DOE/RL-2011-28
Revision 0

Response Action Report for 200-MG-1 Operable Unit Waste Site 600-226

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

U.S. DEPARTMENT OF ENERGY
Richland Operations Office

P.O. Box 550
Richland, Washington 99352

DOE/RL-2011-28
Revision 0

Response Action Report for 200-MG-1 Operable Unit Waste Site 600-226

Date Published
May 2011

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

U.S. DEPARTMENT OF ENERGY
Richland Operations Office

P.O. Box 550
Richland, Washington 99352

Release Approval 05/11/2011
Date

Approved for Public Release;
Further Dissemination Unlimited

Approval Page

Title: *Response Action Report for 200-MG-1 Operable Unit Waste Site 600-226*

O. A. Farabee
U.S. Department of Energy, Richland Operations Office

O A Farabee
Signature

5/20/11
Date

Executive Summary

This response action report documents the successful completion of the removal action conducted at the 600-226 waste site, also known as the Gun Site H-42 Dumping Area, which is located within the 200-MG-1 Operable Unit in the 600 Area of the Hanford Site in southeastern Washington State. The removal, treatment, and disposal (RTD) alternative was proposed in DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*[1] (EE/CA) and selected in DOE/RL-2009-86, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in 200-MG-1 Operable Unit*[2] (Action Memorandum).

The selected removal action for 600-226 included excavating the waste site to the extent required to meet specified soil removal action levels (RALs), disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility, and verifying that residual concentrations of contaminants of potential concern (COPCs) are less than the established RALs. The 600-226 investigation was performed in accordance with DOE/RL-2009-60[3], Revision 1, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites* and DOE/RL-2009-53, Revision 1, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*[4].

The 600-226 investigation commenced in January 2010 with visual inspections and radiological surveys, followed by soil sampling to determine the nature and extent of COPCs present in waste site soils. Analytical results from investigative sampling indicated COPC concentrations in soils at 600-226 exceeded RALs, providing substantiation for selection of the RTD alternative. The removal action proceeded through RTD of contaminated soil and concluded with verification sampling in December 2010. The results of verification sampling, laboratory analysis, and data

---

[1] DOE/RL-2008-44, 2009, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www2.hanford.gov/arpir/?content=findpage&AKey=0096350.

[2] DOE/RL-2009-86, 2010, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in the 200-MG-1 Operable Unit,* Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0084449.

[3] DOE/RL-2009-60, 2011, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites,* Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=1003290272.

[4] DOE/RL-2009-53, 2010, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=1010180132.

evaluation indicate that the waste site achieved compliance with RALs and established removal action objectives.

The analytical results show that the residual soil concentrations of COPCs support reasonably anticipated future land uses described in the EE/CA and Action Memorandum. These results also support reclassification to "interim closed out" status in accordance with the process described in RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures,* Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System[5]. Institutional controls are not required given that there is no deep zone associated with 600-226.

This waste site and the data acquired from the 600-226 sampling evolutions will be included in the risk assessment and the remedial investigation/feasibility study for final remedial decisions of the Outer Area.

[5] RL-TPA-90-0001, 2007, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/hanford/files/TPA-MP14.pdf.

Contents

1 Introduction 1-1

1.1 Site Description 1-1
1.1.1 Hanford General Site Information 1-1
1.1.2 200-MG-1 Operable Unit 1-3
1.2 Regulatory and Enforcement History 1-5
1.3 Environmental Setting 1-5

2 Waste Site Background 2-1

2.1 Waste Site 600-226 2-1
2.2 Description of the Selected Alternative 2-2
2.2.1 Removal Action Objectives 2-3
2.2.2 Exposure and Land Use Assumptions 2-6
2.2.3 Design Summary 2-7
2.3 Decision Document Amendments, Significant Differences, or Waivers 2-7

3 Response Activity Summary 3-1

3.1 Summary of Activities 3-1
3.1.1 Waste Site 600-226 Investigative Sampling 3-1
3.1.2 Waste Site 600-226 Excavation 3-3
3.1.3 Waste Site 600-226 Verification Sampling 3-3
3.1.4 Backfill and Revegetation 3-3
3.1.5 Statement of Protectiveness 3-4

4 Chronology of Events 4-1

5 Demonstration of Completion 5-1

5.1 Attainment of Performance Standards 5-1
5.1.1 Performance Standard Documentation 5-2
5.1.2 Response Action Objectives Verification 5-2
5.1.3 Contaminant Identification 5-2
5.2 Construction Quality Assurance/Quality Control 5-5
5.3 Cleanup Verification Quality Assurance/Quality Control 5-5
5.4 Regulatory Oversight 5-6

6 Final Inspection and Certifications 6-1

7 Operations and Maintenance Activities 7-1

7.1 Remedy Related Operations and Maintenance or Monitoring 7-1
7.2 Institutional Controls 7-1
7.3 Five-Year Reviews 7-1

8 Summary of Project Costs 8-1

9 Waste Site Reclassification 9-1

10 Observations and Lessons Learned 10-1

11 Contact Information 11-1

12 References 12-1

Appendix

A Sampling Results for the 600-226 Waste Site ..... A-i

Figures

Figure 1-1. Location of the Hanford Site in Washington State 1-2
Figure 1-2. 200-MG-1 Operable Unit and 600-226 Waste Site 1-4
Figure 2-1. Waste Site 600-226 Boundary and Operational Areas 2-1
Figure 3-1. Initial Investigative Sample Locations 3-2
Figure 3-2. Verification and Bias Sampling Locations 3-4

Tables

Table 2-1. Nonradiological Removal Action Levels 2-4
Table 3-1. Concentrations of Contaminants of Potential Concern Exceeding Removal Action Levels 3-2
Table 4-1. Removal Action Chronology 4-1
Table 5-1. Summary of Attainment of Cleanup Objectives 5-2
Table 5-2. Comparison of Verification Sample Results Against RALs for Nonradiological COPCs 5-3
Table 8-1. Cost Summary 8-1
Table A-1. Analytical Results for Investigative Sampling for Nonradionuclide Contaminants of Potential Concern A-2
Table A-2. Analytical Results for Final Verification Sampling for Nonradionuclide Contaminants of Potential Concern A-5

Terms

AAA	anti-aircraft artillery
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
DQA	data quality assessment
Ecology	Washington State Department of Ecology
EE/CA	*Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*
EPA	U.S. Environmental Protection Agency
HEIS	Hanford Environmental Information System
N/A	not available
NA	no analysis
NPL	National Priorities List
O&M	operations and maintenance
OU	operable unit
QA	quality assurance
QC	quality control
RAL	removal action level
RAO	removal action objective
RAR	response action report
RAWP	*Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*
RDL	required detection limit
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RTD	removal, treatment, and disposal
SAP	*Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*

Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VSP	Visual Sample Plan
XRF	x-ray fluorescence
WIDS	Waste Identification Data System

1 Introduction

This response action report (RAR) documents the successful completion of the non-time-critical removal action at the 600-226 waste site. The removal action alternative of removal, treatment, and disposal (RTD) was proposed in DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites* (EE/CA), and subsequently selected and authorized by DOE/RL-2009-86, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in 200-MG-1 Operable Unit* (Action Memorandum). Analytical results from investigative sampling indicated that 600-226 soils exceeded the removal action levels (RALs), thus supporting the RTD alternative. This RAR documents the RTD action and verification sampling results at the 600-226 waste site. This documentation has been prepared based on U.S. Environmental Protection Agency (EPA) guidance provided in EPA 540-R-98-016, *Close Out Procedures For National Priorities List Sites*.

This RAR provides a summary of the actions taken and resultant data to verify that conditions at 600-226 have achieved compliance with the established RALs and meet the removal action objectives (RAOs) provided in the Action Memorandum. The documentation process is consistent with the U.S. Department of Energy (DOE) *Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)* Remedial Action Site Closure Guidance (DOE, 2010).

Statutory authority for the action taken is in accordance with CERCLA (as amended by the *Superfund Amendments and Reauthorization Act of 1986)*, Executive Order 12580, the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al., 1989), also known as the Tri-Party Agreement, and 40 Code of Federal Regulations 300, "National Oil and Hazardous Substances Pollution Contingency Plan."

In December 2010, the non-time-critical removal action for the 600-226 waste site was completed in accordance with DOE/RL-2009-53, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit* (RAWP). This RAR provides the following information relative to the completion of the subject removal action:

- Background, historical information, regulatory enforcement history, and environmental setting pertinent to this waste site
- Description of the selected alternative, RAOs, and exposure and land use assumptions provided in the related regulatory documents
- Summary of the completed actions, resulting data collected to support completion of the removal action, comparison of data against objectives, and demonstration that RAOs have been achieved

1.1 Site Description

General information on the Hanford Site and the 200-MG-1 Operable Unit (OU) provides a background of the 600-226 waste site and the development of the removal action for the waste site and is described in the subsections that follow.

1.1.1 Hanford General Site Information

The Hanford Site, which is part of the DOE nuclear weapons complex, occupies approximately 1,517 km^2 (586 mi^2) along the Columbia River in Benton County, northwest of the City of Richland in the lower Columbia Basin in southeastern Washington State (Figure 1-1). From the outset in the early 1940s, with construction of the world's first large-scale plutonium production facility, until approximately 1989, the Hanford Site mission included producing plutonium for nuclear weapons. Other activities included

nuclear research and development, along with nuclear materials production. These activities created a wide variety of chemical and radioactive wastes that were released into the environment. The Hanford Site mission is now focused on the cleanup of those wastes and ultimate closure of the Hanford Site.

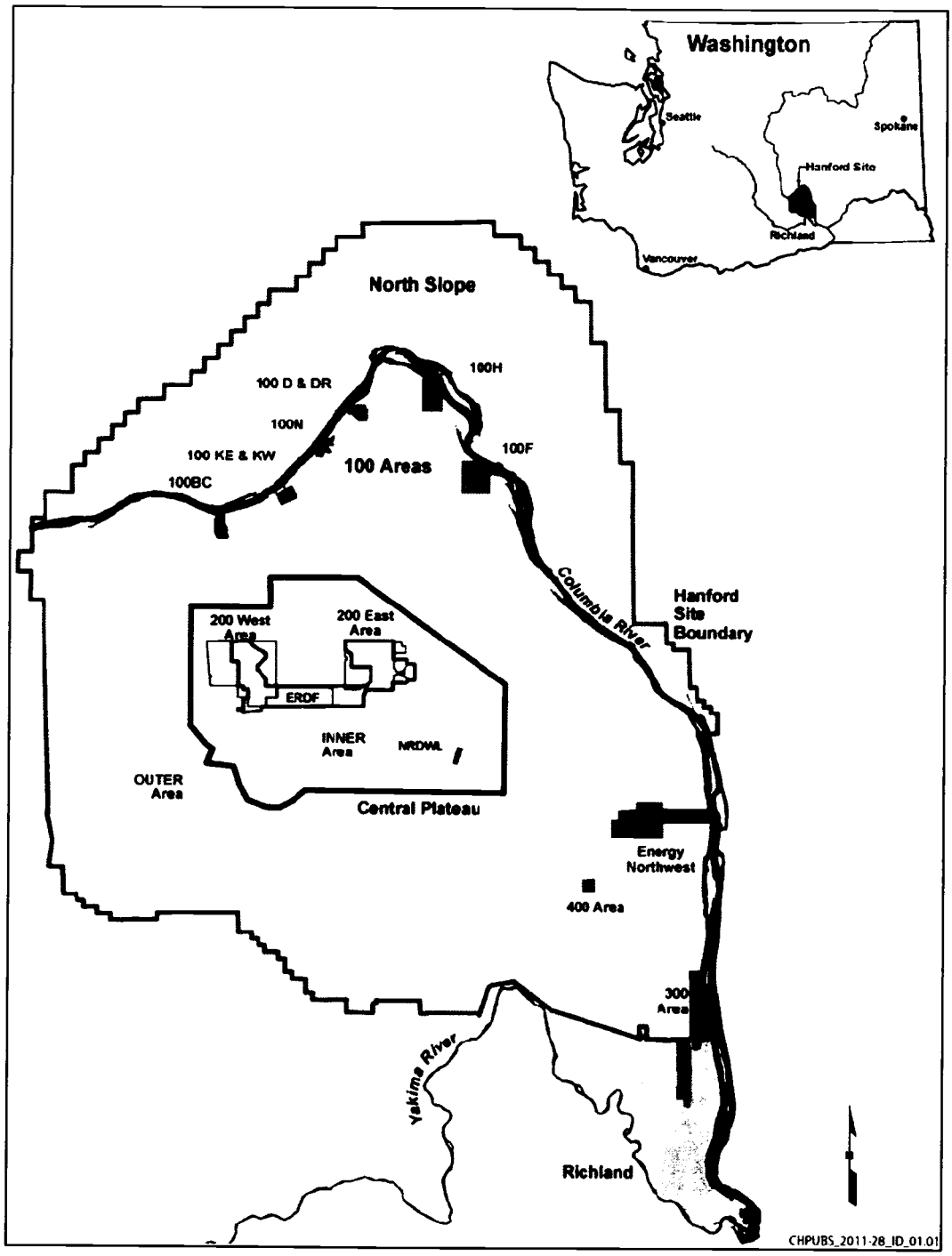

Figure 1-1. Location of the Hanford Site in Washington State

1.1.2 200-MG-1 Operable Unit

The Washington State Department of Ecology (Ecology), DOE, and EPA created the 200-MG-1 OU through the Tri-Party Agreement Milestone M-015-06-02 and Tri-Party Agreement Change Request C-06-02. The 200-MG-1 OU is comprised of waste sites in the 200 East, 200 West, and 600 Areas of the Hanford Site. The 600 Area encompasses those areas south of the Columbia River that are not part of another designated area (e.g., 300 Area, 200 East Area, and 100-K Area) and are not specifically identified (Figure 1-1). The 200-MG-1 OU waste sites consist of French drains, trenches, cribs, ditches, and retention basins with shallow contamination (generally less than 4.6 m [15 ft] below ground surface [bgs]) where chemical and radioactive contaminants were released during material transfers (i.e., unplanned release sites). In addition, some 200-MG-1 OU sites were produced by airborne dissemination of radioactive particles or biodegradation and dispersion of plant or animal matter. For those sites containing radionuclides, the radionuclide inventory for this conceptual model group does not include transuranic isotopes greater than or equal to 100 nCi/g.

All of the waste sites contained in the 200-MG-1 OU are located within the Central Plateau, as described in the EE/CA and Action Memorandum. As shown in Figure 1-2, the 600-226 waste site is located south of the 200 East Area and north of State Route 240.

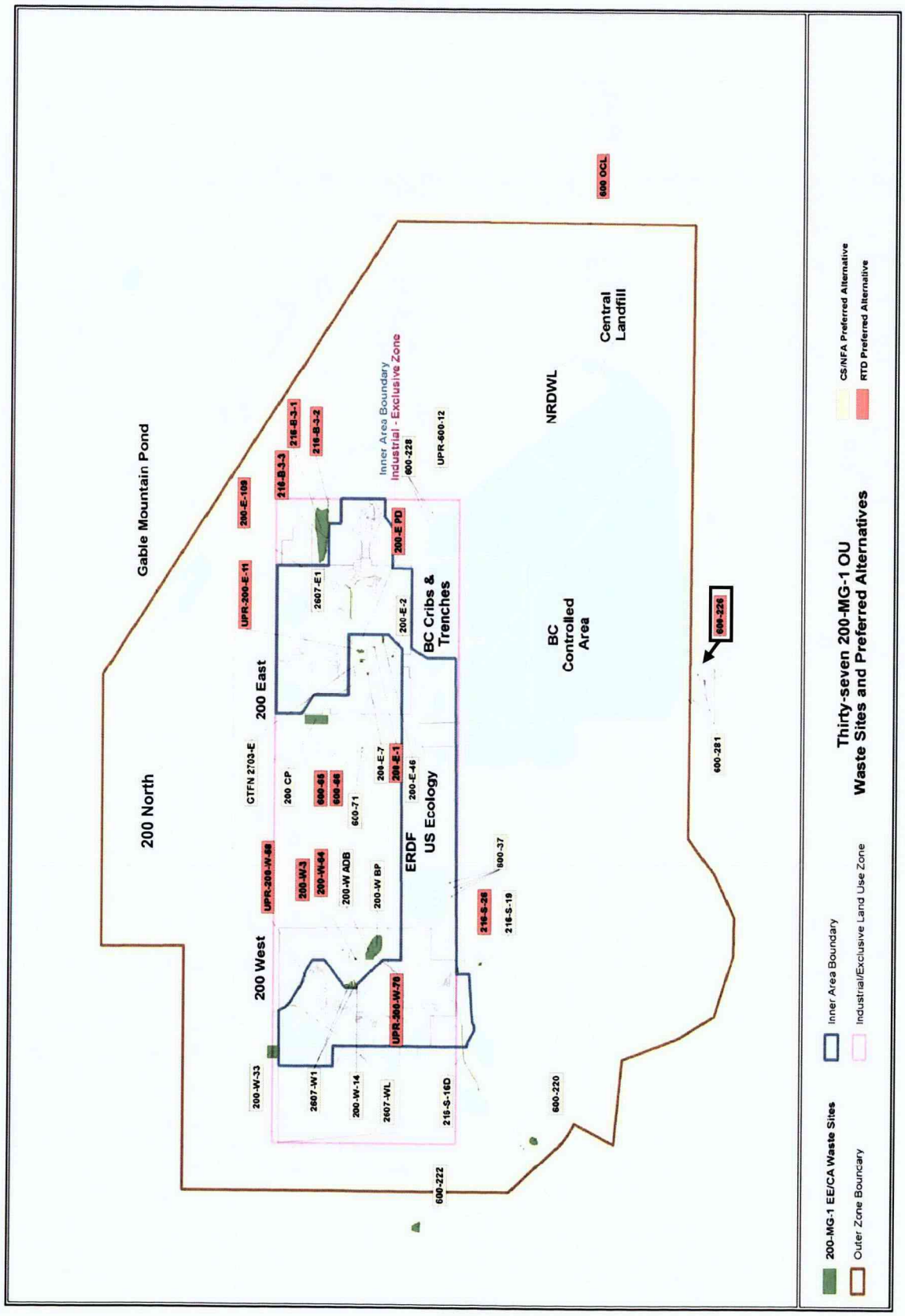

Figure 1-2. 200-MG-1 Operable Unit and 600-226 Waste Site

1.2 Regulatory and Enforcement History

As discussed in Chapter 1, statutory authority for this removal action is taken in accordance with CERCLA. Further governing requirements for compliance with CERCLA and *Resource Conservation and Recovery Act of 1976* activities at Hanford are in accordance with the Tri-Party Agreement. The Hanford Site was proposed for inclusion on the National Priorities List (NPL) (53 FR 23988, "National Priorities List for Uncontrolled Hazardous Waste Sites—Update 7"), and was placed on the NPL on November 3, 1989 (54 FR 41015, "National Priorities List for Uncontrolled Hazardous Waste Sites—Final Rule 10/04/89") by EPA. EPA placed the four aggregate areas (i.e., the 100, 200, 300, and 1100 Areas) on the NPL. The 200 Area NPL site consists of the 200 West and East Areas, which contain waste management facilities and inactive irradiated fuel reprocessing facilities. The site also includes the 200 North Area, formerly used for interim storage and staging of irradiated fuel, and the waste sites assigned to the 200-MG-1 OU.

1.3 Environmental Setting

The Hanford Site is located within the semiarid Pasco Basin in the northern portion of the Columbia Plateau. Normal annual precipitation is 17.7 cm (7 in.). According to PNL-10285, *Estimated Recharge Rates at the Hanford Site*, approximately 2.6 to 17.3 mm (0.1 to 0.7 in.) per year recharge is estimated in the 100 Area.

The bedrock beneath the site is basalt of the Columbia River Basalt group. The Ringold Formation and the Hanford formation cover the basalt throughout the Central Plateau. Poorly consolidated, river-deposited, well-drained sands, gravels, cobbles, and boulders dominate these units. The Ringold Formation is an interstratified sequence of unconsolidated clay, silt, sand, and gravel-to-cobble sediment deposited by the ancestral Columbia River. The Hanford formation consists of un-cemented gravels, sands, and silts deposited by Pleistocene cataclysmic floodwaters. Groundwater from the Hanford Site discharges to the Columbia River, which is the dominant surface water body of the Hanford Site. The direction of groundwater flow beneath the Central Plateau is typically toward the east-northeast. The uses of the Columbia River include the production of hydroelectric power, irrigation, drinking water, recreation, and natural resources.

The average depth of groundwater in the 200 Area ranges from approximately 50 m (164 ft) to greater than 100 m (328 ft) bgs. Additional details on the geology and hydrogeology underlying the 200 Area and the 200-MG-1 OU are not provided in the base response action documents given that the 200-MG-1 OU was created for shallow zone (less than 4.6 m [15 ft] in depth) waste sites and is assumed not to be a threat to groundwater quality. This assumption is based on historical and process knowledge regarding volumes of liquids discharged, lack of mobility of contaminants, and shallow depths of the discharge(s).

The nearest natural surface water body to 600-226 is the Yakima River located approximately 14.1 km (8.76 mi) to the south-southeast. Located approximately 12.8 km (7.95 mi) north of 600-226 is an ephemeral spring that is the source of water at the intermittent West Lake (216-N-8 Pond), where the water table is relatively shallow, situated roughly 3.7 m (12 ft) bgs. The potential for natural groundwater recharge within a majority of the 200 Area is limited to precipitation infiltration. Estimates of recharge from precipitation at the Hanford Site vary from 0 to 10 cm (0 to 4 in.) per year.

2 Waste Site Background

This chapter provides a description of the 600-226 waste site, information on process and background, describes the selected alternative, and delineates the RAOs and cleanup standards applicable to this removal action as prescribed in the Action Memorandum.

2.1 Waste Site 600-226

The 600-226 waste site is located in the 600 Area, south of the 200 East Area and north of State Route 240 (Figure 2-1). The waste site has comparatively low relief. Vegetation cover at 600-226 is typical for the region, dominated by grasses and sagebrush. The waste site was identified and entered into the Waste Information Data System (WIDS) database in 1997 due to presence of debris. WIDS describes the waste site as a dumping area for the H-42 Gun Site and catalogs debris including pipe, glass, empty buckets, dried paint, broken concrete, cans, dry cell batteries, and a 208 L (55 gal) drum. The waste site lacks a well-defined physical boundary (i.e., fence or other postings), and WIDS does not provide dimensions; however, WIDS provides a location marker (Figure 3-1). Several additional WIDS sites are associated with the H-42 Gun Site. These related waste sites include 600-49, known as the H-42 Gun Site Building Foundation and Ammunition Storage waste site; 6607-2, the septic system site; and 600-281, the waste site identified by additional debris.

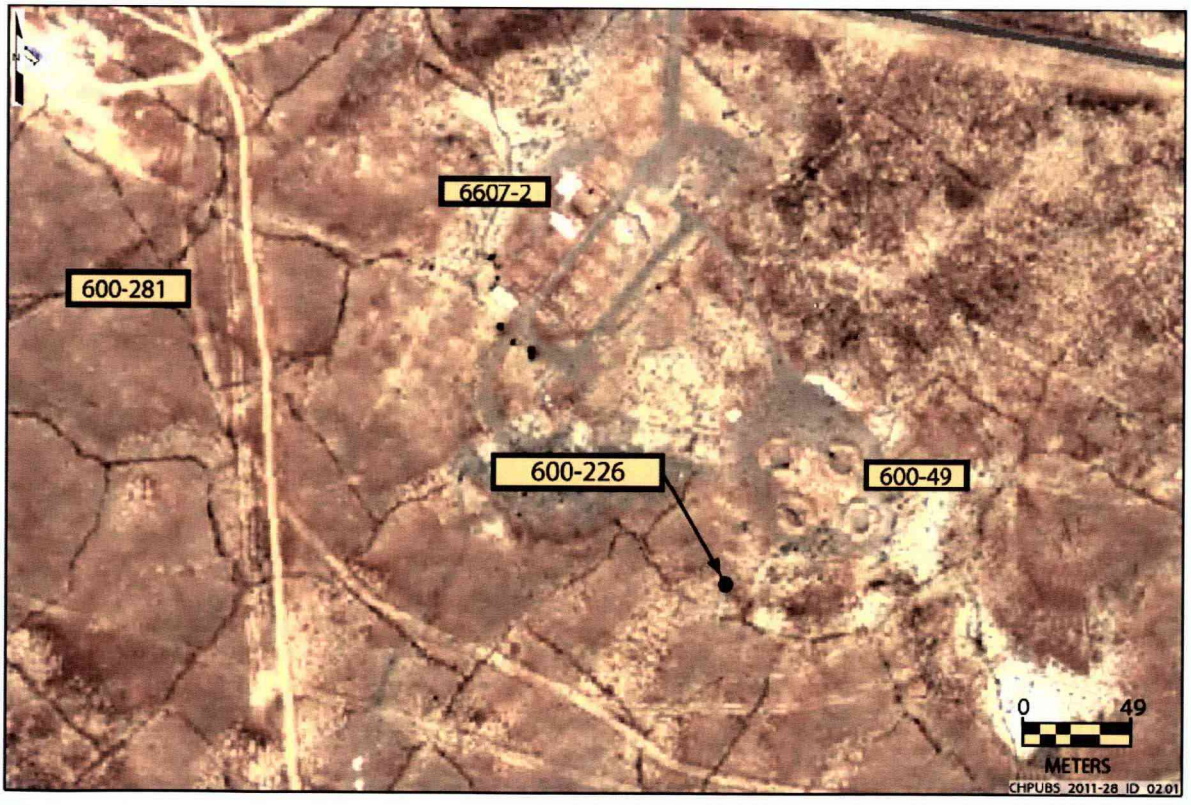

Figure 2-1. Waste Site 600-226 Boundary and Operational Areas

In an effort to establish air defense for the Hanford Site, anti-aircraft artillery (AAA) battery positions were situated around the reactor and chemical processing areas. Sixteen AAA batteries were eventually constructed. The extent of time the AAA gun sites operated varies, but historical documents indicate that activity peaked between 1950 and 1958. In 1957, most of the gun sites and their associated structures and

equipment were declared excess by the government, removal from service was initiated, and the sites were razed (typically, foundations and revetments remain).

Although variety existed in exact detail and footprint from site-to-site, the typical Hanford AAA site covered approximately 8.1 ha (20 ac), commonly contained roughly 20 buildings and structures, and included standard utility distribution systems (electric, water, communication, transportation, and sanitary and sewage waste facilities). The standard complement of structures included barracks, mess halls, craft shops, pump houses, motor pools, latrines, and shower facilities. A water cistern located at each site typically augmented the water supply, and each site relied upon its own sewer system that terminated at on-site septic tanks with engineered drain fields. A small arms range, either 15 m (50 ft) or 91 m (100 yd) in length, was common for most installations. Those installations with AAA weapons emplacements maintained four 120 mm guns, each placed in a circular revetment constructed of sandbags. Most refuse was collected for off-site disposal, although some domestic refuse was disposed of at each site.

The process and release mechanism for this waste site is abandonment, miscellaneous dumping, and accumulation of debris not clearly associated with specific projects or facilities but presumed to be related to the H-42 Gun Site. The current form of all waste materials is solid. No references could be found to substantiate that liquid waste materials (other than potential indiscriminate small spills) were being dumped or discarded at this site. No chemical or radiological processes involving sustained release of materials could be found associated with this waste site. No documentation was discovered to indicate that stabilizing material was ever added to this waste site. The date of the accumulation and origin of the materials are unknown.

A range fire in June 2000 exposed several additional areas of debris. This debris included material suspected to be asbestos, glass, metal pipes, gauges, military issue dishes, and other sundry items. Even though the additional exposed debris was presumed to be associated with the H-42 Gun Site (based on the type of debris) and was in close proximity to the 600-226 waste site, these areas were incorporated into the 600-281 waste site.

2.2 Description of the Selected Alternative

The selected alternative for 600-226 was RTD given the nature of the debris according to the EE/CA and Action Memorandum. Contaminants of potential concern (COPCs) were not anticipated to exceed the RALs; however, RTD was preferred as cost effective and protective of human health and the environment. Analytical results from investigative sampling indicated several soil COPC concentrations in excess of the RALs. Activities involved in the RTD action set forth in the RAWP and DOE/RL-2009-60, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites* (SAP), include soil excavation and verification sampling to demonstrate that the remaining in situ soil contaminant concentrations are equal to or less than the established RALs, and that no additional removal action is required. The general removal action sampling design and criteria are provided below followed by a summary of removal action history, specific sampling design and methodology, and analytical results for 600-226.

The following key design elements and inputs were considered relevant during development of the 600-226 sample design:

- Direct visual inspection of the 600-226 surface was conducted using available historical and process knowledge as a guide for visual cues such as staining, discoloration, absence of vegetation, and other anomalies.

- Radiological field screening was conducted at the surface of the 600-226 waste site to provide an indication of the presence of radiological COPCs.
- Surface geophysical surveying (using ground penetrating radar) was conducted to identify subsurface features.
- Chemical field screening performed during RTD activities was used to verify the extent of contamination or, in conjunction with visual indicators, to identify areas of potential contamination that would require RTD.
- Judgmental sampling and random sampling were conducted in adherence to the methodology prescribed in the SAP. The use of a judgmental methodology based on process knowledge and visual indicators was appropriate for the investigative sampling evolution. Random samples collected from the excavation, and bias samples collected in close proximity to the excavation, were considered appropriate for the verification sampling evolution.

Based on these key design features, investigative soil samples were collected from 600-226 and analyzed for COPC concentrations. The analytical results showed concentrations of COPCs greater than RALs, which reinforced implementation of RTD and provided requisite information to commence excavation activities. Soils were removed from the impacted area and verification sampling was conducted. Verification sampling results substantiated COPC concentrations in remaining 600-226 soils were less than the RALs. Table 5-2 provides the maximum concentrations for each COPC from the verification sampling analytical data. Table A-1 and Table A-2 (Appendix A) provide detailed summaries of all analytical data results for sampling conducted at 600-226.

Personnel with current training and qualifications performed radiological field surveys of soil samples and sampling locations during the sampling evolutions. Survey methods and practices were conducted in accordance with established contractor procedures and protocols. All radiological surveys conducted at 600-226 resulted in radiological dose readings less than detection and/or less than background (as applicable to the instrument), and no detectable contamination was found in the waste site area.

2.2.1 Removal Action Objectives

The removal action alternatives for the 200-MG-1 OU waste sites were evaluated based on their overall ability to protect human health and the environment and their effectiveness in maintaining both short-term and long-term protection. The selected alternative must meet the following RAOs established in the Action Memorandum:

- **RAO 1**—Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with nonradiological constituents to 4.6 m (15 ft) bgs at concentrations above the appropriate RALs.
- **RAO 2**—Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with radiological constituents to 4.6 m (15 ft) bgs at concentrations above the appropriate RALs.
- **RAO 3**—Control the sources of groundwater contamination to minimize impacts to groundwater resources, protect the Columbia River from adverse impacts, and reduce the degree of groundwater cleanup that may be required under future action.
- **RAO 4**—Prevent adverse impacts to cultural resources and threatened or endangered species, and minimize wildlife habitat disruption.

The RALs for waste sites identified in the Action Memorandum are based on the RAOs noted above. These RALs are based on attainment of acceptable levels of human health, ecological risk, and protection of groundwater but are not less than background levels or detection limits for waste sites. Attainment of RALs is intended to meet the first three RAOs and is expected to satisfy the RAOs established in the final record of decision (ROD). The fourth RAO is met through cultural and ecological reviews performed before starting removal action activities. Table 2-1 lists the RALs applicable to 600-226. The attainment of RALs and RAOs is provided in Section 5 of this report.

Table 2-1. Nonradiological Removal Action Levels

Contaminant of Potential Concern	Background Concentration[a] (mg/kg)	Direct Exposure[b] (mg/kg)	Groundwater Protection[c] (mg/kg)	Required Detection Limit (mg/kg)	Removal Action Levels (mg/kg)
Antimony	5	32	5.4	0.6	5.4
Arsenic	6.5	6.5[d]	6.5[d]	1.0	6.5[d]
Barium	132	16,000	1,650	2	1,650
Beryllium	1.51	160	63.2	0.5	63.2
Boron	NA	16,000	210	2	210
Cadmium	0.81	80	0.81[d]	0.5	0.81[d]
Chromium (Total)	18.5	120,000	2,000	1	2,000
Chromium (VI)	NA	240	--[e]	0.5	--[e]
Cobalt	15.7	24	15.7[d]	2	15.7[d]
Copper	22.0	3,200	284	1	284
Lead	10.2	250	3,000	5.0	250
Lithium	33.5	160	192	2.5	160
Manganese	512	3,760	512[d]	5	512[d]
Mercury	0.33	24	2.09	0.2	2.09
Nickel	19.1	1,600	130	4	130
Selenium	0.78	400	5.2	1	5.2
Silver	0.73	400	13.6	0.2	13.6
Strontium	NA	48,000	2,920	1	2,920
Tin	NA	48,000	48,000	10	48,000
Uranium (Soluble Salts)	3.21	240	3.21[d]	1	3.21[d]
Vanadium	85.1	560	2,240	2.5	560
Zinc	67.8	24,000	5,970	1	5,970
PCB Aroclor 1016	NA	0.5	0.094	0.017	0.094

Table 2-1. Nonradiological Removal Action Levels

Contaminant of Potential Concern	Background Concentration[a] (mg/kg)	Direct Exposure[b] (mg/kg)	Groundwater Protection[c] (mg/kg)	Required Detection Limit (mg/kg)	Removal Action Levels (mg/kg)
PCB Aroclor 1221	NA	0.5	0.017[d]	0.017	0.017[d]
PCB Aroclor 1232	NA	0.5	0.017[d]	0.017	0.017[d]
PCB Aroclor 1242	NA	0.5	0.039	0.017	0.039
PCB Aroclor 1248	NA	0.5	0.039	0.017	0.039
PCB Aroclor 1254	NA	0.5	0.066	0.017	0.066
PCB Aroclor 1260	NA	0.5	0.72	0.017	0.5
Acenaphthene	NA	4,800	98	0.33	98
Acenaphthylene	NA	4,800	98	0.33	98
Anthracene	NA	24,000	2,270	0.33	2,270
Benzo(a)anthracene	NA	1.37	0.86	0.33	0.86
Benzo(a)pyrene	NA	0.137	0.233[f]	0.33	0.33[d]
Benzo(b)fluoranthene	NA	1.37	2.95[f]	0.33	1.37
Benzo(g,h,i)perylene	NA	2,400	25,700	0.33	2,400
Benzo(k)fluoranthene	NA	1.37	2.95[f]	0.33	1.37
Chrysene	NA	13.7	9.56	0.33	9.56
Dibenz(a,h)anthracene	NA	1.37	4.29	0.33	1.37
Fluoranthene	NA	3,200	631	0.33	631
Fluorene	NA	3,200	101	0.33	101
Indeno(1,2,3-cd) pyrene	NA	1.37	8.33	0.33	1.37
Naphthalene	NA	1,600	4.46	0.33	4.46
Phenanthrene	NA	24,000	1,140	0.33	1,140
Pyrene	NA	2,400	655	0.33	655
Carbon Tetrachloride[g]	N/A	7.69	0.0031	0.005	0.005
Xylene[h]	N/A	16,000	14.6	0.01	14.6
Nitrate (as Nitrogen)	11.8	128,000	40	0.75	40
TPH-Diesel	NA	2,000	2,000	5	2,000
TPH-Kerosene	NA	2,000	2,000	5	2,000
Fluoride[i]	N/A	4,800	16	5	16

Table 2-1. Nonradiological Removal Action Levels

Contaminant of Potential Concern	Background Concentration[a] (mg/kg)	Direct Exposure[b] (mg/kg)	Groundwater Protection[c] (mg/kg)	Required Detection Limit (mg/kg)	Removal Action Levels (mg/kg)
Asbestos	N/A	N/A[j]	N/A[j]	N/A[j]	1 %[j]

a. If Hanford Site-specific background data are not available, values are then taken from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values are available from nonradiological background data in DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Table D9-2.

b. Direct contact values were calculated based on WAC 173-340-740, "Model Toxics Control Act—Cleanup," "Unrestricted Land Use Soil Cleanup Standards," using method B methodology and assumptions.

c. The groundwater protection values were obtained using equations provided in WAC 173-340-747(4), "Model Toxics Control Act—Cleanup," "Deriving Soil Concentrations for Ground Water Protection," with the physical parameters obtained from the Washington State Department of Ecology website.

d. Where cleanup levels are less than background or RDLs, cleanup levels default to background or RDLs in accordance with WAC 173-340-700(6)(d), "Model Toxics Control Act—Cleanup," "Overview of Cleanup Standards," and WAC 173-340-707(2), "Model Toxics Control Act—Cleanup," "Analytical Considerations," respectively.

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

f. The soil concentration for protection of groundwater values for benzo(a)pyrene and benzo(k)fluoranthene were incorrectly reported in DOE/RL-2009-48, *Action Memorandum for Non-Time-Critical Removal Action for 11 Waste Sites in 200-MG-1 Operable Unit*, and have been corrected.

g. Carbon tetrachloride is applicable to 11 waste sites authorized by DOE/RL-2009-48.

h. Xylene is applicable only to the 200-W-3, 216-S-19 and 216-S-26 waste sites.

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

j. The removal action level for asbestos in soil is 1 percent by weight (measured using polarized light microscopy). EPA has used this value for determining if response actions for asbestos should be undertaken (*Clarifying Cleanup: Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups*, OSWER 9345.4-05 [EPA, 2004]). Further evaluation of removal actions for asbestos will be conducted as needed on a site-specific basis in the Outer Area RI/FS.

Ecological screening values, based on WAC 173-340-900, "Model Toxics Control Act—Cleanup," "Tables," Table 749-3, are used for screening purposes only and are not considered cleanup levels for this CERCLA removal action (described in more detail in Section 5 of the Action Memorandum). If analytical results exceed the ecological screening values, the results will be further evaluated during the final ecological risk assessment, in accordance with the remedial investigation/feasibility study (RI/FS) for the Central Plateau, to make final cleanup decisions.

2.2.2 Exposure and Land Use Assumptions

The 600-226 is located within the Central Plateau, as discussed in more detail in the EE/CA and Action Memorandum for the 200-MG-1 OU. Land use for the Central Plateau is designated for reasonably anticipated future land uses detailed in the EE/CA and Action Memorandum (for the purposes of this interim action, RAOs were selected that would support unrestricted land use).

2.2.3 Design Summary

The RTD alternative was selected for 600-226 as the preferred alternative as documented in the Action Memorandum. Investigative sampling and analysis indicated that COPC concentrations in the waste site soils were greater than RALs. The RTD action included excavation of contaminated soil and other materials. Following removal of the impacted soil, verification sampling was conducted to substantiate that COPC concentrations of remaining 600-226 soils were less than RALs. The sampling objectives for the 600-226 waste site included visual inspection and collection of discrete soil samples from the waste site as described in Section 3.1. Key features of the site-specific sampling design for 600-226 included the following:

- Direct visual inspection of the surface of the 600-226 waste site was conducted, using available information as a guide for visual cues such as staining, discoloration, absence of vegetation, and other anomalies.
- Radiological field screening was conducted at the surface of the waste site to provide an indication of the presence of radiological COPCs.
- Surface geophysical surveying (using ground penetrating radar) was conducted to identify subsurface features.
- Chemical field screening performed during RTD activities was used to verify the extent of contamination or, in conjunction with visual indicators, to identify areas of potential contamination that would require RTD.
- Judgmental and random sampling were conducted in adherence to methodology prescribed in the SAP. The use of a judgmental methodology based on process knowledge and visual indicators was deemed appropriate for the investigative sampling evolution. Random samples collected from the base and sidewalls of the excavation, and bias samples collected in close proximity to the excavation, were determined to be adequate and appropriate for the verification sampling evolution.

2.3 Decision Document Amendments, Significant Differences, or Waivers

No amendments to the EE/CA or Action Memorandum, or technical impracticability waivers, were associated with this removal action. A Tri-Party Agreement change (TPA-CN-350) has been approved for the Action Memorandum to add sites to the scope of the removal action; however, the change had no effect on the previously authorized action or on cleanup levels for this waste site.

3 Response Activity Summary

In accordance with the EE/CA and Action Memorandum, the selected removal action alternative for 600-226 was RTD. Results of investigative sampling indicated COPC concentrations greater than RALs. The removal activities proceeded through excavation and in-process chemical field screening to remove impacted soils under the RTD alternative. Upon conclusion of RTD activities, verification sampling was conducted to demonstrate that COPC concentrations in soils at 600-226 were less than the RALs, demonstrating that RAOs established for this interim action were satisfied.

3.1 Summary of Activities

The removal action at 600-226 was conducted between January and December 2010. Activities included the collection of focused and random samples, as specified in Section 2.2 of this document, in adherence to methodologies stipulated in the SAP. The following key activities were pertinent to the removal action at 600-226:

- Collection of judgmental (investigative) soil samples based on visual indicators
- Excavation of impacted soil as an element of the RTD alternative, due to analytical results exceeding the RALs
- Collection of bias samples from the area adjacent to the excavation to demonstrate that the extent of contamination has been mitigated by the excavation and is bounded by the verification samples
- Collection of random samples from excavated areas for verification purposes with laboratory analysis for COPCs, and data evaluation of analytical results to demonstrate achievement of RALs

3.1.1 Waste Site 600-226 Investigative Sampling

A site evaluation was performed over several days beginning in January through March 2010. The evaluation included the visual inspection component of the sampling activities described in the SAP, which contributed to sampling design development, and supported job planning for the investigative sampling evolution. The visual inspection incorporated observational indicators and historical information to identify areas of concern, which included several rusted metal containers of various capacities (18.9 L [5 gal], 3.78 L [1 gal], and 0.94 L [0.25 gal]) scattered over an area approximately 3.71 m^2 (40 ft^2) in size.

Radiological field screening was performed at 600-226. The field portable radiological detection equipment utilized survey methods and practices in accordance with established contractor procedures and protocols by personnel with current training and qualifications. No radiological postings were present at the waste site. All radiological results were found to be less than detection limits and/or less than background (as applicable to the instrument), and no radiological contamination was discovered. The waste site was confirmed to be a nonradiological site, and radiological COPCs were eliminated from the list of analytes to be included for laboratory analysis.

Investigative soil sampling points were based on visual indicators at the worst case location established during site evaluation. The surface sample (0.15 to 0.30 m [0.5 to 1 ft] bgs) was collected on May 5, 2010, and the depth sample (0.91m [3 ft] bgs) was collected on May 14, 2010. Figure 3-1 provides investigative sample collection locations.

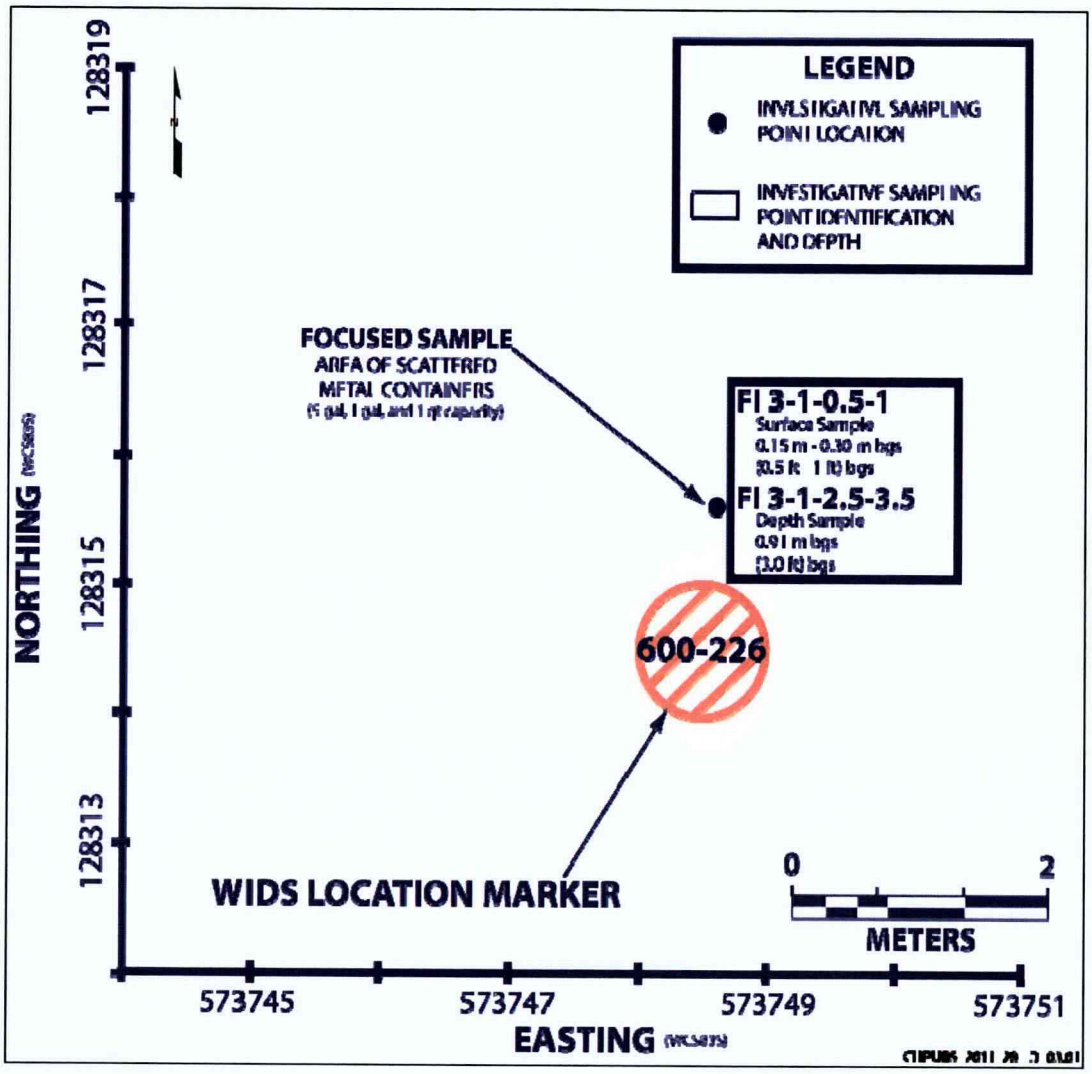

Figure 3-1. Initial Investigative Sample Locations

Results from the investigative sampling evolution demonstrated that COPCs exceeded the RALs, substantiating implementation of the RTD alternative. A summary of analytical results exceeding RALs is provided in Table 3-1.

Table 3-1. Concentrations of Contaminants of Potential Concern Exceeding Removal Action Levels

Investigative Sampling		
Contaminant of Potential Concern	**Removal Action Level (mg/kg)**	**HEIS# B25DY9 FI 3-1-2.5-3.5 Depth (mg/kg)**
Antimony	5.4	**180**
Lead	250	**287**

Note: Depth samples were taken at 0.91 m (3 ft) bgs.

3.1.2 Waste Site 600-226 Excavation

In accordance with the RAWP, given that investigative sampling results indicated COPC concentrations were greater than RALs, the RTD alternative was implemented. RTD was followed by verification sampling to demonstrate residual COPC concentrations of soils were less than the RALs, thereby demonstrating achievement of the RAOs.

The 600-226 waste site excavation was initiated on October 15, 2010. The extent of excavation was determined utilizing visual indicators, initially in the area where rusted metal containers were observed, and then transitioning to the burn pit, which was observed at approximately 0.9 m (3 ft) bgs. The excavation depth was approximately 1.2 m (4 ft) bgs.

The presence of visual indicators coupled with in-process chemical field screening (using x-ray fluorescence [XRF]), which indicated the presence of metal COPCs, further refined the extent of excavation an additional 0.61 m (2 ft) of material. Therefore, the total excavation depth was approximately 1.8 m (6 ft) bgs. The surface area of the final excavation was approximately 20.9 m^2 (226 ft^2); the maximum extent is shown in Figure 3-2.

3.1.3 Waste Site 600-226 Verification Sampling

Analytical results of investigative sampling indicated that concentrations of COPCs were greater than the RALs, initiating excavation at 600-226. The initial vertical extent of the excavation was determined utilizing visual indicators; however, based on chemical field screening results and the presence of visual indicators, the vertical extent of the excavation was extended. Upon completion of RTD activities, a verification sampling design was developed utilizing Visual Sample Plan[6] (VSP) software to place samples within the area of excavation. The sample locations were selected randomly by VSP on a systematic grid with a random start. The area of excavation was approximately 20.9 m^2 (226 ft^2); therefore, two discrete soil samples were collected from the base and sidewall of the excavation and analyzed for COPCs (Figure 3-2).

The area immediately to the southwest of the excavation contained an accumulation of metal debris just below the surface. During RTD activities, a section of metal bar stock was observed projecting above the ground surface near the 600-226 waste site. As a result of operational safety concerns, the metal bar stock was removed, which led to the discovery of additional assorted metal debris. The unearthed metal was collected for disposal. Two biased soil samples were collected: one surface sample and one depth sample at approximately 1.2 m (4 ft) bgs in the area of the buried metal debris. These two biased samples in the area of the unearthed metal debris were placed to demonstrate that the extent of contamination for the 600-226 waste site has been mitigated by the excavation and is bounded by the verification samples.

Laboratory analytical results from investigative and verification samples are provided in Table A-1 and Table A-2 (Appendix A). Comparison of the verification analytical results against RALs (as identified in Table 5-2) demonstrated that remaining in situ soils at 600-226 have COPC concentrations that are less than RALs, affirming completion of the RTD alternative.

3.1.4 Backfill and Revegetation

As described in Sections 2.1 and 5.5.1 of the RAWP backfill and/or contouring may take place at the 600-226 waste site upon concurrence by the signing parties that the RAOs have been attained. Finalization of a backfill concurrence form enabled backfill and/or contouring to proceed at the 600-226

6 PNNL-16939, *Visual Sample Plan, Version 5.0 User's Guide*. Visual Sample Plan is a registered trademark of Pacific Northwest National Laboratory, Richland, Washington.

waste site. The backfill concurrence form was approved by the regulatory agency(ies) on February 16, 2011. Backfill at the 600-222 waste site was completed on March 3, 2011.

In accordance with the ecological compliance review conducted for the 600-226 waste site, this area does not meet the requirements of a Level III or Level IV designation as described in DOE/RL-96-32, *Hanford Site Biological Resources Management Plan*. Revegetation at the 600-226 waste site is not required; however, the 600-226 waste site has been reseeded.

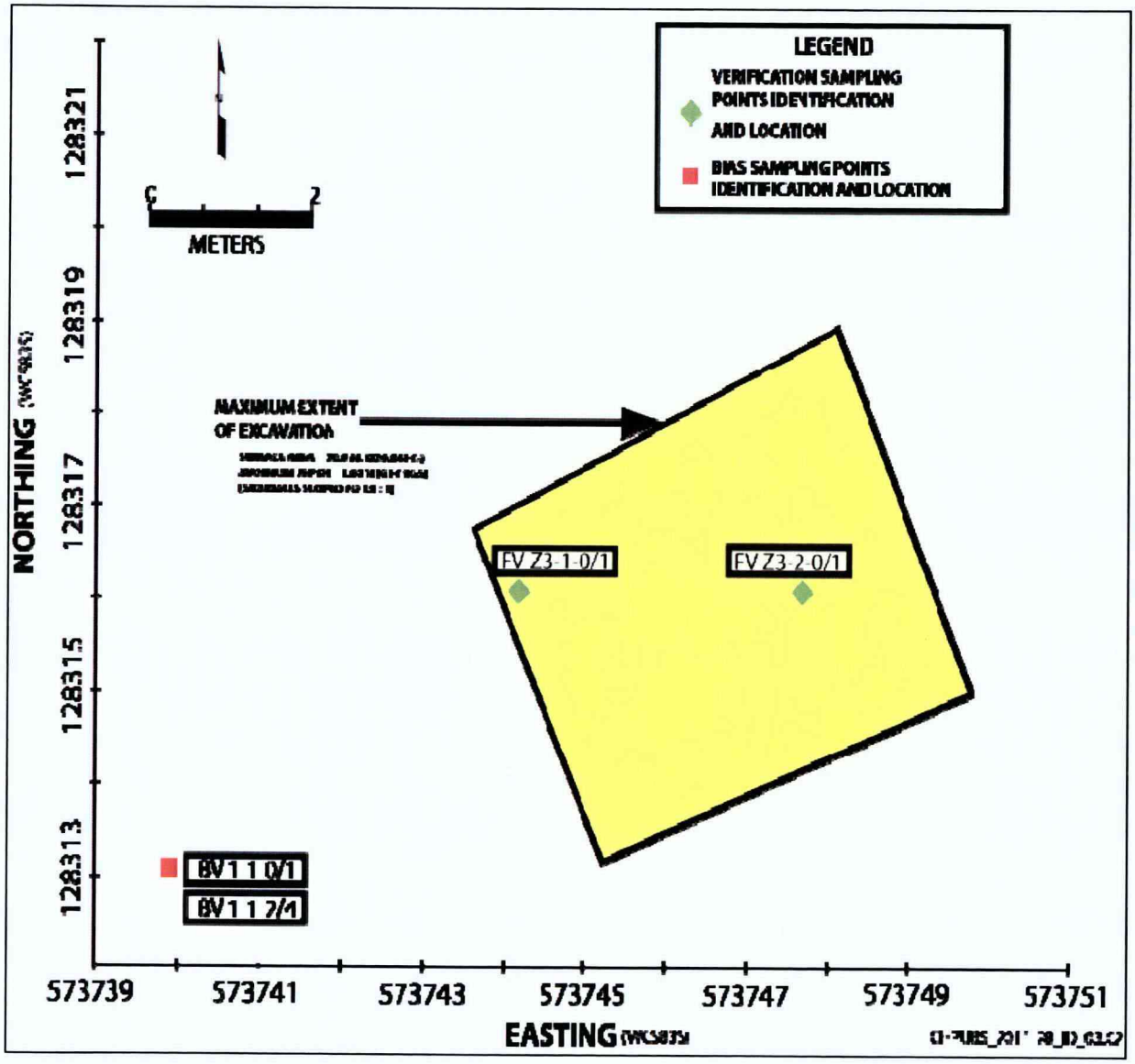

Figure 3-2. Verification and Bias Sampling Locations

3.1.5 Statement of Protectiveness

In accordance with the SAP, the soil at 600-226 has been sampled, analyzed by a certified laboratory, and the data have been evaluated. The results obtained through implementation of the RTD alternative demonstrate that COPC concentrations in the soil at 600-226 are less than RALs (discussed in further detail in Section 5). In addition, these results indicate that residual concentrations will support reasonably

anticipated future land uses described in the EE/CA and Action Memorandum. Further, residual concentrations of COPCs in soil throughout the 600-226 waste site are unlikely to affect groundwater or the Columbia River. A review of the sampling results substantiates that the removal action at 600-226 has achieved the RAOs established in the Action Memorandum and identified in the RAWP.

4 Chronology of Events

A chronology of major events associated with sampling conducted at the 600-226 waste site is presented in Table 4-1. The chronology includes approval of the regulatory documents that form the basis of the removal action and key fieldwork activities associated with the removal action.

Table 4-1. Removal Action Chronology

Date	Event
June 5, 2009	DOE/RL-2008-44, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, approved
January 7, 2010	Site evaluation and initial radiological field screen
March 17, 2010	Visual inspection and site evaluation
April 15, 2010	DOE/RL-2009-86, Rev. 0, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in 200-MG-1 Operable Unit*, approved
April 19, 2010	Surface geophysical (ground penetrating radar) investigation
April 21, 2010	Draft of DOE/RL-2009-53, Rev. 1, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, completed and routed for approval
May 14, 2010	Investigative sampling of 600-226 completed
May 20, 2010	Draft of DOE/RL-2009-60, Rev. 1, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*, completed and routed for approval
August 11, 2010	Laboratory analytical data evaluation completed
October 7, 2010	DOE/RL-2009-53, Rev. 1, approved
October 15, 2010	RTD of the 600-226 waste site commenced
October 28, 2010	RTD of the 600-226 waste site completed
December 12, 2010	Verification sampling of the 600-226 waste site completed
December 21, 2010	Laboratory analytical data evaluation completed
January 10, 2011	DOE/RL-2009-60, Rev. 1, approved
January 11, 2011	Analytical data verified against RALs in final regulatory documents
February 16, 2011	Backfill Concurrence Form approved
March 3, 2011	Backfill and/or contouring completed
March 11, 2011	Reseeding at the 600-226 waste site completed

5 Demonstration of Completion

This chapter addresses the process for demonstrating achievement of performance standards, which include attaining RALs and RAOs and maintaining the required quality control (QC) during removal activities.

5.1 Attainment of Performance Standards

Verification sampling, laboratory analysis, and data evaluation confirm that 600-226 meets the RAOs identified in the Action Memorandum, and residual levels of COPCs remaining in the soil are less than or equal to the established RALs. As shown in Table 5-1, RAOs 1 and 2 are achieved by preventing unacceptable risk to human health and environment through direct exposure to soils and debris by reducing the concentrations of COPCs to less than or equal to the RALs. RAO 3 is achieved by preventing migration and/or leaching of radiological and nonradiological contamination to groundwater by reducing the concentration of COPCs to less than or equal to the RALs. RAO 4 is met through cultural and ecological evaluation, performed in January 2010, and by implementation of considerations and recommendations during work activities. Demonstration that COPC concentration in soil at the 600-226 waste site is less than RALs (Table 5-2) meets RAOs 1, 2, and 3.

In accordance with methodology prescribed in the RAWP and SAP, investigative sampling of 600-226 consisted of visual inspection and focused soil sampling performed in May 2010. Analytical data from the investigative sampling evolution indicated COPC concentrations greater than RALs, which reinforced implementation of the RTD alternative. Excavation of impacted soils, followed by a verification sampling evolution, were performed in December 2010. The results, provided in Table A-1 and Table A-2 (Appendix A), demonstrate that no chemical COPC concentrations are greater than RALs present at 600-226, thus meeting RAOs 1, 2, and 3.

Table 5-1. Summary of Attainment of Cleanup Objectives

Removal Action Objective	Compliance Methods	Removal Action Objective Attained?
RAO 1: Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with nonradiological constituents to 4.6 m (15 ft) bgs at concentrations above the appropriate RALs.	Achieved through verification soil sampling, performed upon completion of RTD activities, which demonstrated that all individual COPC concentrations are less than the RALs.	Yes
RAO 2: Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with radiological constituents to 4.6 m (15 ft) bgs at concentrations above the appropriate RALs.	Achieved through the radiological survey of soils within 600-226, conducted during site evaluation and sampling evolutions, which resulted in no measured dose rates greater than background established for the waste site and no detectable radiological contamination. This demonstrates that all individual COPC concentrations are less than or equal to the RALs.	Yes
RAO 3: Control the sources of groundwater contamination to minimize impacts to groundwater resources, protect the Columbia River from adverse impacts, and reduce the degree of groundwater cleanup that may be required under future actions.	Achieved through verification soil sampling, performed upon completion of RTD activities, which demonstrated that concentrations of COPCs in soil were less than established RALs.	Yes
RAO 4: Prevent adverse impacts to cultural resources and threatened or endangered species, and minimize wildlife habitat disruption.	Achieved through cultural and ecological evaluation and the implementation of considerations during removal activities to minimize wildlife habitat and cultural artifact disruption.	Yes

This waste site and the data obtained from the subject investigative and verification sampling evolutions will be included in the RI/FS for final remedial decisions for the Outer Area.

5.1.1 Performance Standard Documentation

This RAR addresses the individual 600-226 waste site and not an OU; therefore, this section is not applicable.

5.1.2 Response Action Objectives Verification

RAO performance standard attainment involves the comparison of soil analytical data to RALs. The RALs, identified in the Action Memorandum and RAWP, are a direct comparison to the maximum results from the verification analytical data (Table 5-2). The full set of analytical results from all samples collected is provided in Appendix A.

5.1.3 Contaminant Identification

Table 5-2 provides a direct comparison of maximum verification sample analytical results for each nonradiological COPC against the established RALs for 600-226.

Table 5-2. Comparison of Verification Sample Results Against RALs for Nonradiological COPCs

Contaminant of Potential Concern	Background Concentration[a] (mg/kg)	Removal Action Levels (mg/kg)	Maximum Concentration in Soil (mg/kg)	Does the Maximum Concentration Exceed Removal Action Levels?
Metals				
Antimony	5	5.4	U	No
Arsenic	6.5	6.5[b]	2.99	No
Barium	132	1,650	102	No
Beryllium	1.51	63.2	0.299	No
Boron	NA	210	U	No
Cadmium	0.81	0.81[b]	U	No
Chromium (Total)	18.5	2,000	13.0	No
Chromium (VI)[c]	NA	NA[c]	U	No
Cobalt	15.7	15.7[b]	5.76	No
Copper	22.0	284	10.6	No
Lead	10.2	250	4.32	No
Lithium	33.5	160	10.2	No
Manganese	512	512[b]	279	No
Mercury	0.33	2.09	U	No
Nickel	19.1	130	11.6	No
Selenium	0.78	5.2	0.367	No
Silver	0.73	13.6	U	No
Strontium	NA	2,920	18.8	No
Thallium	0.1	1.59	U	No
Tin	NA	48,000	0.316	No
Uranium (soluble salts)	3.21	3.21[b]	0.386	No
Vanadium	85.1	560	35.1	No
Zinc	67.8	5,970	37.3	No
Polychlorinated Biphenyls				
Aroclor 1016	NA	0.094	U	No
Aroclor 1221	NA	0.017[b]	U	No
Aroclor 1232	NA	0.017[b]	U	No
Aroclor 1242	NA	0.039	U	No
Aroclor 1248	NA	0.039	U	No

Table 5-2. Comparison of Verification Sample Results Against RALs for Nonradiological COPCs

Contaminant of Potential Concern	Background Concentration[a] (mg/kg)	Removal Action Levels (mg/kg)	Maximum Concentration in Soil (mg/kg)	Does the Maximum Concentration Exceed Removal Action Levels?
Aroclor 1254	NA	0.066	U	No
Aroclor 1260	NA	0.5	U	No
Polynuclear Aromatic Hydrocarbons				
Acenaphthene	NA	98	U	No
Acenaphthylene	NA	98	U	No
Anthracene	NA	2,270	U	No
Benzo(a)anthracene	NA	0.86	U	No
Benzo(a)pyrene	NA	0.33[b]	U	No
Benzo(b)fluoranthene	NA	1.37	U	No
Benzo(g,h,i)perylene	NA	2,400	U	No
Benzo(k)fluoranthene	NA	1.37	U	No
Chrysene	NA	9.56	U	No
Dibenz(a,h)anthracene	NA	1.37	U	No
Fluoranthene	NA	631	U	No
Fluorene	NA	101	U	No
Indeno(1,2,3-cd)pyrene	NA	1.37	U	No
Naphthalene	NA	4.46	U	No
Phenanthrene	NA	1,140	U	No
Pyrene	NA	655	U	No
Anion				
Nitrate (as Nitrogen)	11.8	40	2.23	No
Total Petroleum Hydrocarbons				
Diesel	NA	2,000	U	No
Kerosene	NA	2,000	U	No

Table 5-2. Comparison of Verification Sample Results Against RALs for Nonradiological COPCs

Contaminant of Potential Concern	Background Concentration[a] (mg/kg)	Removal Action Levels (mg/kg)	Maximum Concentration in Soil (mg/kg)	Does the Maximum Concentration Exceed Removal Action Levels?

a. If Hanford Site-specific background data are not available, values are then taken from Ecology Publication 94-115, *Natural Background Soil Metals Concentrations in Washington State*. Hanford Site background values are available from nonradiological background data in DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Table D9-2.

b. Where cleanup levels are less than background or RDLs, cleanup levels default to background or RDLs in accordance with WAC 173-340-700(6)(d), "Model Toxics Control Act—Cleanup," "Overview of Cleanup Standards," and WAC 173-340-707(2), "Model Toxics Control Act—Cleanup," "Analytical Considerations," respectively.

c. 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 is the calculated value using K_d=0, based on PNNL-13895, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, and WAC 173-340-747, "Model Toxics Control Act—Cleanup," "Deriving Soil Concentrations for Groundwater Protection," equation 747-1.
- 2.1 mg/kg is based on DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area.*
- 18.4 mg/kg is based on Ecology, 2007, Cleanup Levels and Risk Calculations (CLARC) database.

U = result is less than laboratory detection limit.

5.2 Construction Quality Assurance/Quality Control

No construction-related aspects were implemented as part of the selected remedy for 600-226; therefore, this section is not applicable.

5.3 Cleanup Verification Quality Assurance/Quality Control

A data quality assessment (DQA) review was performed to compare the sampling approach and analytical data with the sampling and data requirements specified by the SAP. This review involved evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use. The assessment review completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality process.

Level C data validation as defined in the contractor's validation procedures, which are based on EPA functional guidelines (e.g., Bleyler, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; and Bleyler, 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*), was performed for the entire sampling and analysis data package for the verification samples collected for 600-226. Level C validation is a review of the QC data and specifically requires verification of deliverables and requested versus reported analyses and qualification of the results based on analytical holding times, method blank results, matrix spikes/matrix spike duplicates, surrogate recoveries, duplicates, and analytical method blanks.

Specific data quality objectives for the site are found in the SAP.

All of the sampling and analysis data generated from the investigative and verification sampling of 600-226 are tracked through the Hanford Environmental Information System (HEIS). All the sampling and analysis data for 600-226 were found to be useable for decision making purposes as provided in the following summary:

Investigative Sample HEIS Identification Numbers. B25DY8 and B25DY9.

Investigative Sample Blanks. Equipment blanks (B25DX4, B25DX5, B25KH4, and B25KH5) were received intact to the laboratory, and holding times were acceptable.

Investigative Sample Field Duplicate. The duplicate (B25DY2) results were acceptable.

Verification Sample HEIS Identification Numbers. B29HM1, B29HM2, B29HL8, and B29HM0.

Verification Sample Blanks. Equipment blank (B29HP2) was received intact to the laboratory, and holding times were acceptable.

Verification Sample Field Duplicate. The duplicate (B29HL9) results were acceptable.

Data Completeness. Analytical reports were submitted for validation and verified for completeness based on the percentage of data determined to be valid (i.e., not rejected). The completion percentage was 100 percent. The data has been determined to be useable for decision making purposes. The final results narrative supporting the sampling analysis activities and findings, and copies of chains of custody were transmitted in letter reports from the analytical laboratory.

Field Screening. Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences of risk. Because of the secondary importance of such data, no validation for physical property data and/or field screening results was performed. However, field quality assurance (QA)/QC were reviewed to ensure that the data are useable. Field instrumentation, calibration, and QA checks were performed in accordance with the following:

- Calibration of radiological field instruments (such as Geiger-Müeller and portable alpha meters) on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in their program documentation.
- Calibration of chemical field screening instruments (such as the XRF) is performed by the instrument manufacturer, in accordance with their established procedures.
- Daily calibration checks are performed and documented for each instrument used in support of waste site sampling and investigation. These checks are made on standard materials that are sufficiently like the matrix under consideration so that direct comparison of data can be made. Daily calibration checks of radiological and chemical field screening instruments were performed by trained and qualified personnel, in accordance with established program and procedural requirements.

The review and approval of completed field radiation surveys by the radiological controls organization represent the data validation and usability review for handheld field radiological measurements.

The DQA review for 600-226 found the analytical results to be accurate within the standard errors associated with the methods, including sampling and sample handling. The data are of the correct type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected because of QA/QC deficiencies. All analytical data were found acceptable for decision-making purposes. All of the sampling analytical data are stored in HEIS.

5.4 Regulatory Oversight

This document provides a summary of the removal action taken at 600-226; it shows a comparison of the data collected to RALs authorized in applicable regulatory documents and provides the basis to reclassify the waste site status (see Chapter 9). Though this report does not require approval by Ecology or the EPA,

concurrence of those agencies is necessary, under CERCLA Chapter 120 and the Tri-Party Agreement, for determinations concerning follow-on remedial actions. This report is therefore provided to the agency(ies) for review, in accordance with the approval process for waste site reclassification, as supporting documentation. Upon approval of the waste site reclassification, a copy of this report will be maintained in the Administrative Record. No additional regulatory oversight was required for the investigative and verification sampling of the 600-226 waste site.

6 Final Inspection and Certifications

There were no final inspections or certifications required in the implementation of the selected alternative for the 600-226 waste site; therefore, this section is not applicable.

7 Operations and Maintenance Activities

This section discusses the operations and maintenance (O&M) for the 600-226 waste site.

7.1 Remedy Related Operations and Maintenance or Monitoring

There are no O&M activities or monitoring requirements for the 600-226 waste site; therefore, this section is not applicable.

7.2 Institutional Controls

Based on the analyses performed and presented in this report, there are no waste site specific institutional controls required at the 600-226 waste site.

7.3 Five-Year Reviews

Five-year reviews are required by CERCLA for post-ROD remedial actions, but do not apply to the 600-222 waste site. This waste site and the data obtained from the subject sampling evolutions will be included in the risk assessment and RI/FS for final remedial decisions of the Outer Area.

8 Summary of Project Costs

For the purposes of reporting costs of removal action for the 600-226 waste site, costs are pro rated utilizing an activity/schedule-based methodology (Table 8-1). This method is not considered to be audit quality data. Actual costs for waste site cleanup will continue to be collected for each OU or closure area in accordance with the current cost tracking methodology. These costs will then be included, in accordance with CERCLA requirements, in the RAR for the final remedial action of the OU or closure area.

Table 8-1. Cost Summary

Cost Item	Actual Cost Fiscal Year 2010 ($)	Actual Cost Fiscal Year 2011 ($)	Actual Total Cost ($)
Removal Action Capital (Construction) Costs	0	0	0
Removal Action Operating Costs	25,646.68	68,615.75	94,262.43
Total Removal Action Cost	25,646.68	68,615.75	94,262.43
Projected Yearly O&M Cost	0	0	0

9 Waste Site Reclassification

The waste site reclassification form for the 600-226 waste site is proposed and processed in accordance with the procedures and definitions described in TPA-MP-14. Reclassification form 2011-024 for the 600-226 waste site proposes that the status of this waste site be changed to "Interim Closed Out." Per TPA-MP-14, "Interim Closed Out" status indicates that a site meets the cleanup standards specified in the approved 200-MG-1 Action Memorandum (i.e., the interim response action decision document). This site will be evaluated under the cleanup standards established for the final ROD for this area.

10 Observations and Lessons Learned

There were no observations or lessons learned applicable for inclusion in this report.

11 Contact Information

The DOE Contractor:

C.B. Walker
Geographic Area Closure Director
CH2M HILL Plateau Remediation Company
P.O. Box 1600, MSIN R3-19
Richland, WA 99352
Telephone: 509-373-2218

The Project Manager for DOE:

F.M. Roddy
200-MG-1 Operable Unit Project Manager
Department of Energy, Richland Operations Office
P.O. Box 550, MSIN A5-11
Richland, WA 99352
Telephone: 509-372-0945

The Project Manager for the Lead Regulatory Agency:

L. Buelow
Environmental Scientist
U.S. Environmental Protection Agency
Hanford Project Office, MSIN B1-46
309 Bradley Blvd., Suite 115
Richland, WA 99352
Telephone: 509-376-5466

12 References

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*. Available at: http://www.access.gpo.gov/nara/cfr/waisidx_10/40cfr300_10.html.

53 FR 23988, "National Priorities List for Uncontrolled Hazardous Waste Sites – Update 7," *Federal Register*, Vol. 53, No. 122, pp. 23988 – 23998, June 24, 1988. Available at: http://www.epa.gov/superfund/sites/npl/p880624.htm#23988.

54 FR 41015, "National Priorities List for Uncontrolled Hazardous Waste Sites – Final Rule 10/04/89," *Federal Register*, Vol. 54, No. 191, pp. 41015 – 41025, October 4, 1989. Available at: http://www.epa.gov/superfund/sites/npl/f891004.htm#41015.

40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List," *Code of Federal Regulations*. Available at: http://edocket.access.gpo.gov/cfr_2009/julqtr/40cfr300AppB.htm.

Bleyler, Ruth, 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*, Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.hanford.gov/ARPIR/index.cfm?content=findpage&AKey=D196013784.

Bleyler, Ruth, 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*, Hazardous Site Evaluation Division, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www2.hanford.gov/ARPIR/index.cfm?content=findpage&AKey=D196013785.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq., Pub. L. 107-377, December 31, 2002. Available at: http://epw.senate.gov/cercla.pdf.

DOE, 2010, *CERCLA Remedial Action Site Closure Guidance*, Draft, Office of Nuclear Safety and Environmental Assistance, U.S. Department of Energy, Washington, D.C. Available at: http://homer.ornl.gov/nuclearsafety/env/guidance/cercla/siteclosure.

DOE/EIS-0222-F, 1999, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, U.S. Department of Energy, Washington, D.C. Available at:
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158842.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158843.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158844.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158845.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158846.
http://www5.hanford.gov/arpir/?content=findpage&AKey=D199158847.

DOE/EIS-0222-SA-01, 2008, *Supplement Analysis: Hanford Comprehensive Land-Use Plan Environmental Impact Statement*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/SAwith_signed-R1.pdf.

DOE/RL-92-24, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Rev. 4, 2 vols., U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at:
http://www2.hanford.gov/arpir/?content=findpage&AKey=0096062.
http://www2.hanford.gov/arpir/?content=findpage&AKey=0096061.

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://www5.hanford.gov/arpir/?content=findpage&AKey=0095436.

DOE/RL-96-32, 2001, *Hanford Site Biological Resources Management Plan*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.pnl.gov/ecomon/docs/brmap/BRMaP.pdf.

DOE/RL-2008-44, 2009, *Engineering Evaluation/Cost Analysis for the 200-MG-1 Operable Unit Waste Sites*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0096350.

DOE/RL-2009-53, 2009, *Removal Action Work Plan for 48 Waste Sites in the 200-MG-1 Operable Unit*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/index.cfm?content=findpage&AKey=0912100290.

DOE/RL-2009-60, 2009, *Sampling and Analysis Plan for Selected 200-MG-1 Operable Unit Waste Sites*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=1003290272.

DOE/RL-2009-86, 2009, *Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in 200-MG-1 Operable Unit*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0084449.

Ecology, 2007, Cleanup Levels and Risk Calculations (CLARC) database, Washington State Department of Ecology. Available at: https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx.

Ecology Publication 94-115, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Toxics Cleanup Program, Washington State Department of Ecology, Olympia, Washington. Available at: http://www.ecy.wa.gov/pubs/94115.pdf.

Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., as amended, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington. Available at: http://www.hanford.gov/?page=81.

EPA 540-R-98-016, 2000, *Close Out Procedures for National Priorities List Sites*, OSWER Directive 9320.2-09A-P, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. Available at: http://www.epa.gov/superfund/programs/npl_hrs/closeout/pdf/guidance.pdf.

Executive Order 12580, 1987, *Superfund Implementation*, Ronald W. Reagan, January 23. Available at: http://www.archives.gov/federal-register/codification/executive-order/12580.html.

Lindsey, K.A., 1996, *The Miocene to Pliocene Ringold Formation and Associated Deposits of the Ancestral Columbia River System, South-Central Washington and North-Central Oregon*, Washington Department of Natural Resources, Washington Division of Geology and Earth Resources, Open File Report 96-8, Olympia, Washington. Available at: http://www/dnr.wa.gov/Publications/ger_ofr96-8_ringold_formation.pdf.

PNL-5506, 1986, *Hanford Site Water Table Changes 1950 through 1980: Data Observations and Evaluation*, Pacific Northwest Laboratory, Richland, Washington.

PNL-10285, 1995, *Estimated Recharge Rates at the Hanford Site*, Pacific Northwest Laboratory, Richland, Washington. Available at: http://www.osti.gov/energycitations/servlets/purl/10122247-XORHkt/webviewable/10122247.pdf.

PNNL-13116, 2000, *Hanford Site Groundwater Monitoring for Fiscal Year 1999*, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=D2736610. http://www5.hanford.gov/arpir/?content=findpage&AKey=D2736978.

PNNL-13895, 2003, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, Pacific Northwest National Laboratory, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=0911300341.

PNNL-16939, 2007, *Visual Sample Plan, Version 5.0 User's Guide*, Pacific Northwest National Laboratory, Richland, Washington. Available at: www.pnl.gov/main/publications/external/technical_reports/PNNL-16939.pdf.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq. Available at: http://epw.senate.gov/rcra.pdf.

RL-TPA-90-0001, 2007, *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://www.hanford.gov/files.cfm/TPA-MP14.pdf.

TPA-CN-350, 2010, *Tri-Party Agreement Change Notice Form: DOE/RL-2009-86, Action Memorandum for Non-Time-Critical Removal Action for 37 Waste Sites in the 200-MG-1 Operable Unit, Rev. 0*, dated March 31, U.S. Department of Energy, Richland Operations Office, and U.S. Environmental Protection Agency, Richland, Washington. Available at: http://www5.hanford.gov/arpir/?content=findpage&AKey=1010270164.

Superfund Amendments and Reauthorization Act of 1986, 42 USC 103, et seq. Available at: http://www.epa.gov/superfund/policy/sara.htm.

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.

340-700, "Overview of Cleanup Standards."

340-707, "Analytical Considerations."

340-747, "Deriving Soil Concentrations for Groundwater Protection."

340-900, "Tables."

Appendix A

Sampling Results for the 600-226 Waste Site

A1 Sampling Results for the 600-226 Waste Site

This appendix contains laboratory analytical results, provided in Table A-1 and Table A-2, from the sampling conducted at the 600-226 waste site. The following information is provided in the table headings: Hanford Environmental Information System identification numbers, field sample identifier, and sample depth. Depths provided in the tables are below ground surface.

Table A-1 provides analytical results from samples collected during the initial investigative phase of sampling, the results of which initiated execution of the RTD alternative.

Table A-2 includes final verification sampling results that demonstrate concentrations of COPCs were below RALs, thereby attesting to the achievement of established RALs and corresponding RAOs.

Table A-1. Analytical Results for Investigative Sampling for Nonradiological Contaminants of Potential Concern

Contaminants of Potential Concern	Removal Action Levels[a] (mg/kg)	Background Concentration[b] (mg/kg)	Required Detection Limit (mg/kg)	B25DY8 FI 3-1-0.5/1 Surface[c] (mg/kg)	B25DY9 FI 3-1-2.5/3.5 0.9 m (3 ft) bgs (mg/kg)
Metals					
Antimony	5.4	5	0.6	U	180
Arsenic	6.5[d]	6.5	1.0	2.28	2.88
Barium	1,650	132	2.0	101	91.5
Beryllium	63.2	1.51	0.5	0.26	0.17
Boron	210	N/A	2.0	7.88	28.7
Cadmium	0.81[d]	0.81	0.5	0.16	0.22
Chromium (Total)	2,000	18.5	1.0	10.6	21.2
Chromium (VI)	N/A	N/A	0.5	U	U
Cobalt	15.7[d]	15.7	2.0	6.24	5.69
Copper	284	22	1.0	13.2	150
Lead	250	10.2	5.0	7.82	287
Lithium	160	33.5	2.5	8.28	9.16
Manganese	512[d]	512	5.0	341	273
Mercury	2.09	0.33	0.2	U	U
Nickel	130	19.1	4.0	9.64	10.7
Selenium	5.2	0.78	1.0	0.97	0.54
Silver	13.6	0.73	0.2	U	U
Strontium	2,920	N/A	1.0	24.4	18.2
Thallium	1.59	0.1	1.0	U	U
Tin	48,000	N/A	10	0.36	15.7
Uranium	3.21[d]	3.21	1.0	0.42	0.37
Vanadium	560	85.1	2.5	41.6	31.4
Zinc	5,970	67.8	1.0	45.1	214
Anion					
Nitrate-N	40	11.8	0.75	U	29.7
Polynuclear Aromatic Hydrocarbons					

Table A-1. Analytical Results for Investigative Sampling for Nonradiological Contaminants of Potential Concern

Contaminants of Potential Concern	Removal Action Levels[a] (mg/kg)	Background Concentration[b] (mg/kg)	Required Detection Limit (mg/kg)	B25DY8 FI 3-1-0.5/1 Surface[c] (mg/kg)	B25DY9 FI 3-1-2.5/3.5 0.9 m (3 ft) bgs (mg/kg)
Acenaphthene	98	N/A	0.33	U	U
Acenaphthylene	98	N/A	0.33	U	U
Anthracene	2,270	N/A	0.33	U	U
Benzo(a)anthracene	0.86	N/A	0.33	U	U
Benzo(a)pyrene	0.33[d]	N/A	0.33	U	U
Benzo(b)fluoranthene	1.37	N/A	0.33	U	U
Benzo(k)fluoranthene	1.37	N/A	0.33	U	U
Benzo(g,h,i)perylene	2,400	N/A	0.33	U	U
Chrysene	9.56	N/A	0.33	U	U
Dibenz(a,h)anthracene	1.37	N/A	0.33	U	U
Fluoranthene	631	N/A	0.33	U	U
Fluorene	101	N/A	0.33	U	U
Indeno(1,2,3-cd)pyrene	1.37	N/A	0.33	U	U
Naphthalene	4.46	N/A	0.33	U	U
Phenanthrene	1,140	N/A	0.33	U	U
Pyrene	655	N/A	0.33	U	U
Polychlorinated Biphenyls					
Aroclor 1016	0.094	N/A	0.17	U	U
Aroclor 1221	0.017[d]	N/A	0.17	U	U
Aroclor 1232	0.017[d]	N/A	0.17	U	U
Aroclor 1242	0.039	N/A	0.17	U	U
Aroclor 1248	0.039	N/A	0.17	U	U
Aroclor 1254	0.066	N/A	0.17	U	40.0
Aroclor 1260	0.5	N/A	0.17	U	U
Total Petroleum Hydrocarbons					
Diesel	2,000	N/A	5.0	U	35.0
Kerosene	2,000	N/A	5.0	U	U

Table A-1. Analytical Results for Investigative Sampling for Nonradiological Contaminants of Potential Concern

Contaminants of Potential Concern	Removal Action Levels[a] (mg/kg)	Background Concentration[b] (mg/kg)	Required Detection Limit (mg/kg)	B25DY8 FI 3-1-0.5/1 Surface[c] (mg/kg)	B25DY9 FI 3-1-2.5/3.5 0.9 m (3 ft) bgs (mg/kg)

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

b. If Hanford Site-specific background data are not available, values are then taken from Ecology Publication 94-115, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Toxics Cleanup Programs, Washington State Department of Ecology, Olympia, Washington. Hanford Site background values are available, and nonradiological background data are from DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Rev. 4, Table D39-2.

c. Surface is 0 to 0.3 m (0 to 1 ft) below ground surface.

d. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits per Ecology Publication 94-06, *Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC*; WAC 173-340-700(6)(d), "Model Toxics Control Act—Cleanup," "Overview of Cleanup Standards;" and WAC 173-340-707(2), "Model Toxics Control Act—Cleanup," "Analytical Considerations," respectively.

NA = no analysis

N/A = not available

U = result is less than laboratory detection limit

Table A-2. Analytical Results for Final Verification Sampling for Nonradiological Contaminants of Potential Concern

Contaminants of Potential Concern	Removal Action Levels[a] (mg/kg)	Background Concentration[b] (mg/kg)	Required Detection Limit (mg/kg)	B29HL8 FV Z3-1-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM0 FV Z3-2-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM1 BV 1-0/1 0.3 m (1 ft) bgs (mg/kg)	B29HM2 BV 1-2/4 1.2 m (4 ft) bgs (mg/kg)
Metals							
Antimony	5.4	5	0.6	U	U	U	U
Arsenic	6.5[c]	6.5	1.0	2.01	2.99	2.36	1.90
Barium	1,650	132	2.0	102	68.1	66.4	57.3
Beryllium	63.2	1.51	0.5	0.223	0.200	0.299	0.22
Boron	210	N/A	2.0	U	U	U	U
Cadmium	0.81[c]	0.81	0.5	U	U	U	U
Chromium (Total)	2,000	18.5	1.0	12.1	13.0	11.6	11.0
Chromium (VI)	2.1	N/A	0.5	U	U	U	U
Cobalt	15.7[c]	15.7	2.0	5.06	5.76	5.42	4.82
Copper	284	22	1.0	8.86	10.6	8.52	9.55
Lead	250	10.2	5.0	4.32	4.02	3.65	3.19
Lithium	160	33.5	2.5	9.37	8.96	9.65	10.2
Manganese	512[c]	512	5.0	278	269	279	241
Mercury	2.09	0.33	0.2	U	U	U	U
Nickel	130	19.1	4.0	11.4	11.6	10.0	10.7
Selenium	5.2	0.78	1.0	U	0.367	U	0.314
Silver	13.6	0.73	0.2	U	U	U	U
Strontium	2,920	N/A	1.0	15.3	18.8	15.9	18.0

Table A-2. Analytical Results for Final Verification Sampling for Nonradiological Contaminants of Potential Concern

Contaminants of Potential Concern	Removal Action Levels[a] (mg/kg)	Background Concentration[b] (mg/kg)	Required Detection Limit (mg/kg)	B29HL8 FV Z3-1-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM0 FV Z3-2-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM1 BV 1-0/1 0.3 m (1 ft) bgs (mg/kg)	B29HM2 BV 1-2/4 1.2 m (4 ft) bgs (mg/kg)
Thallium	1.59	0.1	1.0	U	U	U	U
Tin	48,000	N/A	10	0.282	0.316	0.265	0.233
Uranium	3.21[c]	3.21	1.0	0.386	0.363	0.363	0.368
Vanadium	560	85.1	2.5	35.1	33.9	33.6	32.5
Zinc	5,970	67.8	1.0	37.3	31.8	33.3	28.3
Anion							
Nitrate-N	40	11.8	0.75	2.23	1.93	U	U
Polynuclear Aromatic Hydrocarbons							
Acenaphthene	98	N/A	0.33	U	U	U	U
Acenaphthylene	98	N/A	0.33	U	U	U	U
Anthracene	2,270	N/A	0.33	U	U	U	U
Benzo(a)anthracene	0.86	N/A	0.33	U	U	U	U
Benzo(a)pyrene	0.33[c]	N/A	0.33	U	U	U	U
Benzo(b)fluoranthene	1.37	N/A	0.33	U	U	U	U
Benzo(k)fluoranthene	1.37	N/A	0.33	U	U	U	U
Benzo(g,h,i)perylene	2,400	N/A	0.33	U	U	U	U
Chrysene	9.56	N/A	0.33	U	U	U	U
Dibenzo(a,h)anthracene	1.37	N/A	0.33	U	U	U	U
Fluoranthene	631	N/A	0.33	U	U	U	U

Table A-2. Analytical Results for Final Verification Sampling for Nonradiological Contaminants of Potential Concern

Contaminants of Potential Concern	Removal Action Levels[a] (mg/kg)	Background Concentration[b] (mg/kg)	Required Detection Limit (mg/kg)	B29HL8 FV Z3-1-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM0 FV Z3-2-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM1 BV 1-0/1 0.3 m (1 ft) bgs (mg/kg)	B29HM2 BV 1-2/4 1.2 m (4 ft) bgs (mg/kg)
Fluorene	101	N/A	0.33	U	U	U	U
Indeno(1,2,3-cd)pyrene	1.37	N/A	0.33	U	U	U	U
Naphthalene	4.46	N/A	0.33	U	U	U	U
Phenanthrene	1,140	N/A	0.33	U	U	U	U
Pyrene	655	N/A	0.33	U	U	U	U
Polychlorinated Biphenyls							
Aroclor 1016	0.094	N/A	0.17	U	U	U	U
Aroclor 1221	0.017[c]	N/A	0.17	U	U	U	U
Aroclor 1232	0.017[c]	N/A	0.17	U	U	U	U
Aroclor 1242	0.039	N/A	0.17	U	U	U	U
Aroclor 1248	0.039	N/A	0.17	U	U	U	U
Aroclor 1254	0.066	N/A	0.17	U	U	U	U
Aroclor 1260	0.5	N/A	0.17	U	U	U	U
Total Petroleum Hydrocarbons							
Diesel	2,000	N/A	5.0	U	U	U	U
Kerosene	2,000	N/A	5.0	U	U	U	U

Table A-2. Analytical Results for Final Verification Sampling for Nonradiological Contaminants of Potential Concern

Contaminants of Potential Concern	Removal Action Levels[a] (mg/kg)	Background Concentration[b] (mg/kg)	Required Detection Limit (mg/kg)	B29HL8 FV Z3-1-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM0 FV Z3-2-0/1 2.1 m (7 ft) bgs (mg/kg)	B29HM1 BV 1-0/1 0.3 m (1 ft) bgs (mg/kg)	B29HM2 BV 1-2/4 1.2 m (4 ft) bgs (mg/kg)

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

b. If Hanford Site-specific background data are not available, values are then taken from Ecology, 1994, Natural Background Soil Metals Concentrations in Washington State, Publication No. 94-115, Washington State Department of Ecology, Olympia, Washington. Hanford Site Background values are available and nonradiological background data are from DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, Rev. 4, Table D39-2.

c. Where cleanup levels are less than background or required detection limits, cleanup levels default to background or required detection limits per Ecology Publication 94-06, *Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC*; WAC 173-340-700(6)(d), "Model Toxics Control Act—Cleanup," "Overview of Cleanup Standards;" and WAC-173-340-707(2), "Model Toxics Control Act—Cleanup," "Analytical Considerations," respectively.

NA = no analysis

N/A = not available

U = result is less than laboratory detection limit