Attachment D2

100 DH Area RIFS Data Quality Assessment

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SGW-54174
Revision 0

100 DH Area RIFS Data Quality Assessment

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

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APPROVED
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Release Approval Date

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Terms

AQA	Analytical Quality Associates, Inc.
CAS	Chemical Abstracts Service
CCC	criterion continuous concentration
CFR	*Code of Federal Regulations*
COPC	contaminant of potential concern
Cr(VI)	hexavalent chromium
DQA	data quality assessment
DQO	data quality objective
DUP	field duplicate sample
EB	equipment rinsate blank
EBRLNE	Eberline Services
EPA	U.S. Environmental Protection Agency
ESL	HEIS designator for Pacific Northwest National Laboratory
FTB	full trip blank
FXR	field transfer blank
FS	feasibility study
GC/MS	gas chromatography/mass spectrometry
GEA	gamma energy analysis
GPC	gas proportional counting
HEIS	Hanford Environmental Information System
HPLC	high pressure liquid chromatography
IDL	instrument detection limit
IC	ion chromatography
ICP	inductively coupled plasma
ICP/AES	inductively coupled plasma/atomic emission spectroscopy
ICP/MS	inductively coupled plasma/mass spectrometry
K_d	distribution coefficient
KPA	kinetic phosphorescence analysis
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LSC	liquid scintillation counter
LVL	Lionville Laboratory
MCL	maximum contaminant level
MDA	minimum detectable activity

MDC	minimum detectable concentration
MDL	method detection limit
MS	mass spectrometry
MS	matrix spike
MSD	matrix spike duplicate
NTU	nephelometric turbidity unit
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
QA	quality assurance
QC	quality control
QL	quantitation limit
REDOX	reduction oxidation (plant or process)
RESRAD	residual radioactivity (dose model)
RI	remedial investigation
ROD	record of decision
RPD	relative percent difference
RUM	Ringold Upper Mud
SAP	sampling and analysis plan
SDG	sample delivery group
SHAW	SHAW Laboratory
S&GRP	Soil and Groundwater Remediation Project
SVOA	semivolatile organic analysis
SVOC	semivolatile organic compound
TARL	Test America Richland
TASL	Test America St. Louis
TAKN	Test America Knoxville
UKPA	total uranium by kinetic phosphorescence analysis
VOA	volatile organic analysis
VOC	volatile organic compound
WAC	*Washington Administrative Code*
WSCF	Waste Sampling and Characterization Facility

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1 Introduction

This data quality assessment (DQA) report evaluates laboratory data for aquifer sediment and groundwater samples collected as part of the Remedial Investigation (RI) for 100-D/H, which included investigations of the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units (OUs). The purpose of this DQA is to determine whether these data are the right type and of sufficient quality and quantity to support remedial action decisions.

The RI for 100-D/H included drilling and sampling 14 characterization wells in 100-D/H in accordance with DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*, hereinafter called the Integrated Work Plan, and DOE/RL-2008-46-ADD1, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 1: 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*, hereinafter called the 100-D/H Work Plan. During drilling, groundwater samples, vadose zone sediment, sediment from within the unconfined aquifer, and sediment below the unconfined aquifer were collected for laboratory analysis. Figure 1-1 shows the locations of the seven characterization wells and four aquifer tubes at 100-D. Figure 1-2 shows the locations of the eight characterization wells and two aquifer tubes at 100-H. Figure 1-3 shows the locations of 52 groundwater wells sampled to support the spatial and temporal evaluation of groundwater contamination in the 100-D and 100-H Areas. Sample collection and analysis were performed in accordance with DOE/RL-2009-40, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study*, hereinafter called the 100-D/H Sampling and Analysis Plan (SAP). Details regarding site and project background and history are provided in the Integrated Work Plan (DOE/RL-2008-46) and 100-D/H Work Plan (DOE/RL-2008-46-ADD1).

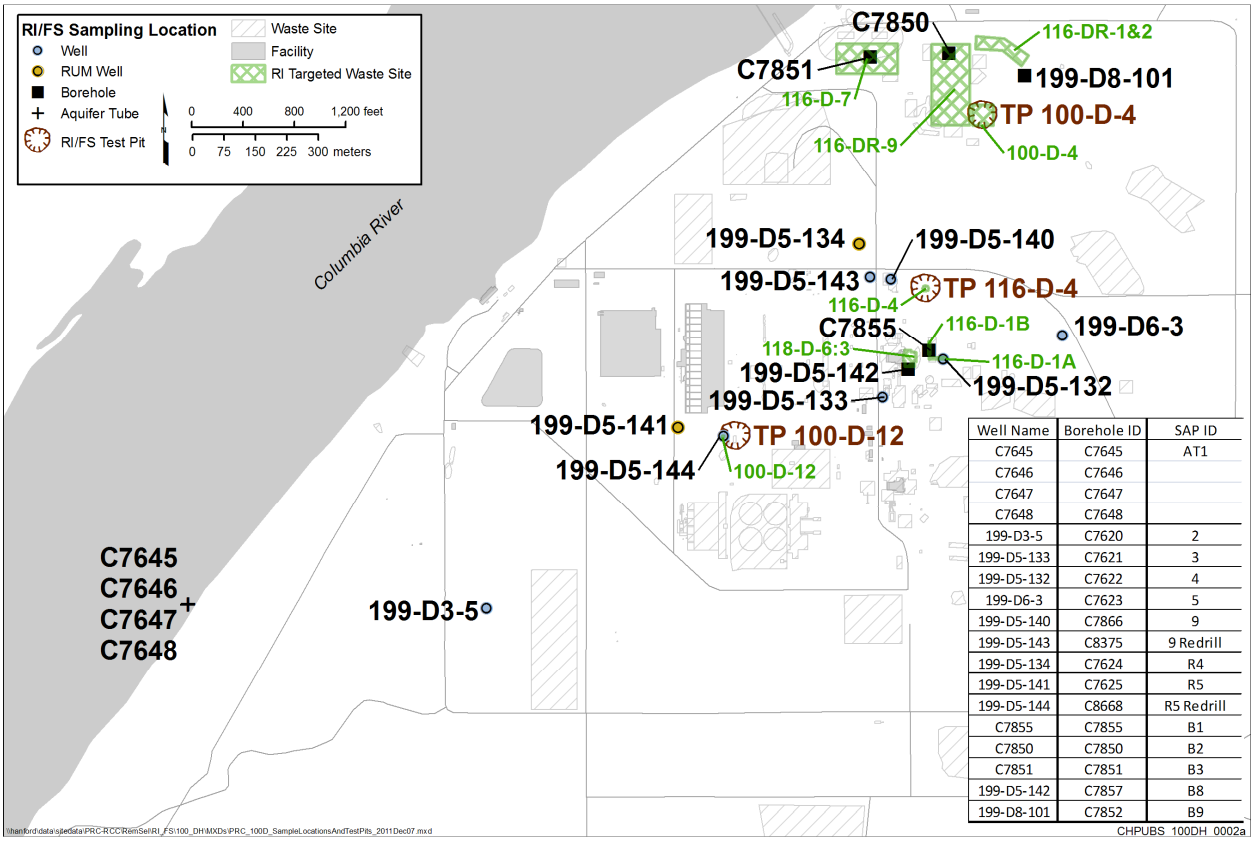
1.1 Laboratory Information

The samples collected were analyzed at the following laboratories:

- Waste Sampling and Characterization Facility (WSCF), located on the Hanford Site, performed chemical and radiochemical analyses on selected soil and groundwater samples.
- Test America, Richland (TARL), located in Richland, Washington, performed chemical and radiochemical analyses on selected groundwater samples.
- Test America, St. Louis (TASL), located in St. Louis, Missouri, performed chemical analyses on selected soil and groundwater samples.
- Test America Knoxville (TAKN) located in Knoxville, Tennessee, performed polychlorinated biphenyl (PCB) congener analyses on selected groundwater samples.
- Eberline Services (EBRLNE) located in Richmond, California, performed radiochemical analyses on selected soil and groundwater samples.
- Lionville Laboratory (LVL) located in Exton, Pennsylvania, performed chemical analyses on selected groundwater samples.
- 222-S Laboratory located on the Hanford site performed chemical analyses on selected groundwater samples.
- Pacific Northwest National Laboratory (ESL) located in Richland, Washington, performed chemical and radiochemical analyses on selected soil and soil extracts.

- SHAW Laboratory (SHAW), located in Knoxville, Tennessee, performed physical properties testing on selected soil samples.

Sections 7 and 9 discuss the analytical data provided by these laboratories.

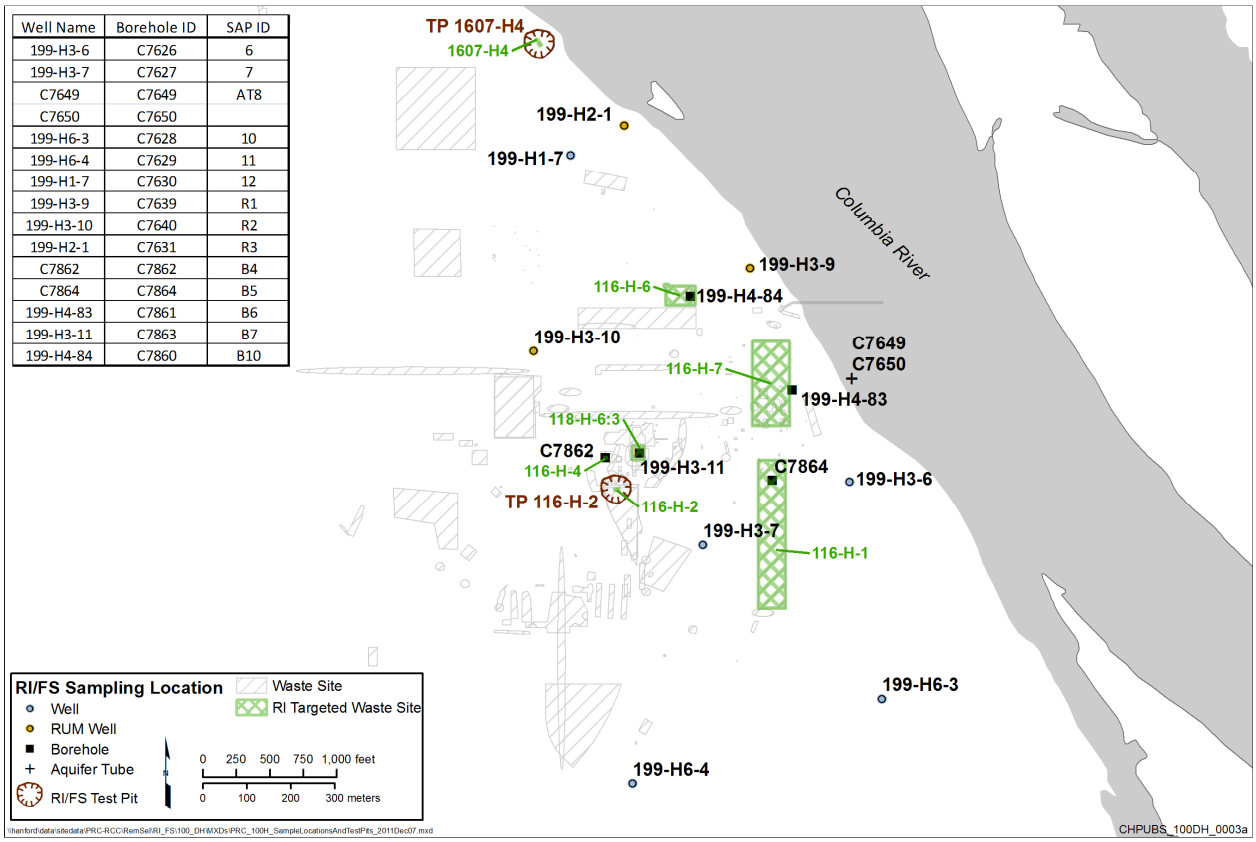


Well Name	Borehole ID	SAP ID
C7645	C7645	AT1
C7646	C7646	
C7647	C7647	
C7648	C7648	
199-D3-5	C7620	2
199-D5-133	C7621	3
199-D5-132	C7622	4
199-D6-3	C7623	5
199-D5-140	C7866	9
199-D5-143	C8375	9 Redrill
199-D5-134	C7624	R4
199-D5-141	C7625	R5
199-D5-144	C8668	R5 Redrill
C7855	C7855	B1
C7850	C7850	B2
C7851	C7851	B3
199-D5-142	C7857	B8
199-D8-101	C7852	B9

Figure 1-1. RI/FS Sampling Locations at 100-D

1.2 Analytical Methods

Samples were analyzed using methods listed in Table 1-1. Both multi-component and single component method-based analyses were used. Multi-component method based analyses are typically based upon U.S. Environmental Protection Agency (EPA) methods, as applicable, and yield concentration data for multiple analytes in a single analysis. The analytes may include both target analytes and non-target analytes. Single component method-based analyses are typically based upon EPA methods, as applicable, and yield concentration data for a single target analyte in a single analysis. Sample results were reported in the Hanford Environmental Information System (HEIS) database. In addition, tentatively identified volatile organic compounds (VOCs) were reported for Method 8260 (SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*).



Well Name	Borehole ID	SAP ID
199-H3-6	C7626	6
199-H3-7	C7627	7
C7649	C7649	AT8
C7650	C7650	
199-H6-3	C7628	10
199-H6-4	C7629	11
199-H1-7	C7630	12
199-H3-9	C7639	R1
199-H3-10	C7640	R2
199-H2-1	C7631	R3
C7862	C7862	B4
C7864	C7864	B5
199-H4-83	C7861	B6
199-H3-11	C7863	B7
199-H4-84	C7860	B10

Figure 1-2. RI/FS Sampling Locations at 100-H

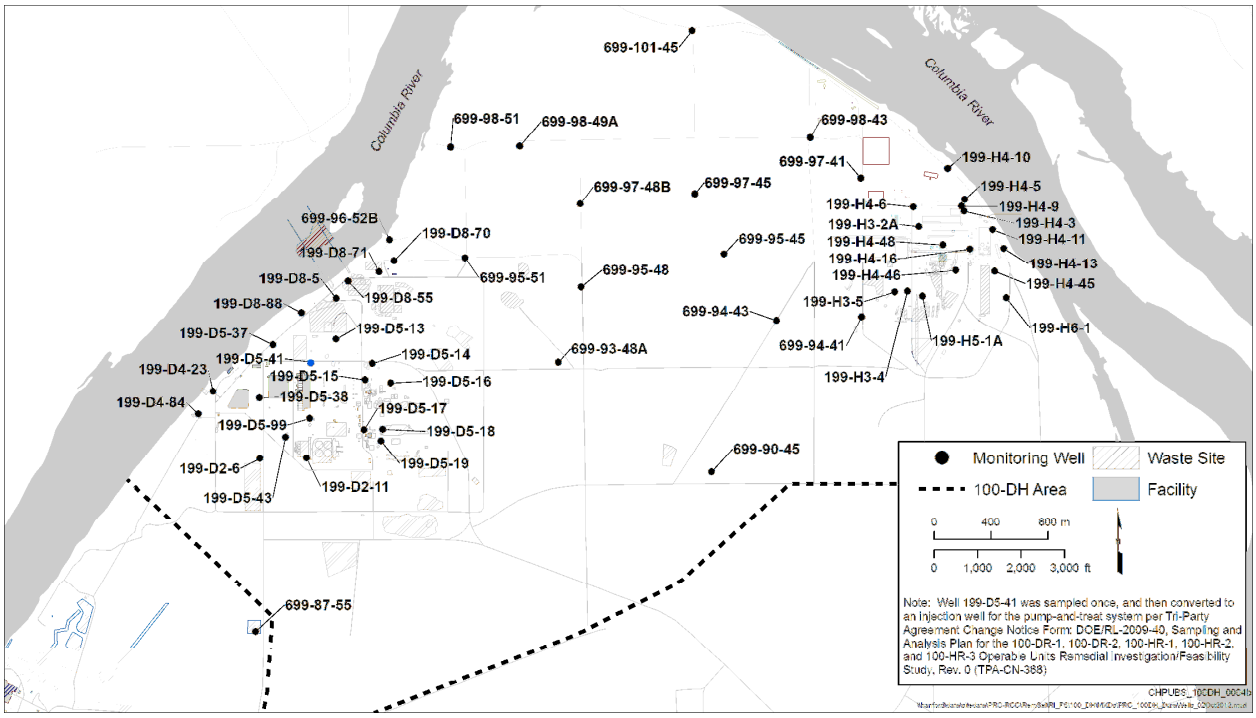


Figure 1-3. RI Spatial/Temporal Groundwater Monitoring Well Locations at 100-D/H

Table 1-1. Analytical Methods

Parameter	Analytical Method
ICP Metals	EPA Method 6010
ICP/MS Metals	EPA Method 200.8 or 6020
Mercury	EPA Method 200.8, 7470 (water), or 7471 (soil)
Uranium	ICP-MS, KPA
Anions	EPA Method 300.0
Hexavalent Chromium	EPA 7196
Cyanide	EPA 9012
VOCs	EPA Method 8260
SVOCs	EPA Method 8270
Pesticides	EPA 8081
PCBs (Congeners)	EPA 1668A
PCBs	EPA 8082
PAHs	EPA 8310
Gross Alpha	GPC
Gross Beta	GPC
Gamma Emitters	Gamma Energy Analysis
Strontium-89/90	GPC
Technetium-99	LSC-Technetium-99
Tritium	LSC – Tritium

Note: For EPA Method 300.0, see EPA/600/R-93/100 *Methods for the Determination of Inorganic Substances in Environmental Samples*. For EPA Method 200.8, see EPA-600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement I*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Third Edition; Final Update IV-B*.

GPC = gas-flow proportional counting
ICP = inductively coupled plasma
KPA = kinetic phosphorescence analysis
LSC = liquid scintillation counter
MS = mass spectrometry
PAH = polynuclear aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
VOC = volatile organic compound

2 Purpose

The purpose of the RI was to collect aquifer sediment and groundwater samples at 100-D/H to determine the nature and extent of contamination, to fill data gaps to support the development of a conceptual site model, to support development of risk assessment models, and to support selection of remedial alternatives. The samples were collected and analyzed in accordance with the 100-D/H SAP (DOE/RL-2009-40) to fill the data needs outlined in the 100-D/H Work Plan (DOE/RL-2008-46-ADD1).

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3 Scope

The DQA process involves the scientific evaluation of data to determine whether the data are of the right type, quality, and quantity to support their intended use. The DQA 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, not upon the technical interpretations of the data values. This DQA focuses on the chemical and radiochemical characterization data collected by sampling saturated soil and groundwater at 100-D/H as required by the 100-D/H SAP (DOE/RL-2009-40). The data are evaluated to determine whether they meet the analytical criteria outlined in the SAP and are adequate to support decision making.

The DQA process applied herein follows guidelines for DQAs established by the Soil and Groundwater Remediation Project (S&GRP). These guidelines are based on EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide*, and complete the EPA data quality lifecycle (planning, implementation, and assessment). EPA/240/B-06/002 outlines five steps for conducting a statistical DQA; however, the portions of the EPA's five-step process describing statistical methods do not apply to this DQA. Statistical methods were not used as part of this DQA for three reasons: (1) the number of samples specified by the 100-D/H SAP and100-D/H Work Plan was not statistically based and the sampling intervals were selected by professional judgment rather than by a random process; (2) no statistical test was defined in the 100-D/H SAP or 100-D/H Work Plan for analysis of the results; and (3) the data will not be used for a statistical analysis to confirm the success of a remedial or response action.

In addition, evaluation of vadose zone sediment samples above the unconfined aquifer, geophysical logging data, and physical properties data is not within the scope of this DQA report.

3.1 Data Verification

Data verification is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set 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 100-D/H SAP (DOE/RL-2009-40) have been collected and that all required measurements and analyses were performed). This evaluation is documented in Chapter 5, which compares the sampling design versus field implementation. In addition, verification is performed for field QC and laboratory QC samples and is documented in Chapters 8 and 9, respectively.

3.2 Data Validation

Data validation is an analyte and sample specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., data verification) to determine the analytical quality of a specific data set, typically in single analytical batches. Data validation is an independent assessment to ensure that the reliability of data is 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; or evaluation of analytical results based on method blanks, 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, which was performed on a percentage of all project data, is described in Section 7.3.

3.3 Data Usability

The data usability assessment, which determines the adequacy of the data to support a particular environmental decision, is based on the verification and validation results. The assessment relates to the adequacy of data to support a specific and defined data need. The usability step involves assessing whether the samples collected and the resulting analytical data meet project quality objectives. Whereas data verification and data validation address quality requirements at the analytical batch level, data usability is concerned with the entirety of data sets available to address a particular data quality objective (DQO). This evaluation is summarized in Chapter 10.

4 Project Objectives

The data needs as described in the 100-D/H Work Plan (DOE/RL-2008-46-ADD1) that involve samples of groundwater and sediment are shown in Table 4-1. Additionally, Table 4-1 presents brief summaries for the scope of work and justification (i.e., data gap being filled) for the individual data need as developed during the work planning process. Laboratory analytical results for these samples have been evaluated as part of this DQA.

Table 4-1. Summary of Data Needs for 100-D/H Groundwater and Saturated Sediment Sampling

Data Need[a,b]	Scope of Work	Justification (Data Gap)
Data Need Number. 5 (Source) Define the extent of groundwater contamination above cleanup standards in select areas of the unconfined aquifer.	Install three new aquifer tubes and five new wells at approved locations in 100-D. Install three new aquifer tubes and five new wells at approved locations in 100-H. Sample the wells for groundwater COPCs presented in the 100-D/H SAP (DOE/RL-2009-40).	The nature and extent of contamination in the unconfined aquifer above cleanup standards has not been defined in selected areas.
Data Need Number 6 (Distribution) Evaluate the utility and adequacy of aquifer tubes in supporting the understanding of groundwater contamination entering the Columbia River. Collect groundwater upwelling data.	Continue collecting aquifer tube sampling data and information per the existing program. Collect groundwater upwelling samples in the Columbia River (DOE/RL-2008-11, *Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River*). A task was included in DOE/RL-2008-46 for evaluating and developing an approach to obtain data that will demonstrate compliance with ambient water quality criteria in the river, for final ROD decisions.	The level of groundwater contamination entering the Columbia River (in particular, the hyporheic zone) is not well known.
Data Need Number 7 (Fate and Transport) Collect physical and hydrogeologic information to further support the evaluation of contaminant fate and transport beneath the unconfined aquifer.	100-D: Drill and sample soil and groundwater from two new boreholes (R4 and R5) drilled through the RUM and into the Ringold unit B. 100-H: Drill and sample soil and groundwater from three new boreholes (R1, R2, and R3) drilled through the RUM and into the Ringold unit B. Collect soil samples at 1.5 m (5 ft) into the RUM at the eight wells installed during the pump-and-treat system expansion.	The nature and extent of contaminants beneath the unconfined aquifer has not been evaluated.

Table 4-1. Summary of Data Needs for 100-D/H Groundwater and Saturated Sediment Sampling

Data Need[a,b]	Scope of Work	Justification (Data Gap)
Data Need Number 10 (Source) Collect soil and water samples from the following units: (1) vadose zone, (2) deep vadose zone, (3) rewetted zone, (4) unconfined aquifer, (5) above the RUM, and (6) within the RUM.	Soil and water analyses needed to determine the potential for each unit to contain sufficient contamination to be a continuing source of groundwater contamination.	The mechanism to explain the persistence of the Cr(VI) plume is unknown.
Data Need Number 12 (Fate and Transport) Collect additional data to support future fate and transport modeling. Assess the physical and hydraulic properties of soil and confirm contaminant K_d to support modeling.	On selected soil samples, physical properties, hydraulic properties, contaminant concentrations, and leaching behavior were evaluated.	Insufficient data are available to support fate and transport modeling.
Data Need Number 13 (Distribution) Collect and analyze groundwater samples from select groundwater monitoring wells.	Additional groundwater data were needed that are spatially representative of 100-D/H, reflect river stage influence, and include groundwater COPCs.	Data are needed to better define the spatial and temporal distribution of groundwater contamination.

a. Data needs were taken from Table 4-6 of DOE/RL-2008-46-ADD1, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 1: 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units.*

b. Batch leach analysis and physical properties results were not evaluated as part of this DQA.

COPC	=	contaminant of potential concern	K_d	=	distribution coefficient
Cr(VI)	=	hexavalent chromium	ROD	=	record of decisions
DQA	=	data quality assessment	RUM	=	Ringold Upper Mud

5 Completeness

5.1 Sampling Design

The type of sampling design is judgmental sampling (e.g., based on prior knowledge, professional judgment, and expertise). The locations of waste sites, test pits, boreholes, groundwater monitoring wells, and aquifer tubes were defined to address the uncertainties and data needs identified during systematic planning. Figures 1-1 through 1-3 show the locations of planned and existing sampling locations described in this 100-D/H SAP (DOE/RL-2009-40).

5.2 Implementation of the Sample Design

Saturated soil and groundwater samples were collected for analysis of the contaminants of potential concern (COPCs) as summarized in Table 5-1 and identified in Tables 2-18 and 2-19 of the 100-D/H SAP (DOE/RL-2009-40). The scope of work performed included the following activities:

- Well drilling, soil and groundwater sampling, and well completion and development for 15 new groundwater wells
- Installation and sampling of 6 new aquifer tubes at low, transition, and high river stage
- Sampling of 53 existing groundwater monitoring wells at low, transition, and high river stage

Note: Well 199-D5-41 was sampled once and then converted to an injection well for the pump-and-treat system per TPA-CN-368, *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40, Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study, Rev. 0*.

Tables 5-2, 5-3, and 5-4 present evaluations of the sample design implementation for the RI wells, spatial and temporal uncertainty groundwater monitoring wells, and aquifer tubes in support of the 100-D/H SAP (DOE/RL-2009-40). In general, the sampling design was implemented as described in the 100-D/H SAP (DOE/RL-2009-40). Minor exceptions occurred based on actual conditions encountered during drilling.

Table 5-1. Summary of 100-D/H Sampling and Analysis Design

Planned Characterization and Analytical Methodologies	Key Features of Sampling and Analysis
Unconfined Aquifer wells: Ten Locations and Ringold Upper Mud wells: Five Locations	
Geologic Archive Sediment Samples	During drilling, take grab samples representing major formations and where significant changes in lithology occur, at intervals specified in the SAP (DOE/RL-2009-40).
Sediment Sampling	During drilling, samples to be collected at approximate depths as outlined in the SAP (DOE/RL-2009-40). Constituents listed as COPCs, the field screening parameters and batch leach test as outlined in the SAP. Physical properties bulk density, grain size distribution, and soil moisture content will be determined for samples collected by split spoon (i.e., coring method).
Groundwater Sampling	During drilling, samples to be collected at approximate depths as outlined in the SAP (DOE/RL-2009-40). Unfiltered groundwater samples will be analyzed for constituents as outlined in the SAP.
New Aquifer Tubes Six Locations and Groundwater Data for Spatial and Temporal Risk Assessment: Thirty-Three Wells	
Groundwater Sampling	Three sampling events to capture aquifer conditions during Columbia River seasonal stages representing "high," "transition," and "low" conditions. Laboratory analyses to cover COPCs listed in Table 6-2.

Sources:

DOE/RL-2008-46-ADD1, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan, Addendum 1*.

DOE/RL-2009-40, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study*.

COPC = contaminant of potential concern
SAP = sampling and analysis plan

Table 5-2. Sample Design Implementation and Completion Evaluation for 100-D/H Remedial Investigation Wells

Well Name	Soil/Aquifer Sediment Samples			Groundwater Samples		
	Number of Samples Estimated[a]	Number of Intervals Sampled	Percent Complete (%)	Number of Samples Estimated[a]	Number of Intervals Sampled	Percent Complete (%)
199-D3-5	1	1	100	5	5	100
199-D5-133	1	1	100	5	5	100
199-D5-132	1	1	100	5	5	100
199-D6-3	1	1	100	5	3	60

Table 5-2. Sample Design Implementation and Completion Evaluation for 100-D/H Remedial Investigation Wells

Well Name	Soil/Aquifer Sediment Samples			Groundwater Samples		
	Number of Samples Estimated[a]	Number of Intervals Sampled	Percent Complete (%)	Number of Samples Estimated[a]	Number of Intervals Sampled	Percent Complete (%)
199-D5-143	1	1	100	5	6	120
199-H3-6	1	1	100	5	2	40
199-H3-7	1	1	100	5	3	60
199-H6-3	1	1	100	5	3	60
199-H6-4	1	1	100	5	4	80
199-H1-7	1	1	100	5	0[b]	0
199-H3-9	4	4	100	8	8	100
199-H3-10	4	4	100	8	8	100
199-H2-1	4	4	100	8	6	75
199-D5-134	4	4	100	8	8	100
199-D5-144	4	4	100	5	5	82

a. Estimates for the numbers of samples at each location are presented in DOE/RL-2009-40, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study*.
In accordance with Table 3-1 in DOE/RL-2009-40, groundwater samples from the 15 full characterization remedial investigation wells depths were approximate and based on the average groundwater levels measured at the wells in the area in 2008. Unfiltered groundwater samples were to be collected at 1.5 m (5-ft) intervals through the unconfined aquifer.

b. Water samples not collected. Ringold Upper Mud (RUM) encountered at 9.6 m (31.5 ft) below ground surface.

Table 5-3. Sample Design Implementation and Completion Evaluation for 100-D/H Spatial and Temporal Uncertainty Groundwater Monitoring Wells

Well Name*	Samples Required	Date Sampling Completed	Percent Complete (%)
199-D2-11	Three sampling events to represent seasonal river stage conditions: High – May/June Transition – March/April Low - October	08-Oct-09, 30-Mar-10, 11-May-10	100
199-D2-6		08-Oct-09, 30-Mar-10, 12-May-10	100
199-D4-23		07-Oct-09, 31-Mar-10, 12-May-10	100
199-D4-84		08-Oct-09, 24-Mar-10, 03-Jun-10	100
199-D5-13		08-Oct-09, 22-Mar-10, 13-May-10	100
199-D5-14		07-Oct-09, 22-Mar-10, 13-May-10	100
199-D5-15		07-Oct-09, 22-Mar-10, 12-May-10	100

Table 5-3. Sample Design Implementation and Completion Evaluation for 100-D/H Spatial and Temporal Uncertainty Groundwater Monitoring Wells

Well Name*	Samples Required	Date Sampling Completed	Percent Complete (%)
199-D5-16		07-Oct-09, 22-Mar-10, 12-May-10	100
199-D5-17		07-Oct-09, 23-Mar-10, 13-May-10	100
199-D5-18		21-Oct-09, 30-Mar-10, 12-May-10	100
199-D5-19		08-Oct-09, 24-Mar-10, 12-May-10	100
199-D5-37		07-Oct-09, 23-Mar-10, 12-May-10	100
199-D5-38		07-Oct-09, 23-Mar-10, 12-May-10	100
199-D5-43		07-Oct-09, 23-Mar-10, 12-May-10	100
199-D5-99		08-Oct-09, 23-Mar-10, 12-May-10	100
199-D8-5		08-Oct-09, 24-Mar-10, 12-May-10	100
199-D8-55		08-Oct-09, 24-Mar-10, 12-May-10	100
199-D8-70		07-Oct-09, 22-Mar-10, 12-May-10	100
199-D8-71		07-Oct-09, 22-Mar-10, 13-May-10	100
199-D8-88		08-Oct-09, 24-Mar-10, 03-Jun-10	100
199-H3-2A		11-Oct-09, 21-Mar-10, 13-May-10	100
199-H3-4		11-Oct-09, 21-Mar-10, 13-May-10	100
199-H3-5		11-Oct-09, 21-Mar-10, 16-May-10	100
199-H4-10		11-Oct-09, 01-Apr-10, 16-May-10	100
199-H4-11		21-Oct-09, 21-Mar-10, 18-May-10	100
199-H4-13		11-Oct-09, 21-Mar-10, 13-May-10	100
199-H4-16		11-Oct-09, 21-Mar-10, 11-Jun-10	100
199-H4-3		05-Nov-09, 22-Apr-10, 20-May-10	100
199-H4-45		11-Oct-09, 21-Mar-10, 13-May-10	100
199-H4-46		11-Oct-09, 21-Mar-10, 13-May-10	100
199-H4-48		11-Oct-09, 21-Mar-10, 13-May-10	100
199-H4-5		11-Oct-09, 24-Mar-10, 18-May-10	100
199-H4-6		11-Oct-09, 21-Mar-10, 16-May-10	100
199-H4-9		11-Oct-09, 01-Apr-10, 16-May-10	100
199-H5-1A		11-Oct-09, 21-Mar-10, 13-May-10	100

Table 5-3. Sample Design Implementation and Completion Evaluation for 100-D/H Spatial and Temporal Uncertainty Groundwater Monitoring Wells

Well Name*	Samples Required	Date Sampling Completed	Percent Complete (%)
199-H6-1		11-Oct-09, 21-Mar-10, 13-May-10	100
699-101-45		09-Oct-09, 22-Mar-10, 18-May-10	100
699-87-55		09-Oct-09, 21-Mar-10, 18-May-10	100
699-90-45		09-Oct-09, 21-Mar-10, 17-May-10	100
699-93-48A		09-Oct-09, 21-Mar-10, 18-May-10	100
699-94-41		09-Oct-09, 18-Mar-10, 18-May-10	100
699-94-43		09-Oct-09, 18-Mar-10, 17-May-10	100
699-95-45		09-Oct-09, 18-Mar-10, 17-May-10	100
699-95-48		09-Oct-09, 21-Mar-10, 17-May-10	100
699-95-51		09-Oct-09, 21-Mar-10, 17-May-10	100
699-96-52B		09-Oct-09, 21-Mar-10, 18-May-10	100
699-97-41		09-Oct-09, 21-Mar-10, 17-May-10	100
699-97-45		09-Oct-09, 18-Mar-10, 17-May-10	100
699-97-48B		09-Oct-09, 18-Mar-10, 18-May-10	100
699-98-43		09-Oct-09, 12-Mar-10, 18-May-10	100
699-98-49A		09-Oct-09, 29-Apr-10, 17-May-10	100
699-98-51		09-Oct-09, 30-Mar-10, 18-May-10	100

*From DOE/RL-2009-40, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study* (Table 3-1).

Table 5-4. Sample Design Implementation and Completion Evaluation for 100-D/H Aquifer Tubes

Location*	Samples Required	Sampling Completed	Percent Complete (%)
C7645	Three sampling events to represent seasonal river stage conditions: High – July Transition – August Low - December	23-Jul-10, 29-Aug-10, 14-Dec-10	100
C7646		23-Jul-10, 29-Aug-10, 14-Dec-10	100
C7647		23-Jul-10, 29-Aug-10, 14-Dec-10	100
C7648		23-Jul-10, 29-Aug-10, 14-Dec-10	100
C7649		10-Aug-10, 15-Sept-10, 16-Dec-10	100
C7650		10-Aug-10, 15-Sept-10, 16-Dec-10	100

*From Table 3-1 in DOE/RL-2009-40, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study*.

6 Data Requirements

6.1 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, the third party data validator, or a data user. The tables of data within this report show all of these applied qualification flags. Potential flags and their definitions are presented in Table 6-1.

Table 6-1. HEIS Database Qualification Flags

Flag	Definition
Laboratory-Applied Flags	
B	**Inorganics and Wetchem*:** The analyte was detected at a value less than the contract-required detection limit but greater than or equal to the MDL. The data should be considered usable for decision making purposes. **Organics:** The analyte was detected in both the associated QC blank and in the sample. **Radionuclides:** The associated QC sample blank has a result greater than or equal to two times the MDA and, after corrections, result is greater than or equal to the MDA for this sample.
C	**Inorganics and Wetchem*:** The analyte was detected in both the sample and the associated QC blank, and the sample concentration was less than or equal to five times the blank concentration. The data should be considered unusable for decision making purposes.
D	**All:** Analyte was reported at a secondary dilution factor, typically greater than one (i.e., the primary preparation required dilution either to 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 any comments that may be in the laboratory report case narrative. **Organics:** Concentration exceeds the calibration range of the GC/MS.
N	**All:** The spike sample recovery is outside control limits. The data should be considered usable for decision making purposes.
J	**Organics:** Indicates the constituent was analyzed for and detected. The associated value is estimated because of a QC deficiency identified during laboratory review. The data should be considered usable for decision making purposes.
U	**All:** The constituent was analyzed for and was not detected. The data should be considered usable for decision making purposes.
UJ	**All:** The constituent was analyzed for and was not detected. Because of a QC deficiency identified during laboratory review, the value reported may not accurately reflect the MDL. The data should be considered usable for decision making purposes.
UR	**All:** Indicates the constituent was analyzed for and not detected; however, because of an identified QC deficiency, the data should be considered unusable for decision making purposes.
R	**All:** Indicates the constituent was analyzed for and detected; however, because of an identified QC deficiency, the data should be considered unusable for decision making purposes.
X	**All:** The result-specific translation of this qualifier code is provided in the data report and/or case narrative.

Table 6-1. HEIS Database Qualification Flags

Flag	Definition
Third-Party Validation Applied Flags	
U	The constituent was analyzed for, but was not detected. 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 reporting limit. The data should be considered usable for decision making purposes.
J	Indicates the constituent was analyzed for 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 for and detected. The associated value is estimated with a suspected positive bias 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 for and detected. The associated value is estimated with a suspected negative bias because of a QC deficiency identified during data validation. The data should be considered usable for decision making purposes.
N	The analysis indicates the presence of an analyte that has been tentatively identified.
NJ	The analysis indicates the presence of an analyte that has been tentatively identified and the associated numerical value represents its approximate concentration.
NJ+	The analysis indicates the presence of an analyte that has been tentatively identified. The associated value is estimated with a suspected positive bias because of a QC deficiency identified during data validation.
NJ-	The analysis indicates the presence of an analyte that has been tentatively identified. The associated value is estimated with a suspected negative bias because of a QC deficiency identified during data validation.
UR	Indicates the constituent was analyzed for and not detected; however, because of an identified QC deficiency, the data should be considered unusable for decision making purposes.
R	Indicates the constituent was analyzed for and detected; however, because of an identified QC deficiency, the data should be considered unusable for decision making purposes.
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 request for data review is first processed).
G	Result has been reviewed and determined to be correct, or the result has been corrected with laboratory confirmation or other supporting information.
H	Laboratory holding time was exceeded before the sample was analyzed.
P	Potential problem. Collection/analysis circumstances make the result questionable.
Q	Associated QC sample is out of limits.

Table 6-1. HEIS Database Qualification Flags

Flag	Definition
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 result 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.

*Wetchem is a group of analytical methods that does not use instrumentation but is associated with "wet" chemical reactions.

HEIS = Hanford Environmental Information System
GC/MS = gas chromatography/mass spectrometry
MDA = minimum detectable activity
MDL = method detection limit
QC = quality control

6.2 Analytical Requirements

Table 6-2 lists the analytical performance requirements, as specified in the 100-D/H SAP (DOE/RL-2009-40), for laboratory analyses of groundwater samples collected from existing wells and aquifer tubes for the100-D/H RI. Table 6-3 presents the analytical performance requirements for laboratory analysis of soil/aquifer sediment samples collected during drilling of new wells for the 100-D/H RI.

Table 6-2. Analytical Performance Requirements for 100-D/H Operable Unit Water Samples

CAS	Analyte	Analytical Method[a]	Estimated Quantitation Limit[b]	Precision Requirement (%)	Accuracy Requirement (%)	Action Level	Action Level Basis
Field Measurements							
—	Oxidation Reduction Potential	REDOX PROBE	N/A	Note d	Note d	N/A	N/A
—	pH Measurement	PROBE	0.5 pH unit	Note d	Note d	N/A	N/A
—	Specific Conductance	PROBE	1 µS/cm	Note d	Note d	N/A	N/A
—	Temperature	PROBE	—	Note d	Note d	N/A	N/A
—	Dissolved Oxygen	PROBE	—	Note d	Note d	N/A	N/A
—	Turbidity	PROBE	0.1 NTU	Note d	Note d	N/A	N/A
Laboratory Measurements (radiological)							
12587-46-1	Gross Alpha	GPC	3 pCi/L	≤30[e]	70-130[e]	15 pCi/L	Federal MCL
12587-47-2	Gross Beta	GPC	4 pCi/L	≤30[e]	70-130[e]	N/A	4 mrem/year Federal MCL
10045-97-3	Cesium-137	GEA	15 pCi/L	≤30[e]	70-130[e]	200 pCi/L	Federal MCL
10198-40-0	Cobalt-60	GEA	25 pCi/L	≤30[e]	70-130[e]	200 pCi/L	Federal MCL
14683-23-9	Europium-152	GEA	50 pCi/L	≤30[e]	70-130[e]	200 pCi/L	Federal MCL
15585-10-1	Europium-154	GEA	50 pCi/L	≤30[e]	70-130[e]	60 pCi/L	Federal MCL
10098-97-2	Strontium-90[f]	Strontium-90	2 pCi/L	≤30[e]	70-130[e]	8 pCi/L	40 CFR 141.66
14133-76-7	Technetium-99	LSC – Technetium-99	15 pCi/L	≤30[e]	70-130[e]	900 pCi/L	40 CFR 141.66
10028-17-8	Tritium	LSC – Tritium	400 pCi/L	≤30[e]	70-130[e]	20,000 pCi/L	40 CFR 141.66

Table 6-2. Analytical Performance Requirements for 100-D/H Operable Unit Water Samples

CAS	Analyte	Analytical Method[a]	Estimated Quantitation Limit[b]	Precision Requirement (%)	Accuracy Requirement (%)	Action Level	Action Level Basis
Laboratory Measurements (nonradiological)							
7440-36-0	Antimony	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	5 µg/L	≤20[e]	80-120[g]	5.60 µg/L	Human Health for the Consumption of Water + Organism
7440-38-2	Arsenic	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	4 µg/L[f,h,i]	≤20[g]	80-120[g]	0.018 µg/L	Human Health for the Consumption of Water + Organism
7440-41-7	Beryllium	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	2 µg/L	≤20[g]	80-120[g]	4.0 µg/L	40 CFR 141.62
7440-43-9	Cadmium	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	2 µg/L[c,f]	≤20[g]	80-120[g]	0.25 µg/L	Freshwater CCC
7440-47-3	Chromium	EPA 6010 (ICP metals)	10 µg/L	≤20[g]	80-120[g]	74 µg/L	Freshwater CCC
7440-48-4	Cobalt	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	4 µg/L	≤20[g]	80-120[g]	4.8 µg/L	WAC 173-340-720(4)
7440-50-8	Copper	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	8 µg/L	≤20[g]	80-120[g]	9 µg/L	Freshwater CCC
7439-92-1	Lead	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	2 µg/L	≤20[g]	80-120[g]	2.1 µg/L	WAC 173-201A
7439-96-5	Manganese	EPA 6010 (ICP metals)	5 µg/L	≤20[g]	80-120[g]	50 µg/L	40 CFR 143.3
7439-97-6	Mercury	EPA 200.8	0.5 µg/L[h]	≤20[g]	80-120[g]	0.05 µg/L[b]	WAC 173-201A
7440-02-0	Nickel	EPA 6010 (ICP metals)	40 µg/L	≤20[g]	80-120[g]	52 µg/L	Freshwater CCC

Table 6-2. Analytical Performance Requirements for 100-D/H Operable Unit Water Samples

CAS	Analyte	Analytical Method[a]	Estimated Quantitation Limit[b]	Precision Requirement (%)	Accuracy Requirement (%)	Action Level	Action Level Basis
7782-49-2	Selenium	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	4 µg/L	≤20[g]	80-120[g]	5 µg/L	Freshwater CCC
7440-22-4	Silver	EPA 6010 (ICP metals)	10 µg/L[h,i]	≤20[g]	80-120[g]	5 µg/L	WAC 173-201A
7440-28-0	Thallium	Trace – ICP (6010) or ICP/MS (6020 or 200.8)	2 µg/L[f,h,i]	≤20[g]	80-120[g]	0.24 µg/L	Human Health for the Consumption of Water + Organism
7440-61-1	Uranium	Total uranium (chemical)	1 µg/L	≤20[g]	80-120[g]	30 µg/L	40 CFR 141.62
7440-62-2	Vanadium	EPA 6010 (ICP metals)	25 µg/L	≤20[g]	80-120[g]	30 µg/L	40 CFR 141.62
7440-66-6	Zinc	EPA 6010 (ICP metals)	10 µg/L	≤20[g]	80-120[g]	91 µg/L	WAC 173-201A
75-35-4	1,1-Dichloroethene	EPA 8260 (VOCs)	2 µg/L[i]	≤20[l]	80-120[l]	1 µg/L[b]	WAC 173-340-720(4)(b)(iii)(A) and (B)
71-43-2	Benzene	EPA 8260 (VOCs)	1.5 µg/L[i]	≤20[l]	80-120[l]	1 µg/L[b]	WAC 173-340-720(4)(b)(iii)(A) and (B)
56-23-5	Carbon Tetrachloride	EPA 8260 (VOCs)	1 µg/L	≤20[l]	80-120[l]	1 µg/L[b]	Human Health for the Consumption of Water + Organism
67-66-3	Chloroform	EPA 8260 (VOCs)	5 µg/L	≤20[l]	80-120l	5.7 µg/L	Human Health for the Consumption of Water + Organism
79-01-6	Trichloroethene	EPA 8260 (VOCs)	1 µg/L[c]	≤20[l]	80-120[l]	1 µg/L[b]	WAC 173-340-720(4)(b)(iii)(A) and (B)
75-01-4	Vinyl Chloride	EPA 8260 (VOCs)	5 µg/L[c]	≤20[l]	80-120[l]	1 µg/L[b]	Human Health for the Consumption of Water + Organism

Table 6-2. Analytical Performance Requirements for 100-D/H Operable Unit Water Samples

CAS	Analyte	Analytical Method[a]	Estimated Quantitation Limit[b]	Precision Requirement (%)	Accuracy Requirement (%)	Action Level	Action Level Basis
18540-29-9	Hexavalent Chromium	EPA 7196 (Hexavalent chromium)	10 µg/L	≤20[g]	80-120[g]	10 µg/L	WAC 173-201A
57-12-5	Cyanide[j,k]	EPA 9012	5 µg/L	≤20[g]	80-120[g]	200 µg/L	Federal MCL
16984-48-8	Fluoride	EPA 300.0 (anions by IC)	500 µg/L	≤20[g]	80-120[g]	960 µg/L	WAC 173-340-720(4)(b)(iii)(A) and (B)
14797-55-8	Nitrate (as Nitrogen)[m]	EPA 300.0 (anions by IC)	250 µg/L	≤20[g]	80-120[g]	10,000 µg/L	40 CFR 141.62
14797-65-0	Nitrite (as Nitrogen)[n]	EPA 300.0 (anions by IC)	250 µg/L	≤20[g]	80-120[g]	1,000 µg/L	40 CFR 141.62
14808-79-8	Sulfate	EPA 300.0 (anions by IC)	500 µg/L	≤20[g]	80-120[g]	250,000 µg/L	40 CFR 143.3
N/A	Pesticides[k,o]	EPA 8081	0.5 to 5 µg/L	≤20[l]	80-120[l]	Compound-specific	Compound-Specific
N/A	PCBs[k,p]	EPA 1668A	0.02 µg/L	≤20[l]	80-120[l]	1E-04 to 1.8E-02 µg/L	Aroclor-specific
N/A	PCBs[k,q]	EPA 8082	5 µg/L	≤20[l]	80-120[l]	1E-04 to 1.8E-02 µg/L	Aroclor-specific
N/A	Polynuclear Aromatic Hydrocarbons[k,r]	EPA 8310	0.5 to 5 µg/L	≤20[l]	80-120[l]	2.8E-03 to 2.4E-03 µg/L	Compound-specific
N/A	SVOC[k,s]	EPA 8270	10 to 50 µg/L	≤20l	80-120l	Compound-specific	Compound-specific

Sources:

40 CFR 141.62, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Inorganic Contaminants."
40 CFR 141.66, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Radionuclides."
40 CFR 143.3, "National Secondary Drinking Water Regulations," "Secondary Maximum Contaminant Levels.
EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*.

Table 6-2. Analytical Performance Requirements for 100-D/H Operable Unit Water Samples

CAS	Analyte	Analytical Method[a]	Estimated Quantitation Limit[b]	Precision Requirement (%)	Accuracy Requirement (%)	Action Level	Action Level Basis

EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*.
SW-846, 2007, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B.*
WAC 173-340-720(4), "Model Toxics Control Act—Cleanup," "Ground Water Cleanup Standards," "Method B Cleanup Levels for Potable Ground Water.

a. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020. For EPA Method 200.8, see EPA-600/R-94-111. For the four-digit EPA methods, see SW-846. Tentatively identified compounds will be reported for Methods SW-846 8260 and 8270.

b. Estimated quantitation limit equal to 5 to 10 times the method detection limit (MDL) (SW-846). MDLs are listed in DOE/RL-2008-66, *Hanford Site Groundwater Monitoring for Fiscal Year 2008* (Table C-30). When the action level is less than the MDL, the action level defaults to the MDL.

c. Background values for radionuclides, total metals, and anions are the 90th percentile values from Table 5-2 (if no value listed, Table 5-1 value used) of DOE/RL-96-61, *Hanford Site Background: Part 3: Groundwater Background*. Table 5-1 values were used for cesium-137, cobalt-60, europium-154, europium-155, technetium-99, antimony, silver, and thallium. The background values in Table 5-2 were derived from samples collected and analyzed for the express purpose of establishing the range of background compositions in the upper portion of the unconfined aquifer. To accomplish this, analytical methods were selected to achieve lower detection limits than commonly realized employing conventional analytical techniques.

d. Field measurements have no specific quality control requirement except to perform checks to verify manufacturer's expected performance.

e. Accuracy criteria shown are for associated batch laboratory control sample percent recoveries. Except for gamma energy analysis (GEA), additional accuracy criteria include analysis-specific evaluations performed for matrix spike, tracer, and/or carrier recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate sample relative percent differences.

f. Strontium-90 will be assessed as total radioactive strontium.

g. Accuracy criteria specified are for calculated percent recoveries for associated analytical batch matrix spike samples. Additional accuracy evaluation based on statistical control limits for analytical batch laboratory control samples is also performed. The precision criteria shown is for batch laboratory replicate matrix spike or replicate sample relative percent differences.

h. To meet or approach calculated action levels, laboratories must use axial-based ("trace") ICP analytical methods. The laboratory also may substitute graphite furnace or ICP/MS methods if estimated quantitation limits are met.

i. Action levels are less than established analytical methodology capabilities. The analytical detection limits will be used for working levels, and will be periodically reviewed to establish if lower detection limit capabilities have become available.

j. Cyanide (Method 9012) – this method will be performed only at monitoring well 199-H4-3 for the low-river and high-river stage events.

k. If a validated detection is obtained, sample collection and analysis for this method at the well will be performed for all subsequent sample events. If there is no validated detection for an analyte or method from the initial scheduled event(s) at the well, that analyte and/or method will be dropped from the analytical suite for the well for subsequent sampling events.

l. Accuracy criteria shown are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control limits, if more stringent. Additional accuracy criteria include analyte-specific evaluations performed for matrix spike and surrogate recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate matrix spike analysis relative percent differences. Tentatively identified compounds will be reported for SW-846 Methods 8260 and 8270.

m. The background concentration listed was determined by converting the Nitrate as Nitrate (Nitrate-NO_3) background value of 26,871 µg/L (DOE/RL-96-61) to Nitrate as Nitrogen (Nitrate-N). The conversion was achieved by application of a 0.226 conversion factor to the Nitrate-NO_3 value [Nitrate-NO_3 (concentration) x 0.226 = Nitrate-N

Table 6-2. Analytical Performance Requirements for 100-D/H Operable Unit Water Samples

CAS	Analyte	Analytical Method[a]	Estimated Quantitation Limit[b]	Precision Requirement (%)	Accuracy Requirement (%)	Action Level	Action Level Basis

(concentration)].

n. The background concentration listed was determined by converting the Nitrite background value of 93.7 µg/L (DOE/RL-96-61) to Nitrite as N. The conversion was achieved by application of a 0.304 conversion factor to the Nitrite value (i.e., 0.304 times Nitrite concentration = Nitrite as Nitrogen concentration).

o. Pesticides (Method 8081) - this method will be performed only at monitoring wells 199-D5-15 and 199-D8-71 for the low-river stage event and at well 199-D8-71 for the high-river stage event.

p. PCBs (Method 1668A) - this method will be performed only at six selected monitoring wells (199-D8-71, 199-D8-55, 199-D5-15, 199-H4-13, 199-H4-48, and 199-H4-10) included in the network for the low-river stage event and for two selected monitoring wells (199-D8-55 and 199-D8-71) for the high river stage event.

q. PCBs (Method 8082) - this method will be performed only at sixteen selected monitoring wells (199-H4-10, 199-H4-13, 199-H4-48, 199-H4-45, 199-H4-11, 199-H4-16, 199-H4-3, 199-H3-2A, 199-D5-99, 199-D5-17, 199-D5-15, 199-D8-88, 199-D8-55, 199-D8-71, 199-D5-13, and 199-D4-84) included in the network for the low-river stage event and five selected monitoring wells (199-H4-3, 199-H4-45, 199-H4-11, 199-D8-55, and 199-D8-71) for the high-river stage event.

r. Polynuclear aromatic hydrocarbons (Method 8310) - this method will be performed only at sixteen selected monitoring wells (199-H4-10, 199-H4-13, 199-H4-48, 199-H4-45, 199-H4-11, 199-H4-16, 199-H4-3, 199-H3-2A, 199-D5-99, 199-D5-17, 199-D5-15, 199-D8-88, 199-D8-55, 199-D8-71, 199-D5-13, 199-D4-84) included in the network for the low-river stage event and five selected monitoring wells (199-H4-3, 199-H4-45, 199-H4-11, 199-D8-55, and 199-D8-71) for the high-river stage event.

s. SVOCs (Method 8270)- this method will be performed at sixteen selected monitoring wells (199-H4-10, 199-H4-13, 199-H4-48, 199-H4-45, 199-H4-11, 199-H4-16, 199-H4-3, 199-H3-2A, 199-D5-99, 199-D5-17, 199-D5-15, 199-D8-88, 199-D8-55, 199-D8-71, 199-D5-13, and 199-D4-84) included in the network for the low-river stage event and five selected monitoring wells (199-H4-3, 199-H4-45, 199-H4-11, 199-D8-55, and 199-D8-71) for the high-river stage event.

CAS = Chemical Abstracts Service
CCC = criterion continuous concentration
CFR = *Code of Federal Regulations*
GEA = gamma energy analysis
GPC = gas proportional counting
IC = ion chromatography
ICP = inductively coupled plasma
LSC = liquid scintillation counter
MCL = maximum contaminant level
MDL = method detection limit
MS = mass spectrometry
N/A = not applicable
NTU = nephelometric turbidity unit
PCB = polychlorinated biphenyl
REDOX = Reduction Oxidation (Plant or process)
SVOC = semivolatile organic compound
VOC = volatile organic compound
WAC = *Washington Administrative Code*

Table 6-3. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from Groundwater Wells During Drilling

CAS Number	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
Field Measurements[d]								
—	Gross gamma	10 pCi/g	N/A	N/A	N/A	Portable sodium iodide detector s	≤50	Note e
12587-46-1	Gross alpha	100 dpm/100 cm^2	N/A	N/A	N/A	Portable contamination detector	≤50	Note e
12587-47-2	Gross beta	5,000 dpm/100 cm^2	N/A	N/A	N/A	Portable contamination detector	≤50	Note e
Laboratory Measurements (radiological)								
10045-97-3	Cesium-137[f]	0.1 pCi/g	6.2 pCi/g	1,465 pCi/g	2,930 pCi/g	Gamma energy analysis	≤30[g]	70-130[g]
10198-40-0	Cobalt-60[f]	0.05 pCi/g	1.4 pCi/g	13,900 pCi/g	27,800 pCi/g			
14683-23-9	Europium-152	0.1 pCi/g	3.3 pCi/g	NV[h]	NV[h]			
15585-10-1	Europium-154	0.1 pCi/g	3.0 pCi/g	NV[h]	NV[h]			
10098-97-2	Strontium-90[f,i]	1 pCi/g	4.5 pCi/g	27.6 pCi/g	55.2 pCi/g	Strontium-90	≤30[g]	70-130[g]
14133-76-7	Technetium-99[f]	0.25 pCi/g	5.7 pCi/g	0.46 pCi/g	0.92 pCi/g	LSC – Technetium-99	≤30[g]	70-130[g]
10028-17-8	Tritium[f]	10 pCi/g	510 pCi/g	12.6 pCi/g	25.2 pCi/g	LSC – Tritium	≤30[g]	70-130[g]
Laboratory Measurements (non-radiological)								
7440-36-0	Antimony	6 mg/kg[k]	32 mg/kg	5.4 mg/kg	25.3 mg/kg	EPA 6010 or 200.8 (ICP or ICP/MS)	≤30[j]	70-130[j]
7440-38-2	Arsenic[l]	10 mg/kg	TBD	TBD	TBD			
7440-41-7	Beryllium	0.5 mg/kg	160 mg/kg	63.2 mg/kg	126 mg/kg			
7440-43-9	Cadmium	0.5 mg/kg[k]	80 mg/kg	0. 69 mg/kg	0.25 mg/kg			

Table 6-3. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from Groundwater Wells During Drilling

CAS Number	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
7440-47-3	Chromium (Total)	1 mg/kg	120,000 mg/kg	2,000 mg/kg	2600 mg/kg			
7440-48-4	Cobalt[m]	2 mg/kg	24mg/kg	15.7 mg/kg	NV			
7440-50-8	Copper	1 mg/kg	3,200 mg/kg	284 mg/kg	1,150 mg/kg			
7439-92-1	Lead	5 mg/kg	250 mg/kg	3,000 mg/kg	840 mg/kg			
7439-96-5	Manganese[n]	5 mg/kg	3,760 mg/kg	512 mg/kg	512 mg/kg			
7440-02-0	Nickel	4 mg/kg	1,600 mg/kg	130 mg/kg	357 mg/kg			
7782-49-2	Selenium	10 mg/kg[k]	400 mg/kg	5.2 mg/kg	1.04 mg/kg			
7440-22-2	Silver	1 mg/kg[k]	400 mg/kg	13.6 mg/kg	0.884 mg/kg			
7440-28-0	Thallium	5 mg/kg[k]	5.6 mg/kg	1.59 mg/kg	4.46 mg/kg			
7440-62-2	Vanadium	2.5 mg/kg	560 mg/kg	2,240 mg/kg	NV			
7440-66-6	Zinc	1 mg/kg	24,000 mg/kg	5,970 mg/kg	226 mg/kg			
18540-29-9	Hexavalent Chromium[o]	0.5 mg/kg	TBD	TBD	TBD	EPA 7196 (Hexavalent chromium)	≤30[j]	70-130[j]
7439-97-6	Mercury	0.2 mg/kg	24 mg/kg	2.09 mg/kg	0.33 mg/kg	EPA 7471 (mercury by cold vapor)	≤30[j]	70-130[j]
7440-61-1	Uranium (Total)[r]	1 mg/kg	240 mg/kg	3.21 mg/kg	3.21 mg/kg	UKPA or via Isotopic	≤30[j]	70-130[j]
16984-48-8	Fluoride	5 mg/kg	4,800 mg/kg	2,880 mg/kg	5,770 mg/kg	EPA 300.0 (anions by IC)	≤30[3]	70-130[3]
147-97-55-8	Nitrate (as Nitrogen)	2.5 mg/kg	128,000 mg/kg	40 mg/kg	80 mg/kg			

Table 6-3. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from Groundwater Wells During Drilling

CAS Number	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			
147-97-65-0	Nitrite (as Nitrogen)	2.5 mg/kg	8,000 mg/kg	4 mg/kg	8 mg/kg			
14808-79-8	Sulfate	5 mg/kg	NV	1,030 mg/kg	2,060 mg/kg			
71-43-2	Benzene	0.005 mg/kg[p]	18.2 mg/kg	0.00448 mg/kg	0.014 mg/kg	EPA 8260 (volatile organics)	≤30[q]	70-130[q]
56-23-5	Carbon Tetrachloride	0.005 mg/kg[p]	7.69 mg/kg	0.031 mg/kg	0.0046 mg/kg			
67-66-3	Chloroform	0.005 mg/kg	164 mg/kg	0.038 mg/kg	0.0607 mg/kg			
540-59-2	1,1-Dichloroethene	0.01 mg/kg[p]	1.67 mg/kg	0.0005 mg/kg	0.0008 mg/kg			
79-01-6	Trichloroethene	0.005 mg/kg[p]	11.2 mg/kg	0.00323 mg/kg	0.0355 mg/kg			
75-01-4	Vinyl Chloride[6]	0.01 mg/kg[p]	0.667 mg/kg	0.00018 mg/kg	0.0252 mg/kg			

a. Unless otherwise noted, Preliminary Cleanup Goals are established in WAC 173-340, *Model Toxics Control Act—Cleanup*.

b. Value includes a groundwater-to-river dilution attenuation factor of 2 based on DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*. A task is included in DOE/RL-2008-46, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*, to evaluate the appropriate dilution attenuation factor. Other considerations for analysis include WAC 173-340-730(6)(b).

c. Equivalent methods may be substituted. For EPA Method 300.0, see EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*. For EPA Method 200.8, see EPA-600/R-94-111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*. For the four-digit EPA methods, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*.

d. Borehole will be logged with a neutron moisture tool and the high resolution, spectral gamma ray logging system. Geologic samples will also be logged. Vadose zone soil samples will be field-screened for gross alpha, gross beta, and gross gamma activities. Aquifer sediment samples will be field-screened for gross gamma activity.

e. Field measurements have no specific QC requirement except to perform checks to verify manufacturer's expected performance.

f. The groundwater protection and river protection preliminary cleanup goal values for cesium-137, cobalt-60, technetium-99, tritium, and strontium-90 were established in DOE/RL-96-17.

g. Accuracy criteria shown are for associated batch laboratory control sample percent recoveries. Except for gamma energy analysis, additional accuracy criteria include analysis-specific evaluations performed for matrix spike, tracer, and/or carrier recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate sample RPDs.

h. Generic RESRAD modeling reported in DOE/RL-96-17 predicts the contaminant will not reach groundwater within 1,000 years; however, site-specific modeling will be performed, as

Table 6-3. Analytical Performance Requirements for Soil/Aquifer Sediment Samples from Groundwater Wells During Drilling

CAS Number	Analyte	Estimated Quantitation Limit	Preliminary Cleanup Goals[a]			Analytical Method[c]	Precision Requirement (%)	Accuracy Requirement (%)
			Direct Exposure	Groundwater Protection	River Protection[b]			

necessary, to determine whether preliminary cleanup goals have been met.

i. Strontium-90 will be assessed as total radioactive strontium.

j. Accuracy criterion specified is for calculated percent recoveries for associated analytical batch matrix spike samples. Additional accuracy evaluation based on statistical control limits for analytical batch laboratory control samples is also performed. The precision criterion shown is for batch laboratory replicate matrix spike or replicate sample RPDs.

k. To meet or approach calculated cleanup goals, laboratories must use axial-based ("trace") ICP analytical methods. The laboratory also may substitute graphite furnace or ICP/MS methods if estimated quantitation limits are met.

l. The preliminary cleanup goal value for arsenic will be re-evaluated as described in DOE/RL-2008-46.

m. Cobalt groundwater and river protection preliminary cleanup goal values are based on Hanford Site background values.

n. The manganese groundwater and river protection preliminary cleanup goal values are not risk based. They based on Hanford site background.

o. A task is included in DOE/RL-2008-46 to re-evaluate hexavalent chromium cleanup levels.

p. Calculated cleanup goals are less than established analytical methodology capabilities. The analytical detection limits will be used for working levels, and will be periodically reviewed to establish if lower detection limit capabilities have become available.

q. Accuracy criteria shown are the minimum for associated batch laboratory control sample percent recoveries. Laboratories must meet statistically based control limits, if more stringent. Additional accuracy criteria include analyte-specific evaluations performed for matrix spike and surrogate recoveries, as appropriate to the method. The precision criteria shown are for batch laboratory replicate matrix spike analysis RPDs. Tentatively identified compounds will be reported for SW-846 Method 8260.

r. The uranium groundwater and river protection preliminary cleanup goal values are not risk-based. The values are based on Hanford Site background.

$CaCO_3$	=	calcium carbonate	NV	=	no value
CAS	=	Chemical Abstracts Service	QC	=	quality control
IC	=	ion chromatography	QL	=	quantitation limit
ICP	=	inductively coupled plasma	RESRAD	=	residual radioactivity (dose model)
MS	=	mass spectrometry	RPD	=	relative percent difference
N/A	=	not applicable	UKPA	=	total uranium by kinetic phosphorescence analysis

6.3 Laboratory Quality Assurance and Quality Control Requirements

The quality assurance/quality control (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 analytical batch or 1 in 20 (5 percent), whichever is more frequent. Laboratory internal QC checks include the following:

- **Laboratory Contamination.** Each analytical batch contains a laboratory (method) blank (material of composition similar to that of the samples with known/minimal contamination from the analytes of interest) carried through the complete analytical process. The method blank 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, or 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, such as gamma energy analysis (GEA), 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 (such as laboratory control spike). In addition to the MS recovery, surrogate compounds are used to evaluate accuracy in the volatile organic analysis. Surrogate compounds with instrumental responses that are typical of the other analytes 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 spike 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.

- **Laboratory Control Samples or QC Reference Samples (Analytical Accuracy).** A laboratory control sample (LCS) is prepared from an independent standard at a concentration other than that used for calibration but 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. Laboratories are also subject to periodic and random audits of laboratory performance, systems, and overall program. Audits check that the laboratories are performing to laboratory contract requirements. No audits were performed with respect to the data analyses performed as part of this project.

7 Results

This chapter includes an overall evaluation of the data against identified regulatory preliminary cleanup goals or action levels and the data validation results for a representative number of sample delivery groups (SDGs).

Collected samples were packaged and sent to the five laboratories as described in Section 1.1. Material collected from designated sample intervals was analyzed using specified analytical methods. Sample material designated for a particular analysis by the selected laboratory was tracked by a unique HEIS database number. Analytical requests for chemical and radiochemical services to be completed by the laboratories were documented on chain-of-custody forms. Analytical results provided by the laboratories were tracked and documented by SDGs in data packages.

7.1 Data Exceeding Preliminary Cleanup Goals or Action Levels

Preliminary cleanup goals for soil/aquifer sediment target analytes and action levels for the groundwater COPCs for spatial and temporal uncertainty monitoring were established in the 100-D/H SAP (DOE/RL-2009-40). Table 6-2 presents the analytical performance requirements and action levels for 100-D/H OU water sample COPCs. Table 6-3 presents the analytical performance requirements and preliminary cleanup goals for aquifer sediment target analytes. Table 7-1 summarizes the results of the comparison of reported results against these regulatory levels.

Table 7-1. Analytical Results Exceeding Preliminary Cleanup Goals or Action Levels

Analyte/Action Level	Location of Exceedances
100-D/H Water Samples	
Strontium 90 (8 pCi/L, 40 CFR 141.66)	Spatial and Temporal Uncertainty: Samples from wells 199-H4-13 (all three rounds), well 199-H4-45 (all three rounds), and well 199-H4-11 (Sample collected on 10/21/09). New wells: 199-D3-5 (sample collected on 11/19/2010), 199-D5-132 (samples collected on 01/12/2011, 01/13/2011 and 01/14/2011), and 199-H3-6 (sample collected on 11/03/2010). Aquifer tubes: C7649 (sample collected on 12/16/2010).
Technetium 99 (900 pCi/L, 40 CFR 141.66)	Spatial and Temporal Uncertainty: Sample from well 199-D5-18 (sample collected on 5/12/10, note: result has been flagged as suspect).
Tritium (20,000 pCi/L, 40CFR 141.66)	Samples from well 199-D6-3 (samples collected on 12/02/2010)
Arsenic (0.018 µg/L, Human Health for the Consumption of Water + Organism)	All samples collected
Cadmium (0.25 µg/L, Freshwater CCC)	New Wells: Samples from well 199-H3-10 (sample collected on 03/22/2011). Aquifer tubes: C7646 (sample collected 08/29/2010).

Table 7-1. Analytical Results Exceeding Preliminary Cleanup Goals or Action Levels

Analyte/Action Level	Location of Exceedances
Chromium (74 µg/L, Freshwater CCC)	Spatial and Temporal Uncertainty: Samples collected from wells 199-D5-99 (all three rounds), 199-D5-13 (all three rounds), 199-D5-14 (all three rounds), 199-D5-15 (all three rounds including duplicate), 199-D5-16 (all three rounds), 199-D5-38 (all three rounds including duplicate), 199-D5-43 (all three rounds), 199-D8-5 (all three rounds including duplicate), 199-D8-88 (all three rounds including duplicate), 199-D8-71 (all three rounds including duplicate), 199-D8-55 (samples collected on 03/24/2010 and 05/12/2012), 699-97-41 (all three rounds), and 199-D8-80 (samples collected on 03/22/2012 and 10/07/09). New Wells: 699-97-45 (sample collected on 05/17/2012), 199-D3-5 (sample collected on 11/19/2010), 199-D5-134 (samples collected on 01/21/2011, 01/24/2011 and 01/25/2011), 199-D5-140 (samples collected on 01/12/2011, 01/13/2011 and 01/14/2011), 199-D5-141 (samples collected on 03/02/2011and 03/08/2011), 199-D5-143 (samples collected on 04/14/2011 and 04/18/2011), and 199-H3-9 (sample collected on 01/24/2011).
Cobalt [4.8 µg/L, WAC 173-340-720(4)(b)(iii)(A) and (B)]	New Wells: Samples collected from wells 199-D5-133 (sample collected on 12/01/2010), 199-H2-1 (sample collected on 02/16/2011) 199-H3-10 (sample collected on 03/22/2011), and 199-H6-3 (samples collected on 11/05/2010).
Copper (9 µg/L, Freshwater CCC)	New Wells: Samples collected from wells 199-D5-132 (samples collected on 01/13/2011), 199-D5-133 (samples collected on 11/29/2010 and 12/01/2010), 199-D5-141 (sample collected on 03/02/2011), 199-D5-143 (sample collected on 04/14/2011), 199-H2-1 (samples collected on 02/16/2011, 02/24/2011 and 02/25/2011), 199-H3-10 (samples collected on 03/21/2011, 03/22/2011 and 03/29/2011), 199-H3-7 (sample collected on 11/10/2010), 199-H3-9 (sample collected on 01/22/2011), 199-H6-3 (samples collected on 11/05/2010), and 199-H6-4 (samples collected on 11/08/2010).
Lead (2.1 µg/L, WAC 173-201A)	New Wells: Samples collected from wells 199-D5-132 (samples collected on 01/13/2011 and 01/14/2011), 199-D5-133 (samples collected on 11/29/2010 and 12/01/2010), 199-D5-143 (sample collected on 04/14/2011), 199-H2-1 (samples collected on 02/16/2011), 199-H3-10 (samples collected on 03/21/2011 and 03/29/2011), 199-H3-7 (sample collected on 11/10/2010), 199-H3-9 (sample collected on 01/22/2011), and 199-H6-3 (samples collected on 11/05/2010).
Hexavalent Chromium (10 µg/L, WAC 173-201A)	Spatial and Temporal Uncertainty: Samples collected from wells 199-D2-6 (all three rounds including duplicate), 199-D4-23 (all three rounds including duplicate), 199-D5-84 (all three rounds including duplicate and split), 199-D5-13 (all three rounds), 199-D5-14 (all three rounds), 199-D5-15 (all three rounds including duplicate), 199-D5-16 (all three rounds including duplicate), 199-D5-17 (sample collected on 10/07/2009), 199-D5-18 (sample

Table 7-1. Analytical Results Exceeding Preliminary Cleanup Goals or Action Levels

Analyte/Action Level	Location of Exceedances
	collected on 10/21/2009), 199-D5-37 (all three rounds), 199-D5-38 (all three rounds including duplicate), 199-D5-43 (all three rounds including duplicate and split), 199-D5-99 (all three rounds), 199-D8-5 (all three rounds including duplicate), 199-D8-55 (all three rounds), 199-D8-70 (all three rounds), 199-D8-71 (all three rounds including duplicate), 199-D8-88 (all three rounds including duplicate), 199-H3-2A (sample collected on 03/21/2010), 199-H3-4 (all three rounds including duplicate), 199-H3-5 (all three rounds), 199-H4-10 (all three rounds), 199-H4-11 (samples collected on 05/18/2010 and 10/21/2009), 199-H3-13 (all three rounds), 199-H4-45 (sample collected on 05/13/2010), 199-H4-46 (all three rounds including duplicate), 199-H4-48 (sample collected on 10/11/2009), 199-H4-5 (sample collected on 05/18/2010), 199-H4-9 (sample collected on 10/11/2009; note: value flagged as suspect), 199-H5-1A (all three rounds), 199-H6-1 (samples collected on 03/21/2010 and 05/13/2010), 699-101-45 (all three rounds), 699-87-55 (samples collected on 03/21/2010 and 05/18/2010), 699-94-41 (all three rounds including duplicate), 699-94-43 (all three rounds), 699-95-45 (all three rounds including duplicate), 699-95-48 (all three rounds), 699-95-51 (all three rounds), 699-96-52B (all three rounds including duplicate), 699-97-41 (all three rounds), 699-97-45 (all three rounds), 699-97-48B (all three rounds), 699-98-43 (all three rounds), and 699-98-51 (samples collected on 10/09/2009 and 03/30/2010). New Wells: 199-D3-5 (samples collected on 11/18/2010 and 11/19/2010), 199-D5-132 (samples collected on 01/12/2011 and 01/13/2011), 199-D-133 (sample collected on 11/29/2010), 199-D5-134 (samples collected on 01/21/2011, 01/24/2011 and 01/25/2011), 199-D5-140 (samples collected on 01/12/2011, 01/13/2011 and 01/14/2011), 199-D5-141 (samples collected on 03/02/2011 and 03/08/2011), 199-D5-143 (samples collected on 04/14/2011 and 04/18/2011), 199-H3-7 (samples collected on 11/11/2010), 199-H3-9 (sample collected on 01/24/2011), and 199-H6-3 (sample collected on 11/08/2010).
Manganese (50 µg/L, 40 CFR 143.3)	Spatial and Temporal Uncertainty: Samples collected from wells 199-H4-6 (samples collected on 10/11/2009 and 03/21/2010) and 699-90-45 (all three rounds including duplicate). New Wells: 199-D5-132 (samples collected on 01/12/2011, 01/13/2011 and 01/14/2011), 199-D5-133 (samples collected on 11/29/2010, 11/30/2010 and 12/01/2010), 199-D5-134 (samples collected on 01/21/2011, 01/24/2011, 01/25/2011, 02/03/2011 and 02/08/2011), 199-D5-140 (samples collected on 01/12/2011, 01/13/2011 and 01/14/2011), 199-D5-141 (samples collected on 03/02/2011, 03/08/2011 and 03/21/2011), 199-D5-143 (samples collected on 04/14/2011), 199-D6-3 (samples collected on 12/02/2010 and 12/03/2010), 199-H2-1 (samples collected on 02/16/2011, 02/24/2011 and 02/25/2011), 199-H3-10 (samples collected on 03/21/2011, 03/22/2011 and 03/29/2011), 199-H3-7 (sample collected on 11/10/2010), 199-H3-9 (samples

Table 7-1. Analytical Results Exceeding Preliminary Cleanup Goals or Action Levels

Analyte/Action Level	Location of Exceedances
	collected on 01/21/2011, 01/22/2011 and 01/26/2011), 199-H6-3 (samples collected on 11/05/2010 and 11/08/2010), and 199-H6-4 (sample collected on 11/08/2010). Aquifer tubes: C7648 (all three rounds), C7650 (sample collected on 08/10/2010), and C7646 (samples collected on 07/23/2010 and 08/29/2010).
Mercury (0.05 µg/L, WAC 173-201A)	All samples collected.
Selenium (5 µg/L, Freshwater CCC)	Spatial and Temporal Uncertainty: Samples collected from wells 199-D8-5 (sample collected on 03/24/2010), 199-D8-70 (sample collected on 03/22/2010), 199-D8-88 (all three rounds), and 699-95-51 (sample collected on 10/09/2009). New Wells: 199-D6-3 (samples collected on 12/02/2010).
Silver (5 µg/L, WAC 173-201A)	ICP-AES (method 6010) - all samples collected. Note: ICP/MS data all below action level.
Thallium (0.24 µg/L, Human Health for the Consumption of Water + Organism)	Spatial and Temporal Uncertainty: Samples collected from wells 199-D8-71 (sample collected on 05/13/2010), 199-H3-2A (sample collected on 10/11/2009), and 199-D8-5 (sample collected on 03/24/2010). Aquifer tubes: C7646 (sample collected 08/29/2010).
Zinc (91 µg/L, WAC 173-201A)	Spatial and Temporal Uncertainty: Samples collected from well 199-D4-84 (all three rounds including field dup). New Wells: 199-D5-133 (samples collected on 11/29/2010 and 11/30/2010), 199-D5-134 (samples collected on 01/25/2011 and 02/03/2011), 199-D5-140 (sample collected on 01/12/2011), 199-D5-141 (sample collected on 03/02/2011), 199-D6-3 (sample collected on 12/03/2010), 199-H2-1 (samples collected on 02/16/2011, 02/24/2011 and 02/25/2011), 199-H3-10 (samples collected on 03/21/2011 and 03/29/2011), and 199-H6-3 (sample collected on 11/05/2010).
Carbon Tetrachloride (1 µg/L, Human Health for the Consumption of Water + Organism)	Spatial and Temporal Uncertainty: Samples collected from wells 199-D5-18 (sample collected on 10/21/09), 199-D2-6 (sample collected on 10/08/09), 199-H4-11 (sample collected on 10/21/09), 699-98-49A (sample collected on 10/09/09) and 699-95-48 (sample collected on 10/09/09), 699-94-43 (sample collected on 10/09/09), 699-95-45 (sample collected on 10/09/09),699-95-51 (sample collected on 10/09/09), 699-96-52B (sample and dup collected on 10/09/09), 699-97-41 (sample collected on 10/09/09), and 699-97-48B (sample collected on 10/09/09). New Wells: 199-H3-9 (sample collected on 02/01/2011 Note: data point has been flagged as suspect).

Table 7-1. Analytical Results Exceeding Preliminary Cleanup Goals or Action Levels

Analyte/Action Level	Location of Exceedances
Chloroform (5.7 µg/L, Human Health for the Consumption of Water + Organism)	Spatial and Temporal Uncertainty: Samples from wells 199-D8-5 (sample collected on 10/08/09), 199-D8-88 (sample collected on 10/08/09), 199-D5-13 (sample collected on 10/08/09), and 199-D5-38 (sample collected on 10/07/09). New Wells: 199-D5-141 (samples collected on 03/02/2011. Note: data points under review) and 199-H3-9 (sample collected on 01/24/2011 Note: data point has been flagged as suspect).
Nitrate (as Nitrogen) (10,000 µg/L, 40 CFR 141.66)	Spatial and Temporal Uncertainty: Samples collected from 199-H4-6 (sample collected on 10/11/09 Note: value flagged as suspect), 199-D5-15 (all three rounds), 199-D2-6 (all three rounds including duplicate), 199-D5-16 (all three rounds), 199-D5-14 (all three rounds), 199-D5-17 (all three rounds), 199-D5-15 (sample collected on 10/07/09), 199-D5-19 (all three rounds), 199-D5-18 (all three rounds), 199-D8-5 (all three rounds including duplicate), 199-D8-71 (all three rounds including duplicate), 199-H4-46 (sample collected on 10/11/09), and 199-D5-13 (all three rounds). New Wells: 199-D3-5 (samples collected on 11/18/2010 and 11/19/2010), 199-D5-132 (samples collected on 01/13/2011 and 01/14/2011), 199-D5-133 (samples collected on 11/30/2010 and 12/01/2010), 199-D5-134 (samples collected on 01/21/2011, 01/24/2011 and 01/25/2011), 199-D5-140 (samples collected on 01/12/2011, 01/13/2011 and 01/14/2011), 199-D5-141 (sample collected on 03/02/2011), 199-D5-143 (samples collected on 04/14/2011 and 04/18/2011), 199-D6-3 (samples collected on 12/02/2010 and 12/03/2010), and 199-H6-3 (sample collected on 199-H6-3).
Sulfate (250,000 µg/L 40 CFR 143.3)	Samples collected from well 199-D4-84 (all three rounds).
Aquifer Sediment Samples	
Manganese (512 mg/kg, WAC 173-340, *Model Toxics Control Act—Cleanup*)	Samples from wells 199-H3-9 (sample collected on 01/22/2011), 199-D5-141 (sample collected on 03/14/2011), and 199-H3-10 (sample collected on 03/17/2011).
Selenium (1.04 mg/kg, WAC 173-340, *Model Toxics Control Act—Cleanup*)	Samples from wells 199-D5-134 (samples collected on 01/25/2011 and 02/01/2011), 199-D5-141 (samples collected on 03/14/2011), 199-D5-143 (sample collected on 12/03/2010), 199-D6-3 (sample collected on 12/03/2010), 199-H1-7 (sample collected on 11/12/2010), 199-H2-1 (samples collected on 02/23/2011), 199-H3-10 (samples collected on 03/17/2011, 03/18/2011 and 03/21/2011), 199-H3-10 (sample collected on 11/11/2010), and 199-H3-9 (samples collected on 01/22/2011 and 01/24/2011).

Table 7-1. Analytical Results Exceeding Preliminary Cleanup Goals or Action Levels

Analyte/Action Level	Location of Exceedances

Sources:

40 CFR 141.66, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Radionuclides."

40 CFR 143.3, "National Secondary Drinking Water Regulations," "Secondary Maximum Contaminant Levels."

WAC 173-201A, "Water Quality Standards for Surface Waters of the State of Washington."

WAC 173-340-720(4), "Model Toxics Control Act—Cleanup," "Groundwater Cleanup Standards," "Method B Cleanup Levels for Potable Ground Water."

ICP/MS = inductively coupled plasma/mass spectrometry

ICP/AES = inductively coupled plasma/atomic emission spectroscopy

7.2 Nondetect Data Exceeding Quantitation Limits

The majority of laboratory detection limits met the quantitation limits (QLs) defined in the 100-D/H SAP (DOE/RL-2009-40) with the following exceptions:

- For the Spatial and Temporal Uncertainty sample data set, the laboratories were not able to meet the QLs listed in the 100-D/H SAP for gross alpha (three non-detects above QL), gross beta (sixteen non-detects above QL), strontium-90 (four non-detects above QL), chromium by method 6010 (all non-detects above QL; note: 200.8 data all met required QL).
- For the Aquifer Tube sample data set, the laboratories were not able to meet the QLs listed in the 100-D/H SAP for cesium-137, cobalt-60, europium-152 and 154 (two non-detects above QLs) and manganese (two non-detects above QL).
- For the Groundwater Water Samples from New Wells data set, the laboratories were not able to meet the QLs listed in the 100-D/H SAP for gross beta (one non-detect above the QL).
- For the Soil/Aquifer Sediment samples from new wells data set, the laboratories were not able to meet the QLs listed in the 100-D/H SAP for hexavalent chromium (fifteen non-detects above the QL).

In all cases listed above, the QLs, and therefore the non-detects, were below the associated action levels for the analyte.

7.3 Data Validation

Data validation was performed by Analytical Quality Associates, Inc. (AQA) of Albuquerque, New Mexico, as documented in the following data validation reports:

- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-007 Project CERC110 Chemical & Radiochemical Validation – Level C* (AQA, 2011a)
- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-008 Project CERC10, SURV10, Chemical & Radiochemical Validation – Level C* (AQA, 2011b)
- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-009 Project SURV10, 100 Area RI/FS, Chemical & Radiochemical Validation – Level C* (AQA, 2011c)

- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-010 Project 100 Area RI/FS, Chemical & Radiochemical Validation – Level C* (AQA, 2011d)
- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-011 Project CERC10, Chemical & Radiochemical Validation – Level C* (AQA, 2011e)
- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-013 Project CERC10, Chemical & Radiochemical Validation – Level C* (AQA, 2011f)
- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-014 Project CERC10, Chemical & Radiochemical Validation – Level C* (AQA, 2011g)
- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-038 Project 100 Area RI/FS, Chemical & Radiochemical Validation – Level C* (AQA, 2011h)
- *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-039 Project 100 Area RI/FS, Chemical & Radiochemical Validation – Level C* (AQA, 2011i)

All data flags assigned resulting from data validation were entered into HEIS.

7.3.1 Validation Summary

The 100-D/H SAP (DOE/RL-2009-40) specifies that at least 5 percent (by matrix and analyte group) of all chemical and radiochemical data must undergo Level C data validation. Validation of selected laboratory data was performed by AQA. Table 7-2 summarizes the samples and laboratory methods that were independently validated for the 100-D/H study. As shown in the table, the 5 percent 100-D/H SAP requirement was satisfied with the exception of ion chromatography and selected radiochemical isotopes in the aquifer sediment matrix. The sample set for these analytes was relatively small and the lack of validation is not expected to adversely impact data quality or usability.

7.3.1.1 Major Deficiencies

A major deficiency results in the qualification of sample data as unusable for decision making purposes. No major deficiencies were found for inorganics, general chemistry, and radiochemistry.

Major deficiencies were noted for two samples resulting in the qualification of some data as unusable non-detects. For one volatile organic analysis (VOA) sample (B257R7), all VOA COPC analytes except chloroform were flagged UR (unusable non-detect) because of an analytical hold time violation. In addition, a major deficiency was found resulting in the qualification of one semivolatile organic analysis (SVOA) sample (B27CB0) as an unusable non-detect for two compounds (3,3 dichlorobenzidine and 4-nitrophenol). These samples are discussed further in Section 10.2, Data Validation Considerations.

Table 7-2. 100-D/H Validated Samples

Analyte Category	Total Number of Samples Analyzed	Total Number of Samples Validated	Percent Validated (%)
100-D/H Operable Unit Water Samples (Dura, Aquifer Tubes, and Groundwater from New Wells) VSR 11-007, VSR 11-008, VSR 11-009, VSR 11-011, VSR 11-013, VSR 11-014, and VSR 11-039			
VOA (8260B)	267	95	35
SVOA (8270C)	48	25	52
PCB (1668 and 8082)	43	16	37
PAH (8310)	23	6	26
Pesticides (8081)	3	1	33
ICP-MS Metals (200.8)	278	37	13
ICP-AES Metals (6010)	191	29	15
Ion Chromatography (300.0)	273	22	8
Hexavalent Chromium (7196a)	273	14	5
Cyanide (4500E or 335.2)	5	1	20
Gross Alpha	261	28	11
Gross Beta	261	28	11
Gamma	259	45	17
Strontium-89/90	259	32	12
Technicium-99	159	31	12
Tritium	256	29	11
Soil/Aquifer Sediment Samples During Drilling VSR 11-010 and VSR11-038			
VOA (8260B)	6	2	33
ICP-MS Metals (200.8)	46	4	9
ICP-AES Metals (6010)	16	1	6
Ion Chromatography (300.0)	6	0	0
Hexavalent Chromium (7196)	29	4	14
Gamma	15	0	0
Strontium-89/90	15	0	0
Technicium-99	15	0	0
Tritium	15	3	20

Table 7-2. 100-D/H Validated Samples

Analyte Category	Total Number of Samples Analyzed	Total Number of Samples Validated	Percent Validated (%)

ICP-AES = inductively coupled plasma/atomic emission spectroscopy
ICP-MS = inductively coupled plasma/mass spectrometry
PAH = polynuclear aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
VOA = volatile organic analysis

7.3.1.2 Minor Deficiencies

A minor deficiency results in qualification of sample data as non-detected or estimated; however, the data should be considered usable for decision making purposes.

A variety of minor deficiencies was identified for inorganics (metals), general chemistry, radiochemistry and organics (VOA, SVOA, PCBs pesticides, and polynuclear aromatic hydrocarbons [PAHs]). These deficiencies led to results being qualified as estimated or as non-detected as summarized in Tables 7-3 and 7-4. A total of 5,393 analytical data points were subject to third party validation, resulting in the application of 2,374 validation flags, which comprises 44 percent of the data set reviewed. A significant number (1,234) of the applied data flags were associated with SVOA data for which the LCS and or MS recoveries did not meet 100-D/H SAP requirements. However, the majority of these results met the statistical performance criteria established by the laboratories. In addition, 896 of the applied data flags were associated with PCB congener analysis, which had blank contamination issues and or missing LCS duplicate (LCSD) data. Due to the extremely low detection levels involved in the PCB congener analysis, it is very difficult to avoid trace levels of contamination during analysis. The levels noted here are not significant enough to affect data use.

Although validation resulted in the application of a relatively large percentage of flags, the issues noted were minor and do not affect the overall usability of the data set.

7.3.2 Qualification Flags Applied to the Data Set

Tables 7-3 and 7-4 list the qualification flags applied to the data set as a result of the data validation process.

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
VSR11-007			
Organics (SW-846 1668A – Polychlorinated Biphenyls)			
PCB 4	J^+	B23VV8, B24CT9, B24CT6	High LCS recovery
PCB 4, PCB 9	J^+	B24CT7	High LCS recovery
PCB 3, PCB 7, PCB 15, PCB 20, PCB 21, PCB 22, PCB 26, PCB 28, PCB 29, PCB 31, PCB 33, PCB 37, PCB 44, PCB 47, PCB 49, PCB 52, PCB 61, PCB 65, PCB 66, PCB 69, PCB 70, PCB 74, PCB 76, PCB 83, PCB 86, PCB 87, PCB 95, PCB 97, PCB 99, PCB 105, PCB 109/108, PCB 116, PCB 117, PCB 118, PCB 119, PCB 125, PCB 128, PCB 132, PCB 137, PCB 141, PCB 146, PCB 147, PCB 149, PCB 156, PCB 157, PCB 158, PCB 164, PCB 166, PCB 174, PCB 177, PCB 180, PCB 187, PCB 193	0.038 U	B23VV8	Laboratory blank contamination
PCB 8, PCB 11, PCB 12 PCB 13, PCB 18, PCB 30	0.057 U	B23VV8	Laboratory blank contamination
PCB 129, PCB 138, PCB 160, PCB 163	0.061 U	B23VV8	Laboratory blank contamination
PCB 153, PCB 1687	0.054 U	B23VV8	Laboratory blank contamination
PCB 8, PCB 11, PCB 12, PCB 13, PCB 18, PCB 30	0.057 U	B24CT9	Laboratory blank contamination
PCB 2, PCB 7, PCB 15, PCB 20, PCB 21, PCB 22, PCB 26, PCB 28, PCB 29, PCB 31, PCB 33, PCB 40, PCB 41, PCB 44, PCB 45, PCB 47, PCB 49, PCB 51, PCB 61, PCB 65, PCB 66, PCB 69, PCB 70, PCB 71, PCB 74, PCB 76, PCB 86, PCB 87, PCB 90, PCB 95, PCB 97, PCB 101, PCB 109/108, PCB 110, PCB 113, PCB 115, PCB 118, PCB 119, PCB 125, PCB 129, PCB 138, PCB 147, PCB 149, PCB 153, PCB 160, PCB 163, PCB 168	0.038 U	B24CT9	Laboratory blank contamination

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
PCB 2, PCB 7, PCB 15, PCB 20, PCB 21, PCB 28, PCB 31, PCB 33, PCB 44, PCB 47, PCB 61, PCB 65, PCB 70, PCB 74, PCB 76, PCB 110, PCB 115, PCB 118, PCB 129, PCB 138, PCB 147, PCB 149, PCB 153, PCB 160, PCB 163, PCB 168	0.038 U	B24CT5	Laboratory blank contamination
PCB 8, PCB 11, PCB 12, PCB 13	0.057 U	B24CT5	Laboratory blank contamination
PCB 1, PCB 2, PCB 7, PCB 15, PCB 20, PCB 21, PCB 22, PCB 28, PCB 31, PCB 33, PCB 37, PCB 44, PCB 47, PCB 65, PCB 118, PCB 129, PCB 138, PCB 147, PCB 149, PCB 153, PCB 160, PCB 163, PCB 168, PCB 180, PCB 193	0.038 U	B24CT4	Laboratory blank contamination
PCB 8, PCB 11, PCB 12, PCB 13	0.057 U	B24CT4	Laboratory blank contamination
PCB 1, PCB 2, PCB 3, PCB 7, PCB 15, PCB 21, PCB 22, PCB 26, PCB 29, PCB 33, PCB 37, PCB 40, PCB 41, PCB 44, PCB 45, PCB 47, PCB 49, PCB 51, PCB 56, PCB 61, PCB 65, PCB 66, PCB 69, PCB 70, PCB 71, PCB 74, PCB 76, PCB 83, PCB 86, PCB 87, PCB 97, PCB 99, PCB 105, PCB 109/108, PCB 110, PCB 115, PCB 118, PCB 119, PCB 125, PCB 128, PCB 132, PCB 141, PCB 146, PCB 156, PCB 157, PCB 158, PCB 164, PCB 166, PCB 171, PCB 173, PCB 203	0.038 U	B24CT7	Laboratory blank contamination
PCB 8, PCB 11, PCB 12, PCB 13	0.057 U	B24CT7	Laboratory blank contamination
PCB 129, PCB 138, PCB 160, PCB 163	0.12 U	B24CT7	Laboratory blank contamination
PCB 8, PCB 12, PCB 11, PCB 13	0.057 U	B24CT6	Laboratory blank contamination
PCB 1, PCB 2, PCB 3, PCB 7, PCB 15, PCB 20, PCB 21, PCB 22, PCB 28, PCB 31, PCB 33, PCB 37, PCB 44, PCB 47, PCB 49, PCB 52, PCB 61, PCB 65, PCB 69, PCB 70, PCB 74, PCB 76, PCB 90, PCB 101, PCB 110, PCB 113, PCB 115, PCB 118, PCB 129, PCB 138, PCB 147, PCB 149, PCB 153, PCB 160, PCB 163, PCB 168	0.038 U	B24CT6	Laboratory blank contamination

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
PCB 2, PCB 3, PCB 7, PCB 15, PCB 20, PCB 21, PCB 26, PCB 28, PCB 29, PCB 31, PCB 33, PCB 37, PCB 44, PCB 47, PCB 52, PCB 61, PCB 65, PCB 70, PCB 74, PCB 76, PCB 90, PCB 101, PCB 110, PCB 113, PCB 115, PCB 118, PCB 129, PCB 138, PCB 147, PCB 149, PCB 153, PCB 160, PCB 163, PCB 168	0.038 U	B24CT8	Laboratory blank contamination
PCB 8, PCB 11, PCB 12, PCB 13	0.057 U	B24CT8	Laboratory blank contamination
PCB 7, PCB 20, PCB 21, PCB 22, PCB 28, PCB 31, PCB 33, PCB 44, PCB 47, PCB 61, PCB 65, PCB 70, PCB 74, PCB 76, PCB 90, PCB 101, PCB 113, PCB 209	0.038 UJ	B25CH5	Laboratory blank contamination and lack of LCSD data
PCB 4, PCB 8, PCB 11, PCB 18, PCB 30	0.057 UJ	B25CH5	Laboratory blank contamination and lack of LCSD data
PCB 15, PCB 26, PCB 29, PCB 32, PCB 37, PCB 49, PCB 52, PCB 56, PCB 60, PCB 64, PCB 66, PCB 69, PCB 83, PCB 85, PCB 86, PCB 87, PCB 88, PCB 91, PCB 92, PCB 95, PCB 97, PCB 99, PCB 105, PCB 107/109, PCB 108/107, PCB 109/108, PCB 110, PCB 114, PCB 115, PCB 116, PCB 117, PCB 118, PCB 119, PCB 122, PCB 123, PCB 124, PCB 125, PCB 128, PCB 129, PCB 130, PCB 132, PCB 134, PCB 135, PCB 136, PCB 137, PCB 138, PCB 139, PCB 140, PCB 141, PCB 143, PCB 146, PCB 147, PCB 149, PCB 151, PCB 153, PCB 156, PCB 157, PCB 158, PCB 160, PCB 163, PCB 164, PCB 166, PCB 167, PCB 168, PCB 170, PCB 171, PCB 173, PCB 174, PCB 176, PCB 177, PCB 178, PCB 179, PCB 180, PCB 183, PCB 185, PCB 187, PCB 193, PCB 194, PCB 195, PCB 198, PCB 201/199	J	B25CH5	Lack of LCSD data

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
PCB 1, PCB 2, PCB 3, PCB 5, PCB 6, PCB 9, PCB 10, PCB 12, PCB 13, PCB 14, PCB 16, PCB 17, PCB 19, PCB 23, PCB 24, PCB 25, PCB 27, PCB 34, PCB 35, PCB 36, PCB 38, PCB 39, PCB 40, PCB 41, PCB 42, PCB 43, PCB 45, PCB 46, PCB 48, PCB 50, PCB 51, PCB 53, PCB 54, PCB 55, PCB 57, PCB 58, PCB 59, PCB 62, PCB 63, PCB 67, PCB 68, PCB 71, PCB 72, PCB 73, PCB 75, PCB 77, PCB 78, PCB 79, PCB 80, PCB 81, PCB 82, PCB 84, PCB 89, PCB 93, PCB 94, PCB 96, PCB 98, PCB 100, PCB 102, PCB 103, PCB 104, PCB 106, PCB 111, PCB 112, PCB 120, PCB 121, PCB 126, PCB 127, PCB 131, PCB 133, PCB 142, PCB 144, PCB 145, PCB 148, PCB 150, PCB 152, PCB 154, PCB 155, PCB 159, PCB 161, PCB 162, PCB 165, PCB 169, PCB 172, PCB 175, PCB 181, PCB 182, PCB 184, PCB 186, PCB 188, PCB 189, PCB 190, PCB 191, PCB 192, PCB 196, PCB 197, PCB 199/200, PCB 200/201, PCB 202, PCB 203, PCB 204, PCB 205, PCB 206, PCB 207, PCB 208	UJ	B25CH5	Lack of LCSD data
PCB 6, PCB 16, PCB 26, PCB 29, PCB 32, PCB 40, PCB 41, PCB 45, PCB 48, PCB 49, PCB 50, PCB 51, PCB 52, PCB 53, PCB 56, PCB 61, PCB 64, PCB 66, PCB 68, PCB 69, PCB 71, 95 PCB , 118 PCB , 132, PCB 135, PCB 136, PCB 147, PCB 149, PCB 151	J	B25CN8	Lack of LCSD data
All congeners <u>except</u>: PCB 4, PCB 6, PCB 7, PCB 8, PCB 11, PCB 16, PCB 18, PCB 20, PCB 21, PCB 22, PCB 26, PCB 28, PCB 29 PCB , 30 PCB , PCB 31, PCB 32 PCB 33, PCB 40, PCB 41, PCB 45, PCB 47, PCB 48, PCB 49, PCB 50 PCB 51, PCB 52, PCB 53, PCB 56, PCB 61, PCB 64, PCB 65, PCB 66, PCB 68, PCB 69, PCB 70, PCB 71, PCB 74, PCB 76, PCB 90, PCB 95, PCB 101,	UJ	B25CN8	Lack of LCSD data

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
PCB 110, PCB 113, PCB 115, PCB 118, PCB 129, PCB 132, PCB 132, PCB 135, PCB 136, PCB 138, PCB 147, PCB 149, PCB 151, PCB 153, PCB 160, PCB 163, PCB 168, PCB 209			
PCB 4, PCB 8, PCB 11, PCB 18, PCB 30	0.057 UJ	B25CN8	Laboratory blank contamination and lack of LCSD data
PCB 7, PCB 20, PCB 21, PCB 22, PCB 28, PCB 31, PCB 33, PCB 44, PCB 47, PCB 65, PCB 70, PCB 74, PCB 76, PCB 90, PCB 101, PCB 110, PCB 113, PCB 115, PCB 129, PCB 138, PCB 153, PCB 160, PCB 163, PCB 168, PCB 209	0.038 UJ	B25CN8	Laboratory blank contamination and lack of LCSD data
PCB 1, PCB 7, PCB 20, PCB 21, PCB 28, PCB 31, PCB 33, PCB 44, PCB 47, PCB 61, PCB 65, PCB 70, PCB 74, PCB 76, PCB 90, PCB 101, PCB 110, PCB 113, PCB 115, PCB 129, PCB 138, PCB 153, PCB 160, PCB 163, PCB 168, PCB 209	0.038 UJ	B25FF2	Laboratory blank contamination and lack of LCSD data
PCB 68, PCB 95, PCB 118, PCB 147, PCB 149, PCB 180, PCB 193	J	B25FF2	Lack of LCSD data
All congeners <u>except</u>: PCB 1, PCB 7, PCB 8, PCB 11, PCB 20, PCB 21, PCB 28, PCB 31, PCB 33, PCB 44, PCB 47, PCB 61, PCB 65, PCB 68, PCB 70, PCB 74, PCB 76, PCB 90, PCB 95, PCB 101, PCB 110, PCB 113, PCB 115, PCB 118, PCB 129, PCB 138, PCB 147, PCB 149, PCB 153, PCB 160, PCB 163, PCB 168, PCB 180, PCB 193, PCB 209	UJ	B25FF2	Lack of LCSD data
PCB 8, PCB 11	0.057 UJ	B25FF2	Laboratory blank contamination and lack of LCSD data

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
VSR11-008			
Inorganics			
Copper	1.0 U	B22575, B22501, B22576, B22547, B22570, B22583, B22579, B225B2, and B22514	Laboratory blank contamination
Cobalt	0.25 U	B22575, B22501, B22576, B22547, B22570, B22583, B22579, B225B2, and B22514	Laboratory blank contamination
Selenium	UJ	B22575 and B22576	Low MS/MSD recoveries
Selenium	J-	B22501, B22547, B22570, B22583, B22579, B225B2, and B22514	Low MS/MSD recoveries
Wet Chemistry (EPA 300.0 – Anions)			
None	None	N/A	N/A
Radiochemistry			
Tritium	J	B257R1	Lack of MS data
Organics (SW-846 8260 – Volatile Organic Compounds)			
None	None	N/A	N/A
Organics (SW-846 8270 – Semivolatile Organic Compounds)			
Pentachlorophenol	UJ	B22576, B22570, B22583, B225B2, and B22514	Low MS and LCS recovery
2-Nitrophenol	UJ	B22576, B22570, B22583, B225B2, and B22514	Low MS recovery and poor MS/MSD precision
VSR11-009			
Inorganics			
None	None	N/A	N/A
Wet Chemistry (EPA 300.0 – Anions)			
None	None	N/A	N/A
Radiochemistry			
None	None	N/A	N/A

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
Organics (SW-846 8260 – Volatile Organic Compounds)			
Vinyl chloride	2.0UJ	B25X93 and B25X94	Low MS and/or MSD recoveries
Chloroform	J	B28KD5 and B28KD6	High MS recoveries
Vinyl chloride 1,1 dichloroethene	UJ	B27C41, B27C50, B27C51, and B27C97	Low MS recoveries
Organics (SW-846 8270 – Semivolatile Organic Compounds)			
phenol	UJ	B25X93 and B25X94	Low surrogate recovery, low MS/MSD recoveries and low LCS recovery
bis(2-chloroethyl)ether 2-chlorophenol 1,3-dichlorobenzene 1,4-dichlorobenzene 1,2-dichlorobenzene 2-methylphenol 2,2_-oxybis(1-chloropropane) n-nitrosodi-n-propyl-amine hexachloroethane nitrobenzene 2-methylnaphthalene isophorone 2-nitrophenol 2,4-dimethylphenol bis(2-chloroethyoxy)methane 2,4-dichlorophenol 1,2,4-trichlorobenzene naphthalene 4-chloroaniline hexachlorobutadiene 4-chloro-3-methylphenol hexachlorocyclopentadiene 2,4,6-trichlorophenol 2,4,5-trichlorophenol 2-chloronaphthalene 2-nitroaniline dimethyl phthalate acenaphthylene 2,6-dinitrotoluene 3-nitroaniline acenaphthene 2,4-dinitropheno 4-nitrophenol Dibenzofuran 2,4-dinitrotoluene	UJ	B25X93 and B25X94	Low MS/MSD recoveries and low LCS recoveries

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
diethyl phthalate fluorine 4-chlorophenyl phenyl ether 4-nitroaniline 4,6-dinitro-2-methylphenol n-nitrosodiphenylamine 4-bromophenyl phenyl ether hexachlorobenzene pentachlorophenol phenanthrene anthracene carbazole fluoranthene pyrene butyl benzyl phthalate benzo(a)anthracene 3,3_-dichlorobenzidine chrysene bis(2-ethylhexyl)phthalate di-n-butyl phthalate di-n-octyl phthalate benzo(b)fluoranthene benzo(k)fluoranthene benzo(a)pyrene indeno(1,2,3-cd)pyrene benzo(ghi)perylene dibenz(a,h)anthracene			
Organics (SW-846 8082 – PCBs)			
None	None	N/A	N/A
Organics (SW-846 8081 – Pesticides)			
Methoxychlor	UJ	B25X93 and B25X94	Poor MS/MSD precision
VSR11-011			
Inorganics			
Chromium	65U	B23W40	Laboratory blank contamination
Wet Chemistry (EPA 300.0 – Anions)			
None	None	N/A	N/A
Radiochemistry			
None	None	N/A	N/A
Organics (SW-846 8260 – Volatile Organic Compounds)			
None	None	N/A	N/A

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
Organics (SW-846 8270 – Semivolatile Organic Compounds)			
Phenol	UJ	B244K0 and B244K1	Low surrogate recovery, and low LCS recovery
Phenol	UJ	B244J7 and B240X6	Low LCS recovery
Acenaphthene Acenaphthylene Benzo(b)fluoranthene Carbazole Bis(2-chloroethoxy)methane Bis(chloroethyl)-ether Bis(2-ethylhexyl)phthalate 4-Chloroaniline 4-Chloro-3-methylphenol 2-Chloronaphthalene 2-Chlorophenol 4-Chlorophenyl phenyl ether Dibenzofuran di-n-Butylphthalate 1,2-Dichlorobenzene 1,3-Dichlorobenzene 1,4-Dichlorobenzene 3,3'-Dichlorobenzidine 2,4-Dichlorophenol Diethyl phthalate 2,4-Dimethylphenol Dimethyl phthalate 2,4-Dinitrotoluene 2,6-Dinitrotoluene Fluorene Hexachlorobutadiene Hexachlorocyclopentadiene Hexachloroethane Indeno(1,2,3-cd)pyrene Isophorone 2-Methylnaphthalene 2-Methylphenol Naphthalene 2-Nitroaniline 3-Nitroaniline 4-Nitroaniline Nitrobenzene 2-Nitrophenol 4-Nitrophenol N-Nitrosodi-n-propylamine 2,2'-Oxybis(1-chloropropane) 1,2,4-Trichlorobenzene 2,4,5-Trichlorophenol	UJ	B244K0, B244K1, B244J7, and B240X6	Low LCS recovery

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
2,4,6-Trichlorophenol			
VSR11-013			
Inorganics			
Copper	1.0U	B257R2	Laboratory blank contamination
Copper	20U	B257H2 and B25808	Laboratory blank contamination
Silver	25U	B25808	Laboratory blank contamination
Thallium	UJ	B257H2, B287H7, B257P8, B257K8, B257Y3, B25CN6, and B25814	Low MS recovery and low LCS recovery
Thallium	UJ	B25CK9, B25808, B25CJ6, B25CJ7, B25CD5, B25CD2, B257K3, and B257J2	Low MS recovery
Wet Chemistry (EPA 300.0 – Anions)			
None	None	N/A	N/A
Radiochemistry			
None	None	N/A	N/A
Organics (SW-846 8260 – Volatile Organic Compounds)			
Chloroform	J	B25CD0 and B257R2	High surrogate recovery
Vinyl chloride	UJ	B25897, B25878, B25883, B25884, B25853, B25858, B25863, B25868, B25835, and B25834	Low MS/MSD recoveries and poor MS/MSD precision
Benzene Trichloroethene	UJ	B257W6, B25821, B258B7, B25829, B25CJ9, B25820, B258B2, and B257Y1	Low MS/MSD recoveries
Vinyl Chloride	UJ	B257W6, B25821, B258B7, B25CJ9, B25829, B25820, B258B2, and B257Y1	Low MS/MSD recoveries and low LCS recoveries
Chloroform	J	B257R7 (batch 0166246)	Low surrogate recovery

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
Vinyl Chloride 1,1-dichloroethene	UJ	B257R7 (batch 0166246)	Low surrogate recovery, low MS/MSD recoveries and poor MS/MSD precision
Trichloroethene	UJ	B257R7 (batch 0166246), B257F7, and B257F6	Low MS/MSD recoveries and poor MS/MSD precision
Carbon tetrachloride Benzene	UJ	B257R7 (batch 0166246), B257F7, and B257F6	Poor MS/MSD precision
Chloroform	J	B257R7 (batch 0174154)	Analyzed beyond the holding time but within 2X holding time, laboratory blank contamination and lack of MS/MSD data
1,1-dichloroethene Benzene Carbon tetrachloride Trichloroethene Vinyl Chloride	UR	B257R7 (batch 0174154)	Analyzed beyond the holding time but within 2X holding time, laboratory blank contamination and lack of MS/MSD data
Chloroform	J	B257X6	High MS/MSD recoveries
Vinyl Chloride	UJ	B257F7 and B257F6	Low MS/MSD recoveries and poor MS/MSD precision
1,1-dichloroethene	UJ	B257F7 and B257F6	Poor MS/MSD precision
Organics (SW-846 8270 – Semivolatile Organic Compounds)			
Phenol	UJ	B257M6, B257N4, B257N3, B257J6, B257L1, B257R2, B257W6, B257Y1, B257R7, B257F7, B257F6, B257X6	low surrogate recovery, low MS recoveries and low LCS recovery
Phenol	UJ	B257Y6, B257T2, B257T3, B257H5	low surrogate recovery, lack of MS/MSD data, low LCS recovery
bis(2-chloroethyl)ether 2-chlorophenol 1,3-dichlorobenzene 1,4-dichlorobenzene 1,2-dichlorobenzene 2-methylphenol 2,2_-oxybis(1-chloropropane) n-nitrosodi-n-propyl-amine hexachloroethane nitrobenzene 2-methylnaphthalene isophorone	UJ	B257M6, B257N4, B257N3, B257J6, B257L1, B257R2, B257Y6, B257T2, B257T3, B257H5, B257W6, B257Y1, B257R7, B257F7, B257F6, B257X6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
2-nitrophenol 2,4-dimethylphenol bis(2-chloroethoxy)methane 2,4-dichlorophenol 1,2,4-trichlorobenzene naphthalene 4-chloroaniline hexachlorobutadiene 4-chloro-3-methylphenol hexachlorocyclopentadiene 2,4,6-trichlorophenol 2,4,5-trichlorophenol 2-chloronaphthalene 2-nitroaniline dimethyl phthalate acenaphthylene 2,6-dinitrotoluene 3-nitroaniline acenaphthene 2,4-dinitrophenol 4-nitrophenol dibenzofuran diethyl phthalate fluorine 4-chlorophenyl phenyl ether 4-nitroaniline 4-bromophenyl phenyl ether hexachlorobenzene phenanthrene anthracene fluoranthene pyrene butylbenzylphthalate di-n-butyl phthalate di-n-octyl phthalate benzo(a)pyrene indeno(1,2,3-cd)pyrene			
bis(2-ethylhexyl)phthalate	J	B257R7	Low MS/MSD recoveries and low LCS recovery
bis(2-ethylhexyl)phthalate	UJ	B257M6, B257N4, B257N3, B257J6, B257L1, B257R2, B257Y6, B257T2, B257T3, B257H5, B257W6, B257Y1, B257F7, B257F6, B257X6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
2,4-dinitrotoluene pentachlorophenol	UJ	B257Y6, B257T2, B257T3, B257H5, B257R7, B257F7, B257F6, B257X6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries
4,6-dinitro-2-methylphenol benzo(b)fluoranthene benzo(ghi)perylene	UJ	B257M6, B257N4, B257N3, B257J6, B257L1, B257R2, B257Y6, B257T2, B257T3, B257H5, B257R7, B257F7, B257F6, B257X6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries
n-nitrosodiphenylamine chrysene	UJ	B257Y6, B257T2, B257T3, B257H5, B257R7, B257F7, B257F6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries
benzo(a)anthracene benzo(k)fluoranthene dibenz(a,h)anthracene	UJ	B257M6, B257N4, B257N3, B257J6, B257L1, B257R2, B257Y6, B257T2, B257T3, B257H5, B257Y1, B257R7, B257F7, B257F6, B257X6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries
3,3_-dichlorobenzidiene	UJ	B257Y1	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries, poor MS/MSD precision
3,3_-dichlorobenzidiene	UJ	B257M6, B257N4, B257N3, B257J6, B257L1, B257R2, B257Y6, B257T2, B257T3, B257H5, B257W6, B257R7, B257F7, B257F6, B257X6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries
hexachlorocyclopentadiene	UJ	B257Y6, B257T2, B257T3, B257H5	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries, poor LCS/LCSD precision
hexachlorocyclopentadiene	UJ	B257M6, B257N4, B257N3, B257J6, B257L1, B257R2, B257W6, B257Y1, B257R7, B257F7, B257F6, B257X6	Low MS/MSD recoveries and/or lack of MS/MSD data and/or low LCS recoveries

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
Organics (SW-846 8082 – PCBs)			
None	None	N/A	N/a
Organics (SW-846 8081 – Pesticides)			
Endosulfan II Endosulfan sulfate Endrin aldehyde	UJ	B257R2	Poor MS/MSD precision
Organics (SW-846 8310 – Polynuclear aromatic hydrocarbons)			
Phenanthrene	1.0 U	B257Y1	blank contamination
phenanthrene	1.0 UJ	B257N4	blank contamination and low LCS recovery
Phenanthrene	1.0 UJ	B257W6	blank contamination and
acenaphthene acenaphthylene benzo(k)fluoranthene benzo(ghi)perylene indeno(1,2,3-cd)pyrene naphthalene	UJ	B257N4, B257N3, B257R2, B257Y6,	low MS recoveries and low LCS recovery
dibenz(a,h)anthracene	UJ	B257N4, B257N3, B257R2, B257Y6	low MS recoveries
acenaphthene acenaphthylene	UJ	B257Y1	low LCS recovery
acenaphthene acenaphthylene dibenz(a,h)anthracene fluorine naphthalene	UJ	B257W6	lack of MS/MSD data and low LCS recovery
anthracene benzo(a)anthracene benzo(b)fluoranthene benzo(k)fluoranthene benzo(ghi)perylene benzo(a)pyrene chrysene fluoranthene indeno(1,2,3-cd)pyrene pyrene	UJ	B257W6	lack of MS/MSD data
benzo(a)anthracene benzo(b)fluoranthene fluoranthene fluorine phenanthrene pyrene	UJ	B257N3, B257R2, B257Y6	low LCS recovery

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
benzo(a)anthracene benzo(b)fluoranthene fluoranthene fluorine	UJ	B257N4	low LCS recovery
dibenz(a,h)anthracene naphthalene	UJ	B257Y1	low MS recovery and low LCS recovery
VSR11-014			
Wet Chemistry (EPA 300.0 – Anions)			
None	None	N/A	N/A
VSR11-039			
Inorganics			
None	None	N/A	N/A
Wet Chemistry (EPA 300.0 – Anions)			
None	None	N/A	N/A
Radiochemistry			
None	None	N/A	N/A
Organics (SW-846 8260 – Volatile Organic Compounds)			
Trichloroethene	UJ	B29HL2 and B27CB0	Low MS/MSD and LCS recoveries
Organics (SW-846 8270 – Semivolatile Organic Compounds)			
3,3-dichlorobenzidine	UR	B27CB0	Very low MS/MSD and LCS recoveries
4-nitrophenol	UR	B27CB0	Very low LCS recovery and low MS/MSD recoveries
1,4-dichlorobenzene pentachlorophenol 2-methylphenol hexachloroethane 2-nitrophenol 2,4-dichlorophenol 2-nitroaniline carbazole	UJ	B27CB0	Low MS and/or MSD recoveries and low LCS recoveries
1,2,4-trichlorobenzene 2,4-dinitrotoluene pyrene 4-chloro-3-methylphenol n-nitroso-di-n-propylamine acenaphthene 2-chlorophenol 2,4-dimethylphenol	UJ	B27CB0	Low LCS recoveries

Table 7-3. Summary of Data Validation Qualification Flags for 100-D/H Water Sample Results (Spatial and Temporal Samples, Aquifer Tubes and Groundwater from New Wells)

Method/Analyte(s)	Qualifier*	Affected Samples (Well)	Reason
naphthalene dibenzofuran fluorine hexachlorobenzene anthracene di-n-butylphthalate benzo(a)pyrene bis(1-chloro-2-propyl)ether 4-chloroaniline			
di-n-octylphthalate	UJ	B27CB0	Poor MS/MSD precision
phenol	UJ	B27CB0	Low MS/MSD recoveries, low LCS recovery and poor MS/MSD precision

*Qualifiers are defined in Table 6-1.

EPA = U.S. Environmental Protection Agency
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
MS = matrix spike
MSD = matrix spike duplicate
NA = not applicable

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Table 7-4. Summary of Data Validation Qualification Flags for 100-D/H Soil/Aquifer Sediment Samples During Drilling

Method/Analyte(s)	Qualifier*	Affected Samples (well)	Reason
VSR11-010			
Inorganics			
Beryllium	0.69 U	B28JK1	Laboratory blank contamination
Manganese	J+	B28JK1	High MS recovery
Wet Chemistry (EPA 300.0 – Anions)			
Hexavalent Chromium	UJ	B28JK1	Low MS and post spike recoveries
VSR11-038			
Inorganics			
Antimony	1.3 U	B29MD7	Laboratory blank contamination
Radiochemistry			
None	None	N/A	N/A
Organics (SW-846 8260 – Volatile Organic Compounds)			
None	None	N/A	N/A

Table 7-4. Summary of Data Validation Qualification Flags for 100-D/H Soil/Aquifer Sediment Samples During Drilling

Method/Analyte(s)	Qualifier*	Affected Samples (well)	Reason

*Qualifiers are defined in Table 6-1.

EPA = U.S. Environmental Protection Agency
MS = matrix spike
N/A = not applicable

7.3.3 Holding Times and Preservation

Holding times are defined as the period from sample collection to sample analysis or extraction, and the period 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.

7.3.2.1 Inorganics

The holding time requirements for metals are as follows:

- The holding time requirements for inductively coupled plasma (ICP) and inductively coupled plasma/mass spectrometry (ICP/MS) metals are analysis within 180 days of sample collection for both soil and water samples.
- Mercury requires analysis within 28 days of sample collection for both soil and water samples. Preservation of soil samples for mercury analysis requires chilling to 4±2°C. Preservation of water samples for metals analysis, including mercury, is acidification with nitric acid (HNO_3) to pH<2 and chilling to 4±2°C.

All samples were properly preserved and analyzed within the prescribed holding times with the following exceptions:

One water sample (B225N9) was re-analyzed for chromium by ICP/MS 13 days past the 180-day holding time limit. The value for this sample was 10.5 µg/L and was H qualified to indicate the missed hold time. In addition, two water samples were re-analyzed by ICP for chromium and nickel outside the hold time limit. Sample B220D3 was re-analyzed 17 days after the 180-day limit and sample B221J4 was analyzed 13 days after the 180-day limit. All results were flagged H to indicate the missed hold time.

7.3.2.2 General Chemistry

The holding time requirements for general chemistry parameters are as follows:

- All anions except nitrate and nitrite – analysis within 28 days of sample collection.
- Nitrate and nitrite – analysis within 48 hours of collection for water samples; extraction within 28 days of collection and analysis within 48 hours of extraction for soil samples.
- Cyanide – analysis within 14 days of sample collection for both soil and water samples.
- Hexavalent chromium – analysis within 24 hours of collection for water samples and within 30 days for soil samples.

Sample preservation for anions requires chilling the groundwater and soil samples to 4±2°C. Cyanide requires preservation of water samples with sodium hydroxide (NaOH) to pH >12 and chilling to 4±2°C.

All samples were properly preserved and analyzed within the prescribed holding times with the following exceptions:

Twenty three water samples were analyzed for nitrate and nitrite outside the 48-hour limit but within two times the limit. The results for these samples were H flagged to indicate the missed hold time. The sample numbers impacted are B23VV2, B23YY7, B23YY8, B23YY9, B24001, B24002, B24004, B24005, B24006, B24007, B24009, B24011, B24012, B24015, B24017, B24018, B24023, B24024, B24025, B24026, B240H4, B256D9, and B25BK3.

One water sample (B24FR5) was re-analyzed for hexavalent chromium 58 days beyond the 24-hour hold time. The sample result was flagged H to indicate the missed hold time.

7.3.2.3 Radionuclides

The maximum holding time for radiochemical analysis is 180 days for both soil and water samples. Sample preservation for water samples requires acid preservation with nitric acid to pH less than 2. There are no specific preservation requirements for radiochemical soil analysis.

All samples were properly preserved and analyzed within the prescribed holding times.

7.3.2.4 Organics

The holding times and preservation requirements for VOCs, semivolatile organic compounds (SVOCs), PCBs, PAHs and pesticides are as follows:

- VOCs (water) – acidify with hydrochloric acid (HCl) or sulfuric acid (H_2SO_4) to pH<2, cool to 4±2°C, and analyze within 14 days of collection; if samples are not acidified, but cooled to 4±2°C, analyze within 7 days of collection.
- VOCs (soil) – Low level: freeze samples and analyze within 14 days. High level: preserve samples in methanol, cool to 4±2°C, and analyze within 14 days of collection. If samples (low or high level) are not frozen or preserved, but cooled to 4±2°C, analyze within 48 hours of collection.
- SVOCs (water and soil) – cool to 4±2°C, and extract within 14 days of collection. Analysis within 40 days from extraction.
- PCBs by method 8082 and 1668A (water) – no preservation, extract within 7 days and analyze within 40 days of extraction.
- PCBs by method 8082 (soil) – cool to approximately 4°C, extract within 14 days and analyze within 40 days of extraction.
- PAHs (water) – no preservation, extract within 7 days and analyze within 40 days of extraction.
- Pesticides (water) – no preservation, extract within 7 days and analyze within 40 days of extraction.

All groundwater and soil samples were properly preserved and analyzed within the prescribed holding time with the following exceptions:

- One water sample (B257R7) was re-analyzed via VOA 6 days beyond the required 14-day analytical hold time. Analytes with positive values were flagged J and non-detects were flagged UR during third party validation for this sample.

There were no improperly preserved samples and minimal missed analytical hold times associated with this data set that might affect data usability.

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8 Field Quality Control

8.1 Field Quality Control Sampling Requirements

The 100-D/H SAP (DOE/RL-2009-40) required collection of full trip blank (FTB) samples, field transfer blank (FXR) samples, equipment rinsate (EB) samples, field duplicate samples (DUP), and split samples. Table 8-1 summarizes the required frequency for each field QC sample type.

Table 8-1. Field Quality Control Checks

QC Sample Type	Purpose	Frequency
Full trip blank	Assess contamination from containers or transportation	One per 20 samples per media sampled.
Field transfer blank	Assess contamination from sampling site	One per day when VOCs are sampled for groundwater monitoring activities. A minimum of one field transfer blank collected at each borehole per media sampled where the sample will undergo volatile organic analysis.
Equipment rinsate blank	Verify adequacy of sampling equipment decontamination	If 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 per media sampled.
Field duplicate	Estimate precision, including sampling and analytical variability	One per batch, 20 samples maximum, for groundwater monitoring activities. A minimum of one field duplicate collected at each borehole per media sampled.
Split sample	Estimate precision, including sampling, analytical, and inter-laboratory variability	At a minimum, one per analytical method, per media, for analyses performed where detection limit and precision and accuracy criteria have been defined in the Performance Requirements Tables (6-2 and 6-3).

8.1.1 Field Blank Requirements

FTB samples 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 it 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. However, the analytical list for FTBs on soil may be limited to VOA, SVOA, and total petroleum hydrocarbons, depending on resolution/determination of the target analyte list. FTBs are not required on aquifer sediments being analyzed for metals, mercury, and hexavalent chromium.

FXR samples are preserved volatile organic analysis sample containers filled at the sample collection site with reagent water or silica sand (as appropriate to the primary sample media) transported to the field. The samples are prepared during the sampling to evaluate potential contamination caused by field

conditions. After collection, field transfer blank bottles are sealed and placed in the same storage container with the samples from the associated sampling event. The field transfer blank samples are analyzed for VOCs only, and are batched with samples for which VOA is requested.

EB samples are collected for sampling devices reused to assess the adequacy of the decontamination process. EBs 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, EBs are not required.

For the field blanks (i.e., FTBs, FXRs, and EBs), results above two times the method detection limit (MDL) are identified as suspected contamination. However, for common laboratory contaminants such as 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 total MDA.

8.1.2 Field Duplicate Requirements

DUPs are used to evaluate sample consistency and the precision of field sampling methods. DUPs are independent samples that are 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 independently.

DUPs are 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 above the detection limit). When sampling is performed from a split spoon, VOC samples and VOC duplicate samples are collected directly from the sampler. The remaining soil/aquifer sediment is then composited in a stainless steel mixing bowl. The soil/aquifer sediment sample and duplicate sample are collected from this composited material.

Evaluation of the results can provide an indication of intra-laboratory variability. Large RPDs can be an indication of laboratory performance problems and should be investigated. Only those DUPs with at least one result greater than five times the MDL or minimum detectable activity (MDA) are evaluated. DUP results must agree within 20 percent (30 percent for soils), as measured by the RPD, to be acceptable.

8.1.3 Split Sample Requirements

A field split sample is a representative sample from a sampling event sent to a third party laboratory (i.e., reference laboratory). Evaluation of the results can provide an indication of inter-laboratory variability. Large RPDs can be an indication of laboratory performance problems and should be investigated. Only those results at least one result greater than five times the MDL or MDA at one or both laboratories are evaluated. Field split sample results must agree within 20 percent (30 percent for soils), as measured by the relative percent difference, to be acceptable.

8.2 Field Quality Control Results

As described in Section 8.1.1, FTB samples are analyzed to determine if positive results may be attributed to contaminants introduced as a result of the transfer of samples from the field to the laboratory. Any analyte measured above the laboratory detection limits is evaluated for potential impacts to associated sample results.

A total of 99 FTB samples were taken in association with the 100-D/H water samples. Of the 1,845 analytical results associated with the FTB samples, 8 results (<1 percent) were observed above two times the laboratory MDLs. These analytes were copper (3 samples), beryllium (1 sample), cobalt (1 sample), nickel (1 sample), selenium (1 sample), and thallium (1 sample). All positive FTB results were “B” flagged by the laboratory as estimates below the laboratory quantitation limit. None of the detected analytes were detected at a value above the action limit, and the values are not of a magnitude significant

enough to impact usability of associated sample values. No FTB results were reported for the soil samples taken at the bottom of the unconfined aquifer.

In addition to FTBs, FXRs were collected specifically for VOA samples. A total of 37 FXR samples were taken in association with the 100-D/H water samples. Of the 222 results reported, none of the results were observed above two times the laboratory MDLs.

A total of two FXR samples were taken in conjunction with the 100-D/H aquifer sediment samples. Of the 12 COPC analytes reviewed, none were detected above two times the laboratory MDLs.

A total of 28 EB samples were taken in association with the 100-D/H water samples. Of the 430 analytical results associated with the EB samples, 3 results (<1%) were observed above two times the laboratory MDLs. These analytes were one each of copper, chloroform, and total beta radio strontium. With the exception of the strontium, all positive EB results were "B" flagged by the laboratory as estimates below the laboratory quantitation limit. The samples associated with the positive strontium EB result were either non-detects or significantly less than the EB result. None of the detected analytes were detected at values significant enough to impact usability of sample data. No EBs were taken with the aquifer sediment sample matrices.

Collection of DUPs was required at a frequency of not less than 1 per 20 100-D/H water samples. DUPs were obtained from the same sample interval using the same equipment and sampling technique as their corresponding primary field sample. The DUP was analyzed for the same COPCs at the same laboratory that analyzed the primary field samples. Duplicate pair results were evaluated if at least one of the two results was greater than 5 times the MDL or minimum detectable concentration (MDC). A total of 82 DUPs were taken in conjunction with the 100-D/H sampling effort. Of the 1,780 data sets evaluated, 2 exceeded the RPD criteria: chromium (1 sample set), and selenium (1 sample set). In both cases, the analytes were flagged "B" (estimates) below the laboratory quantitation limits.

Field split samples were also taken for the 100-D/H water samples. Field split samples were obtained from the same sample interval using the same equipment and sampling technique as their corresponding primary field sample. The field split sample was analyzed for the same COPCs at a different laboratory that analyzed the primary field samples. Split pair results were evaluated if at least one of the two results was greater than 5 times the MDL or MDC. A total of 33 field split samples were taken in conjunction with the 100-D/H sampling effort. Of the 411 data sets evaluated, none exceeded the RPD criteria.

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9 Laboratory Quality Control

In addition to the evaluation performed on field QC data (as described in Chapter 8), a broad review of the laboratory QC results was also conducted. Laboratory QC results were stored electronically in HEIS for the data and were evaluated using various database queries against the acceptance criteria. Table 9-1 provides a summary of the laboratory QC acceptance criteria used.

Table 9-1. Laboratory Quality Control Acceptance Criteria

QC Element	Acceptance Criteria
Laboratory Duplicate Samples	Laboratory duplicate samples with at least one result greater than 5 times the MDL or MDC must have an RPD less than or equal to 20% for water and 30% for solid matrixes to be considered acceptable.
Laboratory Blank Samples	Laboratory blank limit is 2 times the MDL, IDL, or MDC. However, for common laboratory contaminants acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit are 5 times the MDL or MDC.
Laboratory Control Samples (LCSs)	LCS percent recovery must be between the upper and lower control limits listed in Tables 6-1 through 6-3 of the 100-D/H SAP (DOE/RL-2009-40).
Matrix Spikes/Matrix Spike Duplicates (where applicable)	Laboratory spikes where the sample result is less than or equal to 4 times the spiking concentration are evaluated by comparing the percent recovery with the upper and lower control limits provided by the laboratory. In addition, where the sample result is less than or equal to 4 times the spiking concentration, the MS/MSD RPD must have an RPD less than or equal to 20% for water and 30% for soil matrices.
Surrogates (where applicable)	Surrogate percent recovery within laboratory established statistical control limits.

Source: DOE/RL-2009-40, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study*

IDL = instrument detection limit
LCS = laboratory control sample
MDC = minimum detectable concentration
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
QC = quality control
RPD = relative percent difference

9.1 Laboratory Contamination

Hanford Site laboratory contracts require that laboratory method blanks be analyzed with each batch of up to 20 samples. A total of 4,278 laboratory blank results were reported for these blanks. A total of 389 results (about 9%) did not meet the evaluation criteria. Of these, 373 of the non-conformances are attributed to PCB congener analysis. The remainder of the non-conformances were limited to arsenic (1 result), copper (4 results), lead (2 results) manganese (1 result), mercury (1 result), vanadium (1 result), diethylphthalate (1 result), and total beta radiostrontium (2 results). All blank values that exceeded the evaluation criteria described in Table 9.1 were observed at concentrations below the laboratory quantitation limits, and the laboratory applied “C” flags to the associated sample data where appropriate. Associated sample data for the PCB congeners and metals analysis were also qualified as non-detected at the laboratory quantitation limit during third party validation as summarized in Table 7-3.

9.2 Laboratory Precision

Laboratory precision is determined by the difference between duplicate sample pair results, between MS/MSD sample results or between LCS/LCSD results when MS/MSD data may not be available. Normally, spike duplicates are used for metals and anions while duplicate sample pairs are analyzed for organic analyses.

A total of 5,963 duplicate, MS/MSD, and/or LCS/LCSD pairs were evaluated. Greater than 99 percent of the results satisfied evaluation criteria. A total of 36 sample pairs exceeded the RPD limits, all of which were in a water matrix. Of the 36 sample pairs exceeding the RPD criteria, 16 were associated with VOA (1,1 dichloroethene, benzene, carbon tetrachloride, chloroform, trichloroethene, and vinyl chloride) involving four samples. Of the remaining twenty that exceeded the RPD criteria, four were associated with 200.8 (chromium and zinc), four with SVOA (2-nitrophenol, 4-chloroaniline, di-n-octylphthalate, and phenol), three with SVOA by high pressure liquid chromatography (HPLC-benzo(b)fluoranthene), three gross beta, two pesticides, two PCBs, and one 6010 (chromium). No data user or third party validation flags were applied to these data points; however, in some instances an “X” flag was applied to the data by the laboratory to note the RPD exceedances.

9.3 Accuracy

Three types of QC are used to assess accuracy. The LCS is used to assess the performance of the laboratory with respect to the method and 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. Laboratory surrogate recoveries are used to assess overall method performance for organic methods.

9.3.1 Laboratory Control Samples

A total of 7,540 LCS results were reported. Greater than 85 percent of the results satisfied evaluation criteria with 1,093 LCS values reported outside the analytical performance requirements listed in Tables 6-2 and 6-3. Of the 1,093 values outside performance requirements, 879 were related to SVOA and all but one of the LCS results were below the 80 percent analytical performance requirement acceptance criteria. It should also be noted that while the results were outside the requirements limits outlined in Tables 6-2 and 6-3, all but five of the LCS recoveries were well within the statistically derived performance criteria established by the laboratories. The remaining values observed outside the performance requirements are as follows:

- 60 SVOA by HPLC (PAH) outside the requirements listed in Tables 6-2 and 6-3, with all but one of the results falling within established laboratory criteria.
- 53 VOA (26 1,1-dichloroethene, 13 trichloroethene, and 14 vinyl chloride) outside the requirements listed in Tables 6-2 and 6-3, with only two (both vinyl chloride) outside the laboratory established limits.
- 35 PCBs by 1668A outside the requirements listed in Tables 6-2 and 6-3, with all but two within established laboratory criteria.
- 28 metals by 200.8 (26 antimony and 2 mercury) outside the requirements listed in Tables 6-2 and 6-3 with only the mercury results falling outside established laboratory criteria.
- 28 PCBs by method 8081 outside the requirements listed in Tables 6-2 and 6-3, with all but two falling within established laboratory criteria.

- 1 hexavalent chromium, which was outside both the requirements listed in Tables 6-2 and 6-3 and laboratory established criteria.

9.3.2 Matrix Spike Recovery

Matrix spike recovery is also used as a measure of analytical accuracy. There were a total of 4,027 matrix spike sample results reported. Of those, 1,147 results (28 percent) did not satisfy the analytical performance requirements described in the 100- D/H SAP; however, all but 49 of the results fell within the statistically derived control limits established by the laboratories. Of the 1,147 results that did not meet the 100-D/H SAP requirements, the largest majority (964) were related to SVOA and all but 6 of those results met the control limits established by the laboratories. The remaining values observed outside the performance requirements are as follows:

- 57 VOA exceedances were observed for all six COPCs with no values exceeding laboratory established criteria
- 55 SVOA by HPLC (PAH) with all but 12 falling within established laboratory criteria
- 27 pesticides with all but 6 falling within established laboratory criteria
- 23 metals by 200.8 (9 chromium, 4 selenium, 4 zinc, 3 mercury, and one each nickel, manganese, and copper) with all but 12 (8 chromium, 2 mercury, 1 manganese, and 1 zinc) falling within established laboratory criteria
- 6 hexavalent chromium with 4 falling outside established laboratory criteria
- 5 ion chromatography (4 sulfate and 1 fluoride) with all falling outside established laboratory criteria
- 7 PCBs by 8082 with all but 2 falling within established laboratory criteria
- 2 silver results by 6010 (both of which fell outside established laboratory criteria)

9.3.3 Surrogate Recovery

Surrogates were analyzed in relation to methods 1668A PCB Congeners, 8081 Pesticides, 8082 PCB, 8260 VOA, 8270 SVOA, and 8310 SVOA by HPLC (PAH).

A total of 88 PCB congener surrogates were evaluated with 100 percent meeting laboratory statistical control limits.

A total of 98 pesticide surrogates were evaluated. Greater than 99 percent of the results were satisfactory with only one value reported outside the laboratory statistical control limits, which was associated with a QC sample and did not affect a sample result.

A total of 129 PCB (method 8082) surrogates were evaluated. Greater than 98 percent of the values were satisfactory with only two results outside the laboratory statistical control limits. Both results were associated with a QC sample and did not affect a sample result.

A total of 1,690 VOA surrogate results were evaluated. Greater than 95 percent of the results were satisfactory, with 77 values reported outside the laboratory statistical control limits. Seventy-five of those values exceeded the maximum laboratory control limits and sample results associated with these surrogate failures have a potential high bias. Failures were noted on the following samples and surrogates (Table 9-2):

Table 9-2. VOA Surrogate Recoveries Outside of Limits

Surrogate	Sample Number
1,2-Dichloroethate-d4	B25CJ3
4-Fluorobromobenzene	B22952, B24489, B24493, B244K6, B244W7, B244W8, B244W9, B244X1, B24573, B24575, B24576, B24577, B24578, B24579, B24580, B24581, B24584, B24590, B24KR1, B257K1, B257K1, B257K1, B257K6, B257L1, B257L6, B257M6, B257N4, B257P2, B257R2, B257T2, B257V1, B257W1, B257X1, B25811, B259P2, B259P3, B259P3, B259P4, B25CD0, B25CH3, B25CJ3, and B25CN4
Dibromofluoromethane	B257K1, B257R2, B259P2, B25CD0, and B25CJ3
Toluene-d8	B244W7, B257K1, B257K1, B257K1, B257L1, B257L6, B257M6, B257M6, B257N3, B257N4, B257P2, B257R2, B257V1, B257W1, B257X1, B25811, B259P2, B259P3, B259P4, B25CD0, B25CJ3, and B25CN4

In addition, surrogates failed to meet the lower control limit on two samples and analytes associated with the surrogate have a potential low bias. The sample/surrogates are B257R7 (surrogate - dibromofluoromethane) and B259P5 (surrogate – toluene-d8).

A total of 836 SVOA surrogate results were evaluated. Greater than 99 percent of the results were satisfactory, with a total of 8 values reported outside the laboratory statistical control limits. Four of the surrogate failures were on QC samples and do not impact sample results. The following two samples had associated surrogate recoveries below the lower laboratory acceptance limit: B25X93 (surrogate-2-fluorobiphenyl) and B225H6 (surrogates – 2-fluorophenol and phenol-d5). Analytes associated with these surrogates for these two samples have a potential low bias.

A total of 54 PAH surrogate results were evaluated. Greater than 92 percent of the results were satisfactory, with a total of 4 values reported outside the laboratory statistical control limits. All 4 results were for the surrogate p-terphenyl and were below the lower acceptance limit. One result was associated with a QC sample. The other three were associated with the following samples: B22529, B257N3, and B257Y6. Results for these three samples associated with p-terphenyl have a potential low bias.

9.4 Review of Laboratory Data Package Case Narratives

Laboratory data package case narratives were reviewed to identify potential QC issues that would affect the usability of these data. Overall, no issues were identified that would have led to the rejection of any reported results. Only some minor data quality issues were identified in the case narratives.

10 Data Usability Conclusions

The assessment noted some deficiencies in the data. These deficiencies are summarized in the following subsections.

10.1 Data Verification Considerations

As shown in Tables 5-2, 5-3, and 5-4, 100 percent of planned groundwater samples were collected from spatial and temporal monitoring wells and aquifer tubes. During drilling, 100 percent of planned soil samples were collected; however, not all planned water samples were collected for same wells. Samples were not collected in cases where there was unexpected lithology resulting in a lack of water for sampling at the planned depth. Planned sampling depths outlined in the 100-D/H SAP (DOE/RL-2009-40) are considered estimates as unexpected conditions preventing sample collection can occur during drilling activities. Based on the review performed in this DQA, all required samples and field QC were collected in accordance with the100-D/H SAP. The analytical data sets are complete and analyses were performed according to the contractually required analytical methodology.

10.2 Data Validation Considerations

With the exception of ion chromatography and some radio-isotopes (gamma, strontium 90, and technetium 99) in the aquifer sediment matrix (a total of 15 samples for each analyte), a minimum of 5 percent of the data collected were subjected to a rigorous third party validation. The data sets mentioned previously were given extra scrutiny during the DQA process and no quality-impacting issues were noted. Most of the QC deficiencies observed during third party validation were minor and were not considered by the validators to limit the utility of the data for decision making. Values for those constituents listed as "J" or "UJ" flagged should be considered estimated but usable. The main validation observations were blank contamination; lack of LCS, LCSD, MS, or MSD data; out of limits LCS, MS, or MSD recoveries; out of limits surrogate recoveries; and samples analyzed outside of regulatory hold time. The data flags assigned during third party validation are summarized in Tables 7-3 and 7-4.

QC deficiencies were noted for only two samples that were considered by the validator to limit the utility of the data for decision making and resulted in "UR" flags being applied for some analytes. Sample B257R7 (batch 0174154) had UR flags applied for all VOA COPC constituents except chloroform due to an analytical hold time exceedance. In this case, however, the sample had been rerun outside of hold time due to a QC failure and the original results were also reported. Validation of the original results (sample B257R7 batch 0166246) resulted in a "UJ" for all constituents except chloroform, which had a "J" flag, and the data are considered usable. Sample B27CB0 had "UR" flags applied to two SVOA constituents (3,3 dichlorobenzidine and 4-nitrophenol) due to very low LCS, MS, and MSD recoveries. These results were initially reported as nondetects but should be considered to have a low bias and be unusable for the purposes of this study.

10.3 Holding Time and Preservation Considerations

With the exception of one sample (B257R7) for which VOA was rerun outside of hold time, all hold times were met for the sample set reviewed. As discussed in Section 10.2, data are available for the original VOA run on this sample and are considered usable. No other impacts to data usability were noted due to hold time considerations.

10.4 Field Quality Control Considerations

Field QC samples were collected and analyzed in accordance with the 100-D/H SAP. In general, results were within precision requirements outlined in the 100-D/H SAP. Values exceeding the precision requirements were minimal, and no systemic issues were identified. No impacts to data usability were noted due to field quality control issues.

10.5 Laboratory Quality Control Considerations

Laboratory QC samples were analyzed with the required frequency outlined in the 100-D/H SAP. In general, performance on laboratory QC met the requirements in the 100-D/H SAP; however, two areas warrant further discussion. A high frequency of laboratory blank contamination was noted during validation of the PCB congener data. With the extremely low detection levels involved in this analysis, low level blank contamination is a common occurrence. The levels of contamination were quite low and in many cases associated with non-detects in the actual samples. Under these conditions, the blank contamination observed minimally impacted sample results and values are considered adequate for their intended use. In addition, a significant number of LCS and MS recoveries for SVOA were outside the recovery limits required by the 100-D/H SAP. In virtually all cases, however, the recoveries met the laboratory statistically derived performance criteria for the method. The statistical performance criteria reported by the laboratory are in agreement with values reported by other laboratories within the analytical industry. The LCS and MS performance demonstrated by the laboratory, while outside those dictated by the 100-D/H SAP in many cases, should be considered as best achievable with current technology and the associated results should be considered adequate for their intended use.

10.6 Conclusions

Based on the results of this DQA, the overall sample sets and associated analytical data are sufficient in quantity and have a sufficiently low degree of suspect (flagged) data points to be usable for DQOs of the 100-D/H SAP (DOE/RL-2009-40). Given the high degree of acceptable data, the analytical results (general chemistry, inorganic, organic, and radiochemical) are considered useable for their intended purposes as indicated in Chapter 2. Samples were collected and analyzed as specified in the 100-D/H SAP. Sample results accurately indicate the presence or absence of target analyte contamination at sample locations. Laboratory and matrix accuracy and precision are in control overall, and no systematic or general discrepancies were displayed. Sample results are believed 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, documented procedures (except as noted in this report and reflected in qualified data points). All results are reported in industry standard units. Although some blank contamination occurred (most frequently associated with PCB congeners), the concentrations were generally low-level and were consistent with normal laboratory and field procedures.

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 DQA are that, with the exception two SVOA results (sample B27CB0 from well 199-D5-132 for 3,3 dichlorobenzidine and 4-nitrophenol), which were qualified as rejected; the data that have been collected are of the right type, quality, and quantity for their intended use.

11 References

40 CFR 141.62, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Inorganic Contaminants," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol22/xml/CFR-2010-title40-vol22-sec141-62.xml.

40 CFR 141.66, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Radionuclides," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol22/xml/CFR-2010-title40-vol22-sec141-66.xml.

40 CFR 143.3, "National Secondary Drinking Water Regulations," "Secondary Maximum Contaminant Levels," *Code of Federal Regulations*. Available at: http://www.gpo.gov/fdsys/pkg/CFR-2010-title40-vol22/xml/CFR-2010-title40-vol22-sec143-3.xml.

AQA, 2011a, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-007 Project CERC110 Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011b, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-008 Project CERC10, SURV10, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011c, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-009 Project SURV10, 100 Area RI/FS, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011d, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-010 Project 100 Area RI/FS, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011e, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-011 Project CERC10, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011f, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-013 Project CERC10, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011g, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-014 Project CERC10, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011h, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-038 Project 100 Area RI/FS, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

AQA, 2011i, *Data Validation Report for CH2M HILL Plateau Remediation Company VSR11-039 Project 100 Area RI/FS, Chemical & Radiochemical Validation – Level C*, Analytical Quality Associates, Inc., Albuquerque, New Mexico.

DOE/RL-96-17, 2009, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0095436.

DOE/RL-96-61, 1997, *Hanford Site Background: Part 3, Groundwater Background*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D197226378.

DOE/RL-2008-11, 2008, *Remedial Investigation Work Plan for Hanford Site Releases to the Columbia River*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0810240394.

DOE/RL-2008-46, 2010, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1002260412.

DOE/RL-2008-46-ADD1, 2010, *Integrated 100 Area Remedial Investigation/Feasibility Study Work Plan*, *Addendum 1: 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=0084374.

DOE/RL-2008-66, 2009, *Hanford Site Groundwater Monitoring for Fiscal Year 2008*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0905131281.

DOE/RL-2009-40, 2010, *Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/pdf.cfm?accession=0084375.

EPA/240/B-06/002, 2006, *Data Quality Assessment: A Reviewer's Guide*, EPA QA/G-9R, Office of Environmental Information, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/quality/qs-docs/g9r-final.pdf.

EPA-600/4-79-020, 1983, *Methods for Chemical Analysis of Water and Wastes*, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=D196019611.

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://monitoringprotocols.pbworks.com/f/EPA600-R-63-100.pdf.

EPA-600/R-94/111, 1994, *Methods for the Determination of Metals in Environmental Samples, Supplement I*, Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio. Available at: http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=300036HL.txt.

Hanford Environmental Information System database, Richland, Washington.

SW-846, 2007, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B*, as amended, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm.

TPA-CN-368, 2010, *Tri-Party Agreement Change Notice Form: DOE/RL-2009-40, Sampling and Analysis Plan for the 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, and 100-HR-3 Operable Units Remedial Investigation/Feasibility Study, Rev. 0*, dated June 30, U.S. Department of Energy, Richland Operations Office, and Washington State Department of Ecology, Richland, Washington. Available at: http://pdw.hanford.gov/arpir/index.cfm/viewDoc?accession=1009100198.

WAC 173-201A, "Water Quality Standards for Surface Waters of the State of Washington," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A.

WAC 173-340, "Model Toxics Control Act—Cleanup," *Washington Administrative Code*, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-340.

173-720, "Groundwater Cleanup Standards."

173-730, "Surface Water Cleanup Standards."

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