SGW-64539
Revision 0

DATA USABILITY ASSESSMENT FOR 300-FF-5 STAGE B GROUNDWATER

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

P.O. Box 1600
Richland, Washington 99352

Approved for Public Release;
Further Dissemination Unlimited

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Terms

DQI	data quality indicator
DUA	data usability assessment
DUP	field duplicate sample
EA	enhanced attenuation
EB	equipment rinsate blank
EPA	U.S. Environmental Protection Agency
FTB	full trip blank
HAPQL	highest allowable practical quantitation limit
HEIS	Hanford Environmental Information System
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LVZ	lower vadose zone
MB	method blank
MDC	minimum detectable concentration
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
OU	operable unit
PRZ	periodically rewetted zone
QA	quality assurance
QC	quality control
RPD	relative percent difference
SAP	sampling and analysis plan

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1 Introduction

This data usability assessment (DUA) report evaluates laboratory data for groundwater samples collected as part of the implementation, performance monitoring, and groundwater monitoring of the enhanced attenuation (EA) remedy for the 300-FF-5 Operable Unit (OU). The data quality indicators (DQIs) assessment included in this DUA is used for samples collected under DOE/RL-2014-42-ADD1, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan Addendum for Stage B Uranium Sequestration* (hereinafter referred to as the 300-FF-5 Sampling and Analysis Plan [SAP] Addendum), because a judgmental sampling design was used. This DUA completes the U.S. Environmental Protection Agency (EPA) data quality life cycle (planning, implementation, and assessment).

When judgmental (focused) sampling designs are implemented in the field, the DQIs precision, accuracy/bias, representativeness, comparability, completeness, and sensitivity for the specific data sets are evaluated according to EPA/240/R-02/004, *Guidance on Environmental Data Verification and Data Validation*. Data verification and data validation are integral to the DQI evaluation process. The CH2M HILL Plateau Remediation Company used the results of the DQI evaluation process to interpret the data and determine if the data quality objectives for this activity have been met.

This report documents the following components of the DUA:

1. Data Verification (Chapter 2)
2. Data Validation (Chapter 3)
3. Data Quality Indicators Evaluation (Chapter 4)
4. Summary and Conclusions (Chapter 5)

1.1 Purpose

The purpose of this DUA is to determine whether the data collected under the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) are the right type and of sufficient quality and quantity to support groundwater monitoring and remediation decisions. The DUA process is not intended to be a definitive analysis of a project or problem. Rather, it provides an initial assessment of the reasonableness of the data that have been generated, based solely on the quality control (QC) information associated with the data and not on the technical interpretations of the data value.

The information contained in this report follows guidelines for DUAs based on EPA/240/R-02/004.

1.2 Scope

This DUA focuses on the data collected by sampling groundwater as required by the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1). The data are evaluated to determine whether they meet the analytical criteria outlined in DOE/RL-2014-42, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan* (hereinafter referred to as the 300-FF-5 SAP). Overall, sample collection and analyses were performed in accordance with the 300-FF-5 SAP Addendum. Specific QC measures are provided in the 300-FF-5 SAP (DOE/RL-2014-42).

This DUA does not include the evaluation of geophysical, field data, radiological, volatile organic compound, soil, skid effluent, or river water data.

1.3 Project Background

This section describes the sampling design and associated project objectives including implementation of the sampling design.

The EA using uranium sequestration by phosphate application was implemented in two stages, A and B. The Stage A EA treated a 0.3 ha (0.75 ac) area, while the Stage B EA treated a 0.9 ha (2.25 ac) area. The purpose of Stage A was to perform the remedy on a small area and establish a baseline from which to refine operations for Stage B. Stage A phosphate application was completed in November 2015. Based on an evaluation of Stage A results, the implementation process was refined for Stage B.

The Stage B EA remedy was designed to deliver three pore volumes or approximately 16,259,900 L of total injection volume of polyphosphate solution uniformly to the lower vadose zone (LVZ) and the periodically rewetted zone (PRZ) within the EA area to sequester uranium. Pore volume is the total volume of void space between sediment particles. Orthophosphate and pyrophosphate chemicals were delivered to the Hanford Site in a blended, concentrated liquid form and mixed with river surface water. The blended solutions were delivered within the pH range of 7.0 to 7.5. These solutions were temporarily stored in chemical storage tanks and delivered to the remediation skids during injection operations. Two remediation skids were used during Stage B to simultaneously inject blended polyphosphate solution at 6 injection wells per skid, for a total of 12 injection wells at a time and 48 wells overall, into 4 individual injection zones. Both skids were used for mixing and pumping phosphate solution for injection in the PRZ followed by injection in the LVZ. Figure 1 shows the 4 injection zones, including the 12 wells in each zone, and additional information not within the scope nor discussed in this DUA.

1.3.1 Sampling Design

Groundwater samples under the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) were collected to monitor the performance of the Stage B remedy application. The groundwater monitoring network was designed so that up to 24 monitoring wells may be sampled daily. The 30 wells sampled including monitoring wells, in addition to injection zones and injection wells, for Stage B are shown in Figure 1.

Baseline groundwater samples were collected at the monitoring wells 1 to 4 weeks before treatment to establish baseline conditions. During phosphate application, groundwater samples were collected daily at the monitoring wells. Groundwater samples were collected at the monitoring wells daily for 1 week after Stage B phosphate application and then weekly for a month to evaluate uranium and phosphate concentrations in the groundwater. Monthly sample collection for a year was also prescribed in the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1). All samples collected at monitoring wells prior to, during, and after treatment were analyzed for uranium, total phosphorus, phosphate, anions (chloride, sulfate, nitrate, and bicarbonate and carbonate alkalinity), cations (calcium, magnesium, sodium, potassium, iron, manganese, and arsenic), and total alkalinity. Sampling design for groundwater performance monitoring samples as required in the 300-FF-5 SAP Addendum are shown in Table 1.

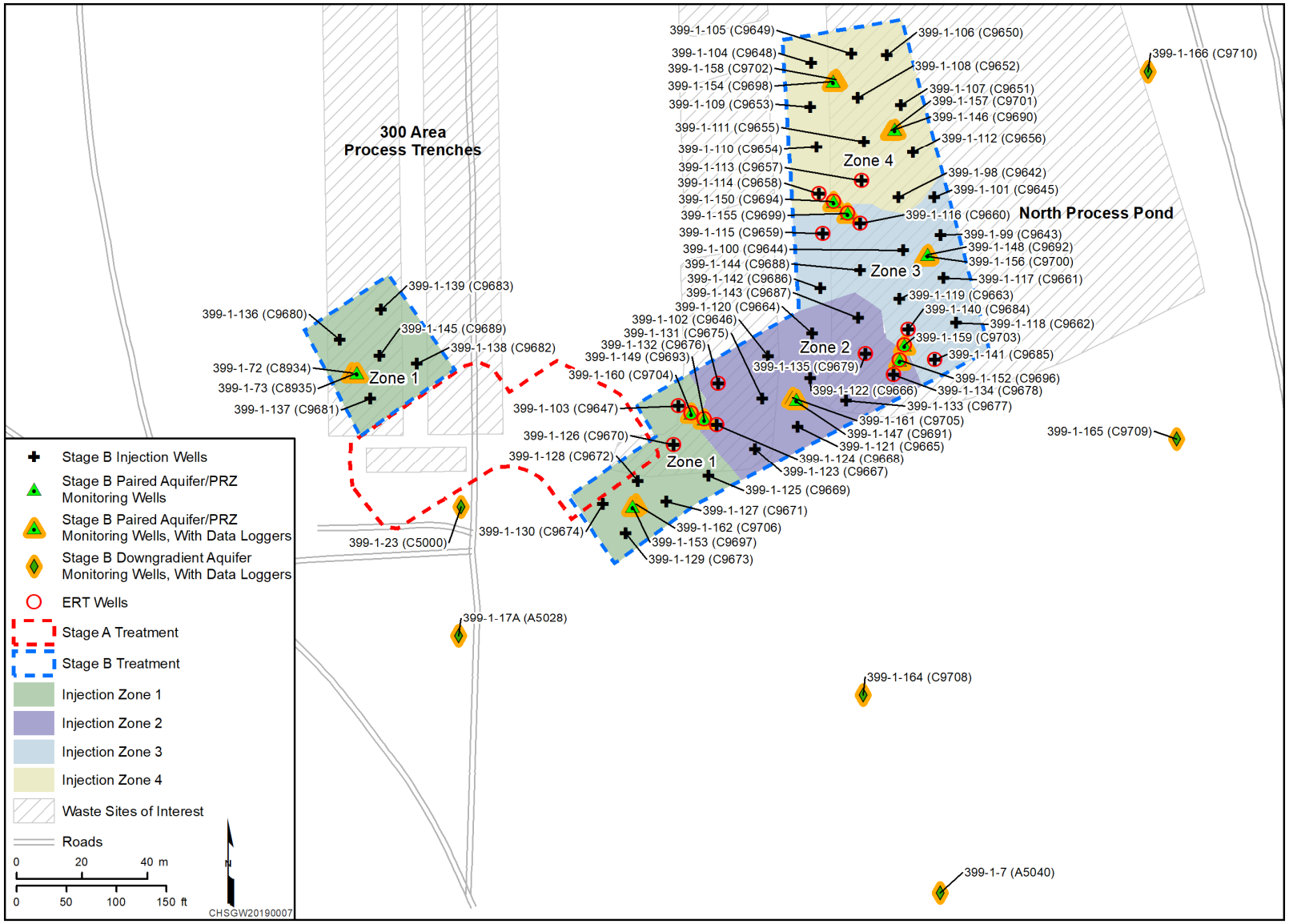

Figure 1. Layout of the Injection Zones, LVZ/PRZ Injection Wells, and Monitoring Wells for the Stage B Enhanced Attenuation Area

Table 1. Sample Design for Stage B Performance Monitoring Groundwater Samples

Grab Sample Analyses	General Sampling Location Information	Sampling Location (Well)	Sampling Frequency for Pre-Treatment	Sampling Frequency During Treatment	Sampling Frequency for Post-Treatment
Uranium Phosphorus Phosphate Chloride Sulfate Nitrate Calcium Magnesium Sodium Potassium Iron Manganese Arsenic Bicarbonate Carbonate Total alkalinity	The 13 wells are existing aquifer monitoring wells in the vicinity and downgradient of the Stage B area.	399-1-23	Monthly, starting 1 month after approval of the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1). In the original 300-FF-5 SAP Addendum, sampling at only the first 6 wells was required. The rest of the wells were added via TPA-CN-0828, approved in August 2018.	Not required	Monthly for 1 year after treatment
		399-1-17A			
		399-2-2			
		399-1-16A			
		399-1-7			
		399-1-55			
		399-1-62			
		399-1-72			
		399-1-158			
		399-1-159			
		399-1-162			
		399-1-2			
		399-1-12			
	Of the 24 wells, 18 are within the Stage B area, 3 are new downgradient wells drilled for Stage B, and 3 are existing downgradient wells.	399-1-146	Once, 1 to 4 weeks before treatment	Daily	Daily for 1 week, then weekly for 4 weeks
		399-1-147			
		399-1-72			
		399-1-73			
		399-1-148			
		399-1-149			
		399-1-150			
		399-1-152			
		399-1-153			
		399-1-154			
		399-1-155			
		399-1-156			
		399-1-157			
		399-1-158			
		399-1-159			
		399-1-160			
		399-1-161			

Table 1. Sample Design for Stage B Performance Monitoring Groundwater Samples

Grab Sample Analyses	General Sampling Location Information	Sampling Location (Well)	Sampling Frequency for Pre-Treatment	Sampling Frequency During Treatment	Sampling Frequency for Post-Treatment
		399-1-162			
		399-1-17A			
		399-1-164			
		399-1-165			
		399-1-166			
		399-1-23			
		399-1-7			
	New aquifer wells.	399-1-155	Not required	Not required	Monthly for 6 months
		399-1-156			
		399-1-157			
		399-1-160			
		399-1-161			
		399-1-164			
		399-1-165			
		399-1-166			

References: DOE/RL-2014-42-ADD1, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan Addendum for Stage B Uranium Sequestration*.

TPA-CN-0828, *Tri-Party Agreement Change Notice Form: DOE/RL-2014-42-ADD1, 300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan Addendum for Stage B Uranium Sequestration*, *Rev. 0.*

SAP = sampling and analysis plan

1.3.2 Project Objectives

The principal study question design objective described in the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) and within the scope of this DUA is to determine the short-term impact to local uranium concentration and groundwater chemistry.

1.3.3 Implementation of the Sample Design

The 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) required grab samples to be collected at up to 30 wells to determine the short-term impact to local uranium concentration and groundwater chemistry.

Sample collection was required before treatment, and daily sample collection was required during treatment and for 1 week after treatment. Then, weekly sampling was required for 4 weeks and monthly for a year. The sampling design was implemented as described in the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) with a few exceptions. These exceptions are described as follows:

- For pretreatment, monthly sampling for the group of 13 wells, sampling began at different times because six wells were included in the original 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) and the other seven added with approval of a Tri-Party Agreement Change Notice Form

(TPA-CN-0828, *Tri-Party Agreement Change Notice Form: DOE/RL-2014-42-ADD1, 300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan Addendum for Stage B Uranium Sequestration, Rev. 0*) months after the original document. Sampling at some wells including 399-1-158, 399-1-159, and 399-1-162 was missed for 2 months due to restricted access because of nearby construction. Sampling at well 399-1-12 was missed for 3 months because the road to access the well was nondrivable for the sampling vehicle.

- For the post-treatment, monthly sampling from the 13 existing wells and 8 new aquifer wells, the inclement weather conditions in February 2019 led to canceling sampling for that month. For the group of eight wells, samples were collected for 5 of the 6 months. Samples for these wells were also collected in June, so sampling did not occur consecutively, but if these samples are included, then samples were collected for 6 months for the eight wells, which satisfies the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) requirement. In addition, samples were collected for 6 months for well 399-1-73. For the group of 13 wells, samples were collected from October 2018 to October 2019 for a total of 12 months, as required, even with the cancelled February event. While special circumstances affected sampling for the group of 24 wells (i.e., insufficient water at some wells preventing the collection of samples in August and other months), groundwater sampling requirements for this group of wells were met. Table 2 summarizes Stage B performance monitoring sampling design requirements and implementation information, and does not include field duplicate, full trip blank (FTB), or equipment rinsate blank (EB) samples.

Table 2. Sample Design Implementation and Completion Evaluation for Stage B Performance Monitoring Groundwater Samples

General Sampling Location Information	Sampling Location (Wells)	Pre-Treatment			During Treatment			Post-Treatment			Percent of Estimated Number Completed
		Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	
The 13 wells are existing aquifer monitoring wells in the vicinity and downgradient of the Stage B area.	399-1-23	Monthly, starting 1 month after approval of the 300-FF-5 SAP Addendum. Sampling was performed starting January (for the first 6 wells), September (for the following 5 wells) in 2017 and March (for the last 2 wells) in 2018 to August 2018.	20	17	Not required	N/A	N/A	Monthly for 1 year after treatment. Sampling was performed October 2018 to October 2019.	12	12	95.7
	399-1-17A		20	20					12	12	
	399-2-2		20	20					12	12	
	399-1-16A		20	20					12	12	
	399-1-7		20	18					12	12	
	399-1-55		20	20					12	12	
	399-1-62		12	12					12	12	
	399-1-72		12	12					12	12	
	399-1-158		12	10					12	12	
	399-1-159		12	10					12	12	
	399-1-162		12	10					12	12	
	399-1-2		6	6					12	12	
	399-1-12		6	2					12	12	

Table 2. Sample Design Implementation and Completion Evaluation for Stage B Performance Monitoring Groundwater Samples

General Sampling Location Information	Sampling Location (Wells)	Pre-Treatment			During Treatment			Post-Treatment			Percent of Estimated Number Completed
		Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	
Of the 24 wells, 18 are within the Stage B area, 3 are new downgradient wells drilled for Stage B, and 3 are existing downgradient wells.	399-1-146	Once, 1 to 4 weeks before treatment. Sampling was performed either 8/27, 8/28, 8/30, or 9/04 in 2018.	1	0	Daily. Sampling was performed 9/04/18 to 9/20/18.	17	0	Daily for 1 week, then weekly for 4 weeks. Sampling was performed 9/21/18 to 9/27/18, then 10/03/18, 10/10/18, 10/17/18, and 10/24/18.	11	3	100 Sample collection was required for a target of 24 wells, not for each of the 24 wells.
	399-1-147		1	0		17	4		11	3	
	399-1-72		1	1		17	17		11	11	
	399-1-73		1	1		17	17		11	10	
	399-1-148		1	0		17	6		11	2	
	399-1-149		1	0		17	9		11	3	
	399-1-150		1	0		17	7		11	4	
	399-1-152		1	0		17	8		11	2	
	399-1-153		1	0		17	5		11	0	
	399-1-154		1	0		17	0		11	2	
	399-1-155		1	1		17	17		11	11	
	399-1-156		1	1		17	17		11	11	
	399-1-157		1	1		17	17		11	11	
	399-1-158		1	1		17	17		11	11	
	399-1-159		1	1		17	17		11	11	
	399-1-160		1	1		17	17		11	11	
	399-1-161		1	1		17	17		11	10	
	399-1-162		1	1		17	14		11	11	
	399-1-17A		1	1		17	16		11	11	
	399-1-164		1	1		17	13		11	10	
	399-1-165		1	1		17	17		11	11	
	399-1-166		1	1		17	17		11	11	
	399-1-23		1	0		17	15		11	11	
	399-1-7		1	1		17	17		11	10	

Table 2. Sample Design Implementation and Completion Evaluation for Stage B Performance Monitoring Groundwater Samples

General Sampling Location Information	Sampling Location (Wells)	Pre-Treatment			During Treatment			Post-Treatment			Percent of Estimated Number Completed
		Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	Sample Collection Frequency	Number Estimated According to 300-FF-5 SAP Addendum	Estimated Number Completed	
New aquifer wells	399-1-155	Not required.	N/A	N/A	Not required	N/A	N/A	Monthly for 6 months after weekly sampling. Sampling was performed November 2018 to April and June 2018.	6	5	100 Samples were collected for 6 months total, but not consecutively. Samples for well 399-1-73 were also collected for 6 months.
	399-1-156								6	5	
	399-1-157								6	5	
	399-1-160								6	5	
	399-1-161								6	5	
	399-1-164								6	5	
	399-1-165								6	5	
	399-1-166								6	5	

Reference: DOE/RL-2014-42-ADD1, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan Addendum for Stage B Uranium Sequestration.*

N/A = not applicable

SAP = sampling and analysis plan

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1.4 Quality Assurance and Quality Control Requirements

This section describes the analytical and laboratory quality assurance and QC requirements identified in the 300-FF-5 SAP (DOE/RL-2014-42) for groundwater samples.

1.4.1 Laboratory Information

The laboratory sample results discussed in this DUA were downloaded from the Hanford Environmental Information System (HEIS) database on April 20, 2019. For this set of data of over 888 samples submitted for laboratory analysis, 21,643 analytical laboratory results were yielded (not including field duplicate [DUP], EB, and FTB samples). The groundwater samples were analyzed at the following laboratories:

- ALS Laboratories, located in Fort Collins, Colorado, performed chemical (including alkalinity, anions, and metals) analyses on select samples. ALS Laboratories generated 14.9% of the analytical laboratory results.
- GEL Laboratories, LLC, located in Charleston, South Carolina, performed chemical (including alkalinity, anions, and metals) analyses on select samples. GEL Laboratories, LLC generated 26.7% of the analytical laboratory results.
- Test America, Denver, located in Denver, Colorado, performed chemical (including alkalinity and metals) analyses on select samples. Test America, Denver generated 17.9% of the analytical laboratory results.
- Test America, Richland, located in Richland, Washington, performed anions analyses on select samples. Test America, Richland generated 11.9% of the analytical laboratory results.
- Test America, St. Louis, located in St. Louis, Missouri, performed chemical (including alkalinity, anions, and metals) analyses on select samples. Test America, St. Louis generated 28.7% of the analytical laboratory results.

Chapters 2, 3, 4, and 5 discuss the analytical data provided by these laboratories.

1.4.2 Analytical Methods

Samples were analyzed using methods listed in Table 3. Both multi and single-component method-based analyses were used. Multicomponent method-based analyses are those analyses that yield concentration data for multiple analytes in a single analysis. The analytes may include both target analytes and nontarget analytes. Single-component method-based analyses are those analyses that yield concentration data for a single target analyte in a single analysis. Sample results were reported in the HEIS database.

1.4.3 Analytical Requirements

Analytical performance requirements for groundwater samples are defined in the 300-FF-5 SAP (DOE/RL-2014-42). Table 4 summarizes the analytical performance requirements for laboratory analysis of water samples.

Table 3. Analytical Methods for Water

Parameter	Analytical Method
Alkalinity	EPA 310.1 or SM 2320
Anions	EPA 300.0 or EPA 9056
ICP-AES Metals	EPA 6010
ICP/MS Metals	EPA 6020

Notes: Complete reference citations are provided in Chapter 6.

For EPA Method 300.0, see EPA/600/R-93/100. For EPA Method 310.1, see EPA/600/4-79/020. For four-digit EPA methods, see the SW-846. For SM 2320, see APHA/AWWA/WEF.

EPA = U.S. Environmental Protection Agency
ICP-AES = inductively coupled plasma-atomic emission spectroscopy
ICP/MS = inductively coupled plasma mass spectroscopy
SM = standard method

Table 4. Analytical Performance Requirements for Water Samples

CAS Number	Analyte	HAPQL (µg/L)	Analytical Method[a]	Precision Requirement (%)[b]	Accuracy Requirement (%)[c]
Performance Requirements for Laboratory Measurements (Inorganics – Cations/Metals)					
7440-61-1	Uranium	15	EPA 6020	≤20	80-120
7440-38-2	Arsenic	10.5	EPA 6010	≤20	80-120
7440-70-2	Calcium	1,000	EPA 6010	≤20	80-120
7439-89-6	Iron	105	EPA 6010	≤20	80-120
7439-95-4	Magnesium	750	EPA 6010	≤20	80-120
7439-96-5	Manganese	5.25	EPA 6010	≤20	80-120
7723-14-0	Phosphorus	262.5	EPA 6010	≤20	80-120
7440-09-7	Potassium	4,000	EPA 6010	≤20	80-120
7440-23-5	Sodium	500	EPA 6010	≤20	80-120
Performance Requirements for Laboratory Measurements (Inorganics – Anions)					
14797-55-8	Nitrate	250	EPA 300.0 or 9056	≤20	80-120
14265-44-2	Phosphate	500	EPA 300.0 or 9056	≤20	80-120
16887-00-6	Chloride	400	EPA 300.0 or 9056	≤20	80-120
14808-79-8	Sulfate	550	EPA 300.0 or 9056	≤20	80-120
ALKALINITY	Total alkalinity	5,000	EPA 310.1 or SM 2320	≤20	80-120
3812-32-6	Carbonate	5,000	EPA 310.1 or SM 2320	≤20	80-120

Table 4. Analytical Performance Requirements for Water Samples

CAS Number	Analyte	HAPQL (µg/L)	Analytical Method[a]	Precision Requirement (%)[b]	Accuracy Requirement (%)[c]
71-52-3	Bicarbonate	5,000	EPA 310.1 or SM 2320	≤20	80-120

Note: Complete reference citations are provided in Chapter 6.

a. Equivalent methods may be substituted. For EPA Method 300.0, see EPA/600/R-93/100. For EPA Method 310.1, see EPA/600/4-79/020. For four-digit EPA methods, see the SW-846. For SM 2320, see APHA/AWWA/WEF.

b. Precision criteria for batch laboratory replicate matrix spike analyses or replicate sample analyses.

c. Accuracy criteria for associated batch matrix spike percent recoveries. Evaluation based on statistical control of laboratory control samples also is performed.

CAS = Chemical Abstracts Service
EPA = U.S. Environmental Protection Agency
HAPQL = highest allowable practical quantitation limit
SM = standard method

1.4.4 Laboratory Quality Assurance and Quality Control Requirements

The quality assurance (QA)/QC requirements govern nearly all aspects of analytical laboratory operation, including instrument procurement, maintenance, calibration, and operation. Laboratory requirements for internal QC checks are performed as appropriate for the analytical method at a rate of one per sample per sample delivery group or 1 in 20 (5%), whichever is more frequent. Laboratory internal QC checks include the following:

- **Laboratory Contamination**. Each analytical batch contains a laboratory method blank (MB) (material of composition similar to that of the samples with known/minimal contamination of the analytes of interest) carried through the complete analytical process. The MB is used to evaluate false positive results in samples caused by contamination during handling at the laboratory.

- **Analytical Accuracy**. For most analyses, a known quantity of representative analytes of interest (matrix spike [MS]) is added to a separate aliquot of a sample from the analytical batch. The known amount added is compared to the actual measured amount to calculate the percent recovery.
  The recovery percentage of the added MS is used to evaluate analytical accuracy. For analyses not amenable to MS techniques (i.e., gamma energy analysis), or where analytical recovery is evaluated from recovery of the tracers or carriers, the accuracy of the laboratory preparation and analysis is evaluated via QC reference samples (i.e., a laboratory control sample [LCS]). In addition to the MS recovery, surrogate compounds are used to evaluate accuracy in the volatile organic analyses. Surrogate compounds with instrumental responses that are typical of the analytes of interest are added into the blanks, samples, and MSs, and the recovery is evaluated.

- **Analytical Precision**. Separate aliquots removed from the sample containers (duplicate samples) are analyzed for each analytical batch for radionuclides and metals. The duplicate sample results are compared to the original sample results, which are evaluated as relative percent differences (RPDs) and are used to assess analytical precision. Alternately, a matrix spike duplicate (MSD) may be used for assessing precision of metals and organic parameters. For a MSD, a separate aliquot is removed from the same sample container and spiked in the same manner as the MS. The results, not recoveries, from the MS/MSD are used to calculate a RPD and to assess precision.

- **LCSs or QC Reference Samples (Analytical Accuracy)**. The LCS may be prepared from an independent standard or from the same standard used for instrument calibration at a concentration within the calibration range. The LCS is taken through all the preparation and analysis steps used in the method. The LCS or QC reference sample measures the accuracy of the analytical process. Depending on how it is introduced into the analysis, the LCS is sometimes referred to as a blank spike sample.

Laboratories are also subject to periodic audits of laboratory performance, systems, and overall program. No audits were performed specific to the data analyses performed as part of this project.

1.4.4.1 Qualification Flags

During the generation of environmental analytical data, any of several qualification flags may be assigned to an individual result. The HEIS database carries qualification flags applied by three sources: the laboratory, third-party data validator, or a data user/reviewer. The tables of data within this report show all of these applied qualification flags. Potential flags and their meaning are provided in Table 5.

Table 5. Qualification Flags

Flag	Definition
Laboratory-Applied Flags	
>	Wetchem: Result greater than quantifiable range or greater than upper limit of the analysis range.
*	Inorganics: Duplicate analysis not within control limits.
+	Inorganics: Correlation coefficient for method of standard additions is <0.995.
A	Organics: Valid for TICs only, as the TIC is a suspected aldol-condensation product.
B	Inorganics and wetchem: The analyte was detected at a value <RDL but ≥IDL/MDL (as appropriate). Organics: The analyte was detected in both the associated QC blank and in the sample, and the blank concentration exceeded the customer's contractual requirements. Radionuclides: The associated QC sample blank has a result of ≥2x the MDA and, after corrections, the result is ≥MDA for this sample.
C	Inorganics and wetchem: The analyte was detected in both the sample and the associated QC method blank, and the blank concentration exceeded the customer's contractual requirements. Organics (pesticide only): The identification of a pesticide confirmed by GC/MS
D	All: Analyte was reported at a secondary dilution factor, typically DF>1 (i.e., the primary preparation required dilution to either bring the analyte within the calibration range or to minimize interference). Required for organics/wetchem if the sample was diluted.
E	Inorganics: Reported value is estimated because of interference. See comment on the cover page, hardcopy case narrative, or specific inorganic hardcopy data sheet.
J	Organics: Estimated value; (1) constituent detected at a level <RDL or PQL and ≥MDL and estimated concentration of TICs.
M	Inorganics: Duplicate precision criteria not met.
N	All (except GC/MS based analysis): Spike and/or spike duplicate sample recovery is outside the control limits. Organics (GC/MS only): Presumptive evidence of compound based on mass spectral library search.
P	Organics (PCB only): Aroclor target analyte with >25% difference between column analyses.

Table 5. Qualification Flags

Flag	Definition
Q	Organics (dioxins and PCB-congeners only): Estimated maximum concentration. Used if one of the qualitative identification criteria is not met (e.g., chlorine isotopic ratios outside the theoretical range).
S	Inorganics: Reported value determined by the method of standard additions.
T	Organics (GC/MS only): Spike and/or spike duplicate sample recovery is outside the control limits.
U	All: The constituent was analyzed for and was not detected. The data should be considered usable for decision-making purposes.
W	Inorganics: Post-digestion spike recovery for GFAA is out of control limit. Sample absorbance is <50% of spike absorbance.
X	All: The result-specific translation of this qualifier code is provided in the data report and/or case narrative. Additional result-specific translation information may also be found in the result comment field in HEIS for this record.
Y	Same as X if more than one flag is required.
Z	Same as X and Y if more than two flags are required.
Third Party Validation-Applied Flags	
U	The constituent was analyzed for but was not detected above the MDL. The data should be considered usable for decision-making purposes.
UJ	The constituent was analyzed for and was not detected. Because of a QC deficiency identified during data validation, the value reported may not accurately reflect the RL. The data should be considered usable for decision-making purposes.
J	Indicates the constituent was analyzed and detected. The associated value is estimated because of a QC deficiency identified during data validation. The data should be considered usable for decision-making purposes.
J+	Indicates the constituent was analyzed and detected. The result is an estimated quantity, but the result may be biased high. The data should be considered usable for decision-making purposes.
J-	Indicates the constituent was analyzed and detected. The associated value is estimated with a suspected negative bias due to QC deficiency identified during data validation. The data should be considered usable for decision-making purposes.
NJ	The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.
C	The target pesticide or Aroclor analyte identification has been confirmed by GC/MS.
X	The target pesticide or Aroclor analyte identification was not confirmed when GC/MS analysis was performed. The data should be considered unusable for decision-making purposes.
UR	Indicates the constituent was analyzed and not detected. However, due to an identified QC deficiency, the data should be considered unusable for decision-making purposes.
R	Rejected value: The value may not reflect true concentrations. The ability to establish detection/nondetection may be questionable. Validation activities identified major QC deficiencies or sample matrix interferences. The data should be considered unusable for most purposes. Any use of this data should be undertaken with great care. The data should not be used for certain regulatory decision-making purposes.

Table 5. Qualification Flags

Flag	Definition
Data User-Applied Flags	
A	Indicates an issue with the chain-of-custody that could affect data usability.
F	Result is undergoing further review. (This review qualifier is assigned when a RDR is first processed.)
G	Record has been reviewed and determined to be correct, or the record has been corrected with laboratory confirmation or other supporting information.
H	Laboratory holding time exceeded before the sample was analyzed.
P	Potential problem. Collection/analysis circumstances make the result questionable.
Q	Associated QC sample is out of limits.
R	Do not use. Further review indicates the result is not valid. (This review qualifier is used only when there is documented evidence that the result is not valid. Generally, results that are "R" qualified will be excluded from statistical evaluations, maps, and other interpretations.)
Y	Result is suspect. Review had insufficient evidence to show the result as valid or invalid.
Z	Miscellaneous circumstance exists. Additional information may be found in the result comment field (in the HEIS result table) for this record and/or in the sample comment field in the HEIS sample table.

Note: Wetchem is a group of analytical methods that are associated with "wet" chemical reactions.

DF = dilution factor
GC/MS = gas chromatograph/mass spectrometer
GFAA = graphite-furnace atomic absorption
HEIS = Hanford Environmental Information System
IDL = instrument detection limit
MDA = minimum detectable activity
MDL = method detection limit
PQL = practical quantitation limit
QC = quality control
RDL = required detection limit
RDR = request for data review
RL = reporting limit
TIC = tentatively identified compound

1.4.5 Field Quality Control Sampling Requirements

The 300-FF-5 SAP (DOE/RL-2014-42) required collection of FTB, EB, DUP, and split samples. Table 6 summarizes the required frequency for each field QC sample type.

Table 6. Project Field Quality Control Checks

QC Sample Type	Purpose	Frequency
Field duplicates	Estimate precision, including sampling and analytical variability.	1 in 20 well trips.
Split sample	Estimate precision, including sampling, analytical, and interlaboratory variability.	As needed. When needed, the minimum is one per analytical method, for analyses performed where the detection limit and precision and accuracy criteria have been defined in the analytical performance requirements table.
Full trip blank	Assess contamination from containers or transportation.	1 per 20 well trips.
Equipment rinsate blank	Verify adequacy of sampling equipment decontamination.	As needed.

Table 6. Project Field Quality Control Checks

QC Sample Type	Purpose	Frequency
		If only disposable equipment is used or equipment is dedicated to a particular well, then an equipment rinsate blank is not required. Otherwise, 1 per 20 samples for each media.*

*Whenever a new type of nondedicated equipment is used, an equipment rinsate blank will be collected every time sampling occurs until it can be shown that less frequent collection of equipment rinsate blanks is adequate to monitor the decontamination procedure for the nondedicated equipment.

QC = quality control

1.4.5.1 Field Blank Requirements

FTBs are samples prepared by the sampling team before traveling to the sampling site. The preserved bottle set is identical to the set collected in the field but is filled with reagent water or silica sand as appropriate to the primary sample media. The bottles are sealed and transported, unopened, to the field in the same storage container used for samples collected the same day. FTBs are typically analyzed for the same constituents as the samples from the associated sampling event.

EB samples are collected for nondedicated sampling devices to assess the adequacy of the decontamination process. EBs will consist of silica sand or reagent water poured over the decontaminated sampling equipment and placed in containers, as identified on the project sampling authorization form. If disposable (i.e., single-use) equipment is used, equipment blanks are not required.

Field blank (i.e., FTB and EB) results greater than two times the method detection limit (MDL) are identified as suspected contamination. However, for common laboratory contaminants (i.e., acetone, methylene chloride, 2-butanone, toluene, and phthalate esters), the limit is five times the MDL. For radiological data, blank results are flagged if they are greater than two times the minimum detectable concentration (MDC).

1.4.5.2 Field Duplicate Requirements

DUPs are used to evaluate sample consistency and the precision of field sampling methods. DUPs are independent samples collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed as independent samples at a single laboratory.

The duplicate should be collected generally from an area expected to have some contamination so valid comparisons between the samples can be made (e.g., at least some of the constituents will be greater than the detection limit).

Evaluation of the results can provide an indication of intralaboratory variability. Only those FUP result pairs with at least one result greater than five times the MDL or MDC are evaluated. FUP results must agree within 20% as measured by the RPD to be acceptable. Large RPDs can be an indication of laboratory performance problems and should be investigated.

1.4.5.3 Split Sample Requirements

Field split samples are duplicate samples from a sampling event sent to two different laboratories for analysis. Evaluation of the results can provide an indication of interlaboratory variability.

Only those field split result pairs with at least one result greater than five times the MDL or MDC are evaluated. Field split sample results must agree within 20% as measured by the RPD to be acceptable. Large RPDs can be an indication of laboratory performance problems and should be investigated.

1.4.6 Laboratory Quality Control Requirements

In addition to the evaluation performed on field QC data (as described in Section 1.4.5), a broad review of the laboratory QC results was also conducted. Laboratory QC results are stored electronically in HEIS and were evaluated using various database queries against the acceptance criteria. Table 7 provides a summary of the laboratory QC acceptance criteria used for water samples as described in the 300-FF-5 SAP (DOE/RL-2014-42).

Table 7. Laboratory QC Acceptance Criteria

QC Element	Acceptance Criteria
Laboratory duplicate samples	Laboratory duplicate samples with one or both of the measured concentrations ≥PQL/MDC and the RPD is ≤20% for water matrices to be considered acceptable.
Laboratory blank samples	Laboratory blank samples must be <MDL or <5% sample concentration.
LCSs	LCS percent recovery must be between the 80% to 120% control limits.
MS/MSD (where applicable)	Laboratory spike percent recovery must be between 75% to 125% control limits. In addition, where the sample result is ≤4x the spiking concentration, the MS/MSD RPD must have an RPD ≤20% for water matrices. Spike values are not applicable when the sample result is >4x the spiking concentration.

Reference: DOE/RL-2014-42, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan*.

LCS	=	laboratory control sample	MSD	=	matrix spike duplicate
MDC	=	minimum detectable concentration	PQL	=	practical quantitation limit
MDL	=	minimum detection limit	QC	=	quality control
MS	=	matrix spike	RPD	=	relative percent difference

2 Data Verification

Data verification is the process of evaluating the completeness, correctness, conformance, and compliance of a specific dataset against the method, procedural, or contractual requirements. It includes confirmation that the specified sampling and analytical requirements have been completed (i.e., verification that the number, type, and location of all samples identified in the 300-FF-5 SAP [DOE/RL-2014-42] and Addendum [DOE/RL-2014-42-ADD1] have been collected and that all required measurements and analyses were performed). This evaluation is documented in the completeness section (Section 4.1.5), which evaluates the sampling design versus field implementation. In addition, verification is performed for field QC and laboratory QC samples and is documented in the field QC and laboratory QC sections (Sections 2.2 and 2.3, respectively).

2.1 Data Verification Results

Data verification requires the evaluation of collected documentation to verify that key information for subsequent validation and data indicator evaluations are present.

Data verification is performed in accordance with company procedures, which require verification of a minimum of 25% of all final analytical data packages. This verification procedure requirement is all inclusive and based on a random selection of the total final analytical data packages and not based on individual projects. For the 300 FF-5 project within the scope of this DUA, analytical data package verification was performed on 213 data deliverables out of 436, which is 49% of the data packages.

The following sections evaluate and describe the sampling design versus field implementation. All discrepancies between the sampling and analysis requirements outlined in the 300 FF-5 SAP (DOE/RL-2014-42) and Addendum (DOE/RL-2014-42-ADD1) and what was actually performed are identified. Data verification is performed for field QC and laboratory QC samples.

2.2 Field Quality Control

The results of the field blanks, field duplicates, and field splits are discussed below. Results discussed below were evaluated to field QC acceptance criteria requirements specified for water samples as identified in the 300-FF-5 SAP (DOE/RL-2014-42).

2.2.1 Field Blanks

FTB samples are analyzed to determine if positive results may be attributed to contaminants introduced as a result of field conditions. Any analyte measured above the laboratory detection limit is evaluated for potential impacts to associated sample results.

A total of 209 FTB and 125 EB samples were collected in association with groundwater sampling. Approximately 890 groundwater samples were collected, thus satisfying the FTB frequency criteria of 1 per 20 samples as required for water samples. All blank results were reported as not detected or less than the quantitation limit and flagged with a “U” or “B” qualifier from the laboratory, except for the constituents listed in Table 8. The concentration of blank sample constituents in Table 8 were compared to the concentrations in regular samples in the same associated sample delivery groups. The following constituents had concentrations greater than 5% of the minimum concentration of a regular sample, indicating there is possible high bias in samples: alkalinity, bicarbonate alkalinity, iron, manganese, nitrate, phosphorus, phosphate, and uranium.

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Table 8. Percent of Maximum EB or FTB Sample Concentration Compared to the Minimum and Maximum Concentration of Regular Samples (µg/L)

Constituent	Concentration of EB Samples			Concentration of FTB Samples			Concentration of Regular Samples				% of Detected Blank Results Compared to the Total Blank Results
	Min	Max	Detected Above the Quantitation Limit	Min	Max	Detected Above the Quantitation Limit	Min	Max	% of Max EB or FTB Concentration in Min	% of Max EB or FTB Concentration in Max	
Alkalinity	10,000	168,000	B3MN75, B3M902	52,000	52,000	B3KVB4	106,000	3,440,000	158.49	4.88	3.06
Bicarbonate alkalinity	10,000	168,000	B3MN75, B3M902	52,000	52,000	B3KVB4	106,000	3,440,000	158.49	4.88	5.45
Calcium	--	--	--	311	311	B3KN65	23,900	55,200	1.3	43.3	0.52
Iron	140	145	B3J4X3, B3C0C7	154	154	B3L3D1	87	111	177.01	138.74	1.57
Manganese	2.6	3	B392X6, B392Y0	1.3	7.2	B3LNX5, B3KT06, B3KMP5	1.1	120	654.55	6	2.84
Nitrate	230	1,230	B3R011, B3P7T9, B3P7Y9, B3LB92, B3HNM2, 3FKM6, B39TF6	620	620	B3M240	1,150	128,000	106.96	0.96	8.16
Phosphorus	--	--	--	349	349	B3KN27	90	2,000,000	387.78	0.02	0.67
Phosphate	2090	2090	B3LP06	552	7360	B3M252, B3L474, B3L0T6, B3KXT0, B3KXN3, B3KXC8, B3KPB0, B3KNN5, B3KM72	491	9,810,000	1,498.98	0.08	10.2
Sodium	--	--	--	461	461	B3KN27	15,000	2,200,000	3.07	0.68	0.52
Uranium	0.1	16	B3NMJ3, B3HNM4, B3HNM0	--	--	--	1.8	3,600	888.89	0.44	1.57

-- = not applicable or no data
EB = equipment rinsate blank
FTB = full trip blank

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Positive results in water blanks for alkalinity are common due to carbon dioxide adsorption and do not indicate a contamination or bias issue. Because of this, lab blanks are not required by the method, and labs have stopped running them. It is recommended that the alkalinity measurement be eliminated from future field blank measurements because the blank results do not add value in the evaluation of method performance.

Three blank sample results for iron had concentrations greater than 5% of regular samples; however, iron is a common laboratory contaminant and its contamination impact is not conclusive.

The percent of detected blank results for nitrate and phosphate compared to the total number of blanks for those constituents is about 8% and 10%, respectively. For these constituents, it is not uncommon to see influence of carryover from more concentrated samples previously analyzed in the following batch of samples analyzed. One of the 10 phosphate blank results (B3KXC8) has a "C" qualifier indicating the analyte was detected in both the field blank sample and laboratory QC blank result, and the lab QC blank is higher the 5% of the sample concentration.

2.2.2 Field Duplicates

Evaluation of the sample/FUP pairs can only be performed accurately when there is sufficient constituent present to be quantified. Therefore, only RPDs where at least one of the samples in the pair was detected above the practical quantitation limit were evaluated.

A total of 1,270 FUP constituent pairs from about 63 duplicate samples, yielding 2,540 results, were evaluated. The sampling frequency requirement for FUPs was met. Forty-four constituent pairs for a total of 1.7% of all results for duplicate samples met the evaluation criterion where at least one of the samples was detected above the practical quantitation limit and had an RPD greater than 20%, exceeding the requirement for water samples. Constituents exceeding RPD acceptance criteria requirements include arsenic, iron, manganese, phosphorus, potassium, sodium, uranium, chloride, nitrate, phosphate, and sulfate. The following summarizes the results for the constituent groundwater FUP pairs meeting evaluation criterion and exceeding acceptance criterion.

- From well 399-1-147, the sample pair (B3KRM7 and B3KRM8) results for nitrate exceeded the QC limits with an RPD of 30.9%.
- From well 399-1-148, the sample pair (B3KTN0 and B3KTN1) results for iron exceeded the QC limits with an RPD of 32.6%. Sample pair (B3M1T2 and B3M247) results for iron and manganese exceeded the QC limits with RPDs of 65.6% and 48.8%, respectively. Sample pair (B3KTN4 and B3KTN5) results for phosphorus, potassium, and sodium exceeded the QC limits with RPDs of 67.1%, 73.3%, and 72.7%, respectively. Sample pair (B3KTN2 and B3KTN3) results for phosphate exceeded the QC limits with an RPD of 24.3%. All results for samples B3M1T2 and B3M247 had the "R" data user-applied flag, and samples B3KTN2 and B3KTN3 results for phosphate had the data user-applied flag "H."
- From well 399-1-149, the sample pair (B3KPW3 and B3KPW4) results for iron exceeded the QC limits with an RPD of 74.3%.
- From well 399-1-150, the sample pair (B3KY07 and B3KY08) results for arsenic, manganese, phosphorus, potassium, and sodium exceeded the QC limits with RPDs of 104.2%, 125.2%, 192.4%, 192.28%, and 192.31%, respectively. Sample pair (B3KY05 and B3KY06) results for nitrate exceeded the QC limits with an RPD of 198.4%, and sample pair (B3KYV9 and B3KYW0) results for phosphate exceeded the QC limits with an RPD of 196.0%. All results for sample B3KY07 and

B3KY05 had the "Y" data user-applied flag and the sample B3KYV9 result for phosphate had the data user-applied flags "HR."

- From well 399-1-154, the sample pair (B3M102 and B3M226) results for iron, manganese, and phosphorus exceeded the QC limits with RPDs of 161.0%, 33.7%, and 25.7%, respectively. All four of these results had the "R" data user-applied flag.
- From well 399-1-155, the sample pair (B3L353 and B3L354) results for sulfate exceeded the QC limits with an RPD of 23.0%.
- From well 399-1-157, the sample pair (B3KR05 and B3KR06) results for chloride, nitrate, phosphate, and sulfate exceeded the QC limits with a RPDs of 152.0%, 170.2%, 198.4%, and 134%, respectively. All of these results for B3KR05 and the chloride result for B3KR06 had the "Y" data user-applied flag.
- From well 399-1-162, the sample pair (B3KTY2 and B3KTY3) results for nitrate and phosphate exceeded the QC limits with RPDs of 110.0% and 105.7%, respectively. All four of these results had the "H" data user-applied flag, and the nitrate result for B3KTY2 also had the "Y" data user-applied flag.
- From well 399-1-166, the sample pair (B3KM54 and B3KM55) results for manganese exceeded the QC limits with an RPD of 63.6%, and sample pair (B3M1X3 and B3M255) results for phosphate exceeded the QC limits with an RPD of 109.6%. The result for sample B3M1X3 had the "A," and the result for sample B3M255 had the "Y' data user-applied flag.
- From well 399-1-16A, the sample pair (B392V1 and B392V2) results for uranium exceeded the QC limits with an RPD of 24.9%. Both results had the "Q" data user-applied flag.
- From well 399-1-17A, the sample pair (B3KND3 and B3KND4) results for manganese exceeded the QC limits with an RPD of 72.1%.
- From well 399-1-23, the sample pair (B3L0B5 and B3L0B6) results for chloride, nitrate, and sulfate exceeded the QC limits with RPDs of 70.3%, 66.7%, and 66.7%, respectively. The sample pair (B3KXW3 and B3KXW4) results for iron exceeded the QC limits with an RPD of 90.3%, and sample pair (B3KVD2 and B3KVD3) results for uranium exceeded the QC limits with an RPD of 27.5%. All results for B3L0B5 had the "Y' data user-applied flag.
- From well 399-1-55, the sample pair (B3LB80 and B3LB81) results for manganese exceeded the QC limits with an RPD of 61.9%.
- From well 399-1-7, the sample pair (B3KPF8, B3KPF9, B3KY93, B3KY94, B3M1D7, and B3M234) results for phosphate exceeded the QC limits with RPDs of 177.9%, 23.6%, and 33.1%, respectively. The result for sample B3KPF9 had the "Y" data user-applied flag.
- From well 399-1-72, the sample pair (B3KMN1 and B3KMN2) results for chloride, nitrate, phosphate, and sulfate exceeded the QC limits with RPDs of 184.6%, 190.9%, 195.9%, and 196.0%, respectively. All results for sample B3KMN1 had the "Y" data user-applied flag, and results for nitrate and phosphate also had the "H" flag. The sample B3KMN2 phosphate result had the "H" data user-applied flag, and the nitrate result had the "HG" flags.
- From well 399-2-2, the sample pair (B39TJ7 and B39TJ8) results for phosphate exceeded the QC limits with an RPD of 21.1%.

2.2.3 Field Splits

No field split samples were collected for this data set. Field split samples are only required when needed.

2.3 Laboratory Quality Control

Laboratory contamination, precision, and accuracy were evaluated to laboratory QC acceptance criteria requirements specified in the 300-FF-5 SAP (DOE/RL-2014-42) for water samples. Results are discussed below.

2.3.1 Laboratory Contamination

CH2M HILL Plateau Remediation Company laboratory contracts require that laboratory MBs be analyzed with each batch of up to 20 samples.

A total of 7,901 laboratory blank results were evaluated for groundwater samples. All blank results were reported as not detected or less than the quantitation limit and flagged with a "U" or "B" qualifier from the laboratory, except for 31 results including alkalinity, bicarbonate alkalinity, iron, manganese, phosphate, potassium, and uranium. Of the 31 results, only 10 were at levels greater than 5%, the lowest sample result and exceeding the acceptance criterion. The 10 blank results exceeding the QC limit included one phosphate, six iron, and three manganese results, for a total 0.13% of all blank results.

2.3.2 Laboratory Precision

Laboratory precision is determined by the difference between duplicate sample pair results or between MS/MSD sample results. For this dataset, spike duplicates are used for metals, duplicates are used for anions and alkalinity, and laboratory control sample duplicates (LCSD) are used for metals, anions, and alkalinity.

For groundwater samples, a total of 1,388 duplicate pairs, 2,943 MS/MSD pairs, and 91 LCS/LCSD pairs were evaluated. There were nine duplicate sample pair results exceeding the 20% RPD criterion required for water samples. The impacted constituents include a chloride pair result at 68% RPD, two sulfate pairs at 94% and 68% RPD, and six phosphate pairs at 24%, 23%, 24%, 71%, 118%, and 22% RPDs. There were five MS/MSD pair results exceeding the acceptance criterion, including three iron pairs at 53%, 29%, and 27.5% RPDs, one manganese pair at 37.1% RPD, and one potassium pair at 26.1% RPD. Including the 14% RPD pair results exceeding the acceptance criterion, the precision data represents an overall QC acceptance rate of 99.68%.

2.3.3 Laboratory Accuracy

Two types of QC were used to assess accuracy for this DUA, the LCS, and the MS. The LCS is used to assess the accuracy of the laboratory preparation and analysis processes. The MS samples are used to assess the accuracy of the published method on the sample matrix and evaluate matrix effects that may bias the data.

A total of 8,213 LCS results were evaluated for groundwater samples. All but one LCS recovery result, at 136% recovery for iron, satisfied the 300-FF-5 SAP (DOE/RL-2014-42) QC requirement criteria.

2.3.3.1 Matrix Spike Recovery

MS recovery is also used as a measure of analytical accuracy. A total of 3,989 MS recovery results were evaluated for groundwater samples. Of these, 57 results met the evaluation criteria and exceeded acceptance criteria required as identified in 300-FF-5 SAP (DOE/RL-2014-42). The 57 exceedances include the following results: 1 for calcium, 3 for chloride, 7 for iron, 7 for magnesium, 13 for nitrate, 14 for phosphate, 2 for potassium, 4 for sodium, 2 for sulfate, and 4 uranium results for a total of 1.4% of

all MS recovery results. Of the 57, 4 MS recovery results for magnesium (samples B3LJ42, B3LJ58, B3LJ62, and B3L5K6) at one laboratory were not calculated for accuracy and precision due to high concentrations of potassium, sodium, and phosphorus requiring higher than usual dilutions of metals analysis which indicate these failures were caused by a sample matrix issue and not a laboratory QC issue. Nondetected constituent values associated with those elevated dilutions are likely biased low. At a different laboratory, 16 of the 57 MS recovery results failures at 0% recovery including 1 for chloride (B3L0T6), 1 for phosphate (B3L0T6), 2 for sulfate (B3L0T6 and B3L5J3), and 12 for nitrate (B3KMC2, B3KMJ6, B3L0T6, B3L582, B3L590, B3L596, B3L5J3, B3L5K5, B3L5K7, B3L5K9, B3LJ17, and B3LJ73) were likely due to instrument or other laboratory error. For analysis of nitrate and phosphate, the laboratory's instrument software was not identifying the peaks for the constituents, causing errors in the final result values. Nondetected constituent values associated with the failures are likely biased low.

3 Data Validation

Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond method or contractual compliance (i.e., data verification) to determine the analytical quality of a specific dataset, typically data in single analytical batches. Data validation is an independent assessment to ensure the reliability of data are known by the user. Analytical data validation provides a level of assurance, based on technical evaluation, that an analyte is either present or absent. Validation might include verification of required deliverables (e.g., the minimum detection limits), verification of instrument calibrations, evaluation of analytical results based on MBs, recovery of various internal standards, correctness of uncertainty calculations, the identification and quantification of analytes, and the effect of quality deficiencies on the analytical sample data. Third-party validation was performed at about 5% for the metals and alkalinity analytes and at about 4.1% for the anions of project data associated with the 330-FF-5 SAP Addendum and is described in Chapter 3.

3.1 Data Validation Reports

Data validation was performed by Analytical Quality Associates, Inc. of Albuquerque, New Mexico. All validation qualifiers resulting from data validation were entered into the HEIS database.

3.2 Data Validation Results

The 300-FF-5 SAP (DOE/RL-2014-42) specifies that data validation activities will be performed at the discretion of the OU project manager and under the direction of Sample Management and Reporting. Typically, at least 5% (by matrix and analyte group) of all chemical data must undergo Level C data validation. Level C data validation includes the evaluation and qualification of sample results based on the following:

- MS, LCS, laboratory duplicate, and chemical and surrogate recovery criteria (as appropriate to the method).
- Full trip blanks, field duplicates, and field splits (if information is provided) are examined. Full trip blank samples were not included in the sample count to determine percent validated.
- No other validation or calculation checks are performed.

Table 9 summarizes the constituents that were independently validated for the 300-FF-5 OU. Table 9 shows 4.9% of the data were validated for the metals analytes, 4.1% of the data were validated for the anions (nitrate, phosphate, chloride, and sulfate) analytes, and 5.3% of the data were validated for the alkalinity analytes.

Table 9. Validated Sample Summary for Water Samples

Analyte	Total Number of Samples Analyzed	Total Number of Samples Validated	Percent Validated	Average Percent Validated by Analysis Method
Uranium	1,765	84	4.8	4.9 (EPA 6010 or 6020)
Arsenic	1,665	84	5.0	
Calcium	1,767	84	4.8	
Iron	1,767	84	4.8	
Magnesium	1,767	84	4.8	
Manganese	1,665	84	5.0	
Phosphorus	1,399	78	5.7	
Potassium	1,767	84	4.8	
Sodium	1,767	84	4.8	
Nitrate	902	37	4.1	4.1 (EPA 300.0 or 9056)
Phosphate	902	37	4.1	
Chloride	902	37	4.1	
Sulfate	902	37	4.1	
Alkalinity	902	48	5.3	5.3 (EPA 310.1 or SM 2320)
Bicarbonate alkalinity	902	48	5.3	
Carbonate alkalinity	902	48	5.3	

Notes: Complete reference citations are provided in Chapter 6.

For EPA Method 300.0, see EPA/600/R-93/100. For EPA Method 310.1, see EPA/600/4-79/020. For four-digit EPA methods, see the SW-846. For Standard Method 2320, see APHA/AWWA/WEF.

EPA = U.S. Environmental Protection Agency

SM = standard method

3.2.1 Major Deficiencies

A major deficiency results in qualification of sample data as unusable for decision-making purposes. Samples that were rejected are listed in Table 10 and Appendix A.

Table 10. Summary of Data Validation Qualification Flags for Water Samples

Method/Analyte(s)	Qualifier*	Affected Samples	Reason
Inorganics (EPA Method 6010 ICP-AES Metals)			
Phosphorus	J+	B3KMR9, B3KMT3, B3KMP5, B3KMN8, B3KMP6, B3KMN9	Laboratory blank contamination
Sodium	J+	B3KMP5, B3KMN8	Laboratory blank contamination
Potassium	J+	B3KR63, B3KR59	Laboratory blank contamination

Table 10. Summary of Data Validation Qualification Flags for Water Samples

Method/Analyte(s)	Qualifier*	Affected Samples	Reason
Inorganics (EPA Method 300 Anions)			
Phosphate	UR	B3KVJ5, B3KVB6, B3KVC6, B3KVC2	Analysis beyond 2x the holding time
Phosphate	R	B3KVD0, B3KVJ0, B3KV85, B3KV86, B3KVH2, B3KVH6, B3KVF3, B3KV75, B3KVK2, B3KV91, B3KVK6, B3KVL0, B3KVB7, B3KVL5, B3KVD7, B3KVD8, B3KVF7, B3KVL7, B3KVJ6	Analysis beyond 2x the holding time
Nitrate	UR	B3KVJ5, B3KVB6, B3KV75	Analysis beyond but within 2x the holding time
Nitrate	J-	B3KVK2, B3KV91, B3KVD0, B3KVJ6, B3KVJ0, B3KV85, B3KV86, B3KVH2, B3KVH6, B3KVF3, B3KVC6, B3KVK6, B3KVL0, B3KVB7, B3KVL5, B3KVC2, B3KVD7, B3KVD8, B3KVF7, B3KVL7	Analysis beyond but within 2x the holding time
Inorganics (EPA Method 6010 ICP-AES Metals)			
Potassium	J+	B3M8X1, B3M8W5, B3M8X2, B3M8W6, B3M931, B3M929	Laboratory blank contamination
Inorganics (EPA Method 6020 ICP/MS Metals)			
Arsenic	J+	B3M8Y1, B3M8Y2, B3M938, B3M8T3, B3M8X1, B3M8W5, B3M8X2, B3M8W6, B3M963, B3M961, B3M931, B3M929, B3M8Y6, B3M8Y4, B3M8T4, B3M939, B3M919, B3M915, B3M8X7	Laboratory blank contamination
Inorganics (EPA Method 300 Anions)			
Phosphate, nitrate	UR	B3P2H5	Analysis beyond the holding time but within 2x the holding time
Phosphate, nitrate	J	B3P2H9, B3N7X1, B3N850, B3N841	Analysis beyond the holding time but within 2x the holding time

Notes: For EPA Method 300.0, see EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*.

For four-digit EPA methods, see the SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium.*

*Qualifiers are defined in Section 1.4.4.1.

EPA = U.S. Environmental Protection Agency

ICP-AES = inductively coupled plasma-atomic emission spectroscopy

ICP/MS = inductively couples plasma/mass spectrometry

3.2.2 Minor Deficiencies

A minor deficiency results in qualification of sample data as an estimate; however, the data are considered usable for decision-making purposes.

In the water samples, minor deficiencies (due to contamination in the blank) led 6 phosphorus, 2 sodium, 8 potassium, and 19 arsenic results being qualified as estimates and flagged "J+." A minor deficiency (analysis outside the hold time but within two times the hold time) led to the nitrate results for 20 samples being qualified as estimates and flagged "J-." Also, minor deficiencies (analysis outside the hold time but within two times the hold time) in four phosphate and four nitrate samples led to these being qualified with the "J" flag.

3.2.3 Qualification Flags Applied to the Data Set

Table 10 lists the qualification flags applied to the data set as a result of the data validation process.

3.2.3.1 Holding Times and Sample Preservation

Holding times are defined as the period of time from sample collection to sample analysis or extraction, and the period of time from sample extraction to sample analysis. Holding times are calculated from the date of sample collection as recorded on the chain-of-custody form to determine the validity of the results.

3.2.3.1.1 Inorganics. The holding time requirements for inductively coupled plasma-atomic emission spectroscopy and inductively couples plasma/mass spectrometry metals are analysis within 180 days of sample collection for water samples.
All samples were properly preserved and analyzed within the prescribed holding times.

3.2.3.1.2 General Chemistry. The holding time requirements for general chemistry parameters are as follows:

- Nitrate and phosphate anions require analysis within 48 hours, while chloride and sulfate anions require analysis within 28 days of sample collection for water samples.
- Alkalinity requires analysis within 14 days of sample collection.

All samples were properly preserved; however, there were 521 instances of constituents analyzed beyond the prescribed holding times. All of the 521 results had the data user-applied flag "H." These include 2 chloride, 200 nitrate, 263 phosphorus in phosphate, 2 sulfate, 18 total alkalinity, 18 bicarbonate alkalinity, and 18 carbonate alkalinity results. All of the chloride, sulfate, total alkalinity, bicarbonate, and carbonate alkalinity results were analyzed within two times the holding time. A total of 175 results for a total of 0.81% (including 48 nitrate results and 127 phosphate results) were analyzed beyond two times the holding time. Of the 175 results analyzed beyond two times the holding time, nitrate samples B3KRP6 and B3KT36 had the data user-applied flag "R," samples B3K808 and B3KMN2 had the data user-applied flag "G," and samples B3KRW6, B3L132, and B3KRX0 had the data user-applied flag "Y," in addition to the "H" flag. For phosphate analytes analyzed beyond two times the holding time, samples B3K808 and B3PYX0 had the data user-applied flag "G," sample B3NXC4 had the data user-applied flag "Q," and samples B3KVC2, B3KVC6, B3KV75, B3KV86, B3KV91, B3KVB7, B3KVD0, B3KVD8, B3KVF3, B3KVF7, B3KVH2, B3KVH6, B3KVJ0, B3KVJ6, B3KVK2, B3KVK6, B3KVL0, B3KVL5, and B3KVL7 had the data user-applied flags "RA," in addition to the "H" flag.

4 Data Quality Indicator Evaluation

The DQI evaluation process is used to assess data usability for nonstatistical (judgmental) sampling designs. Data verification and data validation reports were reviewed to determine the usability of the dataset as a whole and the quality of individual results as appropriate in terms of the following DQIs:

- **Precision**: Describes the repeatability of field duplicate data and laboratory QC duplicates (e.g., RPDs of laboratory sample duplicates, LCS duplicates, and MS/MSD pairs).
- **Accuracy/Bias**: Discuss evidence of field contamination and laboratory QC (e.g., percent recoveries of LCSs and MSs).
- **Representativeness**: Discuss the extent to which the sampling design was accomplished and the representativeness of the samples and the design as a whole. Identify any specific measurements not representative of the target condition, explain why they are nonrepresentative, and discuss the impact to the data set.
- **Comparability**: If multiple laboratories were used or if this data set is intended to be combined with others, discuss the nature of differences that may limit the comparability. For example, note that samples were analyzed using recognized standard methods. If multiple laboratories analyzed field QC split samples, discuss how closely the results agreed between the two laboratories.
- **Completeness**: Discuss the accomplishment of all SAP-required data generating activities. Include a comparison of samples actually collected versus samples identified in the original sampling design. Include required field QC blanks, duplicates, and splits in the comparison. Also, compare the analyses performed to the analyses identified in the SAP. Comment on the impact to data set usability of any planned samples that were not taken or analyses not performed.
- **Sensitivity**: Discuss any laboratory data that do not meet the SAP-required reporting limits and other decision thresholds as described in the project data quality objectives.

4.1 Data Quality Indicator Evaluation Results

The DQI evaluation step involves assessing whether the samples collected and the resulting analytical data meet project quality objectives in terms of the DQIs described above. The data verification acceptance rates discussed below are based on the evaluation of QC performance compared to the SAP requirements for the entire data set. Validation acceptance rates are based on the data determined to be valid (i.e., not rejected) in the validated dataset.

4.1.1 Precision

Laboratory precision is determined by the difference between duplicate sample pair results or between MS/MSD sample results.

For water samples, data verification results showed an overall precision QC acceptance rate of 99.68% based on precision. The iron and manganese results for sample B3M0X1, associated with RPD exceedances, had the data user-applied flag “R.”

4.1.2 Accuracy/Bias

Laboratory accuracy was assessed for this DUA by using two types of QC: the LCS and the MS. These QC types are used to determine the accuracy of the laboratory preparation and analysis process and to evaluate matrix effects that may bias the data.

For water, data verification results showed an overall accuracy QC acceptance rate of about 98.57% based on MS recovery (57 failures of 3,989 MS results). Of the 57, four MS recovery results for magnesium (samples B3LJ42, B3LJ58, B3LJ62, and B3L5K6) at one laboratory were not calculated for accuracy and precision due to high concentrations of potassium, sodium, and phosphorus requiring higher-than-usual dilutions of metals analysis, which indicate these failures were caused by a sample matrix issue and not a laboratory QC issue. Non-detected constituent values associated with those elevated dilutions are likely biased low. At a different laboratory, 16 of the 57 MS recovery results failed at 0% recovery, including 1 for chloride (B3L0T6), 1 for phosphate (B3L0T6), 2 for sulfate (B3L0T6 and B3L5J3), and 12 for nitrate (B3KMC2, B3KMJ6, B3L0T6, B3L582, B3L590, B3L596, B3L5J3, B3L5K5, B3L5K7, B3L5K9, B3LJ17, and B3LJ73). These were likely due to instrument or other laboratory error. For analysis of nitrate and phosphate, the laboratory's instrument software was not identifying the peaks for the constituents, causing errors in the final result values. Nondetected constituent values associated with the failures are likely biased low. The iron result for sample B3M0X1 and the nitrate result for sample B3KMJ6, associated with accuracy failures, had the data user-applied flag "R."

All but 1 (LCS result for iron at 136% recovery) of 8,213 LCS recoveries satisfied the QC criteria.

4.1.3 Representativeness

In general, the sampling design was accomplished as identified in Table 2. A few issues were observed with accuracy and precision, leading to one iron and manganese result for sample B3M0X1 being rejected and one nitrate result for B3KMJ6 also being rejected, but no systemic issues were observed.

A summary of rejected results by analyte with the application of "R" qualifiers resulting from the Request for Data Review process are provided in Table 11. For a list of samples with rejected results and "R" data user-applied flags, see Appendix A. A total of 334 metal results were flagged with the "R" flag due to high turbidity in samples because the associated wells did not have sufficient water to collect a representative sample. About 122 results associated with anions had the "R" flag applied. Of these instances, 30 of the results associated with anions had the "R" flag applied because the analysis holding time was exceeded. These include 8 nitrate and 22 phosphate results, and the phosphate results are possibly biased low. These nitrate and phosphate results should be considered usable for determining the short-term impact to local groundwater chemistry. Associated data for all samples except the rejected values are valid for decision-making purposes. Rejected phosphate data can also be alternatively acquired from phosphorus results, thus reducing the impact of rejected phosphate data for usability. All the other samples were analyzed within the holding time. In addition, 71 results were impacted by high turbidity caused by collecting samples from wells with insufficient water, 17 results were impacted by an isolated laboratory instrument issue not correctly identifying peaks, and another 4 results were impacted by laboratory high sample dilution or other data issues. About 82 results associated with alkalinity analyses had the "R" flag applied. Of the 82 results, 54 results were impacted by the high turbidity issue caused by insufficient water in wells, and the other 28 results were "R" flagged due to elevated nondetect results of carbonate alkalinity caused by laboratory reducing sample volume or diluting the sample because of the high total alkalinity concentration in samples. Carbonate alkalinity is a calculated result value and an artifact of the analysis method that is typically reported, even if the analyte is not present in the sample. Therefore, the carbonate alkalinity results flagged "R" do not negatively impact the usability of the data. Combined, the 538 results summarized in Table 11 make up about 2.5% of the total analytical laboratory results.

Table 11. Summary of Water Samples with "R" Data Review Qualification Flags

Method/Analyte(s)	Qualifier*	Number of Affected Samples
Inorganics (EPA Method 6010 ICP-AES Metals)		
Calcium	R	37
Iron	R	37
Magnesium	R	37
Phosphorus	R	38
Potassium	R	37
Sodium	R	37
Inorganics (EPA Method 6020 ICP/MS Metals)		
Arsenic	R	37
Manganese	R	37
Uranium	R	37
Wet Chemistry (EPA Method 300.0 – Anions)		
Chloride	R	18
Nitrate	R	38
Phosphate	R	18
Sulfate	R	18
Nitrate	HR	7
Phosphate	HR	3
Nitrate	RAH	1
Phosphate	RAH	19
Inorganics (SM 2320 Alkalinity or EPA Method 310.1)		
Alkalinity	R	18
Bicarbonate alkalinity	R	18
Carbonate alkalinity	R	46

Notes: Complete reference citations are provided in Chapter 6.

For EPA Method 300.0, see EPA/600/R-93/100. For EPA Method 310.1, see EPA/600/4-79/020. For four-digit EPA methods, see the SW-846. For SM 2320, see APHA/AWWA/WEF, .

*Qualifiers are defined in Section 1.4.4.1.

EPA = U.S. Environmental Protection Agency
ICP-AES = inductively coupled plasma-atomic emission spectroscopy
ICP/MS = inductively coupled plasma mass spectroscopy
SM = standard method

The data quality indicators show the data set to be representative and with no significant bias.

4.1.4 Comparability

To generate comparable samples, sampling was accomplished using the same procedures uniformly for field sampling. Five different laboratories were used to analyze the samples. Laboratory analyses were performed using industry-recognized standard procedures (Table 3) and generated comparable results.

4.1.5 Completeness

About 98.6% of water samples that were estimated to be collected in the 300-FF-5 SAP Addendum (DOE/RL-2014-42-ADD1) were collected successfully and analyzed for the target analytes identified. Of all analytical results, 2.5% had the "R" qualifier applied. which means it was not usable and approximately 96.0% of the data collected were usable.

4.1.5.1 Field Blanks

The 300-FF-5 SAP (DOE/RL-2014-42) FTB frequency requirement for groundwater samples is one per 20 samples, and based on this, the 209 FTBs out of 888 samples collected satisfy this criterion.

4.1.5.2 Field Duplicates

The DUP frequency requirement for groundwater sampling QC is one per 20 samples, and based on this, the approximate 63 DUP out of 888 samples collected satisfies this criterion.

4.1.5.3 Field Splits

As specified in the 300-FF-5 SAP for water samples, field splits are required as needed, and when needed, the frequency criterion of one sample per analytical method is required. No field split samples were collected for this data set.

4.1.6 Sensitivity

All water sample results were compared to the 300-FF-5 SAP (DOE/RL-2014-42) required highest allowable practical quantitation limits (HAPQLs) for water samples listed in Table 3. The review was done by confirming that all "U" flagged (analyzed but not detected) and "B" flagged (detected but below the lab practical quantitation limit) results were below the requirement. The analytes and potential impacts on the data for decision-making purposes are shown below.

For anions, 3 nitrate, 1 sulfate, and 26 phosphate results were above the respective HAPQLs. The three nitrate results (12,400 µg/L for B3L0P7 and B3L0T7, which were "U" flagged, and 13,700 µg/L for B3KP20, which was "B" flagged) above the HAPQL of 250 µg/L were due to high concentrations of phosphate and the samples required high dilutions (200 times). These nitrate results were significantly below the cleanup level of 45,000 µg/L and do not impact data usability. HAPQLs are directly influenced by the dilution factor (i.e., a dilution factor of two would cause the HAPQL to increase by two times). The sulfate result (37,000 µg/L of B3KMJ6, which was flagged "BD") above the HAPQL of 550 µg/L was due to the high concentration of phosphate and the sample required a high dilution (200 times). The 26 phosphate results were above the HAPQL due to either the sample matrix and high concentrations of nitrate, sulfate, and chloride or a laboratory issue of unit conversion that caused the lab to report elevated practical quantitation limits (PQLs). There are no clean up levels identified in the 300-FF-5 SAP (DOE/RL-2014-42) associated with sulfate or phosphate.

There were 79 calculated carbonate alkalinity results outside the HAPQL; however, the associated sample volumes were reduced for analysis due to the high concentration of the analyte. There are no clean up levels identified in the 300-FF-5 SAP (DOE/RL-2014-42) associated with carbonate alkalinity.

For metals, 40 calcium, 130 iron, 55 magnesium, 18 phosphorus, 45 potassium, 2 sodium, 65 arsenic, 102 manganese, and 4 uranium results were outside their respective HAPQLs. All of the associated samples were diluted due to the high concentration of potassium, sodium, and phosphorus. The four uranium sample results (19.2 µg/L for B3KY04, 20.2 µg/L for B3KY08, 19.6 µg/L for B3KYD3, and 19.3 µg/L for B3KYD5) that were above the HAPQL of 15 µg/L were also "BD" flagged and diluted 50 times. These are below the cleanup level of 30 µg/L for uranium and do not impact data usability. There are no cleanup levels identified in the 300-FF-5 SAP (DOE/RL-2014-42) associated with the other metals.

Results exceeding HAPQLs make up about 2.6% of all analytical results and were primarily caused by elevated levels of phosphate, potassium, sodium, phosphorus, and alkalinity in samples, which consequently lead the laboratories to dilute samples or use reduced sample volumes prior to performing analyses. These data do not negatively affect the purpose nor usability of the data.

5 Conclusions

Based on the results of this DUA, the sample set is sufficiently complete as there is a low overall degree of qualified data points. Given the high degree of acceptable data, the analytical results are considered usable for the intended purposes as indicated in Chapter 4. Samples were collected and analyzed as specified in the 300-FF-5 SAP (DOE/RL-2014-42) and addendum (DOE/RL-2014-42-ADD1). Sample results accurately indicate the presence or absence of target analytes.

Laboratory and matrix accuracy and precision were in control overall, and no systematic or general discrepancies were obvious. Sample results appear to be representative of site conditions at the time of collection. Results obtained are comparable to industry standards in that collection and analytical techniques followed approved and documented procedures (except as noted in this report and reflected in qualified data points). All results are reported in industry standard units.

Detection limits, precision, accuracy, and data completeness were evaluated to determine whether any analytical data should be rejected as a result of QA/QC deficiencies. The conclusions of this DUA are that the data that have been collected are of the right type, quality, and quantity for direct regulatory use for example and assessment of remediation systems.

Finally, analytical data package verification was performed on 49% of the data packages in accordance with the verification procedure and met the 300-FF-5 SAP (DOE/RL-2014-42) requirements. Data validation was performed on 4.8% of the analytical data and met the 300-FF-5 SAP (DOE/RL-2014-42) requirements. The data are suitable and usable for their intended purpose.

6 References

APHA/AWWA/WEF, 2017, *Standard Methods for the Examination of Water and Wastewater.* 23rd Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

DOE/RL-2014-42, 2015, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://pdw.hanford.gov/document/0079669H.

DOE/RL-2014-42-ADD1, 2016, *300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan Addendum for Stage B Uranium Sequestration*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: https://pdw.hanford.gov/document/0071642H.

Modified by:

TPA-CN-0828, 2018, *Tri-Party Agreement Change Notice Form: DOE/RL-2014-42-ADD1, 300-FF-5 Operable Unit Remedy Implementation Sampling and Analysis Plan Addendum for Stage B Uranium Sequestration*, *Rev. 0*, dated August 16, U.S. Department of Energy, Richland Operations Office, and U.S. Environmental Protection Agency, Richland, Washington. Available at: https://pdw.hanford.gov/document/0064831H.

EPA/240/R-02/004, 2002, G*uidance on Environmental Data Verification and Data Validation*, QA/G-8. Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/sites/production/files/2015-06/documents/g8-final.pdf.

EPA/600/4-79/020, 2002, *Methods for Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=NERL&dirEntryId=39602.

EPA/600/R-93/100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=30002U3P.txt.

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*, as updated, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/hw-sw846/sw-846-compendium.

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Appendix A

Water Samples with “R” Data Review Qualification Flags

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Contents

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Table

Table A-1. Water Samples with "R" Data Review Qualification Flags A-1

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A1 Introduction

Table A-1 is a list of 538 samples with rejected results and "R" data user-applied flags. The "R" data flag means do not use and further review indicates the result is not valid. From the 538 total, 334 metal results, 71 anion results, and 54 alkalinity results were flagged with the "R" flag due to high turbidity in samples because the associated wells did not have sufficient water to collect a representative sample.

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-12	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PYW3
399-1-146	SM 2320 Alkalinity	Alkalinity	R	B3M0W3
399-1-146	SM 2320 Alkalinity	Alkalinity	R	B3M1F9
399-1-146	SM 2320 Alkalinity	Alkalinity	R	B3M1R4
399-1-146	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M0W3
399-1-146	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1F9
399-1-146	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1R4
399-1-146	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M0W3
399-1-146	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1F9
399-1-146	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1R4
399-1-146	EPA 300.0 Anions	Chloride	R	B3M0W4
399-1-146	EPA 300.0 Anions	Chloride	R	B3M1H0
399-1-146	EPA 300.0 Anions	Chloride	R	B3M1R5
399-1-146	EPA 300.0 Anions	Nitrate	R	B3M0W4
399-1-146	EPA 300.0 Anions	Nitrate	R	B3M1H0
399-1-146	EPA 300.0 Anions	Nitrate	R	B3M1R5
399-1-146	EPA 300.0 Anions	Phosphate	R	B3M0W4
399-1-146	EPA 300.0 Anions	Phosphate	R	B3M1H0
399-1-146	EPA 300.0 Anions	Phosphate	R	B3M1R5
399-1-146	EPA 300.0 Anions	Sulfate	R	B3M0W4
399-1-146	EPA 300.0 Anions	Sulfate	R	B3M1H0
399-1-146	EPA 300.0 Anions	Sulfate	R	B3M1R5
399-1-146	EPA 6010 ICP-AES Metals	Calcium	R	B3M0W1
399-1-146	EPA 6010 ICP-AES Metals	Calcium	R	B3M0W5
399-1-146	EPA 6010 ICP-AES Metals	Calcium	R	B3M1F7
399-1-146	EPA 6010 ICP-AES Metals	Calcium	R	B3M1H1
399-1-146	EPA 6010 ICP-AES Metals	Calcium	R	B3M1R2

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-146	EPA 6010 ICP-AES Metals	Calcium	R	B3M1R6
399-1-146	EPA 6010 ICP-AES Metals	Iron	R	B3M0W1
399-1-146	EPA 6010 ICP-AES Metals	Iron	R	B3M0W5
399-1-146	EPA 6010 ICP-AES Metals	Iron	R	B3M1F7
399-1-146	EPA 6010 ICP-AES Metals	Iron	R	B3M1H1
399-1-146	EPA 6010 ICP-AES Metals	Iron	R	B3M1R2
399-1-146	EPA 6010 ICP-AES Metals	Iron	R	B3M1R6
399-1-146	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0W1
399-1-146	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0W5
399-1-146	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1F7
399-1-146	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1H1
399-1-146	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1R2
399-1-146	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1R6
399-1-146	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0W1
399-1-146	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0W5
399-1-146	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1F7
399-1-146	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1H1
399-1-146	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1R2
399-1-146	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1R6
399-1-146	EPA 6010 ICP-AES Metals	Potassium	R	B3M0W1
399-1-146	EPA 6010 ICP-AES Metals	Potassium	R	B3M0W5
399-1-146	EPA 6010 ICP-AES Metals	Potassium	R	B3M1F7
399-1-146	EPA 6010 ICP-AES Metals	Potassium	R	B3M1H1
399-1-146	EPA 6010 ICP-AES Metals	Potassium	R	B3M1R2
399-1-146	EPA 6010 ICP-AES Metals	Potassium	R	B3M1R6
399-1-146	EPA 6010 ICP-AES Metals	Sodium	R	B3M0W1
399-1-146	EPA 6010 ICP-AES Metals	Sodium	R	B3M0W5
399-1-146	EPA 6010 ICP-AES Metals	Sodium	R	B3M1F7
399-1-146	EPA 6010 ICP-AES Metals	Sodium	R	B3M1H1
399-1-146	EPA 6010 ICP-AES Metals	Sodium	R	B3M1R2
399-1-146	EPA 6010 ICP-AES Metals	Sodium	R	B3M1R6
399-1-146	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0W1

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-146	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0W5
399-1-146	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1F7
399-1-146	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1H1
399-1-146	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1R2
399-1-146	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1R6
399-1-146	EPA 6020 ICP/MS Metals	Manganese	R	B3M0W1
399-1-146	EPA 6020 ICP/MS Metals	Manganese	R	B3M0W5
399-1-146	EPA 6020 ICP/MS Metals	Manganese	R	B3M1F7
399-1-146	EPA 6020 ICP/MS Metals	Manganese	R	B3M1H1
399-1-146	EPA 6020 ICP/MS Metals	Manganese	R	B3M1R2
399-1-146	EPA 6020 ICP/MS Metals	Manganese	R	B3M1R6
399-1-146	EPA 6020 ICP/MS Metals	Uranium	R	B3M0W1
399-1-146	EPA 6020 ICP/MS Metals	Uranium	R	B3M0W5
399-1-146	EPA 6020 ICP/MS Metals	Uranium	R	B3M1F7
399-1-146	EPA 6020 ICP/MS Metals	Uranium	R	B3M1H1
399-1-146	EPA 6020 ICP/MS Metals	Uranium	R	B3M1R2
399-1-146	EPA 6020 ICP/MS Metals	Uranium	R	B3M1R6
399-1-147	EPA 300.0 Anions	Chloride	R	B3M0W8
399-1-147	EPA 300.0 Anions	Chloride	R	B3M1H4
399-1-147	EPA 300.0 Anions	Chloride	R	B3M1R9
399-1-147	EPA 300.0 Anions	Nitrate	R	B3KPJ6
399-1-147	EPA 300.0 Anions	Nitrate	R	B3KPV0
399-1-147	EPA 300.0 Anions	Nitrate	R	B3M0W8
399-1-147	EPA 300.0 Anions	Nitrate	R	B3M1H4
399-1-147	EPA 300.0 Anions	Nitrate	R	B3M1R9
399-1-147	EPA 300.0 Anions	Phosphate	R	B3M0W8
399-1-147	EPA 300.0 Anions	Phosphate	R	B3M1H4
399-1-147	EPA 300.0 Anions	Phosphate	R	B3M1R9
399-1-147	EPA 300.0 Anions	Sulfate	R	B3M0W8
399-1-147	EPA 300.0 Anions	Sulfate	R	B3M1H4
399-1-147	EPA 300.0 Anions	Sulfate	R	B3M1R9
399-1-147	EPA 310.1 Alkalinity	Alkalinity	R	B3M0W7

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-147	EPA 310.1 Alkalinity	Alkalinity	R	B3M1H3
399-1-147	EPA 310.1 Alkalinity	Alkalinity	R	B3M1R8
399-1-147	EPA 310.1 Alkalinity	Bicarbonate alkalinity	R	B3M0W7
399-1-147	EPA 310.1 Alkalinity	Bicarbonate alkalinity	R	B3M1H3
399-1-147	EPA 310.1 Alkalinity	Bicarbonate alkalinity	R	B3M1R8
399-1-147	EPA 310.1 Alkalinity	Carbonate alkalinity	R	B3KPT9
399-1-147	EPA 310.1 Alkalinity	Carbonate alkalinity	R	B3M0W7
399-1-147	EPA 310.1 Alkalinity	Carbonate alkalinity	R	B3M1H3
399-1-147	EPA 310.1 Alkalinity	Carbonate alkalinity	R	B3M1R8
399-1-147	EPA 6010 ICP-AES Metals	Calcium	R	B3M0W7
399-1-147	EPA 6010 ICP-AES Metals	Calcium	R	B3M0W9
399-1-147	EPA 6010 ICP-AES Metals	Calcium	R	B3M1H3
399-1-147	EPA 6010 ICP-AES Metals	Calcium	R	B3M1H5
399-1-147	EPA 6010 ICP-AES Metals	Calcium	R	B3M1R8
399-1-147	EPA 6010 ICP-AES Metals	Calcium	R	B3M1T0
399-1-147	EPA 6010 ICP-AES Metals	Iron	R	B3M0W7
399-1-147	EPA 6010 ICP-AES Metals	Iron	R	B3M0W9
399-1-147	EPA 6010 ICP-AES Metals	Iron	R	B3M1H3
399-1-147	EPA 6010 ICP-AES Metals	Iron	R	B3M1H5
399-1-147	EPA 6010 ICP-AES Metals	Iron	R	B3M1R8
399-1-147	EPA 6010 ICP-AES Metals	Iron	R	B3M1T0
399-1-147	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0W7
399-1-147	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0W9
399-1-147	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1H3
399-1-147	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1H5
399-1-147	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1R8
399-1-147	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1T0
399-1-147	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0W7
399-1-147	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0W9
399-1-147	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1H3
399-1-147	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1H5
399-1-147	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1R8

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-147	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1T0
399-1-147	EPA 6010 ICP-AES Metals	Potassium	R	B3M0W7
399-1-147	EPA 6010 ICP-AES Metals	Potassium	R	B3M0W9
399-1-147	EPA 6010 ICP-AES Metals	Potassium	R	B3M1H3
399-1-147	EPA 6010 ICP-AES Metals	Potassium	R	B3M1H5
399-1-147	EPA 6010 ICP-AES Metals	Potassium	R	B3M1R8
399-1-147	EPA 6010 ICP-AES Metals	Potassium	R	B3M1T0
399-1-147	EPA 6010 ICP-AES Metals	Sodium	R	B3M0W7
399-1-147	EPA 6010 ICP-AES Metals	Sodium	R	B3M0W9
399-1-147	EPA 6010 ICP-AES Metals	Sodium	R	B3M1H3
399-1-147	EPA 6010 ICP-AES Metals	Sodium	R	B3M1H5
399-1-147	EPA 6010 ICP-AES Metals	Sodium	R	B3M1R8
399-1-147	EPA 6010 ICP-AES Metals	Sodium	R	B3M1T0
399-1-147	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0W7
399-1-147	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0W9
399-1-147	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1H3
399-1-147	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1H5
399-1-147	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1R8
399-1-147	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1T0
399-1-147	EPA 6020 ICP/MS Metals	Manganese	R	B3M0W7
399-1-147	EPA 6020 ICP/MS Metals	Manganese	R	B3M0W9
399-1-147	EPA 6020 ICP/MS Metals	Manganese	R	B3M1H3
399-1-147	EPA 6020 ICP/MS Metals	Manganese	R	B3M1H5
399-1-147	EPA 6020 ICP/MS Metals	Manganese	R	B3M1R8
399-1-147	EPA 6020 ICP/MS Metals	Manganese	R	B3M1T0
399-1-147	EPA 6020 ICP/MS Metals	Uranium	R	B3M0W7
399-1-147	EPA 6020 ICP/MS Metals	Uranium	R	B3M0W9
399-1-147	EPA 6020 ICP/MS Metals	Uranium	R	B3M1H3
399-1-147	EPA 6020 ICP/MS Metals	Uranium	R	B3M1H5
399-1-147	EPA 6020 ICP/MS Metals	Uranium	R	B3M1R8
399-1-147	EPA 6020 ICP/MS Metals	Uranium	R	B3M1T0
399-1-148	SM 2320 Alkalinity	Alkalinity	R	B3M0X1

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-148	SM 2320 Alkalinity	Alkalinity	R	B3M1H7
399-1-148	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M0X1
399-1-148	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1H7
399-1-148	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M0X1
399-1-148	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1H7
399-1-148	EPA 300.0 Anions	Chloride	R	B3M0X2
399-1-148	EPA 300.0 Anions	Chloride	R	B3M1H8
399-1-148	EPA 300.0 Anions	Nitrate	HR	B3KT36
399-1-148	EPA 300.0 Anions	Nitrate	HR	B3KTN3
399-1-148	EPA 300.0 Anions	Nitrate	HR	B3KXJ0
399-1-148	EPA 300.0 Anions	Nitrate	R	B3KTV4
399-1-148	EPA 300.0 Anions	Nitrate	R	B3KXY5
399-1-148	EPA 300.0 Anions	Nitrate	R	B3M0X2
399-1-148	EPA 300.0 Anions	Nitrate	R	B3M1H8
399-1-148	EPA 300.0 Anions	Nitrate	RAH	B3KV75
399-1-148	EPA 300.0 Anions	Phosphate	R	B3M0X2
399-1-148	EPA 300.0 Anions	Phosphate	R	B3M1H8
399-1-148	EPA 300.0 Anions	Phosphate	RAH	B3KV75
399-1-148	EPA 300.0 Anions	Sulfate	R	B3M0X2
399-1-148	EPA 300.0 Anions	Sulfate	R	B3M1H8
399-1-148	EPA 6010 ICP-AES Metals	Calcium	R	B3M0X1
399-1-148	EPA 6010 ICP-AES Metals	Calcium	R	B3M0X3
399-1-148	EPA 6010 ICP-AES Metals	Calcium	R	B3M1H7
399-1-148	EPA 6010 ICP-AES Metals	Calcium	R	B3M1H9
399-1-148	EPA 6010 ICP-AES Metals	Iron	R	B3M0X1
399-1-148	EPA 6010 ICP-AES Metals	Iron	R	B3M0X3
399-1-148	EPA 6010 ICP-AES Metals	Iron	R	B3M1H7
399-1-148	EPA 6010 ICP-AES Metals	Iron	R	B3M1H9
399-1-148	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0X1
399-1-148	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0X3
399-1-148	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1H7
399-1-148	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1H9

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-148	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0X1
399-1-148	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0X3
399-1-148	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1H7
399-1-148	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1H9
399-1-148	EPA 6010 ICP-AES Metals	Potassium	R	B3M0X1
399-1-148	EPA 6010 ICP-AES Metals	Potassium	R	B3M0X3
399-1-148	EPA 6010 ICP-AES Metals	Potassium	R	B3M1H7
399-1-148	EPA 6010 ICP-AES Metals	Potassium	R	B3M1H9
399-1-148	EPA 6010 ICP-AES Metals	Sodium	R	B3M0X1
399-1-148	EPA 6010 ICP-AES Metals	Sodium	R	B3M0X3
399-1-148	EPA 6010 ICP-AES Metals	Sodium	R	B3M1H7
399-1-148	EPA 6010 ICP-AES Metals	Sodium	R	B3M1H9
399-1-148	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0X1
399-1-148	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0X3
399-1-148	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1H7
399-1-148	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1H9
399-1-148	EPA 6020 ICP/MS Metals	Manganese	R	B3M0X1
399-1-148	EPA 6020 ICP/MS Metals	Manganese	R	B3M0X3
399-1-148	EPA 6020 ICP/MS Metals	Manganese	R	B3M1H7
399-1-148	EPA 6020 ICP/MS Metals	Manganese	R	B3M1H9
399-1-148	EPA 6020 ICP/MS Metals	Uranium	R	B3M0X1
399-1-148	EPA 6020 ICP/MS Metals	Uranium	R	B3M0X3
399-1-148	EPA 6020 ICP/MS Metals	Uranium	R	B3M1H7
399-1-148	EPA 6020 ICP/MS Metals	Uranium	R	B3M1H9
399-1-149	SM 2320 Alkalinity	Alkalinity	R	B3M0X6
399-1-149	SM 2320 Alkalinity	Alkalinity	R	B3M1J2
399-1-149	SM 2320 Alkalinity	Alkalinity	R	B3M1T7
399-1-149	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M0X6
399-1-149	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1J2
399-1-149	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1T7
399-1-149	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M0X6
399-1-149	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1J2

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-149	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1T7
399-1-149	EPA 300.0 Anions	Chloride	R	B3M0X7
399-1-149	EPA 300.0 Anions	Chloride	R	B3M1J3
399-1-149	EPA 300.0 Anions	Chloride	R	B3M1T8
399-1-149	EPA 300.0 Anions	Nitrate	R	B3M0X7
399-1-149	EPA 300.0 Anions	Nitrate	R	B3M1J3
399-1-149	EPA 300.0 Anions	Nitrate	R	B3M1T8
399-1-149	EPA 300.0 Anions	Phosphate	HR	B3KRN8
399-1-149	EPA 300.0 Anions	Phosphate	R	B3M0X7
399-1-149	EPA 300.0 Anions	Phosphate	R	B3M1J3
399-1-149	EPA 300.0 Anions	Phosphate	R	B3M1T8
399-1-149	EPA 300.0 Anions	Sulfate	R	B3M0X7
399-1-149	EPA 300.0 Anions	Sulfate	R	B3M1J3
399-1-149	EPA 300.0 Anions	Sulfate	R	B3M1T8
399-1-149	EPA 6010 ICP-AES Metals	Calcium	R	B3M0X4
399-1-149	EPA 6010 ICP-AES Metals	Calcium	R	B3M0X8
399-1-149	EPA 6010 ICP-AES Metals	Calcium	R	B3M1J0
399-1-149	EPA 6010 ICP-AES Metals	Calcium	R	B3M1J4
399-1-149	EPA 6010 ICP-AES Metals	Calcium	R	B3M1T5
399-1-149	EPA 6010 ICP-AES Metals	Calcium	R	B3M1T9
399-1-149	EPA 6010 ICP-AES Metals	Iron	R	B3M0X4
399-1-149	EPA 6010 ICP-AES Metals	Iron	R	B3M0X8
399-1-149	EPA 6010 ICP-AES Metals	Iron	R	B3M1J0
399-1-149	EPA 6010 ICP-AES Metals	Iron	R	B3M1J4
399-1-149	EPA 6010 ICP-AES Metals	Iron	R	B3M1T5
399-1-149	EPA 6010 ICP-AES Metals	Iron	R	B3M1T9
399-1-149	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0X4
399-1-149	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0X8
399-1-149	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1J0
399-1-149	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1J4
399-1-149	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1T5
399-1-149	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1T9

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-149	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0X4
399-1-149	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0X8
399-1-149	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1J0
399-1-149	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1J4
399-1-149	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1T5
399-1-149	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1T9
399-1-149	EPA 6010 ICP-AES Metals	Potassium	R	B3M0X4
399-1-149	EPA 6010 ICP-AES Metals	Potassium	R	B3M0X8
399-1-149	EPA 6010 ICP-AES Metals	Potassium	R	B3M1J0
399-1-149	EPA 6010 ICP-AES Metals	Potassium	R	B3M1J4
399-1-149	EPA 6010 ICP-AES Metals	Potassium	R	B3M1T5
399-1-149	EPA 6010 ICP-AES Metals	Potassium	R	B3M1T9
399-1-149	EPA 6010 ICP-AES Metals	Sodium	R	B3M0X4
399-1-149	EPA 6010 ICP-AES Metals	Sodium	R	B3M0X8
399-1-149	EPA 6010 ICP-AES Metals	Sodium	R	B3M1J0
399-1-149	EPA 6010 ICP-AES Metals	Sodium	R	B3M1J4
399-1-149	EPA 6010 ICP-AES Metals	Sodium	R	B3M1T5
399-1-149	EPA 6010 ICP-AES Metals	Sodium	R	B3M1T9
399-1-149	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0X4
399-1-149	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0X8
399-1-149	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1J0
399-1-149	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1J4
399-1-149	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1T5
399-1-149	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1T9
399-1-149	EPA 6020 ICP/MS Metals	Manganese	R	B3M0X4
399-1-149	EPA 6020 ICP/MS Metals	Manganese	R	B3M0X8
399-1-149	EPA 6020 ICP/MS Metals	Manganese	R	B3M1J0
399-1-149	EPA 6020 ICP/MS Metals	Manganese	R	B3M1J4
399-1-149	EPA 6020 ICP/MS Metals	Manganese	R	B3M1T5
399-1-149	EPA 6020 ICP/MS Metals	Manganese	R	B3M1T9
399-1-149	EPA 6020 ICP/MS Metals	Uranium	R	B3M0X4
399-1-149	EPA 6020 ICP/MS Metals	Uranium	R	B3M0X8

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-149	EPA 6020 ICP/MS Metals	Uranium	R	B3M1J0
399-1-149	EPA 6020 ICP/MS Metals	Uranium	R	B3M1J4
399-1-149	EPA 6020 ICP/MS Metals	Uranium	R	B3M1T5
399-1-149	EPA 6020 ICP/MS Metals	Uranium	R	B3M1T9
399-1-150	EPA 300.0 Anions	Chloride	R	B3M0Y1
399-1-150	EPA 300.0 Anions	Chloride	R	B3M1J7
399-1-150	EPA 300.0 Anions	Chloride	R	B3M1V2
399-1-150	EPA 300.0 Anions	Nitrate	R	B3M0Y1
399-1-150	EPA 300.0 Anions	Nitrate	R	B3M1J7
399-1-150	EPA 300.0 Anions	Nitrate	R	B3M1V2
399-1-150	EPA 300.0 Anions	Phosphate	R	B3M0Y1
399-1-150	EPA 300.0 Anions	Phosphate	R	B3M1J7
399-1-150	EPA 300.0 Anions	Phosphate	R	B3M1V2
399-1-150	EPA 300.0 Anions	Phosphate	RAH	B3KV86
399-1-150	EPA 300.0 Anions	Sulfate	R	B3M0Y1
399-1-150	EPA 300.0 Anions	Sulfate	R	B3M1J7
399-1-150	EPA 300.0 Anions	Sulfate	R	B3M1V2
399-1-150	EPA 310.1 Alkalinity	Alkalinity	R	B3M0Y0
399-1-150	EPA 310.1 Alkalinity	Alkalinity	R	B3M1J6
399-1-150	EPA 310.1 Alkalinity	Alkalinity	R	B3M1V1
399-1-150	EPA 310.1 Alkalinity	Bicarbonate alkalinity	R	B3M0Y0
399-1-150	EPA 310.1 Alkalinity	Bicarbonate alkalinity	R	B3M1J6
399-1-150	EPA 310.1 Alkalinity	Bicarbonate alkalinity	R	B3M1V1
399-1-150	EPA 310.1 Alkalinity	Carbonate alkalinity	R	B3M0Y0
399-1-150	EPA 310.1 Alkalinity	Carbonate alkalinity	R	B3M1J6
399-1-150	EPA 310.1 Alkalinity	Carbonate alkalinity	R	B3M1V1
399-1-150	EPA 6010 ICP-AES Metals	Calcium	R	B3M0Y0
399-1-150	EPA 6010 ICP-AES Metals	Calcium	R	B3M0Y2
399-1-150	EPA 6010 ICP-AES Metals	Calcium	R	B3M1J6
399-1-150	EPA 6010 ICP-AES Metals	Calcium	R	B3M1J8
399-1-150	EPA 6010 ICP-AES Metals	Calcium	R	B3M1V1
399-1-150	EPA 6010 ICP-AES Metals	Calcium	R	B3M1V3

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-150	EPA 6010 ICP-AES Metals	Iron	R	B3M0Y0
399-1-150	EPA 6010 ICP-AES Metals	Iron	R	B3M0Y2
399-1-150	EPA 6010 ICP-AES Metals	Iron	R	B3M1J6
399-1-150	EPA 6010 ICP-AES Metals	Iron	R	B3M1J8
399-1-150	EPA 6010 ICP-AES Metals	Iron	R	B3M1V1
399-1-150	EPA 6010 ICP-AES Metals	Iron	R	B3M1V3
399-1-150	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0Y0
399-1-150	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0Y2
399-1-150	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1J6
399-1-150	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1J8
399-1-150	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1V1
399-1-150	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1V3
399-1-150	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0Y0
399-1-150	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0Y2
399-1-150	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1J6
399-1-150	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1J8
399-1-150	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1V1
399-1-150	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1V3
399-1-150	EPA 6010 ICP-AES Metals	Potassium	R	B3M0Y0
399-1-150	EPA 6010 ICP-AES Metals	Potassium	R	B3M0Y2
399-1-150	EPA 6010 ICP-AES Metals	Potassium	R	B3M1J6
399-1-150	EPA 6010 ICP-AES Metals	Potassium	R	B3M1J8
399-1-150	EPA 6010 ICP-AES Metals	Potassium	R	B3M1V1
399-1-150	EPA 6010 ICP-AES Metals	Potassium	R	B3M1V3
399-1-150	EPA 6010 ICP-AES Metals	Sodium	R	B3M0Y0
399-1-150	EPA 6010 ICP-AES Metals	Sodium	R	B3M0Y2
399-1-150	EPA 6010 ICP-AES Metals	Sodium	R	B3M1J6
399-1-150	EPA 6010 ICP-AES Metals	Sodium	R	B3M1J8
399-1-150	EPA 6010 ICP-AES Metals	Sodium	R	B3M1V1
399-1-150	EPA 6010 ICP-AES Metals	Sodium	R	B3M1V3
399-1-150	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0Y0
399-1-150	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0Y2

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-150	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1J6
399-1-150	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1J8
399-1-150	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1V1
399-1-150	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1V3
399-1-150	EPA 6020 ICP/MS Metals	Manganese	R	B3M0Y0
399-1-150	EPA 6020 ICP/MS Metals	Manganese	R	B3M0Y2
399-1-150	EPA 6020 ICP/MS Metals	Manganese	R	B3M1J6
399-1-150	EPA 6020 ICP/MS Metals	Manganese	R	B3M1J8
399-1-150	EPA 6020 ICP/MS Metals	Manganese	R	B3M1V1
399-1-150	EPA 6020 ICP/MS Metals	Manganese	R	B3M1V3
399-1-150	EPA 6020 ICP/MS Metals	Uranium	R	B3M0Y0
399-1-150	EPA 6020 ICP/MS Metals	Uranium	R	B3M0Y2
399-1-150	EPA 6020 ICP/MS Metals	Uranium	R	B3M1J6
399-1-150	EPA 6020 ICP/MS Metals	Uranium	R	B3M1J8
399-1-150	EPA 6020 ICP/MS Metals	Uranium	R	B3M1V1
399-1-150	EPA 6020 ICP/MS Metals	Uranium	R	B3M1V3
399-1-152	SM 2320 Alkalinity	Alkalinity	R	B3M0Y4
399-1-152	SM 2320 Alkalinity	Alkalinity	R	B3M1V5
399-1-152	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M0Y4
399-1-152	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1V5
399-1-152	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M0Y4
399-1-152	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1V5
399-1-152	EPA 300.0 Anions	Chloride	R	B3M0Y5
399-1-152	EPA 300.0 Anions	Chloride	R	B3M1V6
399-1-152	EPA 300.0 Anions	Nitrate	HR	B3KRP6
399-1-152	EPA 300.0 Anions	Nitrate	HR	B3KT49
399-1-152	EPA 300.0 Anions	Nitrate	HR	B3KTP7
399-1-152	EPA 300.0 Anions	Nitrate	R	B3KPL3
399-1-152	EPA 300.0 Anions	Nitrate	R	B3KPX1
399-1-152	EPA 300.0 Anions	Nitrate	R	B3KRD8
399-1-152	EPA 300.0 Anions	Nitrate	R	B3KTX1
399-1-152	EPA 300.0 Anions	Nitrate	R	B3M0Y5

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-152	EPA 300.0 Anions	Nitrate	R	B3M1V6
399-1-152	EPA 300.0 Anions	Phosphate	R	B3M0Y5
399-1-152	EPA 300.0 Anions	Phosphate	R	B3M1V6
399-1-152	EPA 300.0 Anions	Phosphate	RAH	B3KV91
399-1-152	EPA 300.0 Anions	Sulfate	R	B3M0Y5
399-1-152	EPA 300.0 Anions	Sulfate	R	B3M1V6
399-1-152	EPA 6010 ICP-AES Metals	Calcium	R	B3M0Y4
399-1-152	EPA 6010 ICP-AES Metals	Calcium	R	B3M0Y6
399-1-152	EPA 6010 ICP-AES Metals	Calcium	R	B3M1V5
399-1-152	EPA 6010 ICP-AES Metals	Calcium	R	B3M1V7
399-1-152	EPA 6010 ICP-AES Metals	Iron	R	B3M0Y4
399-1-152	EPA 6010 ICP-AES Metals	Iron	R	B3M0Y6
399-1-152	EPA 6010 ICP-AES Metals	Iron	R	B3M1V5
399-1-152	EPA 6010 ICP-AES Metals	Iron	R	B3M1V7
399-1-152	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0Y4
399-1-152	EPA 6010 ICP-AES Metals	Magnesium	R	B3M0Y6
399-1-152	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1V5
399-1-152	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1V7
399-1-152	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0Y4
399-1-152	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M0Y6
399-1-152	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1V5
399-1-152	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1V7
399-1-152	EPA 6010 ICP-AES Metals	Potassium	R	B3M0Y4
399-1-152	EPA 6010 ICP-AES Metals	Potassium	R	B3M0Y6
399-1-152	EPA 6010 ICP-AES Metals	Potassium	R	B3M1V5
399-1-152	EPA 6010 ICP-AES Metals	Potassium	R	B3M1V7
399-1-152	EPA 6010 ICP-AES Metals	Sodium	R	B3M0Y4
399-1-152	EPA 6010 ICP-AES Metals	Sodium	R	B3M0Y6
399-1-152	EPA 6010 ICP-AES Metals	Sodium	R	B3M1V5
399-1-152	EPA 6010 ICP-AES Metals	Sodium	R	B3M1V7
399-1-152	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0Y4
399-1-152	EPA 6020 ICP/MS Metals	Arsenic	R	B3M0Y6

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-152	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1V5
399-1-152	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1V7
399-1-152	EPA 6020 ICP/MS Metals	Manganese	R	B3M0Y4
399-1-152	EPA 6020 ICP/MS Metals	Manganese	R	B3M0Y6
399-1-152	EPA 6020 ICP/MS Metals	Manganese	R	B3M1V5
399-1-152	EPA 6020 ICP/MS Metals	Manganese	R	B3M1V7
399-1-152	EPA 6020 ICP/MS Metals	Uranium	R	B3M0Y4
399-1-152	EPA 6020 ICP/MS Metals	Uranium	R	B3M0Y6
399-1-152	EPA 6020 ICP/MS Metals	Uranium	R	B3M1V5
399-1-152	EPA 6020 ICP/MS Metals	Uranium	R	B3M1V7
399-1-153	EPA 300.0 Anions	Nitrate	R	B3KMJ6
399-1-153	EPA 6010 ICP-AES Metals	Calcium	R	B3M589
399-1-153	EPA 6010 ICP-AES Metals	Iron	R	B3M589
399-1-153	EPA 6010 ICP-AES Metals	Magnesium	R	B3M589
399-1-153	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M589
399-1-153	EPA 6010 ICP-AES Metals	Potassium	R	B3M589
399-1-153	EPA 6010 ICP-AES Metals	Sodium	R	B3M589
399-1-153	EPA 6020 ICP/MS Metals	Arsenic	R	B3M589
399-1-153	EPA 6020 ICP/MS Metals	Manganese	R	B3M589
399-1-153	EPA 6020 ICP/MS Metals	Uranium	R	B3M589
399-1-154	SM 2320 Alkalinity	Alkalinity	R	B3M1K8
399-1-154	SM 2320 Alkalinity	Alkalinity	R	B3M1W3
399-1-154	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1K8
399-1-154	SM 2320 Alkalinity	Bicarbonate alkalinity	R	B3M1W3
399-1-154	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1K8
399-1-154	SM 2320 Alkalinity	Carbonate alkalinity	R	B3M1W3
399-1-154	EPA 300.0 Anions	Chloride	R	B3M1K9
399-1-154	EPA 300.0 Anions	Chloride	R	B3M1W4
399-1-154	EPA 300.0 Anions	Nitrate	R	B3M1K9
399-1-154	EPA 300.0 Anions	Nitrate	R	B3M1W4
399-1-154	EPA 300.0 Anions	Phosphate	R	B3M1K9
399-1-154	EPA 300.0 Anions	Phosphate	R	B3M1W4

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-154	EPA 300.0 Anions	Sulfate	R	B3M1K9
399-1-154	EPA 300.0 Anions	Sulfate	R	B3M1W4
399-1-154	EPA 6010 ICP-AES Metals	Calcium	R	B3M1K8
399-1-154	EPA 6010 ICP-AES Metals	Calcium	R	B3M1L0
399-1-154	EPA 6010 ICP-AES Metals	Calcium	R	B3M1W3
399-1-154	EPA 6010 ICP-AES Metals	Calcium	R	B3M1W5
399-1-154	EPA 6010 ICP-AES Metals	Iron	R	B3M1K8
399-1-154	EPA 6010 ICP-AES Metals	Iron	R	B3M1L0
399-1-154	EPA 6010 ICP-AES Metals	Iron	R	B3M1W3
399-1-154	EPA 6010 ICP-AES Metals	Iron	R	B3M1W5
399-1-154	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1K8
399-1-154	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1L0
399-1-154	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1W3
399-1-154	EPA 6010 ICP-AES Metals	Magnesium	R	B3M1W5
399-1-154	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1K8
399-1-154	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1L0
399-1-154	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1W3
399-1-154	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1W5
399-1-154	EPA 6010 ICP-AES Metals	Potassium	R	B3M1K8
399-1-154	EPA 6010 ICP-AES Metals	Potassium	R	B3M1L0
399-1-154	EPA 6010 ICP-AES Metals	Potassium	R	B3M1W3
399-1-154	EPA 6010 ICP-AES Metals	Potassium	R	B3M1W5
399-1-154	EPA 6010 ICP-AES Metals	Sodium	R	B3M1K8
399-1-154	EPA 6010 ICP-AES Metals	Sodium	R	B3M1L0
399-1-154	EPA 6010 ICP-AES Metals	Sodium	R	B3M1W3
399-1-154	EPA 6010 ICP-AES Metals	Sodium	R	B3M1W5
399-1-154	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1K8
399-1-154	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1L0
399-1-154	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1W3
399-1-154	EPA 6020 ICP/MS Metals	Arsenic	R	B3M1W5
399-1-154	EPA 6020 ICP/MS Metals	Manganese	R	B3M1K8
399-1-154	EPA 6020 ICP/MS Metals	Manganese	R	B3M1L0

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-154	EPA 6020 ICP/MS Metals	Manganese	R	B3M1W3
399-1-154	EPA 6020 ICP/MS Metals	Manganese	R	B3M1W5
399-1-154	EPA 6020 ICP/MS Metals	Uranium	R	B3M1K8
399-1-154	EPA 6020 ICP/MS Metals	Uranium	R	B3M1L0
399-1-154	EPA 6020 ICP/MS Metals	Uranium	R	B3M1W3
399-1-154	EPA 6020 ICP/MS Metals	Uranium	R	B3M1W5
399-1-155	EPA 300.0 Anions	Nitrate	R	B3KXM0
399-1-155	EPA 300.0 Anions	Nitrate	R	B3KY28
399-1-155	EPA 300.0 Anions	Nitrate	R	B3KYM6
399-1-155	EPA 300.0 Anions	Nitrate	R	B3L069
399-1-155	EPA 300.0 Anions	Nitrate	R	B3L0P7
399-1-155	EPA 300.0 Anions	Phosphate	RAH	B3KVH2
399-1-156	SM 2320 Alkalinity	Carbonate alkalinity	R	B3P498
399-1-156	EPA 300.0 Anions	Phosphate	RAH	B3KVH6
399-1-157	EPA 300.0 Anions	Phosphate	RAH	B3KVJ0
399-1-158	SM 2320 Alkalinity	Carbonate alkalinity	R	B3NX85
399-1-158	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RB27
399-1-158	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RJ61
399-1-158	EPA 300.0 Anions	Phosphate	RAH	B3KVJ6
399-1-159	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PP00
399-1-159	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PYX6
399-1-159	EPA 300.0 Anions	Phosphate	RAH	B3KVK2
399-1-160	SM 2320 Alkalinity	Carbonate alkalinity	R	B3P4B0
399-1-160	EPA 300.0 Anions	Nitrate	R	B3KMT6
399-1-160	EPA 300.0 Anions	Nitrate	R	B3KP20
399-1-160	EPA 300.0 Anions	Phosphate	RAH	B3KVK6
399-1-161	EPA 300.0 Anions	Nitrate	R	B3KR24
399-1-161	EPA 300.0 Anions	Phosphate	RAH	B3KVL0
399-1-162	EPA 300.0 Anions	Phosphate	RAH	B3KVL5
399-1-164	EPA 300.0 Anions	Nitrate	R	B3KJJ4
399-1-164	EPA 300.0 Anions	Phosphate	RAH	B3KVB7
399-1-165	EPA 300.0 Anions	Phosphate	RAH	B3KVC2

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-1-165	EPA 6010 ICP-AES Metals	Phosphorus	R	B3M1C1
399-1-166	EPA 300.0 Anions	Phosphate	RAH	B3KVC6
399-1-16A	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PYY7
399-1-16A	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RB46
399-1-17A	SM 2320 Alkalinity	Carbonate alkalinity	R	B3NMJ5
399-1-17A	SM 2320 Alkalinity	Carbonate alkalinity	R	B3R005
399-1-17A	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RJ84
399-1-17A	EPA 300.0 Anions	Phosphate	HR	B3KRK4
399-1-17A	EPA 300.0 Anions	Phosphate	HR	B3KT84
399-1-17A	EPA 300.0 Anions	Phosphate	RAH	B3KVD0
399-1-2	SM 2320 Alkalinity	Carbonate alkalinity	R	B3P497
399-1-23	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PP68
399-1-23	EPA 300.0 Anions	Phosphate	RAH	B3KVD8
399-1-55	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PP01
399-1-55	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RB66
399-1-55	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RJB2
399-1-62	SM 2320 Alkalinity	Carbonate alkalinity	R	B3R037
399-1-62	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RJB8
399-1-7	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PP18
399-1-7	EPA 300.0 Anions	Phosphate	RAH	B3KVF3
399-1-72	SM 2320 Alkalinity	Carbonate alkalinity	R	B3R047
399-1-72	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RB83
399-1-72	SM 2320 Alkalinity	Carbonate alkalinity	R	B3RJD1
399-1-72	EPA 300.0 Anions	Phosphate	RAH	B3KVF7
399-1-73	EPA 300.0 Anions	Nitrate	HR	B3KNM1
399-1-73	EPA 300.0 Anions	Nitrate	R	B3KM41
399-1-73	EPA 300.0 Anions	Nitrate	R	B3KNB1
399-1-73	EPA 300.0 Anions	Phosphate	RAH	B3KVL7
399-2-2	SM 2320 Alkalinity	Carbonate alkalinity	R	B3NMR6
399-2-2	SM 2320 Alkalinity	Carbonate alkalinity	R	B3PP32

Table A-1. Water Samples with "R" Data Review Qualification Flags

Sampling Location (Wells)	Analytical Method	Analyte	Data User-Applied Flags	Sample
399-2-2	SM 2320 Alkalinity	Carbonate alkalinity	R	B3R009

Notes: Complete reference citations are provided in Chapter A-2.

For EPA Method 300.0, see EPA/600/R-93/100. For EPA Method 310.1, see EPA/600/4-79/020. For four-digit EPA methods, see SW-846. For Standard Method 2320, see APHA/AWWA/WEF, .

EPA = U.S. Environmental Protection Agency

ICP-AES = inductively coupled plasma-atomic emission spectroscopy

ICP/MS = inductively coupled plasma mass spectroscopy

SM = standard method

Data flags:

A = Indicates an issue with the chain-of-custody that could affect data usability.

H = Laboratory holding time exceeded before the sample was analyzed.

R = Do not use. Further review indicates the result is not valid. (This Review Qualifier is used only when there is documented evidence that the result is not valid. Generally, results that are "R" qualified will be excluded from statistical evaluations, maps, and other interpretations.)

A2 References

APHA/AWWA/WEF, 2017, *Standard Methods for the Examination of Water and Wastewater.* 23rd Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

EPA/600/4-79/020, 2002, *Methods for Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://cfpub.epa.gov/si/si_public_record_Report.cfm?Lab=NERL&dirEntryId=39602.

EPA/600/R-93/100, 1993, *Methods for the Determination of Inorganic Substances in Environmental Samples*, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=30002U3P.txt.

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods Compendium*, as updated, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: https://www.epa.gov/hw-sw846/sw-846-compendium.