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Revision 0

Data Quality Assessment Report for the Central Plateau Non-Operational Areas

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

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Richland, Washington 99352

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Executive Summary

This report summarizes the data validation and data quality assessment (DQA) efforts performed in support of the sampling and analysis of soil samples taken from the Central Plateau nonoperational areas during fiscal year (FY) 2011. This work was performed in accordance with the U.S. Department of Energy (DOE), Richland Operations Office (DOE-RL) document DOE/RL-2010-55,[1] which implements a systematic approach to identify and review nonoperational property (NP) in the outer areas, which is the geographic area between waste sites. DOE-RL is performing a multi-pronged evaluation of these NP areas, which includes reviews of existing programs that collect data outside of waste sites, such as the following:

- Air emissions monitoring
- Liquid effluent monitoring
- Ambient air monitoring near Hanford Site facilities and operations
- Sitewide and offsite ambient air monitoring
- Sitewide and offsite soil monitoring
- Sitewide and offsite vegetation monitoring
- Radiological surface survey data and dose measurements near Hanford Site facilities and operations

Based on reviews performed in FY 2011, two NP areas, one in the southwestern and one in the northwestern corners of the Hanford Central Plateau, were identified for soil sampling and laboratory analysis to confirm that they had not been affected by Hanford Site operations. If determined to be free of Hanford contaminants, these NP areas would be identified as not needing environmental cleanup, consistent with DOE plans to reduce the footprint of the Hanford Site by the year 2015.[2]

Based on the data validation and DQA, it is concluded that the data collected from these two NP areas are of the right type, quality, and quantity to support their intended use. Detection limits, precision, accuracy, and completeness were analyzed to determine

[1] In progress, *Remedial Investigation/Feasibility Study Work Plan for the 200-CW-1, 200-CW-3 and 200-OA-1 Operable Units*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
[2] Dr. Ines Triay, DOE Assistant Secretary of Environmental Management, December 2008.

whether any analytical results should be rejected as a result of quality assurance/quality control deficiencies. Overall, the analytical data were found to be acceptable for DOE's decision-making purposes.

The information contained in this report follows the general guidelines for DQAs established by the U.S. Environmental Protection Agency in EPA/240/B-06/002.[3]

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

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Terms

AEA	alpha energy analysis
AQA	Analytical Quality Associates, Inc.
bgs	below ground surface
COPC	contaminant of potential concern
CRDL	contract required detection limit
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DQA	data quality assessment
EB	equipment blank
EPA	U.S. Environmental Protection Agency
FY	fiscal year
GEA	gamma energy analysis
GPS	global positioning system
HEIS	Hanford Environmental Information System
ICP	inductively coupled plasma
LCS	laboratory control sample
MDA	minimum detectable activity
MDL	minimum detection limit
MS	matrix spike
MSD	matrix spike duplicate
NP	nonoperational property
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PAL	project analytical lead
PCB	polychlorinated biphenyl
QC	quality control
RAL	removal action level
RL	reporting limit
RPD	relative percent difference

SAP	sampling and analysis plan
SDG	sample delivery group
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbon
TPH-D	total petroleum hydrocarbons, diesel range
TPH-K	Total petroleum hydrocarbons, kerosene range
WSCF	Waste Sampling and Characterization Facility

Metric Conversion Chart

Into Metric Units			Out of Metric Units		
If You Know	*Multiply By*	*To Get*	*If You Know*	*Multiply By*	*To Get*
Length			**Length**		
Inches	25.4	millimeters	Millimeters	0.039	inches
Inches	2.54	centimeters	Centimeters	0.394	inches
Feet	0.305	meters	Meters	3.281	feet
Yards	0.914	meters	Meters	1.094	yards
Miles	1.609	kilometers	Kilometers	0.621	miles
Area			**Area**		
Sq. inches	6.452	sq. centimeters	Sq. centimeters	0.155	sq. inches
Sq. feet	0.093	sq. meters	Sq. meters	10.76	sq. feet
Sq. yards	0.0836	sq. meters	Sq. meters	1.196	sq. yards
Sq. miles	2.6	sq. kilometers	Sq. kilometers	0.4	sq. miles
Acres	0.405	hectares	Hectares	2.47	acres
Mass (weight)			**Mass (weight)**		
Ounces	28.35	grams	Grams	0.035	ounces
Pounds	0.454	kilograms	Kilograms	2.205	pounds
Ton	0.907	metric ton	Metric ton	1.102	ton
Volume			**Volume**		
Teaspoons	5	milliliters	Milliliters	0.033	fluid ounces
Tablespoons	15	milliliters	Liters	2.1	pints
Fluid ounces	30	milliliters	Liters	1.057	quarts
Cups	0.24	liters	Liters	0.264	gallons
Pints	0.47	liters	Cubic meters	35.315	cubic feet
Quarts	0.95	liters	Cubic meters	1.308	cubic yards
Gallons	3.8	liters			
Cubic feet	0.028	cubic meters			
Cubic yards	0.765	cubic meters			
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
Radioactivity			**Radioactivity**		
Picocuries	37	millibecquerel	Millibecquerel	0.027	picocuries

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1 Introduction

This data quality assessment (DQA) report evaluates laboratory data for soil samples collected from two areas of the nonoperational property (NP), which is the geographic area between Hanford waste sites. The DQA is intended to determine whether the data are the right type and of sufficient quality and quantity to support U.S. Department of Energy (DOE), Richland Operations Office (DOE-RL) footprint reduction decision making. The information contained in this report follows general guidelines for DQAs established by Soil and Groundwater Remediation Project administrative procedure GRP-EE-01-1.22, "Data Quality Assessment." This procedure, in turn, is based upon the U.S. Environmental Protection Agency (EPA) guide EPA/240/B-06/002 (*Data Quality Assessment: A Reviewer's Guide*, EPA QA/G-9R).

This report assesses soil data gathered by collection of surface samples from undisturbed and unused NP land areas using conventional surface soil sampling techniques. The two NP areas sampled were identified for sampling through a multi-pronged DOE evaluation of the NP areas. Because the NP areas were not Hanford waste sites, sampling and analysis was initiated via a request for analytical services form, in lieu of a sampling and analysis plan (SAP).

The two NP areas were designated for Round 1 sampling (southwestern portion of Central Plateau) and for Round 2 sampling (northeastern portion of Central Plateau). Sampling locations were randomly selected without regard for topographical features. The characterization data obtained from the field sampling and laboratory analysis could affect footprint reduction decision-making in the affected NP areas and future land use options.

1.1 Background

In December 2008, Dr. Ines Triay, DOE Assistant Secretary of Environmental Management announced plans to achieve significant reduction of the footprint of the Hanford Site by the year 2015. Those plans are being implemented in part through DOE/RL-2010-55 (*Remedial Investigation/Feasibility Study Work Plan for the 200-CW-1, 200-CW-3 and 200-OA-1 Operable Units*, Draft A) by addressing NP in the outer areas, which is the geographic area between waste sites. DOE-RL is performing a multi-pronged evaluation of these NP areas, which includes reviews of existing programs that collect data outside of waste sites, such as the following:

- Air emissions monitoring
- Liquid effluent monitoring
- Ambient air monitoring near Hanford Site facilities and operations
- Sitewide and offsite ambient air monitoring
- Sitewide and offsite soil monitoring
- Sitewide and offsite vegetation monitoring
- Radiological surface survey data and dose measurements near Hanford Site facilities and operations

Based on reviews performed in fiscal year (FY) 2011, two areas of the NP, one in the southwestern and one in the northwestern corners of the Hanford Central Plateau, were identified for soil sampling and laboratory analysis to confirm that they had not been affected by Hanford operations. If determined to be free of Hanford Site contaminants, these NP areas would be identified as not needing environmental cleanup, consistent with the DOE plans to reduce the footprint of the Hanford Site.

1.2 Sample and Laboratory Information

The Waste Sampling and Characterization Facility (WSCF) analytical laboratory performed all chemical and radiological analyses on the soil samples collected from the NP areas. WSCF is located on the Hanford Site and is operated by the Mission Support Alliance for DOE-RL.

Chapters 7 through 9 discuss the analytical data provided by the laboratory.

2 Purpose

The DQA process assesses the quality of the data collected to determine whether the data are the right type and of sufficient quality and quantity for their intended use (in this case, to support the footprint reduction decision making for the NP area located in the Central Plateau outer area).

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 the intended use. The DQA is not intended to be a definitive analysis of a project or problem. Instead, it provides an initial assessment of the reasonableness of the data that have been generated, based purely upon the quality control (QC) associated with the data, but generally does not provide the technical implications of the data values themselves.

This DQA focuses on the chemical and radionuclide characterization data collected by sampling two designated NP areas: Round 1 sampling (southwestern portion of Central Plateau) and Round 2 sampling (northeastern portion of Central Plateau). The data will be examined to determine whether they meet the analytical quality criteria outlined in the *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites* (200-MG-1 OU SAP) (DOE/RL-2009-60), and to determine whether the data are adequate to support decision making.

This DQA was performed in accordance with procedure GRP-EE-01-1.22. This procedure, in turn, is generally based upon EPA/240/B-06/002, *Data Quality Assessment: A Reviewer's Guide*, and roughly consists of data verification, data validation, and data usability evaluations.

Data Verification. The process of evaluating the completeness, correctness, and conformance/ compliance of a specific dataset against the method, procedural, or contractual requirements. It includes confirmation that the specified sampling and analytical requirements have been completed. This includes verification that the number, type, and location of all samples identified in the SAP have been collected and that all required measurements and analyses were performed. This evaluation is documented in the Completeness chapter, which evaluates the sampling design versus field implementation. In addition, verification is performed for field QC and laboratory QC and is documented in their respective sections.

Data Validation. An analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (that is, data verification) to determine the analytical quality of a specific dataset. Data validation includes a determination, where possible, of the reasons for any failure to meet method, procedural, or contractual requirements, and an evaluation of the impact of such failure on the overall dataset. It includes confirmation that the particular requirements for a specific intended use are fulfilled. Validation was performed on a percentage of all project data and is described in the Results chapter.

Data Usability. A determination of the adequacy of the data to support a particular environmental decision that is based upon 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

process execution and the resulting data meet project quality objectives. This evaluation is summarized in the Data Usability chapter.

4 Project Objectives

As discussed in Chapter 1, the NP areas were sampled to support footprint reduction decision making by DOE-RL. Because the NP areas are not Hanford waste sites, the development of sampling designs did not follow the data quality objective/SAP process normally applied for waste site confirmatory sampling. Instead, the assumption was made that the site-specific planning processes used for the 200-MG-1 operable unit (OU) were applicable to the NP areas because of similar terrain and the proximity of the 200-MG-1 sites. Therefore, the sampling design planning process for the NP areas relied on the data quality elements endemic to the 200-MG-1 OU SAP (DOE/RL-2009-60). While this DQA is based on the EPA guidelines, it follows the quality elements of the 200-MG-1 OU SAP (DOE/RL-2009-60).

4.1 NP Area Characterization Samples

The basis for the NP area sampling is presented in DOE/RL-2010-55, Draft A:

> *Examination of the historical data, industrial operations, and waste management practices reveals that 17 samples (and associated radiological surveys) are needed in the southwestern and eastern areas of the Outer Area. Eleven locations are identified for sampling in the southwestern area and six locations are identified for sampling in the eastern area. Addition of these samples in the southwestern area will provide the basis to support* the *applicability of the statistical model in this area. The six additional samples in the eastern area provide a test of the statistical model. The additional samples serve to fill a spatial gap in the existing samples in an area that could be argued to be downwind of sources and therefore warrant the additional investigation. Taken together, the samples in both areas provide an improvement in the spatial distribution of surface soil samples that will bolster the defensibility of the modeling approach. The 200-MG-1 SAP (DOE/RL-2009-60) contains an inclusive list of chemical analytes and is proposed for use in collecting the additional 17 samples.*

Because the NP areas are unused portions of the Hanford Central Plateau, characterization focused on shallow surface soil sampling. As stated above, Round 1 sampling called for the collection of 11 primary samples and 2 alternate locations in case the primary sample locations were not accessible or suitable. Round 2 required sampling in six locations. The planned sampling depths were from 0 to 15 cm (0 to 6 in.).

The project provided the following instructions to the samplers:

- **NP Round 1**—Sample locations will be randomly selected from within the investigation area identified in Figure 1. The selection of final location decisions will be made by the Field project analytical lead (PAL) and samplers. Figure 1 shows 11 preferred locations with 2 alternates. The two locations west of Highway 240 (NP-08 and NP-10) are preferred. The alternates may be substituted if necessary. Field radiological surveys will be performed in conjunction with soil sampling to verify the presence or absence of radiological constituents. Sampling coordinates will be logged via global positioning system (GPS).

- **NP Round 2**—Sample locations will be randomly selected from within the investigation area identified in Figure 2. The selection of final location decisions will be made by the Field PAL and samplers. Figure 2 shows six sampling locations. Field radiological surveys will be performed in

conjunction with soil sampling to verify the presence or absence of radiological constituents. All samples are east of the 200 East Area and the BC Controlled Area. Sampling coordinates will be logged via GPS.

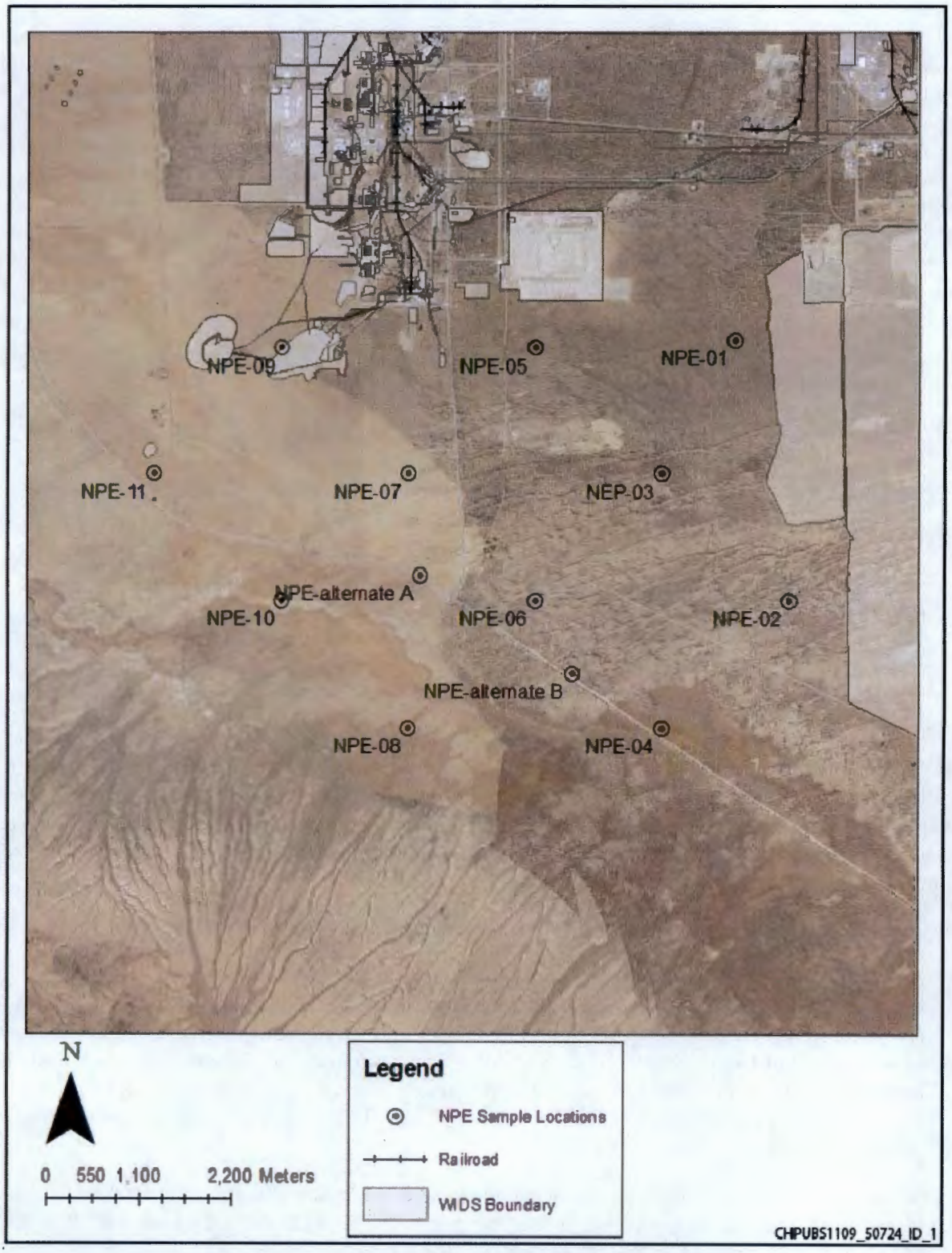

Figure 1. NP Area Round 1 Sampling Locations

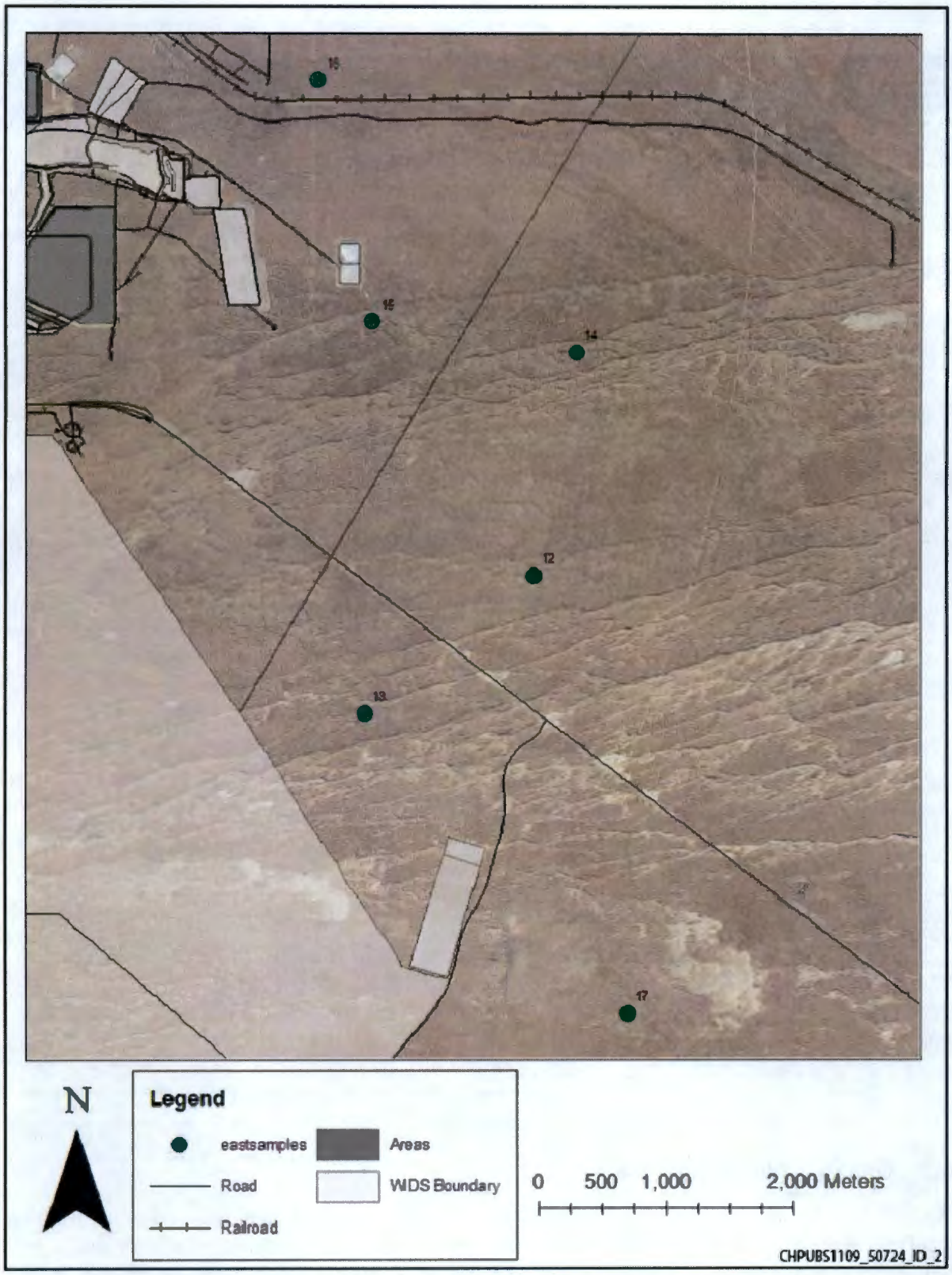

Figure 2. NP Area Round 2 Sampling Locations

Table 1 presents the sampling design summary.

Table 1. NP Area Sampling Design Summary

Planned Survey or Analytical Methodology	Key Features of Design
NP Round 1	
Soil Sampling	Determine contaminant concentrations in an unused and uncharacterized area in the southwest portion of the Central Plateau Outer Areas. Collect one shallow soil sample from each of the sampling locations shown in Figure 1. Soil samples will be analyzed for the following contaminants: metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, hexavalent chromium, lead, lithium, manganese, mercury, nickel, selenium, silver, strontium, thallium, tin, uranium, vanadium, zinc), SVOCs (acenaphthene, acenaphthylene, anthracene, benzo[*a*]anthracene, benzo[*a*]pyrene, benzo[*b*]fluoranthene, benzo[*ghi*]perylene, benzo[*k*]fluoranthene, chrysene, dibenz[*a,h*]anthracene, fluoranthene, fluorene, indeno[*1,2,3-cd*]pyrene, naphthalene, phenanthrene, pyrene), TPH-D, TPH-K, PCBs (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260), gross alpha, and gross beta.
Radiological Surveys	Perform routine radiological surveys of soil sampling areas in accordance with normal operating methods.
NP Round 2	
Soil Sampling	Determine contaminant concentrations in an unused and uncharacterized area in the northeast portion of the Central Plateau Outer Areas. Collect one shallow soil sample from each of the sampling locations shown in Figure 2. Soil samples will be analyzed for the following contaminants: metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, hexavalent chromium, lead, lithium, manganese, mercury, nickel, selenium, silver, strontium, thallium, tin, uranium, vanadium, zinc), SVOCs (acenaphthene, acenaphthylene, anthracene, benzo[*a*]anthracene, benzo[*a*]pyrene, benzo[*b*]fluoranthene, benzo[*ghi*]perylene, benzo[*k*]fluoranthene, chrysene, dibenz[*a,h*]anthracene, fluoranthene, fluorene, indeno[*1,2,3-cd*]pyrene, naphthalene, phenanthrene, pyrene), TPH-D, TPH-K, PCBs (Aroclor 1016, Aroclor 1221, Aroclor 1232, Aroclor 1242, Aroclor 1248, Aroclor 1254, Aroclor 1260), gross alpha, and gross beta.
Radiological Surveys	Perform routine radiological surveys of soil sampling areas in accordance with normal operating methods.

NP = nonoperational property
SVOC = semivolatile organic compound
TPH-D = total petroleum hydrocarbons, diesel range
TPH-K = total petroleum hydrocarbons, kerosene range

4.2 Quality Control Samples

In addition to the primary site characterization samples, collocated field duplicates and equipment rinsate blanks were required. Field duplicate samples are obtained from locations near the corresponding primary field samples and analyzed at the same laboratory. Equipment rinsate blanks are water samples that have been used to rinse the sampling equipment.

The project request for analytical services form called for the collection of a field duplicate and equipment blank (EB) with each primary sample location because of the observation that each sample location was very remote from the others, which caused a concern that the sampling effort might be spread over many weeks.

Contaminants of potential concern (COPCs) are listed in Table 2. Table 3 presents the NP Round 1 sampling plan, and Table 4 presents the NP Round 2 sampling plan. Tables 3 and 4 show QC sampling requirements.

Table 2. Contaminants of Potential Concern for the NP Areas

Radioactive Constituents	
Gross Alpha	Gross Beta
Chemical Constituents—Metals	
Antimony	Manganese
Arsenic	Mercury
Barium	Nickel
Beryllium	Selenium
Boron	Strontium
Cadmium	Silver
Chromium	Thallium
Cobalt	Tin
Hexavalent Chromium	Uranium
Copper	Vanadium
Lead	Zinc
Lithium	
Chemical Constituents—Other Inorganics	
Nitrate/Nitrite	pH (Soil)
Semivolatile Organics	
Acenaphthene	Chrysene
Acenaphthylene	Dibenz[*a,h*]anthracene
Anthracene	Fluoranthene
Benzo[*a*]anthracene	Fluorene
Benzo[*a*]pyrene	Indeno[*1,2,3-cd*]pyrene
Benzo[*b*]fluoranthene	Naphthalene
Benzo[*ghi*]perylene	Phenanthrene

Table 2. Contaminants of Potential Concern for the NP Areas

Benzo[*k*]fluoranthene	Pyrene
Total petroleum hydrocarbons, diesel range Total petroleum hydrocarbons, kerosene range	Aroclor 1242
Aroclor 1016	Aroclor 1248
Aroclor 1221	Aroclor 1254
Aroclor 1232	Aroclor 1260

NP = nonoperational property

Table 3. NP Round 1 (Southwestern Portion of Central Plateau) Sampling Plan

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth bgs	Analyte List[a]	Physical Properties	
					Sample Interval	Parameters
Shallow surface soil sampling	Per sampling maps	15 cm (6 in.)	0 to 15 cm (0 to 6 in.)	Table 1	N/A	N/A
Maximum Number of Samples						11
Approximate Number of Field QC Samples						22[b]
Approximate Total Number of Samples						33

a. See Table 6 for detection limits and other analytical parameters.

b. One duplicate and one EB at each sample location.

bgs = below ground surface

EB = equipment blank

N/A = not applicable

NP = nonoperational property

QC = quality control

Table 4. NP Round 2 (Northeastern Portion of Central Plateau) Sampling Plan

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth bgs	Analyte List[a]	Physical Properties	
					Sample Interval	Parameters
Shallow surface soil sampling	Per sampling maps	15 cm (6 in.)	0 to 15 cm (0 to 6 in.)	Table 1	N/A	N/A
Maximum Number of Samples						6
Approximate Number of Field QC Samples						12[b]
Approximate Total Number of Samples						18

a. See Table 6 for detection limits and other analytical parameters.

b. One duplicate and one EB at each sample location.

bgs = below ground surface

EB = equipment blank

N/A = not applicable

NP = nonoperational property

QC = quality control

5 Completeness

5.1 Sample Design

Shallow soil samples were collected from the NP areas in accordance with the request for analytical services forms, sampling authorization forms, and sample collection maps (Figures 1 and 2).

5.2 Implementation of the Sampling Design

This section summarizes the sampling. The samples were collected and transported in accordance with the 200-MG-1 OU SAP (DOE/RL-2009-60) and with procedure GRP-FS-04-G-029, *Non-VOC Soil and Sediment Sampling*. All samples were obtained in FY 2011 using disposable sampling spoons.

The soil samples and requisite QC samples were submitted to WSCF laboratory for chemical and radionuclide analysis. The sampling locations, Hanford Environmental Information System (HEIS) database numbers, and raw data for the chemical and radionuclide analysis samples are detailed in Appendix A.

Table 5 presents a summary of the sampling performed in 2011. Samples were analyzed for the constituents called out in the respective request for analytical services forms.

The QC sampling requirements discussed in Section 4.2 and Tables 3 and 4 identified the need for one field duplicate and one EB for each sample location. However, before sampling began, the project team decided that there was no need for that degree of QC sampling, and it was decided that the normal rate of QC sampling (1/20 primary samples) would suffice.

Table 5. Sample Design Implementation and Completeness Evaluation

Location	Samples Required	Sampling Completed	Complete
NP Round 1	11 samples from 13 possible sampling locations	11 surface samples were collected from the NP Round 1 Area.	100 percent of surface soil
NP Round 1	Radiological surveys	Radiological surveys were conducted as planned.	100 percent
NP Round 2	Six samples from six sampling locations	Six soil surface samples were collected from the NP Round 2 Area.	100 percent of surface soil
NP Round 2	Radiological surveys	Radiological surveys were conducted as planned.	100 percent

NP = nonoperational property

6 Data Review

6.1 Analytical Requirements

The radionuclide and chemical COPCs associated with the 200-MG-1 OU waste sites were adopted for use in the sampling of the NP areas as shown in Table 2. Table 6 provides the analytical performance requirements for laboratory analysis of soil.

Table 6. Analytical Performance Requirements for Soil Samples

Parameter/ Analyte	Analytical Method[a]	Overall Removal Action Levels[b]	Required Detection Limit	Precision Requirement (percent)	Accuracy Requirement (percent)
Metals					
Antimony	EPA 6010/200.8	5.4 mg/kg	0.6 mg/kg[c]	≤ 30[d]	70 to 130[d]
Arsenic	EPA 6010/200.8	6.5 mg/kg	1.0 mg/kg[c]	≤ 30[d]	70 to 130[d]
Barium	EPA 6010/200.8	1,650 mg/kg	2.0 mg/kg	≤ 30[d]	70 to 130[d]
Beryllium	EPA 6010/200.8	63.2 mg/kg	0.5 mg/kg	≤ 30[d]	70 to 130[d]
Boron	EPA 6010/200.8	210 mg/kg	2.0 mg/kg	≤ 30[d]	70 to 130[d]
Cadmium	EPA 6010/200.8	0.81 mg/kg	0.5 mg/kg	≤ 30[d]	70 to 130[d]
Chromium (total)	EPA 6010/200.8	2,000 mg/kg	1.0 mg/kg	≤ 30[d]	70 to 130[d]
Chromium (VI)	EPA 7196	[g]	0.5 mg/kg	≤ 30[d]	70 to 130[d]
Cobalt	EPA 6010/200.8	15.7 mg/kg	2.0 mg/kg	≤ 30[d]	70 to 130[d]
Copper	EPA 6010/200.8	284 mg/kg	1.0 mg/kg	≤ 30[d]	70 to 130[d]
Lead	EPA 6010/200.8	250 mg/kg	5.0 mg/kg	≤ 30[d]	70 to 130[d]

Table 6. Analytical Performance Requirements for Soil Samples

Parameter/ Analyte	Analytical Method[a]	Overall Removal Action Levels[b]	Required Detection Limit	Precision Requirement (percent)	Accuracy Requirement (percent)
Lithium	EPA 6010/200.8	160 mg/kg	2.5 mg/kg	≤ 30[d]	70 to 130[d]
Manganese	EPA 6010/200.8	512 mg/kg	5.0 mg/kg	≤ 30[d]	70 to 130[d]
Mercury	EPA 7471	2.09 mg/kg	0.2 mg/kg[c]	≤ 30[d]	70 to 130[d]
Nickel	EPA 6010/200.8	130 mg/kg	4.0 mg/kg	≤ 30[d]	70 to 130[d]
Selenium	EPA 6010/200.8	5.2 mg/kg	1.0 mg/kg[c]	≤ 30[d]	70 to 130[d]
Silver	EPA 6010/200.8	13.6 mg/kg	0.2 mg/kg[c]	≤ 30[d]	70 to 130[d]
Strontium	EPA 6010/200.8	2,920 mg/kg	1.0 mg/kg	≤ 30[d]	70 to 130[d]
Thallium	EPA 6010/200.8	1.59 mg/kg	1.0 mg/kg	≤ 30[d]	70 to 130[d]
Tin	EPA 6010/200.8	48,000 mg/kg	10 mg/kg	≤ 30[d]	70 to 130[d]
Uranium	EPA 6010/200.8	3.21 mg/kg	1.0 mg/kg	≤ 30[d]	70 to 130[d]
Vanadium	EPA 6010/200.8	560 mg/kg	2.5 mg/kg[c]	≤ 30[d]	70 to 130[d]
Zinc	EPA 6010/200.8	5,970 mg/kg	1.0 mg/kg[c]	≤ 30[d]	70 to 130[d]
PCBs					
Aroclor 1016	PCB 8082	0.094 mg/kg	0.017 mg/kg	≤ 50[d]	50 to 150[d]
Aroclor 1221	PCB 8082	0.017 mg/kg	0.017 mg/kg	≤ 50[d]	50 to 150[d]
Aroclor 1232	PCB 8082	0.017 mg/kg	0.017 mg/kg	≤ 50[d]	50 to 150[d]
Aroclor 1242	PCB 8082	0.039 mg/kg	0.017 mg/kg	≤ 50[d]	50 to 150[d]
Aroclor 1248	PCB 8082	0.039 mg/kg	0.017 mg/kg	≤ 50[d]	50 to 150[d]
Aroclor 1254	PCB 8082	0.066 mg/kg	0.017 mg/kg	≤ 50[d]	50 to 150[d]
Aroclor 1260	PCB 8082	0.5 mg/kg	0.017 mg/kg	≤ 50[d]	50 to 150[d]
PAHs					
Acenaphthene	GC-MS 8270	98 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Acenaphthylene	GC-MS 8270	98 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Anthracene	GC-MS 8270	2,270 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Benzo[*a*]anthracene	GC-MS 8270	0.86 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Benzo[*a*]pyrene	GC-MS 8270	0.33 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Benzo[*b*]fluoranthene	GC-MS 8270	1.37 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]

Table 6. Analytical Performance Requirements for Soil Samples

Parameter/ Analyte	Analytical Method[a]	Overall Removal Action Levels[b]	Required Detection Limit	Precision Requirement (percent)	Accuracy Requirement (percent)
Benzo[*k*]fluoranthene	GC-MS 8270	1.37 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Benzo[*g,h,i*]perylene	GC-MS 8270	2,400 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Chrysene	GC-MS 8270	9.56 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Dibenz[*a,h*]anthracene	GC-MS 8270	1.37 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Fluoranthene	GC-MS 8270	631 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Fluorene	GC-MS 8270	101 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Indeno[*1,2,3-cd*]pyrene	GC-MS 8270	1.37 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Naphthalene	GC-MS 8270	4.46 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Phenanthrene	GC-MS 8270	1,140 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Pyrene	GC-MS 8270	655 mg/kg	0.33 mg/kg	≤ 30[d]	70 to 130[d]
Anion					
Nitrate (as N)	Anions-IC 300.0	40 mg/kg	0.75 mg/kg	≤ 30[d]	70 to 130[d]
Fluoride[h]	Anions-IC 300.0	16 mg/kg	5 mg/kg	≤ 30[d]	70 to 130[d]
TPH					
Diesel Range	TPH-D	2,000 mg/kg	5.0 mg/kg	≤ 30[d]	70 to 130[d]
Kerosene Range	TPH-K	2,000 mg/kg	5.0 mg/kg	≤ 30[d]	70 to 130[d]
Volatile Organics					
Carbon tetrachloride	EPA 8260	0.005 mg/kg	0.005 mg/kg	≤ 30[d]	70 to 130[d]
Xylene[f]	EPA 8260	14.6 mg/kg	0.001 mg/kg	≤ 30[d]	70 to 130[d]
Other Nonradiological					
Asbestos[i]	Polarized light microscopy	1 percent[i]	N/A[i]	N/A	N/A
Radiological					
Americium-241	GEA	31.1 pCi/g	1.0 pCi/g	≤ 30[e]	70 to 130[e]
Cesium-137	GEA	6.2 pCi/g	0.1 pCi/g	≤ 30[e]	70 to 130[e]
Europium-152	GEA	3.3 pCi/g	0.1 pCi/g	≤ 30[e]	70 to 130[e]
Europium-154	GEA	3.0 pCi/g	0.1 pCi/g	≤ 30[e]	70 to 130[e]
Europium-155	GEA	125 pCi/g	0.1 pCi/g	≤ 30[e]	70 to 130[e]

Table 6. Analytical Performance Requirements for Soil Samples

Parameter/ Analyte	Analytical Method[a]	Overall Removal Action Levels[b]	Required Detection Limit	Precision Requirement (percent)	Accuracy Requirement (percent)
Plutonium-238	PU AEA	38.8 pCi/g	1.0 pCi/g	≤ 30[e]	70 to 130[e]
Plutonium-239/240	PU AEA	33.9 pCi/g	1.0 pCi/g	≤ 30[e]	70 to 130[e]
Strontium-90	GFPC	4.5 pCi/g	1.0 pCi/g	≤ 30[e]	70 to 130[e]
Technetium-99	LSC/GPC	15 pCi/g	15 pCi/g	≤ 30[e]	70 to 130[e]
Tritium	LSC	30 pCi/g	30 pCi/g	≤ 30[e]	70 to 130[e]
Uranium-233/234	U AEA	1.1 pCi/g	1.0 pCi/g	≤ 30[e]	70 to 130[e]
Uranium-235	U AEA	0.5 pCi/g	0.5 pCi/g	≤ 30[e]	70 to 130[e]
Uranium-238	U AEA	1.1 pCi/g	1.0 pCi/g	≤ 30[e]	70 to 130[e]

a. The analytical method selection is based on available methods for laboratories currently contracted to the Hanford Site. Equivalent methods may be substituted in future sampling and analysis instructions or other documents. For the four-digit EPA method, see SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, 3rd edition.* For EPA Method 200.8, see EPA/600/R-94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1.* For EPA Method 300.0, see EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes.*

b. The overall removal action levels are from DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit.*

c. 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 mass spectrometry methods if required detection limits are met.

d. The accuracy criteria specified are for calculated percent recoveries for associated analytical batch MS samples. Additional accuracy evaluation based on statistical control limits for analytical batch LCSs also is performed. The precision criteria shown are for batch laboratory replicate MS or replicate sample RPDs.

e. The accuracy criteria shown are for associated batch LCS percent recoveries. Except for GEA, additional accuracy criteria include analysis-specific evaluations performed for MS, tracer, and/or carrier recoveries as appropriate to the method. The precision criteria shown are for batch laboratory replicate sample RPDs.

f. Xylenes are target analytes for Waste Site 200-W-3 only.

g. Based on process knowledge, chromium (VI) is not expected to be present at 200-MG-1 OU waste sites. The following values are given to help guide cleanup:

- 0.2 mg/kg—calculated value using K_d=0, based on PNNL-13895, 2003, *Hanford Contamination Distribution. Coefficient Database and Users Guide,* and WAC 173-340-747, Equation 747-1.
- 2.1 mg/kg—based on DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area.*
- 18.4 mg/kg—based on Ecology, 2007, Cleanup Levels and Risk Calculations (CLARC) database.

h. Fluoride is added as a COPC for selected sites, 216-S-19 and 216-S-26, based on process history.

i. The RAL for asbestos in soil is 1 percent by weight (measured using Polarized Light Microscopy). EPA has used this value for determining whether response actions for asbestos should be undertaken (OSWER9345.4-05). Further evaluation of removal actions for asbestos will be conducted as needed on a site-specific basis in the Outer Area RI/FS.

AEA	=	alpha energy analysis	LCS	=	laboratory control sample
CLARC	=	Cleanup Levels and Risk Calculations database	MS	=	matrix spike
COPC	=	contaminant of potential concern	OU	=	operable unit
EPA	=	U.S. Environmental Protection Agency	PAH	=	polynuclear aromatic hydrocarbon
GC	=	gas chromatograph	PCB	=	polychlorinated biphenyl

Table 6. Analytical Performance Requirements for Soil Samples

Parameter/ Analyte	Analytical Method[a]	Overall Removal Action Levels[b]	Required Detection Limit	Precision Requirement (percent)	Accuracy Requirement (percent)

GC-MS = gas chromatograph-mass spectrometer
GEA = gamma energy analysis
GFPC = gas flow proportional counting
GPC = gas proportional counting
IC = ion chromatography
ICP = inductively coupled plasma
LSC = liquid scintillation counting
PNNL = Pacific Northwest National Laboratory
PU = plutonium
RAL = removal action level
RPD = relative percent difference
TPH-D = total petroleum hydrocarbons, diesel range
TPH-K = total petroleum hydrocarbons, kerosene range
U = uranium

6.2 Laboratory Quality Assurance and Quality Control Requirements

The quality assurance/QC requirements govern nearly all aspects of analytical laboratory operation including instrument procurement, maintenance, calibration, and operation. Additional laboratory requirements for internal QC checks are performed as appropriate for the analytical method at a rate of 1 per sample delivery group (SDG) 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 of 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 (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 corrected via internal standards (such as alpha energy analysis [AEA]), accuracy 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, semivolatile organic analysis, and PCB compound analyses. Surrogates are compounds with instrumental responses that are typical of the other analytes. The surrogates are added into the blanks, samples, and MSs, and the recovery is evaluated.

- **Analytical Precision**—separate aliquots removed from the same sample container (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 an MSD, a separate aliquot is removed from the same sample container and spiked in the same manner as an MS. The recoveries from the MS/MSD are used to calculate an RPD and to assess precision.

- **QC Reference Samples or Laboratory Control Samples**—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 preparation and analysis steps used in the method. The LCS or QC reference sample measures the accuracy of the analytical process. Depending on how it is introduced into the analysis, the LCS sometimes is referred to as a blank-spike sample. Laboratories are also subject to periodic and random audits of laboratory performance, systems, and overall program. Audits ensure 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.

6.3 Qualification Flags

During the generation of environmental 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 validator, or a data user. The tables of data within this report show all of these applied qualification flags. Flags and their meanings are as follows:

- **B**—(Inorganics and Wetchem)—The analyte was detected at a value less than the contract required detection limit (CRDL), but greater than or equal to the minimum detection limit (MDL). The data should be considered usable for decision-making purposes.

- **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 5 times the blank concentration. The data should be considered unusable for decision-making purposes.

- **D**—(Organics and Wetchem)—The analyte was identified in an analysis at a secondary dilution factor (that is, dilution factor different from 1.0). The data should be considered usable for decision-making purposes.

- **E**—(Inorganics)—Reported value is estimated because of interference. See any comments that may be in the laboratory report case narrative.

- **E**—(Organics)—Concentration exceeds the calibration range of the gas chromatograph/mass spectrometer.

- **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 data validation. 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**—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 MDL. The data should be considered usable for decision-making purposes.

- **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.
- **X**—(All)—The result-specific translation of this qualifier code is provided in the data report and/or case narrative.

6.4 Removal Action Levels

Removal action levels (RALs) were established in the 200-MG-1 OU SAP (DOE/RL-2009-60) for the target analytes. Table 6 presents the analytical performance requirements and RALs for nonradionuclides and radionuclides, respectively.

7 Results

This chapter of the DQA report discusses the analytical results for the soil samples collected at the NP areas at the Central Plateau Outer Area for contaminant characterization.

All samples were sent to the WSCF lab for analysis using the same chemical and radiochemical analytical methods. Each sample was tracked by a unique HEIS database number.

The quality of these sample results are analyzed in this report. Analytical requests for chemical and radiochemical services to be completed by the laboratory are documented on Chain-of-Custody forms. Analytical results provided by the laboratories are tracked and documented in SDG data packages. This chapter includes an overall evaluation of the data against identified removal action levels and the validation results for a representative number of SDG data packages.

7.1 Soil Sample Analysis Results

The soil sample results are presented in Appendix A. Sample results are presented by the location. This is the dataset upon which this DQA is based.

7.2 Data Exceeding Removal Action Levels

The RALs were established in the 200-MG-1 OU SAP (DOE/RL-2009-60) for the target analytes and are presented in Table 7. The RALs were compared to the analytical sample results from the HEIS database. Table 7 summarizes the results of this comparison.

Table 7. Analytical Results Exceeding Removal Action Levels

Constituent	HEIS	Detected Value	RAL
Manganese	B2BH34	554 mg/kg	512 mg/kg (groundwater protection)

HEIS = Hanford Environmental Information System

RAL = removal action level

7.3 Nondetect Exceeding Removal Action Levels

Nearly all laboratory detection limits met applicable detection limit targets defined in the 200-MG-1 OU SAP (DOE/RL-2009-60). However, no data usability concerns are associated with these elevated detection levels. The following specific detection limit exceedances were observed.

7.3.1 Nitrate Analyses

Nitrate—five of the nondetect samples exceeded the target detection limits for nitrate (0.75 mg/kg). However, all detection limits remained below the identified cleanup limit of 40 mg/kg from the 200-MG-1 OU SAP (DOE/RL-2009-60).

7.4 Data Validation

Data validation was performed by Analytical Quality Associates, Inc. (AQA) of Albuquerque, New Mexico, as documented in *Data Validation Report for CH2M Hill Plateau Remediation Company VSR11-053 Project Outer Area, Chemical Validation-Level C* (AQA, 2011). All validation flags were placed in the HEIS database.

The criteria used in this validation varied and were selected by the validator from the 200-MG-1 OU SAP (DOE/RL-2009-60), chain of custody forms, the data validation method, or the statistical limits established by the analytical laboratory because of incomplete coverage by any one source. The sources of the criteria are called out in the sections that follow.

7.4.1 Data Validation Summary

The 200-MG-1 OU SAP (DOE/RL-2009-60) specifies that at least 5 percent of the data will undergo Level C independent third-party validation. Validation of selected laboratory data was performed by AQA and reported in AQA, 2011. Table 8 summarizes the samples and laboratory methods, which were independently validated for soil samples from the NP areas. As shown in these tables, the 5 percent SAP requirement was met for all selected samples.

Table 8. NP Area Validated Soil Samples

Analyte Category	Samples Validated	Validation Totals		
		Total Number of Samples Validated	Total Number of Samples Analyzed	Percent Validated
(AQA, 2011)				
Semivolatiles (8270D, THP-D)	B2BH54, B2BH28 B2BH30, B2BH36 B2BH37	5	19	26
PCBs (8082)	B2BH54, B2BH28 B2BH30, B2BH36 B2BH37	5	19	26
Metals (6010C and 200.8)	B2BH54, B2BH28 B2BH30, B2BH36 B2BH37	5	19	26
General Chemistry (300.0, 7196A, 9040B, 9045)	B2BH54, B2BH28 B2BH30, B2BH36 B2BH37	5	19	26

Table 8. NP Area Validated Soil Samples

Analyte Category	Samples Validated	Validation Totals		
		Total Number of Samples Validated	Total Number of Samples Analyzed	Percent Validated
Gross Alpha Gross Beta	B2BH54, B2BH28 B2BH30, B2BH36 B2BH37	5	19	26

NP = nonoperational property
PCB = polychlorinated biphenyl
THP-D = total petroleum hydrocarbons, diesel range

7.4.1.1 Major Deficiencies

None found for organics, general chemistry, and radiochemistry.

A major deficiency was found for metals, leading to qualification of the antimony results for samples B2BH28, B2BH30, B2BH36, and B2BH37 as unusable because of a very high LCS recovery. This is discussed further in Chapter 10, Data Usability Conclusions.

7.4.1.2 Minor Deficiencies

None found for organics or radiochemistry.

A minor deficiency was identified for metals, leading to qualification of the vanadium sample result for sample B2BH54 as a nondetect because of a laboratory blank contamination.

A minor deficiency was found in general chemistry, leading to qualification of hexavalent chromium sample results as estimates because of an MS recovery below the acceptance limit. Minor deficiencies led to qualification of pH sample results as estimates because of exceeding holding times.

7.4.1.3 Qualification Flags Applied to the Dataset

Table 9 lists all qualification flags applied to the dataset as a result of the data validation process.

Table 9. Summary of Qualification Flags for NP Area Sample Data

Method Analytes	Qualifier	Samples Affected	Reason
(AQA, 2011)			
Metals			
Antimony	UR*	B2BH28, B2BH30, 2BH36, B2BH37	Very high LCS recovery
Vanadium	U	B2BH54	Laboratory blank contamination

Table 9. Summary of Qualification Flags for NP Area Sample Data

Method Analytes	Qualifier	Samples Affected	Reason
General Chemistry			
pH	J	B2BH28, B2BH30, B2BH36, B2BH37	Analyzed beyond the folding time
Hexavalent chromium	UJ	B2BH28, B2BH36	Low MS recovery
Hexavalent chromium	J	B2BH30, B2BH37	Low MS recovery

* This qualifier is evaluated further and revised in Section 10.1 of this report.

NP = nonoperational property

PCBs = polychlorinated biphenyl

LCS = laboratory control sample

MS = matrix spike

7.4.2 Holding Times and Sample Preservation

Holding times are calculated from Chain-of-Custody forms to determine the validity of the results.

7.4.2.1 Organics

The holding time requirements for the organic parameters are as follows:

- Semivolatile organics and total petroleum hydrocarbons, diesel range (TPH-D) in soil require extraction within 14 days of sample collection and analysis within 40 days of sample extraction.
- Semivolatile organics and TPH-D in water require extraction within 7 days of sample collection and analysis within 40 days of sample extraction.
- Sample preservation requires chilling to 4°C. In addition, TPH-D in water requires acid preservation with hydrochloric acid to pH less than 2.
- PCBs in soil samples require extraction within 1 year of sample collection and analysis within 1 year of sample extraction. Sample preservation requires chilling to 4°C.

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

7.4.2.2 Metals

The holding time requirements for metals are as follows:

- Inductively coupled plasma (ICP) spectrometer metals require analysis within 180 days of sample collection.
- Mercury requires analysis within 28 days of sample collection. Sample preservation for soil samples requires chilling to 4°C. Sample preservation for water samples requires chilling to 4°C and acid preservation with nitric acid to pH less than 2.

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

7.4.2.3 General Chemistry

The holding time requirements are as follows:

- Nitrate—extraction of soils within 28 days of sample collection and analysis within 48 hours of extraction; analysis of waters within 48 hours of sample collection.
- Hexavalent chromium—analysis of soils within 30 days of sample collection and analysis of waters within 24 hours of sample collection.
- pH—analysis as soon as possible after sample collection.

Sample preservation requires chilling to 4°C, except for pH in water that has no sample preservation requirement. The samples were extracted and analyzed within the prescribed holding times and properly preserved with the following exceptions:

- Samples B2BH28, B2BH30, B2BH36, and B2BH37 were analyzed for pH 4 days after sample collection. Based on professional judgment, the pH results should be qualified as estimates and flagged "J."

7.4.2.4 Radiochemistry

The maximum holding time for radiochemical analysis is 180 days. 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 of the validated samples were analyzed within the prescribed holding time and properly preserved.

7.4.3 Blanks

The blank data results are reviewed to assess the extent of contamination introduced through sampling, sample preparation, and analysis.

7.4.3.1 Laboratory Blanks

All laboratory blank results for the organics, general chemistry, and radiochemistry were acceptable. The metals laboratory blank results were acceptable with the following exception. For SDG WSCF112290, the vanadium laboratory blank result was greater than the MDL but less than the reporting limit (RL). The vanadium result for Sample B2BH54 was a detect less than the RL and should be qualified as a nondetect at the RL (4.0 μg/L) and flagged "U."

7.4.3.2 Trip Blanks

No trip blanks were submitted for third-party validation of organics, metals, general chemistry, or radionuclide analysis.

7.4.3.3 Field Blanks

No field blanks were submitted for third-party validation of organics, metals, general chemistry, or radionuclide analysis.

7.4.3.4 Equipment Blanks

All EB results for the organics, general chemistry, and radiochemistry were acceptable. All metals EB results were acceptable with the following exceptions. Copper, vanadium, and zinc were detected in EB B2BH54. The vanadium result has been qualified as a nondetect and flagged "U" because of laboratory blank contamination.

7.4.4 Accuracy

Accuracy is evaluated by reviewing surrogate results, MS sample results, and LCS results. According to the 200-MG-1 OU SAP (DOE/RL-2009-60), accuracy limits vary:

- Semivolatile and total petroleum hydrocarbon (TPH) soil MS limits from the 200-MG-1 OU SAP (DOE/RL-2009-60) are 70 to 130 percent. The 8270D surrogate accuracy limits used for data validation were the statistical ones established by the analytical laboratory. The TPH-D surrogate accuracy limits were the ones specified by the data validation procedure (GRP-GD-003), 50 to 150 percent, in this case.
- PCB soil MS accuracy limits are 50 to 150 percent. The surrogate accuracy limits were the ones specified by the data validation procedure (GRP-GD-003), 30 to 150 percent in this case.
- Metals soil MS accuracy limits are 70 to 130 percent.
- General chemistry soil MS accuracy limits are 70 to 130 percent.
- The radiochemistry methods performed do not require MS analysis. Soil MS accuracy limits are therefore not specified.

In general, the soil LCS accuracy limits are the ones specified by the data validation procedures—GRP-GD-002 and GRP-GD-003. Water accuracy limits were not provided in the 200-MG-1 OU SAP (DOE/RL-2009-60) and are therefore specified by the data validation procedures. The accuracy limits for reported analytes not listed in the 200-MG-1 OU SAP (DOE/RL-2009-60) are specified by the data validation procedures.

7.4.4.1 Surrogates

All surrogate recoveries were acceptable.

7.4.4.2 Matrix Spike/Matrix Spike Duplicate Samples

The MS/MSD recoveries for organics were acceptable with the following exceptions:

- For WSCF112290, the MS/MSD recoveries for TPH-D were above the upper acceptance limit, indicating a potentially high bias on the sample result. The TPH-D and TPH-K results for sample B2BH54 were nondetects and should not be qualified.
- For WSCF112291, the MS recovery for TPH-D was above the upper acceptance limit, indicating a potentially high bias on the sample result. The TPH-D and TPH-K results for Samples B2BH28, B2BH30, B2BH36, and B2BH37 were nondetects and should not be qualified.
- It is noted that Aroclor 1254 was the only analyte reported for the MS/MSD. Method 8082 guidance specifies Aroclor 1016 and Aroclor 1260 for MS/MSD analyses. No sample data are qualified as a result.

The MS/MSD recoveries for metals were acceptable with the following exceptions:

- For SDG WSCF112290, the MSD recovery for mercury was greater than the upper acceptance limit, indicating a potentially high bias on the sample result. The mercury results for sample B2BH54 was a nondetect and should not be qualified.

All MS/MSD recoveries for general chemistry were acceptable with the following exceptions:

- For SDG WSCF112291, the MS recovery for hexavalent chromium was less than the lower acceptance limit, indicating a potentially low bias on the sample result. The hexavalent chromium results for Samples B2BH28 and B2BH36 were nondetects, so they should be qualified as estimates and flagged "UJ." The hexavalent chromium results for Samples B2BH30 and B2BH37 were detects and should be qualified as estimates and flagged "J."

The radiochemistry methods performed do not require MS analysis.

7.4.4.3 Laboratory Control Samples

All LCS recoveries for organics were acceptable with the following exceptions:

- For WSCF112290, the LCS recovery for TPH-D was above the upper acceptance limit. The TPH-D and TPH-K results for Sample B2BH54 were nondetects and should not be qualified. For WSCF112291, the LCS recovery for TPH-D was above the upper acceptance limit. The TPH-D and TPH-K results for Samples B2BH28, B2BH30, B2BH36, and B2BH37 were nondetects and should not be qualified.
- It is noted that Aroclor 1254 was the only analyte reported for the LCS. Method 8082A guidance specifies Aroclor 1016 and Aroclor 1260 for LCS analyses. No sample data are qualified as a result.

All LCS recoveries for metals were acceptable with the following exception:

- For SDG WSCF112291, the LCS recovery for antimony was greater than 170 percent. The antimony results for Samples B2BH28, B2BH30, B2BH36, and B2BH37 were nondetects and should be qualified as unusable and flagged "UR."

All LCS recoveries for general chemistry and radiochemistry were acceptable.

7.4.5 Precision

Precision is evaluated by reviewing MS/MSD results, field duplicate sample results, and field split sample results. These QC results provide information on the laboratory reproducibility and sampling activity adequacy to acquire consistent sample results. For the organics, metals, and general chemistry, the 200-MG-1 OU SAP (DOE/RL-2009-60) specifies the RPD limits of ≤30 percent. The limits for reported analytes not listed in the 200-MG-1 OU SAP (DOE/RL-2009-60) are specified by the data validation procedure GRP-GD-003. When duplicate RPDs exceed the limits and have associated results less than 5 times the RLs, with differences less than 1 time the water RLs, or differences less than 2 times the soil RLs, no precision degradation occurred.

For radiochemistry, the RPD limits are specified by the data validation procedure GRP-GD-002. When duplicate RPDs exceed the limits and have associated results <5 times the minimum detectable concentrations, the precision limits are those specified by the data validation procedure.

7.4.5.1 MS/MSD Samples

All applicable MS/MSD RPD values (organics, metals, and general chemistry) were acceptable.

7.4.5.2 Lab Duplicates

All applicable lab duplicate results (general chemistry and radiochemistry) were acceptable.

7.4.5.3 Field Duplicate Samples

All field duplicate results for organics, metals, general chemistry, and radiochemistry were acceptable.

7.4.5.4 Field Split Samples

No field splits were submitted for validation.

7.4.6 Detection Limits

Reported MDLs are compared against the CRDLs to ensure that laboratory detection limits meet the required criteria.

All reported sample MDLs for organics, metals, and general chemistry were below the CRDLs. Gross alpha and gross beta CRDLs were not provided in the 200-MG-1 OU SAP (DOE/RL-2009-60).

7.4.7 Completeness

SDGs WSCF112290 and WSCF112291 were submitted for validation and verified for completeness. Completeness is based on the percentage of data determined to be valid (i.e., not rejected).

The completion percentage was 100 percent for organics, general chemistry, and radiochemistry. The completion percentage for metals was 97 percent because of the high LCS recovery for antimony, which resulted in the rejected antimony values for Samples B2BH28, B2BH30, B2BH36, and B2BH37.

8 Field Quality Control

8.1 Field Quality Control Sampling Requirements

The 200-MG-1 OU SAP (DOE/RL-2009-60) requires collection of field duplicates and equipment rinsate blanks. Field duplicate samples are obtained from the same surface sample media using the same equipment and sampling technique as the corresponding primary field samples. Field duplicate samples are analyzed for the same COPCs at the same laboratory that had analyzed the corresponding primary field samples. The requirement is for field duplicates to comprise 5 percent of the sampling activities.

Equipment rinsate blanks are required when nondedicated sampling devices are used. EBs consist of pure deionized water washed through decontaminated sampling equipment and placed in containers. Equipment rinsate blanks are used to verify the adequacy of sampling equipment decontamination procedures. A minimum of one field equipment rinsate blank is collected from each waste site or sampling area where soil sampling is performed using nondedicated sampling equipment, as noted in the 200-MG-1 OU SAP (DOE/RL-2009-60).

The request for analytical services form used to initiate the sampling of the NP areas called for the collection of one field duplicate and one EB per day of sampling because of the perception that the NP areas were so distant from one another. Implementation of this requires a very long time to complete, which could diminish the significance of the field QC sampling. However, when a dedicated sampling team was assigned to the NP area sampling, the project team decided to default to the field QC sampling frequencies specified in the 200-MG-1 OU SAP (DOE/RL-2009-60).

8.2 Field Quality Control Results

For the 2011 sampling effort, a single EB result was reported for the NP area sampling (Rounds 1 and 2). Of the 52 results reported, 3 exceeded criteria and were the common metals copper, vanadium, and zinc as shown in Appendix C, Table C-1.

Field duplicate samples were obtained from the same sample interval using the same equipment and sampling technique as their corresponding primary field sample. The field duplicate sample was analyzed for the same COPCs at the same laboratory that analyzed the corresponding primary field samples.

Duplicate pair results were evaluated if at least one of the two results was greater than 5 times the minimum detectable activity (MDA) or MDL. For the NP areas, one shallow soil field duplicate pair was collected as required by the 200-MG-1 OU SAP (DOE/RL-2009-60). Duplicate results all met the 200-MG-1 OU SAP (DOE/RL-2009-60) criterion (less than 30 RPD) without exceptions.

9 Laboratory Quality Control

In addition to the rigorous validation performed on a selected subset of the data (as described in Chapter 8), a broad review of the laboratory QC results was also conducted for soils data. Laboratory QC results were stored electronically in the HEIS and were evaluated using various database queries against the acceptance criteria (Table 10).

Table 10. Laboratory QC Acceptance Criteria

QC Element	Acceptance Criteria
Lab Duplicates	Lab duplicates with a result greater than 5 times the MDL[a] or MDA[b] must have an RPD less than or equal to 30 percent to be considered acceptable.
Lab Blanks	Lab blank limit is 2 times the MDL, instrument detection limit, or MDA. However, for common laboratory contaminants acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the QC limit are 5 times the MDL.
LCSs	LCS percent recovery must be between the minimum control limit provided by the 200-MG-1 OU SAP (DOE/RL-2009-60) and maximum control limit.
Lab Spikes	Lab 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 minimum and maximum 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 30 percent.

a. Nonradchem analysis

b. Radchem analysis

QC = quality control
LCS = laboratory control sample
MDA = minimum detectable activity
MDL = minimum detectable limit
MS = matrix spike
MSD = matrix spike duplicate
RPD = relative percent difference
SAP = sampling and analysis plan

The data review was performed by evaluating all associated laboratory hardcopy data package case narratives. All data flags were uploaded by the WSCF into the HEIS.

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 102 lab blanks were reported with the lab QC associated with the NP area soil dataset. Greater than 99 percent of the results were within control limits. Nonconformances were limited to one result at low concentrations, which would not be expected to affect field data results (Appendix B, Table B-1).

9.2 Laboratory Precision

The laboratory precision is determined by the difference between duplicate sample pair results or between MS/MSD pairs. Normally, spike duplicates are used for metals and anions while MS/MSD are used for organic analyses. A total of 10 laboratory duplicate results were reported. All of those met the <30 percent RPD requirement.

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 MSs 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.

9.3.1 Laboratory Control Samples

A total of 73 LCS results were reported for the NP area dataset, 97 percent of which were within control limits. Two of the results exceeded QC requirements for the LCS percent recovery to be within the minimum and maximum laboratory control limits (Appendix B, Table B-2). All were TPH-D results. In all cases, the TPH-D results for the primary samples were nondetects and were not qualified.

9.3.2 Laboratory Spike Recovery

Laboratory spike recovery is also used as a measure of laboratory accuracy. For the 2011 dataset, there were 126 individual spiked-sample results, 97 percent of which met the control limits set up by the laboratory. Appendix B, Table B-3, shows the results, which did not meet criteria (4 of 126). Of these, the TPH-D results showed a consistently high bias.

9.3.3 Laboratory Surrogates

Finally, as part of volatile and semivolatile organic analyses, TPH, and PCB analyses, one or more compounds that are not likely to be contained in an environmental sample (a surrogate) are injected into each sample as a measure of overall method performance on that specific sample. The NP area dataset contained 94 individual surrogate results, all of which were inside of the laboratory-specified acceptability criteria.

9.3.4 Review of NP Area Laboratory QC Information

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. Some minor data quality issues were indentified in the case narratives and are briefly summarized below:

- The lab blank results for WSCF112290 showed vanadium contamination. The vanadium result for Sample B2BH54 was a detect less than the RL and has been qualified as a nondetect at the RL (4.0 µg/L) and flagged "U."
- Two LCS results showed TPH-D recoveries above the control limit. However, in all cases, the sample results were nondetects and were not qualified.
- TPH-D and mercury recoveries in some MS/MSDs exceeded the upper acceptance limits. In all cases, the samples were nondetects and were not qualified.

10 Data Usability Conclusions

This assessment noted some deficiencies in the data. These deficiencies are summarized in the following sections.

10.1 Validation

A minimum of 5 percent of the data collected in the NP area characterization were subjected to a rigorous third-party validation. Most of the observed QC deficiencies were minor. Values for those constituents listed with "J" or "UJ" flags should be considered estimated but useable. The main validation observations are as follows:

- All metals EB results were acceptable with the following exceptions: copper, vanadium, and zinc were detected in EB B2BH54. The vanadium result has been qualified as a nondetect and flagged "U" because of laboratory blank contamination.
- Samples B2BH28, B2BH30, B2BH36, and B2BH37 were analyzed for pH four days after sample collection. Based on professional judgment, the pH results should be qualified as estimates and flagged "J."
- For SDG WSCF112291, the MS recovery for hexavalent chromium was less than the lower acceptance limit. The hexavalent chromium results for Samples B2BH28 and B2BH36 were nondetects and should be qualified as estimates and flagged "UJ." The hexavalent chromium results for Samples B2BH30 and B2BH37 were detects and should be qualified as estimates and flagged "J."

One of the QC deficiencies was considered by the validator to limit the utility of the data for decision making and was flagged "UR" (SDG WSCF112291) based on a high LCS recovery for antimony (>170 percent). This qualifier assignment was evaluated further, resulting in the determination that the data should be considered usable and is assigned a "UJ" qualifier based on the following:

- The LCS results for antimony were high for the samples in question. Significantly, this high recovery would yield a positive bias on the sample results, which were nondetects in all four cases.
- The regulatory action level for antimony is 5.4 mg/kg, nearly an order of magnitude above the detection limit of 0.6 mg/kg.
- The highest of the four sample results was nearly half the detection limit at 0.31 mg/kg.
- The positive bias on the sample results is not sufficient to overcome the large margins between the sample results and the action level.

10.2 Field QC

Only one EB was collected during the NP area sampling effort, which met the SAP requirement for 200-MG-1. Copper, vanadium, and zinc were detected in EB B2BH54.

One field duplicate pair was collected for semivolatiles, PCBs, metals, general chemistry, and gross alpha/beta in a group of 17 primary samples, which meets the 200-MG-1 OU SAP (DOE/RL-2009-60) requirement of five (5 percent) field duplicates for the performed sampling activities. Field duplicate results met the established criteria without exception.

10.3 Laboratory QC

Review of available laboratory QC showed good overall analytical performance. The only qualifier flags were associated with Sample B2BH54 that exhibited vanadium contamination in the laboratory blank and low MS recovery in hexavalent chromium samples B2BH28, B2BH30, B2BH36, and B2BH37, leading to application of "UJ" and "J" flags. Minor deficiencies were noted in several other cases that did not warrant application of qualifier flags, as noted below:

- For WSCF112290, the MS and MSD recoveries for TPH-D were above the upper acceptance limit. The TPH-D and TPH-K results for Sample B2BH54 were nondetects and should not be qualified.
- For WSCF112291, the MS recovery for TPH-D was above the upper acceptance limit. The TPH-D and TPH-K results for Samples B2BH28, B2BH30, B2BH36, and B2BH37 were nondetects and should not be qualified.
- For WSCF112290, the LCS recovery for TPH-D was above the upper acceptance limit. The TPH-D and TPH-K results for Sample B2BH54 were nondetects and should not be qualified.
- For WSCF112291, the LCS recovery for TPH-D was above the upper acceptance limit. The TPH-D and TPH-K results for samples B2BH28, B2BH30, B2BH36, and B2BH37 were nondetects and should not be qualified.
- It is noted that Aroclor 1254 was the only analyte reported for the MS/MSD. Method 8082 guidance specifies Aroclor 1016 and Aroclor 1260 for MS/MSD analyses. No sample data are qualified as a result.
- For SDG WSCF112290, the MSD recovery for mercury was greater than the upper acceptance limit. The mercury result for Sample B2BH54 was a nondetect and should not be qualified.

10.4 Overall Conclusions

Samples were collected and analyzed as specified in the applied 200-MG-1 OU SAP (DOE/RL-2009-60). Sample results accurately indicate the presence and/or absence of target analyte contamination at sample locations. Laboratory and matrix accuracy and precision are in control overall, and no systematic 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 methods (except as noted in this report and reflected in qualified data points). All results are reported in industry standard units. Although one incident of blank contamination occurred, the concentration was very low and the primary sample was a nondetect.

Detection limits, precision, accuracy, and data completeness were analyzed to determine whether any analytical data should be rejected as a result of quality assurance/QC deficiencies. The conclusion of this assessment is that the data that have been collected are of the right type, quality, and quantity for direct regulatory use (for example, remedial assessment).

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Appendix A

NP Area Sample Data

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Table A-1. Location NP Area Sampling Results

COPC Metals	B2BH28 NPE-01 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH30 NPE-02 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH32 NPE-03 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH34 NPE-04 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH36 NPE-05 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH37 NPE-05 0 to 30 cm (0 to 12 in.) DUP (mg/kg)	B2BH38 NPE-06 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH40 NPE-07 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH44 NPE-09 0 to 30 cm (0 to 12 in.) (mg/kg)
Antimony	U	U	U	U	U	U	U	U	U
Arsenic	2.63	4.01	2.14	4.12	3	2.73	2.88	2.54	2.52
Barium	162	61	72.4	143	93.4	88	76.2	78.5	91.5
Beryllium	0.351	0.26	0.284	0.375	0.342	0.292	0.164	0.281	0.198
Boron	9.22	5.63	7.23	16.4	10.1	10.8	6.53	8.27	9.12
Cadmium	U	U	U	0.174	U	0.0972	U	U	U
Chromium	9.88	11.9	8.6	15.6	8.62	7.96	10.5	8.37	9.19
Hexavalent Chromium	U	0.0922	0.0609	0.342	U	0.0506	U	0.0886	0.0616
Cobalt	8.58	5.26	6.18	12.3	8.76	8.4	5.9	7.37	8.24
Copper	11.2	8.63	7.96	21.2	11	10.7	9.01	9.01	9.78
Lead	5.35	4.4	4.3	10.7	5.45	5.52	5.01	4.91	4.93
Lithium	5.97	8.87	6.92	10.9	6.15	6.36	7.78	6.2	6.53
Manganese	396	260	283	554	396	392	294	338	393
Mercury	U	U	U	U	U	U	U	U	U
Nickel	9.22	11.3	7.39	16.1	8.88	8.53	9.99	12.6	9.58
Selenium	1.08	0.584	0.31	0.82	0.933	0.995	0.31	0.482	0.519
Silver	U	U	U	U	U	U	U	U	U
Strontium	22.8	20.6	19.2	35.4	23.2	20.6	21.7	22.5	20.4

Table A-1. Location NP Area Sampling Results

Thallium	U	U	0.132	0.159	U	U	0.131	U	U
Tin	0.458	0.249	0.429	0.639	0.427	0.438	0.34	0.356	0.428
Uranium	0.421	0.397	0.588	0.594	0.43	0.447	0.376	0.801	0.448
Vanadium	65.7	30.3	44.8	55.9	66.8	65.3	31.2	50.8	59
Zinc	48.4	31.5	37.3	60.3	47.6	47	36.6	41.5	45.9
COPC Metals	**B2BH48 NPE-11 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH50 NPE-AltA 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH52 NPE-AltB 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB5 NPE-12 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB7 NPE-13 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB9 NPE-14 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC1 NPE-15 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC3 NPE-16 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC5 NPE-17 0 to 30 cm (0 to 12 in.) (mg/kg)**
Antimony	U	U	U	U	U	U	U	U	U
Arsenic	2.47	2.59	3.15	2.35	2.58	2.15	2.17	2.95	2.69
Barium	85.1	74.1	102	75.3	61.4	78	70.6	78.1	79
Beryllium	0.1	0.225	0.109	0.256	0.171	0.21	0.139	0.267	0.289
Boron	8.64	8.37	7.16	6.34	4.02	5.75	5.34	5.47	4.85
Cadmium	U	U	U	0.104	U	0.101	U	U	U
Chromium	9.59	10.2	11.7	9.32	11.3	9.37	7.81	9.91	10.2
Hexavalent Chromium	0.0622	0.0609	0.077	U	U	U	U	U	U
Cobalt	7.27	6.59	5.9	7.47	5.6	7.72	7.76	8.16	7.58
Copper	9.02	9.17	9.18	9.24	9	9.68	10.5	11.6	9.95
Lead	5.5	5.13	4.87	5.41	4.46	4.68	4.65	5.73	5.14
Lithium	6.79	7.43	9.76	7.16	8.46	6.98	6.36	8.05	7.63
Manganese	342	309	287	301	250	321	312	322	315

Table A-1. Location NP Area Sampling Results

Mercury	U	U	U	U	U	U	U	U	U
Nickel	9.58	10.3	11.8	9.03	9.58	8.59	8.63	10.3	9.87
Selenium	0.408	0.31	0.31	0.497	0.382	0.749	0.528	0.667	0.527
Silver	U	U	U	U	U	U	U	U	U
Strontium	19.8	25.2	29.3	18.3	17.8	18.7	18.6	22.2	19.5
Thallium	U	U	U	0.122	0.132	U	U	U	U
Tin	0.353	0.329	0.255	0.479	0.372	0.483	0.416	0.493	0.386
Uranium	0.45	0.382	0.423	0.471	0.626	0.517	0.445	0.536	0.477
Vanadium	47.4	46.3	33.9	61	38.4	61.9	64.5	52.4	60.1
Zinc	39.3	42.5	37.9	45.2	36.9	46	45.5	44.4	41.1
COPC PCBs/PAH	**B2BH28 NPE-01 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH30 NPE-02 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH32 NPE-03 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH34 NPE-04 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH36 NPE-05 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH37 NPE-05 0 to 30 cm (0 to 12 in.) DUP (mg/kg)**	**B2BH38 NPE-06 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH40 NPE-07 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH44 NPE-09 0 to 30 cm (0 to 12 in.) (mg/kg)**
Aroclor 1016	U	U	U	U	U	U	U	U	U
Aroclor 1221	U	U	U	U	U	U	U	U	U
Aroclor 1232	U	U	U	U	U	U	U	U	U
Aroclor 1242	U	U	U	U	U	U	U	U	U
Aroclor 1248	U	U	U	U	U	U	U	U	U
Aroclor 1254	U	U	U	U	U	U	U	U	U
Aroclor 1260	U	U	U	U	U	U	U	U	U

Table A-1. Location NP Area Sampling Results

Acenaphthene	U	U	U	U	U	U	U	U	U
Acenaphthylene	U	U	U	U	U	U	U	U	U
Anthracene	U	U	U	U	U	U	U	U	U
Benzo[*a*]anthracene	U	U	U	U	U	U	U	U	U
Benzo[*a*]pyrene	U	U	U	U	U	U	U	U	U
Benzo[*b*]fluoranthene	U	U	U	U	U	U	U	U	U
Benzo[*ghi*]perylene	U	U	U	U	U	U	U	U	U
Benzo[*k*]fluoranthene	U	U	U	U	U	U	U	U	U
Chrysene	U	U	U	U	U	U	U	U	U
Dibenz[*a,h*]anthracene	U	U	U	U	U	U	U	U	U
Fluoranthene	U	U	U	U	U	U	U	U	U
Fluorene	U	U	U	U	U	U	U	U	U
Indeno[*1,2,3-cd*]pyrene	U	U	U	U	U	U	U	U	U
Naphthalene	U	U	U	U	U	U	U	U	U
Phenanthrene	U	U	U	U	U	U	U	U	U
Pyrene	U	U	U	U	U	U	U	U	U
COPC PCBs/PAH	**B2BH48 NPE-11 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH50 NPE-AltA 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH52 NPE-AltB 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB5 NPE-12 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB7 NPE-13 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB9 NPE-14 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC1 NPE-15 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC3 NPE-16 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC5 NPE-17 0 to 30 cm (0 to 12 in.) (mg/kg)**
Aroclor 1016	U	U	U	U	U	U	U	U	U
Aroclor 1221	U	U	U	U	U	U	U	U	U

Table A-1. Location NP Area Sampling Results

Aroclor 1232	U	U	U	U	U	U	U	U	U
Aroclor 1242	U	U	U	U	U	U	U	U	U
Aroclor 1248	U	U	U	U	U	U	U	U	U
Aroclor 1254	U	U	U	U	U	U	U	U	U
Aroclor 1260	U	U	U	U	U	U	U	U	U
Acenaphthene	U	U	U	U	U	U	U	U	U
Acenaphthylene	U	U	U	U	U	U	U	U	U
Anthracene	U	U	U	U	U	U	U	U	U
Benzo[*a*]anthracene	U	U	U	U	U	U	U	U	U
Benzo[*a*]pyrene	U	U	U	U	U	U	U	U	U
Benzo[*b*]fluoranthene	U	U	U	U	U	U	U	U	U
Benzo[*ghi*]perylene	U	U	U	U	U	U	U	U	U
Benzo[*k*]fluoranthene	U	U	U	U	U	U	U	U	U
Chrysene	U	U	U	U	U	U	U	U	U
Dibenz[*a,h*]anthracene	U	U	U	U	U	U	U	U	U
Fluoranthene	U	U	U	U	U	U	U	U	U
Fluorene	U	U	U	U	U	U	U	U	U
Indeno[*1,2,3-cd*]pyrene	U	U	U	U	U	U	U	U	U
Naphthalene	U	U	U	U	U	U	U	U	U
Phenanthrene	U	U	U	U	U	U	U	U	U
Pyrene	U	U	U	U	U	U	U	U	U

Table A-1. Location NP Area Sampling Results

COPC Anion	B2BH28 NPE-01 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH30 NPE-02 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH32 NPE-03 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH34 NPE-04 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH36 NPE-05 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH37 NPE-05 0 to 30 cm (0 to 12 in.) DUP (mg/kg)	B2BH38 NPE-06 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH40 NPE-07 0 to 30 cm (0 to 12 in.) (mg/kg)	B2BH44 NPE-09 0 to 30 cm (0 to 12 in.) (mg/kg)
Nitrate	8.63	6.86	5	14.4	4.87	4.78	7.13	7.53	5.14
TPH	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
TPH–diesel range	U	U	U	U	U	U	U	U	U
TPH–kerosene range	U	U	U	U	U	U	U	U	U
COPC Anion	**B2BH48 NPE-11 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH50 NPE-AltA 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BH52 NPE-AltB 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB5 NPE-12 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB7 NPE-13 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHB9 NPE-14 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC1 NPE-15 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC3 NPE-16 0 to 30 cm (0 to 12 in.) (mg/kg)**	**B2BHC5 NPE-17 0 to 30 cm (0 to 12 in.) (mg/kg)**
Nitrate	3.96	5.49	3.79	4.05	5.49	4.65	U	U	4.52
TPH	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
TPH–diesel range	U	U	U	U	U	U	U	U	U
TPH–kerosene range	U	U	U	U	U	U	U	U	U

COPC = contaminant of potential concern
DUP = duplicate
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbon
U = undetected

Appendix B

Laboratory Quality Control Results

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B1 Data Qualifiers

One or more of the following data qualifiers may be used in data presented in Tables B-1 and B-2.

- **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 minimum detection limit (MDL). The data should be considered usable for decision-making purposes.
- **C**—(Inorganics and Wetchem)—The analyte was detected in both the sample and the associated quality control (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**—(Organics and Wetchem)—The analyte was identified in an analysis at a secondary dilution factor (that is, dilution factor different than 1.0). The data should be considered usable for decision-making purposes.
- **E**—(Inorganics)—Reported value is estimated because of interference. See any comments that may be in the laboratory report case narrative.
- **E**—(Organics)—Concentration exceeds the calibration range of the gas chromatograph/ mass spectrometer.
- **N**—(All)—The spike sample recovery is outside control limits. The data should be considered usable for decision-making purposes.
- **NJ**—The analysis indicates the presence of an analyte that has been tentatively identified, and the associated numerical value represents its approximate concentration.
- **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.
- **J**—(Organics)—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 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 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.
- **U**—(All)—The constituent was analyzed for and 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 MDL. The data should be considered usable for decision-making purposes.
- **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.
- **X**—(All)—The result-specific translation of this qualifier code is provided in the data report and/or case narrative.

Table B-1. Lab Blank Results Exceeding NP Area Sample Criteria

Lab Sample No.	Batch No.	Method Name	Constituent	Value Reported	Analytical Units Reported	Qualifier	Reporting Limit
112290001	182291	200.8-ICP/ MS	Vanadium	0.232	µg/L	B	0.2

ICP = inductively coupled plasma
MS = matrix spike
NP = nonoperational property

Table B-2. Lab Control Sample Recoveries Exceeding NP Area Sample Criteria

Sample No.	Constituent	Result	Units	Qualifier	Percent Recovered	Min. Control Limit	Max. Control Limit
B2BH54	TPH-D	3900	µg/L	X	154.1	65	128
B2BH28 B2BH30 B2BH36 B2BH37	TPH-D	140	µg/L	X	142.4	70	130
B2BH28 B2BH30 B2BH36 B2BH37	Sb	155	mg/kg	UJ	171.7	70	130

NP = nonoperational property
Sb = antimony
TPH-D = total petroleum hydrocarbons, diesel range

Table B-3. MS/MSD Results Exceeding Recovery NP Area Sample Criteria

QC Type	Sample No.	Constituent	Value Reported	Sample Concentration	Units	Percent Recovered	Min. Control Limit	Max. Control Limit
MS	B2BH54	TPH-D	4200	70	µg/L	176.4	70	130
MSD	B2BH54	TPH-D	4100	70	µg/L	169.2	70	130
MSD	B2BH54	Hg	2.67	<0.10	µg/L	133.7	70	130
MS	B2BH28 B2BH30 B2BH36 B2BH37	TPH-D	710	70	µg/L	142.8	70	130

Hg = mercury
MS/MSD = matrix spike/matrix spike duplicate
NP = nonoperational property
QC = quality control
TPH-D = total petroleum hydrocarbons, diesel range

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Appendix C

Field Quality Control Results

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C1 Data Qualifiers

The general format for data qualifiers follows the data qualifiers found in the U.S. Environmental Protection Agency National Functional Guidelines (OSWER 9240.1-45 and OSWER 9240.1-48).

One or more of the following data qualifiers may be used in data presented in Tables C-1 and C-2.

- **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 minimum detection limit (MDL). The data should be considered usable for decision-making purposes.
- **C**—(Inorganics and Wetchem)—The analyte was detected in both the sample and the associated quality control (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**—(Organics and Wetchem)—The analyte was identified in an analysis at a secondary dilution factor (that is, dilution factor different than 1.0). The data should be considered usable for decision-making purposes.
- **E**—(Inorganics)—Reported value is estimated because of interference. See any comments that may be in the laboratory report case narrative.
- **E**—(Organics)—Concentration exceeds the calibration range of the gas chromatograph/ mass spectrometer.
- **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 due to a QC deficiency identified during data validation. 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**—The constituent was analyzed for and was not detected. Due to a QC deficiency identified during data validation, the value reported may not accurately reflect the MDL. The data should be considered usable for decision-making purposes.
- **UR**—Indicates the constituent was analyzed for and not detected; however, due to an identified QC deficiency, the data should be considered unusable for decision-making purposes.
- **R**—Indicates the constituent was analyzed for and detected; however, due to 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 C-1. NP Area Field Blank Results Exceeding Criteria

Field QC Type	Sample No.	Constituent	Result	Units	Qualifier	Reporting Limit/ MDA
EB	B2BH54	Acenaphthene	1	µg/L	U	1
EB	B2BH54	Acenaphthylene	1	µg/L	U	1
EB	B2BH54	Anthracene	1	µg/L	U	1
EB	B2BH54	Benzo[*a*]anthracene	1	µg/L	U	1
EB	B2BH54	Benzo[*a*]pyrene	1	µg/L	U	1
EB	B2BH54	Benzo[*b*]fluoranthene	1	µg/L	U	1
EB	B2BH54	Benzo[*ghi*]perylene	1	µg/L	U	1
EB	B2BH54	Benzo[*k*]fluoranthene	1	µg/L	U	1
EB	B2BH54	Chrysene	1	µg/L	U	1
EB	B2BH54	Dibenz[*a,h*]anthracene	1	µg/L	U	1
EB	B2BH54	Fluoranthene	1	µg/L	U	1
EB	B2BH54	Fluorene	1	µg/L	U	1
EB	B2BH54	Indeno[*1,2,3-cd*]pyrene	1	µg/L	U	1
EB	B2BH54	Naphthalene	1	µg/L	U	1
EB	B2BH54	Phenanthrene	1	µg/L	U	1
EB	B2BH54	Pyrene	1	µg/L	U	1
EB	B2BH54	TPH-D	70	µg/L	UNX	70
EB	B2BH54	TPH-K	70	µg/L	U	70
EB	B2BH54	Aroclor 1016	0.09	µg/L	U	0.09
EB	B2BH54	Aroclor 1221	0.2	µg/L	U	0.2
EB	B2BH54	Aroclor 1232	0.09	µg/L	U	0.09
EB	B2BH54	Aroclor 1242	0.09	µg/L	U	0.09
EB	B2BH54	Aroclor 1248	0.09	µg/L	U	0.09
EB	B2BH54	Aroclor 1254	0.09	µg/L	U	0.09
EB	B2BH54	Aroclor 1260	0.09	µg/L	U	0.09
EB	B2BH54	Antimony	0.6	µg/L	UD	0.6
EB	B2BH54	Arsenic	0.8	µg/L	UD	0.8
EB	B2BH54	Barium	0.4	µg/L	UD	0.4

Table C-1. NP Area Field Blank Results Exceeding Criteria

Field QC Type	Sample No.	Constituent	Result	Units	Qualifier	Reporting Limit/ MDA
EB	B2BH54	Beryllium	0.1	µg/L	UD	0.1
EB	B2BH54	Boron	13	µg/L	U	13
EB	B2BH54	Cadmium	0.2	µg/L	UD	0.2
EB	B2BH54	Chromium	1	µg/L	UD	1
EB	B2BH54	Cobalt	0.1	µg/L	UD	0.1
EB	B2BH54	Copper	2.56	µg/L	D	0.2
EB	B2BH54	Lead	0.2	µg/L	UD	0.2
EB	B2BH54	Lithium	5	µg/L	U	5
EB	B2BH54	Nickel	0.4	µg/L	UD	0.4
EB	B2BH54	Manganese	0.2	µg/L	UD	0.2
EB	B2BH54	Mercury	0.1	µg/L	UDN	0.1
EB	B2BH54	Selenium	0.6	µg/L	UD	0.6
EB	B2BH54	Silver	0.2	µg/L	UD	0.2
EB	B2BH54	Strontium	0.2	µg/L	UD	0.2
EB	B2BH54	Thallium	0.1	µg/L	UD	0.1
EB	B2BH54	Tin	0.1	µg/L	UD	0.1
EB	B2BH54	Uranium	0.1	µg/L	UD	0.1
EB	B2BH54	Vanadium	0.536	µg/L	BDC	0.4
EB	B2BH54	Zinc	5.13	µg/L	BD	1.6
EB	B2BH54	Hexavalent Chromium	2	µg/L	U	2
EB	B2BH54	Nitrate	168	µg/L	UD	168
EB	B2BH54	pH Measurement	5.8	unitless		0.01
EB	B2BH54	Gross alpha	-0.084	pCi/L	U	1.5
EB	B2BH54	Gross beta	1.6	pCi/L	U	2.5

EB = equipment blank
MDA = minimum detectable activity
NP = nonoperational property
QC = quality control
TPH-D = total petroleum hydrocarbons, diesel range
TPH-K = total petroleum hydrocarbons, kerosene range

Table C-2. NP Area Field Duplicate Results

COPC	B2BH36 (mg/kg)	B2BH37 DUP (mg/kg)	RPD (mg/kg)
Metals			
Antimony	U	U	-
Arsenic	3	2.73	9.42
Barium	93.4	88	5.95
Beryllium	0.342	0.292	15.77
Boron	10.1	10.8	-6.69
Cadmium	U	0.0972	-
Chromium	8.62	7.96	7.96
Hexavalent Chromium	U	0.0506	-
Cobalt	8.76	8.4	4.19
Copper	11	10.7	2.76
Lead	5.45	5.52	-1.27
Lithium	6.15	6.36	-3.35
Manganese	396	392	1.01
Mercury	U	U	-
Nickel	8.88	8.53	4.02
Selenium	0.933	0.995	-6.43
Silver	U	U	-
Strontium	23.2	20.6	11.8
Thallium	U	U	-
Tin	0.427	0.438	-2.54
Uranium	0.43	0.447	-3.87
Vanadium	66.8	65.3	2.27
Zinc	47.6	47	1.26
PCBs			
Aroclor 1016	U	U	-
Aroclor 1221	U	U	-
Aroclor 1232	U	U	-
Aroclor 1242	U	U	-

Table C-2. NP Area Field Duplicate Results

COPC	B2BH36 (mg/kg)	B2BH37 DUP (mg/kg)	RPD (mg/kg)
Aroclor 1248	U	U	-
Aroclor 1254	U	U	-
Aroclor 1260	U	U	-
PAHs			
Acenaphthene	U	U	-
Acenaphthylene	U	U	-
Anthracene	U	U	-
Benzo[*a*]anthracene	U	U	-
Benzo[*a*]pyrene	U	U	-
Benzo[*b*]fluoranthene	U	U	-
Benzo[*ghi*]perylene	U	U	-
Benzo[*k*]fluoranthene	U	U	-
Chrysene	U	U	-
Dibenz[*a,h*]anthracene	U	U	-
Fluoranthene	U	U	-
Fluorene	U	U	-
Indeno[*1,2,3-cd*]pyrene	U	U	-
Naphthalene	U	U	-
Phenanthrene	U	U	-
Pyrene	U	U	-
Anion			
Nitrate	4.87	4.78	1.86
TPH			
TPH–diesel range	U	U	-
TPH–kerosene range	U	U	-

COPC = contaminant of potential concern
DUP = duplicate
NP = nonoperational property
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RPD = relative percent difference
TPH = total petroleum hydrocarbon

C2 References

OSWER 9240.1-45, 2004, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review: Final*, EPA 540-R-04-004, Office of Superfund Remediation and Technology Innovation, U.S. Environmental Protection Agency, Washington, D.C. Available at: National Functional Guidelines for Inorganic Data Review (PDF).

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