10-WG-20180406-02	2016-04-20180911-01	2016-04-WG-20180911-02
Analyte	Unit					
Antimony	mg/L				0.002	
Arsenic	mg/L				0.0016	
Barium	mg/L				0.091	
Beryllium	mg/L				0.00058	
Boron	mg/L		0.55		0.38	
Cadmium	mg/L				0.001	
Calcium	mg/L		610		87	
Chloride	mg/L		14000		240	
Chromium	mg/L				0.002	
Cobalt	mg/L				0.001	
Dissolved Solids, Total	mg/L		20000		1100	
Fluoride	mg/L		5		0.36	
Lead	mg/L				0.001	
Lithium	mg/L				0.053	
Mercury	mg/L				0.0002	
Molybdenum	mg/L				0.015	
pH, Field	SU	9.49		7.1		7.62
Radium-226/228	pCi/L				0.512	
Selenium	mg/L				0.005	
Sulfate	mg/L		540		420	
Thallium	mg/L				0.001	

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Analytical Data Summary
Fly Ash Reservoir
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		FEDERAL 9/13/2018 N	FEDERAL 9/13/2018 N	FEDERAL 9/13/2018 N	FEDERAL 9/13/2018 N	FEDERAL 9/13/2018 N
	Location ID	96153R	96153R	2016-09	2016-09	96154R
	Sample ID	96153-R-20180913-01	96153R-WG-20180913-02	2016-09-20180913-01	2016-09-WG-20180913-02	96154-R-20180913-01
Analyte	Unit					
Antimony	mg/L	0.002				
Arsenic	mg/L	0.005				
Barium	mg/L	0.028				
Beryllium	mg/L	0.0052				
Boron	mg/L	0.32				
Cadmium	mg/L	0.00027				
Calcium	mg/L	150		16		3.2
Chloride	mg/L	19		1800		410
Chromium	mg/L	0.002				
Cobalt	mg/L	0.2				
Dissolved Solids, Total	mg/L	1600				
Fluoride	mg/L	1.4		2		4.4
Lead	mg/L	0.001				
Lithium	mg/L	0.16				
Mercury	mg/L	0.0002				
Molybdenum	mg/L	0.003				
pH, Field	SU		6.04		12.07	
Radium-226/228	pCi/L	0.72				
Selenium	mg/L	0.005				
Sulfate	mg/L	1100		74		42
Thallium	mg/L	0.001				

Notes
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Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 9/13/2018 N	FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N
	Location ID	96154R	2016-01	2016-01	2016-02	2016-02
	Sample ID	96154R-WG-20180913-02	2016-01-20180925-01	2016-01-WG-20180925-02	2016-02-20180925-01	2016-02-WG-20180925-02
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L		0.25		0.48	
Cadmium	mg/L					
Calcium	mg/L		78		730	
Chloride	mg/L		180		14000	
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L		1100		19000	
Fluoride	mg/L		5.8		2.5	
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU	10.11		12.2		7.04
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L		86		140	
Thallium	mg/L					

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Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N
	Location ID	2016-03	2016-03	2016-06	2016-06	9910
	Sample ID	2016-03-20180925-01	2016-03-WG-20180925-02	2016-06-20180925-01	2016-06-WG-20180925-02	9910-20180925-01
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L	0.43		0.49		0.52
Cadmium	mg/L					
Calcium	mg/L	140		4.8		12
Chloride	mg/L	23		620		840
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L	1000		1400		2400
Fluoride	mg/L	0.22		5.7		2
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU		7		8.24	
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L	410		100		110
Thallium	mg/L					

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Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N	FEDERAL 9/25/2018 N	FEDERAL 10/1/2018 N	FEDERAL 10/1/2018 N
	Location ID	9910	2016-08	2016-08	2016-10	2016-10
	Sample ID	9910-WG-20180925-02	2016-08-20180925-01	2016-08-WG-20180925-02	2016-10-20181001-01	2016-10-WG-20181001-02
Analyte	Unit					
Antimony	mg/L					
Arsenic	mg/L					
Barium	mg/L					
Beryllium	mg/L					
Boron	mg/L		0.1		0.52	
Cadmium	mg/L					
Calcium	mg/L		340		650	
Chloride	mg/L		920		16000	
Chromium	mg/L					
Cobalt	mg/L					
Dissolved Solids, Total	mg/L		2400		23000	
Fluoride	mg/L		1.4		2.5	
Lead	mg/L					
Lithium	mg/L					
Mercury	mg/L					
Molybdenum	mg/L					
pH, Field	SU	7.64		12.45		7.11
Radium-226/228	pCi/L					
Selenium	mg/L					
Sulfate	mg/L		27		560	
Thallium	mg/L					

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Appendix D
Analytical Data Summary
Fly Ash Reservoir
Gavin Power Plant

		FEDERAL 10/4/2018 N	FEDERAL 10/23/2018 N	FEDERAL 10/23/2018 N	FEDERAL 10/23/2018 N
	Location ID	96147	96147	2016-07	2016-07
	Sample ID	96147-WG-20181004-02	96147-20181023-01	2016-07-20181023-01	2016-07-WG-20181023-02
Analyte	Unit				
Antimony	mg/L				
Arsenic	mg/L				
Barium	mg/L				
Beryllium	mg/L				
Boron	mg/L		0.46	0.42	
Cadmium	mg/L				
Calcium	mg/L		10	12	
Chloride	mg/L		640	1100	
Chromium	mg/L				
Cobalt	mg/L				
Dissolved Solids, Total	mg/L		1900	1800	
Fluoride	mg/L		5.6	2.9	
Lead	mg/L				
Lithium	mg/L				
Mercury	mg/L				
Molybdenum	mg/L				
pH, Field	SU	8			9.75
Radium-226/228	pCi/L				
Selenium	mg/L				
Sulfate	mg/L		130	49	
Thallium	mg/L				

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