0072587

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MAR 23 2007

07-AMCP-0126

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Addressees:

SUPPLEMENTAL REMEDIAL INVESTIGATION/ FEASIBILITY STUDY WORK PLAN FOR THE 200 AREAS CENTRAL PLATEAU OPERABLE UNITS, DOE/RL-2007-02, DRAFT A, VOLUMES I AND II

The purpose of this letter is to submit the attached Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units, DOE/RL-2007-02, DRAFT A, Volumes I and II for your review and approval.

This transmittal represents completion of Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Milestone M-013-50 due March 31, 2007. The regulatory review period is scheduled to conclude on May 30, 2007, and we look forward to receiving your comments, on or before that date.

We would like to thank you for your cooperation and assistance in working with the U.S. Department of Energy, Richland Operations Office and its contractors to complete the year-long data quality objectives development process that led to identification of the supplemental characterization needs described in the attached work plan. We sincerely appreciate your contributions to this collaborative effort.

If you have any questions, please contact me, or your staff may contact, Matt McCormick, Assistant Manager for the Central Plateau, on (509) 373-9971.

Sincerely,

Keith A. Klein
Manager

AMCP:BLF

Attachment

cc w/attach:
C. E. Cameron, EPA
J. B. Price, Ecology
Administrative Record
Environmental Portal

cc w/o attach:
B. A. Austin, FHI
R. E. Piippo, FHI
J. G. Vance, FFS

DOE/RL-2007-02
Draft A
Volume 1

Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units

Volume I: Work Plan and Appendices

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

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

DOE/RL-2007-02
Draft A
Volume 1

Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units

Volume I: Work Plan and Appendices

Date Published
March 2007

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

United States Department of Energy
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J. D. Aardal 03/07/2007
Release Approval Date

Approved for Public Release;
Further Dissemination Unlimited

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APPENDICES

FIGURES

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TERMS

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CDQO	confirmation data quality objective
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
CSAP	confirmatory sampling and analysis plan
DDQO	design data quality objective
DOE	U.S. Department of Energy
DQO	data quality objective
DSAP	design sampling and analysis plan
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
HRR	high-resolution resistivity
MESC/MNA/IC	maintain existing soil cover/monitored natural attenuation/ institutional controls
NCP	National Contingency Plan (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan")
NPL	National Priorities List (40 CFR 300, Appendix B, "National Priorities List")
OU	operable unit
PUREX	Plutonium-Uranium Extraction (Plant or process)
RAO	remedial action objective
RAWP	remedial action work plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RDR	remedial design report
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
RL	DOE, Richland Operations Office
ROD	record of decision
RTD	removal, treatment, and disposal
SAP	sampling and analysis plan
SSSP	site-specific field-sampling plan
TBD	to be determined
Tri-Parties	U.S. Department of Energy, U.S. Environmental Protection Agency, Washington State Department of Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VDQO	verification data quality objective
VSAP	verification sampling and analysis plan
WAC	*Washington Administrative Code*

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	25.40	millimeters	millimeters	0.0394	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 (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

1.0 INTRODUCTION

This Supplemental Work Plan consists of two volumes. Volume I contains the work plan, overall sampling and analysis plan (SAP), and summary field activities to be implemented to augment existing data and information for the Central Plateau. Volume II contains the detailed sampling plans for individual waste sites or groups of waste sites to be investigated under this work plan.

The 200 Areas (commonly called the Central Plateau) of the U.S. Department of Energy's (DOE) Hanford Site (Hanford) currently are on the U.S. Environmental Protection Agency's (EPA) National Priorities List (NPL) (40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," Appendix B, "National Priorities List,"), along with the 100, 300, and 1100 Areas. An NPL site is identified as a site impacted by environmental contamination from industrial waste materials posing real and/or potential threats to human health or the environment. The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) and its implementing regulations, 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan" (NCP), direct the responses, either remedial or removal, for cleanup of NPL sites. These responses to Hanford Site NPL listings are mandated under the *Hanford Federal Facility Agreement and Consent Order*, known as the Tri-Party Agreement (Ecology et al. 1989a, as amended), as directed by the DOE, Richland Operations Office (RL), the EPA, and the Washington State Department of Ecology (Ecology), known as the Tri-Parties.

The CERCLA remedial action process has been identified as the appropriate response action for waste sites on the Central Plateau. These waste sites have been organized into source operable units (OU) for remedial actions, including the investigation and evaluation phases. In addition, the groundwater under the Central Plateau has been organized into separate groundwater OUs. The remedial actions for these groundwater OUs are being investigated and evaluated under a separate CERCLA remedial action process.

One of the first remedial activities is the remedial investigations (RI) phase. As a result of analyzing and evaluating the waste-site RIs performed to date and other existing data from the source OUs on the Central Plateau, the Tri-Parties concluded that supplemental RI data are needed to augment the existing data. The supplemental data are needed to support the evaluation of remedial alternatives, which is conducted during the feasibility study (FS) phase of the remedial action process. This document is an RI/FS supplemental work plan, which, along with the associated SAP (Appendix A), supports the supplemental RI activities that RL, the EPA, and Ecology have determined are necessary to make or augment remedial decisions for waste sites on the Central Plateau of the Hanford Site.

In 1999, the Tri-Parties approved DOE/RL-98-28, *200 Areas Remedial Investigation/ Feasibility Study Implementation Plan – Environmental Restoration Program*. This plan detailed the strategy for a streamlined approach to collecting RI data on the Central Plateau that relied on a process-based grouping of waste sites into OUs. The plan identified the use of RI/FS work plans to focus RI activities on a defined set of representative waste sites.[1] Under DOE/RL-98-28, the decisions were to be made on the representative waste sites, thereby streamlining and reducing costs for the RIs. Data on analogous sites would be collected following the record of decision (ROD) and would be focused on defining the extent of contamination, obtaining design data, and confirming that the analogous site conceptual model was appropriately represented by the representative waste site.

Between 1999 and 2001, RI/FS work plans were developed and approved for the following source OUs:

- **200-CW-1** Gable Mountain Pond/B Pond and Ditches Cooling Water Waste Group (DOE/RL-99-07, *200-CW-1 Operable Unit RI/FS Work Plan and 216-B-3 RCRA TSD Unit Sampling Plan*)
- **200-CS-1** Chemical Sewer Waste Group (DOE/RL-99-44, *200-CS-1 Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan*)
- **200-TW-1** Scavenged Waste Group/200-TW-2 Tank Waste Group/200-PW-5 Fission Product-Rich Waste Group (DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*).

In 2002, the Tri-Parties conducted a thorough review of the cleanup approach that was being applied through DOE/RL-98-28 and identified improvements to accelerate cleanup of these waste sites. As part of this improved approach to accelerating waste site cleanup, the Tri-Parties agreed to consolidate the 23 process-based source OUs into 12 OU groups based on similarities between contaminant sources (Tri-Party Agreement Change Packages M-13-02-01 and M-15-02-01, approved in June 2002). To date, RI/FS work plans have been approved for the above listed and for the following source OUs or OU groups:

- **200-CW-5** U Pond/Z-Ditches Cooling Water Waste Group, including 200-CW-2, 200-CW-4, and 200-SC-1 (DOE/RL-99-66, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units*)
- **200-PW-2** Uranium-Rich Process Waste Group/200-PW-4 General Process Waste Group (DOE/RL-2000-60, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Units RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-PW-2 and 200-PW-4 Operable Units*)

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[1] Waste sites are combined into groups of sites with similar location, geology, waste-site history, contaminants, etc. Within each group, one or more representative waste sites is selected for comprehensive field investigations, including sampling. Findings from site investigations at representative waste sites then are applied to other waste sites in the waste group that were not characterized. Sites for which field data have not been collected are assumed to have similar or "analogous" characteristics to the site that was characterized. Investigations to confirm the analogous relationships, rather than full characterization, would be performed at the sites not selected as representative.

- **200-LW-1** 200 Area Chemical Laboratory Waste Group/200-LW-2 300 Area Chemical Laboratory Waste Group (DOE/RL-2001-66, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*)

- **200-MW-1** Miscellaneous Waste Group (DOE/RL-2001-65, *200-MW-1 Miscellaneous Waste Group Operable Unit RI/FS Work Plan*)

- **200-PW-1** Plutonium/Organic Rich Process Waste Group/200-PW-3 Organic Rich Process Waste Group/200-PW-6 Plutonium Fission Product-Rich Process Waste Group (DOE/RL-2001-01, *Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit RI/FS Work Plan, Includes: 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units*).

RL conducted RIs in accordance with the approved work plans. The RIs conducted through fiscal year 2006 are summarized in Table 1-1. In addition to the RI data collected under the approved work plans, data have been collected under other programs at the Hanford Site. These data also are useful in assisting the decision-making process. Data collected during the RIs and other programs were reported and evaluated through RI reports and FSs. Proposed plans were developed to support public review of the RI/FS process and the proposed remedial alternatives.

During the regulatory agency review of the Central Plateau RI reports and FSs, a need for additional data above that identified in the approved RI/FS work plans was identified by EPA and Ecology in response to stakeholder input. The Tri-Parties undertook a supplemental data quality objectives (DQO) process in fiscal years 2005 and 2006 to evaluate data needs and to reach agreement on a path forward for supplemental data collection that would augment the RI and other data already collected. The elements of the DQO are integrated into this work plan, SAP (Appendix A), and other supporting appendices.

Table 1-1 provides a summary of the documentation status of Central Plateau waste-site source OUs on the environmental remediation pathway.

Table 1-1. Summary of Operable Unit Status. (2 Pages)

Operable Unit	Work Plan	RI Complete?	Remedial Investigation Report	Feasibility Study
200-CS-1	DOE/RL-99-44, Revision 0, approved October 2000	Yes	DOE/RL-2004-17, Revision 0 submitted January 2005; Revision 1 pending	DOE/RL-2005-63, Draft A submitted March 2006; Revision 0 pending
200-CW-1, 200-CW-3, 200 North	DOE/RL-99-07, Revision 0, approved December 2000	Yes	DOE/RL-2000-35, Revision 0 approved March 2001	DOE/RL-2002-69, Draft A submitted March 2003; Draft B pending
200-CW-5, 200-CW-2, 200-CW-4, 200-SC-1	DOE/RL-99-66, Revision 0, approved August 2003	Yes	DOE/RL-2003-11, Revision 0 conditionally approved October 2004	DOE/RL-2004-24, Draft A submitted October 2004; Draft B pending

Table 1-1. Summary of Operable Unit Status. (2 Pages)

Operable Unit	Work Plan	RI Complete?	Remedial Investigation Report	Feasibility Study
200-LW-1, 200-LW-2	DOE/RL-2001-66, Revision 0, approved August 2002	Yes	DOE/RL-2005-61, Draft A submitted February 2006; Revision 0 pending	Not yet issued
200-MW-1	DOE/RL-2001-65, Revision 0, approved July 2002	Yes	DOE/RL-2005-62, Draft A submitted April 2006; Revision 0 pending	Not yet issued
200-PW-1, 200-PW-3, 200-PW-6	DOE/RL-2001-01, Revision 0, approved August 2004	Yes	DOE/RL-2006-51, Draft A submitted October 2006; Revision 0 pending	Not yet issued
200-PW-2, 200-PW-4	DOE/RL-2000-60, Revision 1, approved September 2004	Yes	DOE/RL-2004-25, Draft A submitted June 2004; Revision 0 pending	DOE/RL-2004-85, Draft A submitted May 2006; Draft B pending
200-TW-1, 200-TW-2, 200-PW-5	DOE/RL-2000-38, Revision 0, approved May 2001	Yes	DOE/RL-2002-42, Revision 0 approved provisionally March 2004	DOE/RL-2003-64, Draft A submitted March 2004; Draft B pending
200-UR-1	DOE/RL-2004-39, Revision 0 submitted May 2005; Revision 1 pending	Partially	Not yet issued	Not yet issued; however, DOE/RL-2004-39 includes an engineering evaluation and cost analysis for the majority of the sites
200-IS-1	DOE/RL-2002-14, Revision 0 submitted May 2004; Revision 1 pending	No	Not yet issued	Not yet issued
200-SW-1/2	DOE/RL-2004-60, Draft A submitted December 2004; Draft B pending	Partially	Not yet issued	Not yet issued

NOTE: This table does not include all the source operable units or the groundwater operable units.
Full reference citations for these documents are located in Chapter 7.0.

To support the assessment of supplemental data needs, the Tri-Parties grouped waste sites into seven conceptual model groups (Model Groups 1 through 7 [see Section 2.1 for descriptions of the model groups]) that are based on risk pathways. These pathways are a function of the type and location of contaminants within, beneath, and around the waste sites. For example, shallow sites have different pathways for exposure than do sites with deeper contamination. The model groups provided a convenient method for determining types and locations of supplemental data needed to support decision making.

One of the conceptual model groups identified, Model Group 1, contains waste sites with shallow or readily addressed contamination for which the Tri-Parties agreed decision making is straight forward and supplemental data are not required prior to decision making (Ecology et. al. 2006, *Hanford Federal Facility Agreement and Consent Order Changes to Central Plateau Waste Site and Groundwater Remediation Milestones [including Tentative Agreement on Negotiations, Introduction, Federal Facilities Agreement and Consent Order Change Control Form M-15-16-02, M-13-06-01, P-11-06-01, C-06-02]*). This model group includes approximately 350 waste sites (i.e., 40 percent of the total Central Plateau waste sites).

These sites are being assigned to two new OUs. Waste sites in Model Group 1 for which Ecology has authority are now included in the new 200-MG-1 OU; EPA sites are in the new 200-MG-2 OU. A Tri-Party Agreement milestone has been identified in the Change Package for submittal of an FS for these sites. Therefore, these Model Group 1 waste sites are not included in the scope of this work plan. The majority of these sites are likely candidates for the removal, treatment, and disposal (RTD) remedy, the no-action remedy, or the maintain existing soil cover/monitored natural attenuation/institutional controls (MESC/MNA/IC) remedy. After the remedy implementation for wastes sites in Model Group 1, further characterization will be conducted for these waste sites to confirm that agreed-upon cleanup levels have been achieved. The remaining model groups are discussed later in this work plan (Section 2.2).

The need for supplemental data led the Tri-Parties to propose changes to the milestones for completing the CERCLA RI/FS process for the Central Plateau source OUs (Ecology et. al. 2006). The proposed milestone changes modify the sequencing for collecting RI data and for producing the subsequent RI/FS documents leading to remedial decisions. The proposed milestone changes allow additional time in the RI/FS milestone schedules to support the supplemental data-collection activities. This approach is intended to provide greater confidence that cleanup decisions are protective of human health and the environment.

1.1 PURPOSE AND SCOPE

The primary purposes of this document are to (1) identify supplemental data-collection activities that have been determined by the Tri-Parties to be needed to support completion of the RI/FS process leading to final RODs for the OUs addressed by this work plan; and (2) to provide RI/FS work plan- and SAP-level direction for implementing the activities in the field. This RI/FS work plan provides the strategy for completing the RI/FS process under the proposed Tri-Party Agreement changes.

The scope of the document is to define and implement the supplemental RI for Model Groups 2 through 7, which include waste sites from the following source OU/OU groups:

- 200-CW-1
- 200-CW-2, 200-CW-4, 200-CW-5, and 200-SC-1
- 200-LW-1 and 200-LW-2
- 200-MW-1
- 200-PW-1, 200-PW-3, and 200-PW-6
- 200-PW-2 and 200-PW-4
- 200-TW-1 and 200-PW-5
- 200-TW-2.

Several other Central Plateau source OUs are not included in the scope of this RI/FS work plan. These OUs are on separate RI/FS paths as follows.

- 200-SW-1 and 200-SW-2 – A DQO process is being conducted for this OU to support revision of an existing Draft A RI/FS work plan (DOE/RL-2004-60, *200-SW-1 Nonradioactive Landfills and Dumps Group Operable Unit and 200-SW-2 Radioactive Landfills and Dumps Group Operable Unit Remedial Investigation/Feasibility Study Work Plan*).
- 200-IS-1 – Similar to 200-SW-1/-2, a DQO is being conducted to support revision of the existing RI/FS work plan (DOE/RL-2002-14, *Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS/Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-IS-1 and 200-ST-1 Operable Units*).
- 200-BC-1 – This is a new OU that consists of the waste sites in the BC Cribs and Trenches Area. A treatability test and other activities are planned for this OU to support completion of the RI/FS process in this area.
- 200-CW-3 – These waste sites are currently included in the 100/200/300 Areas remaining sites ROD (EPA/ROD/R10-99/039, *Interim Action Record of Decision, 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-1, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington*) and associated remedial action work plans (RAWP). Planning to remediate four of these sites is currently underway. The other three 200-CW-3 waste sites will be remediated in the future. Because the 100/200/300 Areas remaining sites ROD is considered an interim ROD, the seven 200-CW-3 waste sites will be included in the 200-MG-2 ROD to obtain the final decision on these sites.
- 200-CS-1 – These sites have been evaluated in a Draft A FS (DOE/RL-2005-63, *Feasibility Study for the 200-CS-1 Chemical Sewer Group Operable Unit*), which is being revised.

In addition, the sites included in Model Group 1, the shallow, straightforward remediation sites, will be assigned to two new Central Plateau source OUs: 200-MG-1 and 200-MG-2. These two new OUs will include sites from most of the previously identified source OUs. Each of these new Model Group 1 OUs will be addressed under a separate FS and/or proposed plan and are not included in the scope of this RI/FS work plan.

1.2 ORGANIZATION OF WORK PLAN

This RI/FS work plan is developed in accordance with EPA guidance (EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final*, OSWER 9355.3-01) and with existing approved RI/FS work plans. This supplemental work plan is presented in two volumes (Volume I and Volume II).

Volume I contains the work plan and the supplemental appendices that capture the appropriate information common to all Central Plateau OUs and waste sites. A key element of Volume I is the overall SAP (Appendix A). This SAP includes a field-sampling plan that provides the sampling strategy for a range of sampling techniques that could be used to obtain the supplemental data. This SAP also provides a quality assurance project plan that will be used to ensure that the data collected meet the appropriate quality assurance and control requirements. The SAP will support all supplemental sampling activities. Volume I also includes appendices that:

- document refinement of applicable or relevant and appropriate requirements (ARAR) originally identified in DOE-RL-98-28 (see Appendix B)
- provide results of the DQO activities and summarize the data-collection activities identified by the Tri-Parties
- provide the basis for determining analytical detection levels based on ARARs.

Volume I is considered a primary document under the Tri-Party Agreement, requiring DOE, EPA, and Ecology approval.

Volume II of this RI/FS work plan is intended to include addenda that contain site-specific field-sampling plans (SSSP) for each waste site to be investigated. Addendum 1 in Volume II of Revision 0 of this work plan includes the near-term (approximately the next 2 years) field-investigation activities. Future addenda to Volume II will be developed to provide SSSPs for the remaining waste sites to be investigated under this work plan. Each SSSP will be developed for an individual waste site or group of waste sites under one lead agency. These SSSPs will contain the detailed sampling strategies, such as number and location of samples, analytes, and sampling and analytical methods. Each addendum will be considered a primary document under the Tri-Party Agreement and will require approval from the DOE and the lead regulatory agency for the OU associated with the waste site or group of waste sites to be investigated. As the remaining SSSPs are developed and approved to support completion of the supplemental RI activities, new addenda will be incorporated into Volume II.

Table 1-2 summarizes the individual waste sites where the Tri-Parties have identified the need for supplemental RI and includes the OU, the assigned model group number, the planned data-collection activities, and the location of the site-specific sampling details for each waste site.

The process associated with this RI/FS work plan is based on Figure 1-1. As supplemental RI information is gathered, the information is evaluated to determine if it provides sufficient understanding of the waste-site conceptual model to support decision making. For the majority of the waste sites and OUs, the supplemental activities identified in Table 1-2 and in Appendix C are considered sufficient to complete the RI/FS process to reach final RODs. Following supplemental data-collection activities, the Tri-Parties will review the data. If supplemental data are considered insufficient to reach a final ROD, then the Tri-Parties will determine the need for a follow-on DQO to support subsequent sampling.

Table 1-2. Supplemental Roll Up 2 through 7 – by Operable Unit. (5 Pages)

Waste Site	Operable Unit	Model #	Supplemental Data-Collection Activities						Crosswalk to Site-Specific Sampling Details
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-25	200-CW-1	5			2			No	Model Group 5 SAP
216-B-3	200-CW-1	5			6+			No	Model Group 5 SAP
216-S-16P	200-CW-2	5			21			No	Model Group 5 SAP
216-S-17	200-CW-2	5			15			No	Model Group 5 SAP
UPR-200-W-124	200-CW-2	5			3			No	Model Group 5 SAP
216-T-4B	200-CW-4	5			4			No	Model Group 5 SAP
216-U-10	200-CW-5	5		1 (140 ft)	8	3		No	Model Group 5 SAP
216-U-11	200-CW-5	5			14			No	Model Group 5 SAP
200-CW-1 Total (M-015-38B, 05/31/2009)			**0**	**1**	**73**	**3**	**0**	**0**	
216-A-30	200-SC-1	6	1					Yes	Volume II, Addendum 1
216-A-37-2	200-SC-1	6					299-E25-21, 299-E25-23, 299-E25-24	Yes	Volume II, Addendum 1
216-B-55	200-SC-1	6			6		299-E28-13	No	Volume II, Addendum 1
216-S-5	200-SC-1	6						Yes	Volume II, Addendum 1
216-S-6	200-SC-1	6		1				Yes	Volume II, Addendum 1
216-T-36	200-SC-1	6	1*	TBD				Complete	Volume II, Addendum 1
200-CW-5 Total (M-015-40D, 4/30/2008)			**2**	**2**	**6**	**0**	**4**	**8**	
216-T-27	200-LW-1	2					299-W14-53	Yes	TBD
216-T-28	200-LW-1	2						Yes	TBD
216-T-34	200-LW-1	6		1				Yes	TBD
216-T-35	200-LW-1	6					299-W11-18	Yes	TBD
216-A-15	200-LW-2	2					Vent riser, if possible	Complete	TBD
216-B-10A	200-LW-2	2			1			Yes (opportunistic)	TBD
216-B-6	200-LW-2	2	1*					Yes	TBD

Table 1-2. Supplemental Roll Up 2 through 7 – by Operable Unit. (5 Pages)

Waste Site	Operable Unit	Model #	Supplemental Data-Collection Activities						Crosswalk to Site-Specific Sampling Details
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-8	200-LW-2	6			2			No	TBD
216-Z-16	200-LW-2	6	1					Yes	TBD
216-Z-17	200-LW-2	6					299-W15-204 moisture log	No	TBD
216-Z-7	200-LW-2	4					Neutron in W15-62, -63, -64, -76, -77, and -78	Yes	TBD
200-LW-1/200-LW-2 Total (M-015-46B, 12/31/2011)			**2**	**1**	**3**	**0**	**9**	**9**	
200-E-102	200-MW-1	4			1			Complete	216-A-4/200-E-102 SAP
216-A-2	200-PW-3	4	1		1			Complete	216-A-2/216-A-21 SAP
216-A-21	200-MW-1	6			1			Complete	216-A-2/216-A-21 SAP
216-A-4	200-MW-1	4	1					Complete	200-MW-1 RI/FS Work Plan; 216-A-4/200-E-102 SAP
216-B-4	200-MW-1	2					Log reverse well if possible	Yes (opportunistic)	
200-MW-1 Total (M-015-44B, 12/31/2008)			**2**	**0**	**2**	**0**	**1**	**2**	
216-A-24	200-PW-3	6						Yes	TBD
216-A-31	200-PW-3	2						Complete	TBD
216-A-7	200-PW-3	6					299-E25-54	Yes	TBD
216-A-8	200-PW-3	6						Yes	TBD
200-PW-1 Total (M-015-45B, 9/30/2007)			**0**	**0**	**0**	**0**	**1**	**3**	
216-A-10	200-PW-2	2						Yes	TBD
216-A-19	200-PW-2	6						Yes	TBD
216-A-36A	200-PW-2	2						Complete	TBD
216-A-36B	200-PW-2	2						Yes	TBD

Table 1-2. Supplemental Roll Up 2 through 7 – by Operable Unit. (5 Pages)

Waste Site	Operable Unit	Model #	Supplemental Data-Collection Activities						Crosswalk to Site-Specific Sampling Details
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-5	200-PW-2	2	1		1			Complete	TBD
216-B-12	200-PW-2	2	1*					Yes	TBD
216-C-1	200-PW-2	6	1*					Yes	TBD
216-S-1&2	200-PW-2	4	1		2		W22-67	Yes	TBD
216-A-37-1	200-PW-4	6						Yes	TBD
216-A-45	200-PW-4	2					299-E17-12, -13, -53, and -54	Yes	TBD
200-PW-2/200-PW-4 Total (M-015-43D, 12/31/2010)			**4**	**0**	**3**	**0**	**5**	**9**	
216-B-11A&B	200-PW-5	6						Yes*	TBD
216-B-50	200-PW-5	2						Yes*	TBD
216-B-57	200-PW-5	2						Yes*	TBD
216-B-62	200-PW-5	6					299-E28-85, 299-E28-86, 299-E28-87, 299-E28-88, 299-E28-90; 299-E28-18 and 299-E28-21, if possible	No	TBD
216-S-13	200-PW-3	2	1				299-W22-21	Yes	TBD
216-S-21	200-PW-5	2			1		299-W23-63	No	TBD
216-S-9	200-PW-5	6					299-W22-25, 299-W22-26	Yes	TBD
216-B-42	200-TW-1	6	1					Yes*	TBD
216-B-43	200-TW-1	2	2*					Yes*	TBD
216-B-44	200-TW-1	2						Yes*	TBD
216-B-45	200-TW-1	2						Yes*	TBD

Table 1-2. Supplemental Roll Up 2 through 7 – by Operable Unit. (5 Pages)

Waste Site	Operable Unit	Model #	Supplemental Data-Collection Activities						Crosswalk to Site-Specific Sampling Details
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-B-46	200-TW-1	2						Yes*	TBD
216-B-47	200-TW-1	2						Yes*	TBD
216-B-48	200-TW-1	2						Yes*	TBD
216-B-49	200-TW-1	2						Yes*	TBD
216-BY-201	200-TW-1	7						Yes*	TBD
216-T-18	200-TW-1	4			4			Yes	TBD
216-T-19	200-PW-1	6	1					Yes	TBD
216-T-26	200-TW-1	2						Yes	TBD
UPR-200-E-9	200-TW-1	6						Yes* (Opportunistic)	TBD
200-TW-1/200-PW-5 Total (M-015-42D, 12/31/2011)			**5**	**0**	**5**	**0**	**11**	**18**	
200-E-45	200-TW-2	7						Yes*	TBD
200-W-52	200-TW-2	4						Complete	TBD
216-B-35	200-TW-2	6						Yes*	TBD
216-B-36	200-TW-2	6						Yes*	TBD
216-B-37	200-TW-2	6						Yes*	TBD
216-B-38	200-TW-2	6						Yes*	TBD
216-B-39	200-TW-2	6						Yes*	TBD
216-B-40	200-TW-2	6						Yes*	TBD
216-B-41	200-TW-2	6						Yes*	TBD
216-B-7A&B	200-TW-2	4			3		E33-18	Yes*	TBD
216-B-8	200-TW-2	6	2*		1			Yes*	TBD
216-T-14	200-TW-2	6						Complete	TBD
216-T-15	200-TW-2	6			4			Complete	TBD
216-T-16	200-TW-2	6						Complete	TBD

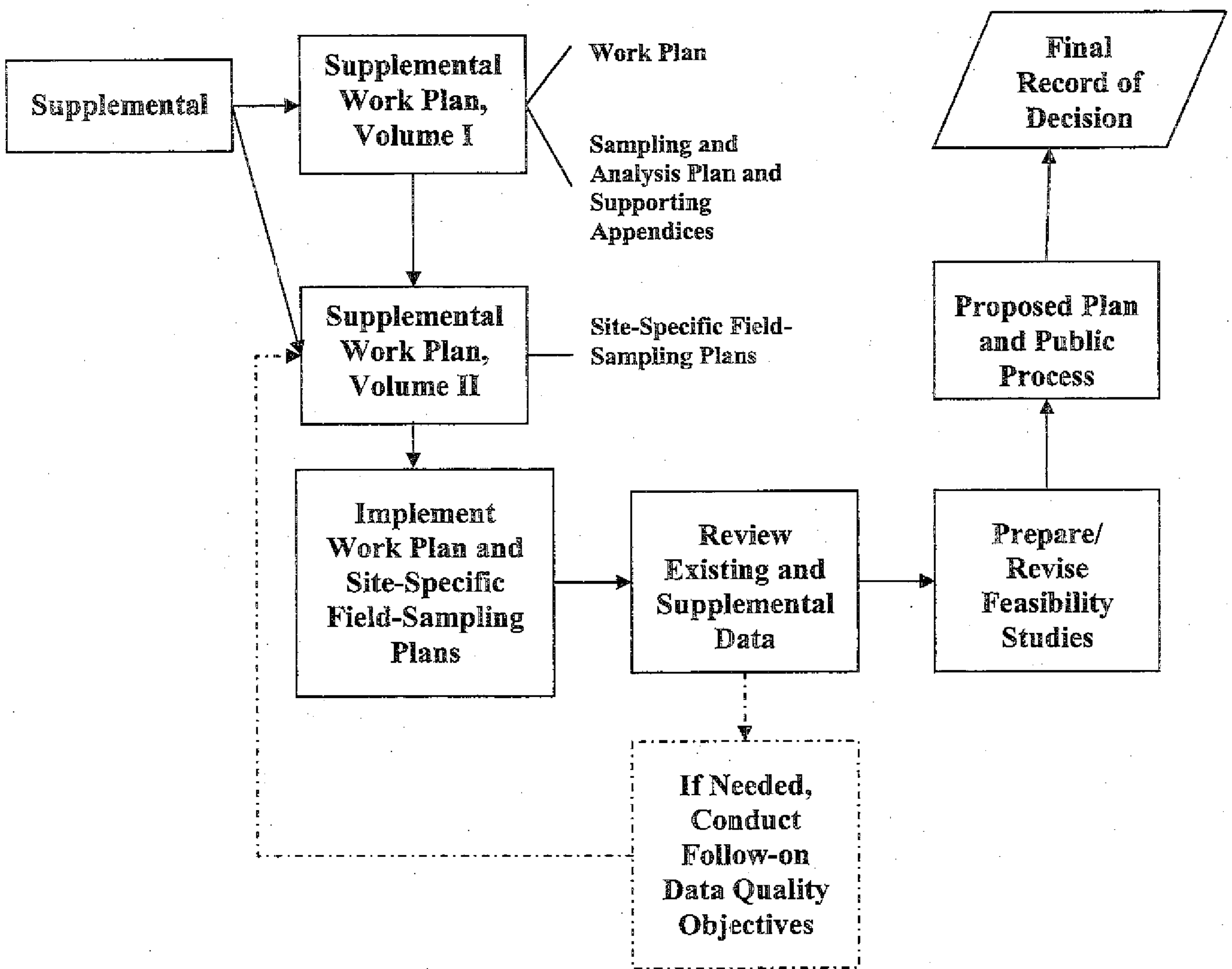
Table 1-2. Supplemental Roll Up 2 through 7 – by Operable Unit. (5 Pages)

Waste Site	Operable Unit	Model #	Supplemental Data-Collection Activities						Crosswalk to Site-Specific Sampling Details
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-17	200-TW-2	6						Complete	TBD
216-T-21	200-TW-2	6						Yes	TBD
216-T-22	200-TW-2	6						Yes	TBD
216-T-23	200-TW-2	6						Yes	TBD
216-T-24	200-TW-2	6						Yes	TBD
216-T-25	200-TW-2	6						Yes	TBD
216-T-3	200-TW-2	7	1					Yes (opportunistic)	TBD
216-T-32	200-TW-2	4			4			Complete	TBD
216-T-5	200-TW-2	4			4			Complete	TBD
216-T-6	200-TW-2	4			4			Yes	TBD
216-T-7	200-TW-2	4	1*	1	1			Complete	TBD
241-T-361	200-TW-2	4						Complete	TBD
200-TW-2 Total (M-015-42E, 12/31/2011)			**4**	**1**	**21**	**0**	**1**	**17**	
Supplemental Work Plan Total			**19**	**5**	**113**	**3**	**32**	**66**	

*** Denotes work activities or wells planned by Groundwater Project. For wells, data will be collected in the vadose zone to support evaluation of waste sites.**

HRR = high-resolution resistivity.
SAP = sampling and analysis plan.
TBD = to be determined.

1 Figure 1-1. Central Plateau Supplemental Investigation Process Flow.



NOTE: Solid lines indicate normal supplemental process leading to final decisions. Dashed lines indicate potential process for some waste sites and/or operable units.

2

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2.0 BACKGROUND AND SETTING

This chapter indicates where geologic setting and general vadose-zone conditions for the Central Plateau have been discussed in other Central Plateau remedial action documents. The Implementation Plan (DOE/RL-98-28) provides preliminary information on the background and setting for the source OUs in the Central Plateau. The subsequent approved RI/FS work plans (see Table 1-1) contain source OU-specific and representative waste-site information on topography, geology, hydrogeology, the vadose zone, groundwater, process history, discharge history, and environmental setting. In addition, other supporting documents present information on the environmental setting and on the ongoing ecological risk assessment efforts for the Central Plateau (see Chapter 7.0, References).

Chapter 2.0 in each of the previously approved RI/FS work plans provides information such as the background and setting for the Central Plateau operations, the processes that discharged waste to the Central Plateau waste sites, geologic and hydrogeologic setting, and groundwater information.

2.1 CONCEPTUAL MODEL GROUPS

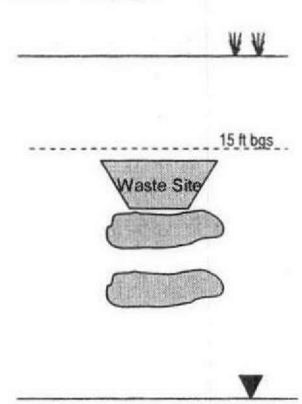
As indicated in Chapter 1.0, the Tri-Parties undertook an activity in fiscal years 2005 and 2006 to evaluate data needs and to reach agreement on a path forward for supplemental data collection that would augment the data already collected. The initial step in this activity was to bin waste sites, based on an updated understanding gained from the RIs performed under the approved RI/FS work plans, irrespective of their assigned source OUs. The Tri-Parties identified seven bins (i.e., model groups); each bin contained waste sites with similar features regarding contaminant distribution and potential risk pathways. Model Groups 2 through 7 are addressed in this work plan; Model Group 1 is not included, as discussed in Chapter 1.0.

2.2 DESCRIPTIONS OF MODEL GROUPS

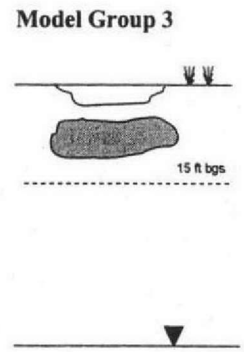
Table 1-2 provides a listing of the waste sites and their associated model groups. Table C-2 in Appendix C provides additional details on the existing information and planned data-collection activities at the individual waste sites. Model Groups 2 through 7 are described in detail as follows (areas of anticipated contamination are highlighted in yellow).

- **Model Group 2, Deep Sites (e.g., 216-B-43 through 216-B-50 Cribs, also known as the BY Cribs):** Sites are characterized by deeper contamination (generally below 4.6 m (15 ft) below ground surface [bgs]), as depicted on the right. These sites do not pose risk to human or ecological receptors for the 0 to 4.6 m (15-ft) zone; however, deeper contaminants likely are present and may pose risk to groundwater and potential future intruders.

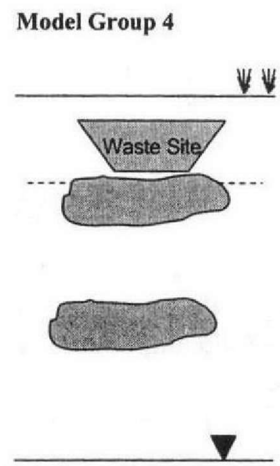
Model Group 2



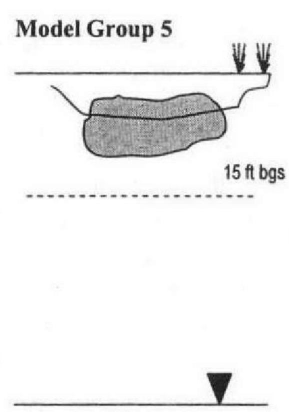
- **Model Group 3, Large-Area Plutonium Sites (i.e., Z Ditches):** This group consists of the Z Ditches and associated sites. These sites are characterized as large sites with shallow transuranic contamination (generally less than 4.6 m [15 ft] bgs), as depicted on the right.



- **Model Group 4, Small and Medium Plutonium Sites (e.g., 216-Z-9 Trench, 216-Z-1A Tile Field):** Sites are characterized by transuranic contamination, which tends to be present deeper than in Model Group 3 but much smaller in extent, as depicted on the right. These sites may pose risks to human and/or ecological receptors, risk to groundwater, and risk to potential intruders. A subset of these sites is associated with organic (e.g., carbon tetrachloride) contamination.

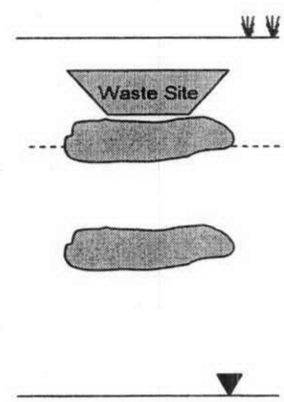


- **Model Group 5, Large Ponds (e.g., 216-A-25 Gable Mountain Pond, 216-U-10 U Pond):** This group consists of the large cooling-water ponds that generally are located around the outer perimeter of the 200 Areas. These ponds tend to have shallow, low-concentration contamination, generally associated with the deeper areas of the pond bottoms, as depicted on the right. A supplemental sampling strategy was identified for these sites, as documented in a standalone SAP (DOE/RL-2006-57, *Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at Model Group 5, Large Area Ponds, Waste Sites*). The SAP is included by reference into this RI/FS work plan.



- **Model Group 6, Shallow and Deep Sites (e.g., 216-T-14 through 216-T-17 Trenches):** Sites are characterized by both deep and shallow contamination. Site contaminants may pose risk to human and ecological receptors, potential future intruders, and the groundwater, as depicted on the right.

Model Group 6



- **Model Group 7, Unique Conceptual Model Sites (e.g., 216-B-5 Reverse Well, 200-E-45 Health Instrument Shaft):** This group consists of miscellaneous sites that have unique conceptual models because of unique construction, waste discharge, or other characteristics. This model group only contains five waste sites, which the Tri-Parties believed were unique enough that they did not fit with any of the other model groups. The waste sites in this model group include three reverse wells, a settling tank, and a health instrument shaft. The settling tank and instrument shaft are associated with waste sites from other model groups. The reverse wells discharged effluent deeper in the vadose zone than other sites, such as cribs or trenches.

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3.0 SUPPLEMENTAL UPDATE TO INITIAL EVALUATION

Under CERCLA, an initial evaluation identifies the waste generating processes, discharge information (such as volumes and inventories), the understanding of the nature and extent of contamination, potential regulatory drivers, potential remedial alternatives, and risk pathways that lead to conceptual site models of the contamination problem being addressed. Initial evaluations are provided for OUs and for associated representative sites in the approved work plans (Table 1-1). For purposes of this work plan, the initial evaluation builds from the approved work plans and provides updates, as necessary, to elements that impact the evaluation of the need for supplemental RIs. The evaluation takes into account the potential ARARs, remedial action objectives (RAO), and potentially viable remedial alternatives. This chapter provides an up-to-date preliminary risk assessment summary for the model groups under supplemental characterization.

3.1 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Potential ARARs are developed during the RI/FS process to ensure that the substantive portions of pertinent environmental regulations are included in the remedial evaluation process. The Implementation Plan (DOE/RL-98-28) provided a starting position for development of potential ARARs for Central Plateau source OUs. Since the Implementation Plan was issued, the current draft FSs have revised those sets of ARARs to reflect the remedial alternatives that may be selected and the conditions that may be encountered when a particular remedial alternative is implemented. The potential ARARs form the basis for determining cleanup levels to which contaminants must be remediated to protect human health and the environment.

For the purposes of this work plan, ARARs have been developed to help in establishing analytical detection limits that are needed to ensure that appropriate cleanup levels can be achieved. These ARARs are a compilation of the pertinent ARARs that have been developed for the individual Central Plateau source OU FSs and are located in Appendix B.

3.2 REMEDIAL ACTION OBJECTIVES

The RAOs are general descriptions of what the remedial action is expected to accomplish (i.e., medium-specific or site-specific goals for protecting human health and the environment). The RAOs are narrative statements, defined as specifically as possible, and usually address the following variables:

- Media of interest (e.g., contaminated soil, solid waste)
- Types of contaminants (e.g., radionuclides, inorganic, organic chemicals)
- Potential receptors (e.g., humans, animals, plants)
- Possible exposure pathways (e.g., external radiation, ingestion).

A preliminary set of RAOs has been developed for use in the Central Plateau OU-related activities, because waste sites located in the Central Plateau generally have similar future land uses, chemical and radiological contamination, exposure pathways and receptors, and media of concern. Each source OU FS will develop a specific set of RAOs that will be tailored for protection of human health and the environment from the nature and extent of contamination from the waste sites. The RAOs to be used for Central Plateau source OUs that are particularly pertinent to establishing appropriate cleanup levels (and the associated analytical detection levels) are as follows (other RAOs have been identified, but do not lead to development of numerical detection limits).

- RAO 1 – Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with nonradiological constituents at concentrations above the industrial-use criteria, as defined in WAC 173-340-745(5), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels," for human health, or the screening criteria in WAC 173-340-7493, "Site-Specific Terrestrial Ecological Evaluation Procedures," for ecological receptors.

- RAO 2 – Prevent unacceptable risk to human health and ecological receptors from exposure to soils and/or debris contaminated with radiological constituents by

  - Preventing exposure to radiological constituents at concentrations that will cause a dose-rate limit of 15 mrem/yr above background for industrial workers (EPA/540/R-99/006, *Radiation Risk Assessment At CERCLA Sites: Q & A*, Directive 9200.4-31P). A dose-rate limit of 15 mrem/yr above background generally achieves the EPA excess lifetime cancer-risk threshold, which ranges from 1×10^{-6} to 1×10^{-4}.

  - Protecting ecological receptors, based on a dose-rate limit of 0.1 rad/day for terrestrial wildlife populations (DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*), which is a "to-be-considered" criterion.

- RAO 3[2] – Prevent migration of hazardous chemical contaminants through the soil column to groundwater or reduce soil concentrations below WAC 173-340-747, "Deriving Soil Concentrations for Ground Water Protection," groundwater protection criteria so that no further degradation of the groundwater results from contaminant leaching from the soil.

- RAO 4[2] – Prevent migration of radioactive contaminants through the soil column to groundwater protection criteria in 40 CFR 141.62, "National Primary Drinking Water Regulations," "Maximum Contaminant Levels for Inorganic Constituents," so that no further degradation of the groundwater results from contaminant leaching from the soil.

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[2] NOTE: It generally is stated that "Protection of the Columbia River from contaminants is achieved through this remedial action objective. There is no surface water in the immediate vicinity of the waste sites that requires a separate objective." This will require validation as part of each individual evaluation.

Action levels in this work plan are identified for purposes of establishing analytical detection limits. The supplemental SAP (Appendix A) includes overall analytical performance tables that provide laboratory detection limits, analytical methods, and quality parameters for the composite list of Central Plateau constituents. The SSSPs identify the waste-site-specific constituents to be analyzed in accordance with these tables.

3.3 PRELIMINARY LIST OF ALTERNATIVES

Preliminary lists of technologies and alternatives were developed and screened in the Implementation Plan (DOE/RL-98-28). Subsequently, these lists were reviewed and refined in the current versions of the FS documents (see Table 1-1). Based on the technology identification and screening, the remedial technologies and process options that were used for development of remedial alternatives are summarized in Table 3-1. Likely remedial action alternatives are listed in Table 3-2. Sections 3.3.1 through 3.3.7 provide summary descriptions of the likely remedial alternatives that will be used for the remediation of the Central Plateau source OUs.

Table 3-1. Process Options and Remedial Technologies. (2 Pages)

General Response Action	Technology Type	Process Option
No Action	No Action	Not Applicable
Institutional Controls	Land-Use Restrictions	Deed Restrictions
	Access Controls	Signs/Fences
		Entry Control
	Monitoring	Ground Water
		Air
	Surface Barriers	Existing Soil Cover
Containment, Including Evapotranspiration Barriers	Surface Barriers	Evapotranspiration Barriers
		Asphalt, Concrete, Cement-Type Cap
		Standard RCRA Caps
	Vertical Barriers	Slurry Walls
		Grout Curtains
		Cryogenic Walls
	Soil Stabilization	Membranes/Sealants/Wind Breaks/Wetting Agents
Removal	Excavation	Conventional
Disposal	Landfill Disposal	Onsite Landfill
		Offsite Landfill/Repository

Table 3-1. Process Options and Remedial Technologies. (2 Pages)

General Response Action	Technology Type	Process Option
Ex Situ Treatment	Thermal Treatment	Calcination
		Thermal Desorption
		Incineration
		Pyrolysis
		Steam Reforming
		Vitrification
	Physical/Chemical Treatment	Chemical Leaching
		Dehalonization
		Vapor Extraction
		Soil Washing
		Mechanical Separation
		Solvent Extraction
		Chemical Reduction/Oxidation
		Solidification/Stabilization
	Biological Treatment	Composting
		Biological Treatment
		Landfarming
		Slurry Phase Biotreatment
In Situ Treatment	Thermal Treatment	Vitrification
		Thermally Enhanced Vapor Extraction
	Chemical/Physical Treatment	Soil Flushing
		Vapor Extraction
		Grout Injection (pipelines and tanks)
		(Deep) Soil Mixing
		Dynamic Compaction (component of engineered barrier)
	Biological Treatment	Biodegradation
		Bioventing
		Natural Attenuation

RCRA = *Resource Conservation and Recovery Act of 1976.*

Table 3-2. Summary of Alternatives and Associated Components.

Technology Type	Process Option	Alternative						
		1	2	3	4	5	6	7
No Action	None	X						
Land-Use Restrictions	Deed Restrictions		X		X	X	X	X
Access Controls	Signs/Fences		X		X	X	X	X
	Entry Control		X		X	X	X	X
Monitoring	Groundwater		X		X	X	X	X
	Air		X		X	X	X	X
Surface Barriers	Existing Soil Cover		X		X			
	Evapotranspiration Barrier				X		X	
Excavation	Conventional			X	X	X		
Landfill Disposal	Onsite Landfill			X	X	X		
	Offsite Landfill/Repository			X	X	X		
In Situ Thermal Treatment	Vitrification							X
In Situ Chemical/Physical Treatment	Vapor Extraction							X
	Grout Injection (pipelines and tanks)							X
	(Deep) Soil Mixing							X
	Dynamic Compaction						X	X
Biological Treatment	Natural Attenuation		X		X	X	X	X

Alternative 1 – No Action.
Alternative 2 – Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.
Alternative 3 – Removal, Treatment, and Disposal.
Alternative 4 – Partial Removal, Treatment, and Disposal with Engineered Surface Barrier.
Alternative 5 – Partial Removal, Treatment, and Disposal coupled with Institutional Controls and Monitored Natural Attenuation.
Alternative 6 – Engineered Surface Barrier.
Alternative 7 – In Situ Treatment.

3.3.1 Alternative 1 – No Action

The NCP, in 40 CFR 300.430(e)(6), "Remedial Investigation/Feasibility Study and Selection of Remedy," "Feasibility Study," requires that a no-action alternative be evaluated as a baseline for comparison with other remedial alternatives. The no-action alternative represents a situation where no legal restrictions, access controls, or active remedial measures are applied to the site. No action implies "walking away from the waste site" and allowing the wastes to remain in their current configuration, affected only by natural processes. No maintenance or other activities would be instituted or continued. Selecting the no-action alternative would require that a waste site pose no unacceptable threat to human health or the environment.

The waste sites addressed in this work plan are expected to require remediation and are not anticipated to be remediated by the no-action alternative. However, should a site be identified for remediation by a no-action alternative, a post-ROD DQO will be used to evaluate verification data needs. Therefore, the supplemental DQO did not focus on identifying data needs for no-action sites.

3.3.2 Alternative 2 – Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls

The waste sites addressed in this work plan are expected to have significant contamination and are not expected to be remediated by this MESC/MNA/IC alternative as a standalone alternative (elements of this alternative may be used in combination with other alternatives, however).

However, if this alternative is determined to be viable for a waste site after supplemental characterization data have been evaluated, then under this alternative, existing soil covers (clean backfill over subsurface structures or a surface-stabilization layer of clean soil, or both) would be maintained and/or augmented as needed to provide protection from intrusion by biological receptors, along with legal barriers (such as deed restrictions and excavation permits) and physical barriers (such as fencing) that would mitigate contaminant exposure. Radioactive contaminants remaining beneath the clean soil cover would be allowed to decay in place (i.e., attenuate naturally), thereby reducing risk until remediation goals are met.

The supplemental DQO process focused on data needs to define the nature of the contamination in both the near surface and deeper vadose zone soils to support risk analysis and modeling activities, the vertical and lateral extent of contamination to support the evaluation of protection of groundwater, and the availability of strongly related existing or proposed supplemental analogous data to support decision making.

3.3.3 Alternative 3 – Removal, Treatment, and Disposal

The sites addressed in this work plan could have contamination extending beyond the viable excavation depth for an RTD alternative; however, supplemental data may be needed to support evaluation of this alternative. Sites will be evaluated for a range of remedial alternatives, including RTD and/or partial RTD alternatives, as appropriate to site conditions. Under this alternative, structures and soil with contaminant concentrations above the future remediation goals would be removed, treated as appropriate, and disposed of at an approved disposal facility.

The remediation of sites under this RTD alternative would use the observational approach. The observational approach is a method of planning, designing, and implementing a remedial action that relies on information (e.g., samples) collected during remediation to guide the direction and scope of the remediation. Data collected are used to assess the extent of contamination and to make "real time" decisions in the field. Targeted (or hot-spot) removals could be considered under this alternative if contamination is localized in only a portion of a waste site.

The supplemental DQO process focused on evaluating existing data to identify gaps in the nature, lateral extent, and vertical extent that are needed to define contaminated volumes and support modeling of protection of groundwater for this alternative. The observational approach would be used to fill further data needs as the actual excavation progresses.

3.3.4 Alternative 4 – Partial Removal, Treatment, and Disposal with Engineered Surface Barrier

Under this alternative, readily accessible contamination would be removed, treated as appropriate, and disposed of at an approved facility. An engineered surface barrier would address protection of groundwater from the remaining contaminants in the vadose zone. Institutional controls would be included in this alternative. The supplemental DQO process focused on the nature and extent of near-surface contamination to support the partial removal of contaminants and the nature and extent of deeper contaminants to support the evaluation and size of the barrier.

3.3.5 Alternative 5 – Partial Removal, Treatment, and Disposal Coupled with Institutional Controls and Monitored Natural Attenuation

This alternative uses the partial RTD activities, as discussed in the previous section. However, remaining contamination is addressed through institutional controls and monitored natural attenuation rather than an engineered surface barrier. The institutional controls and monitored natural attenuation are as described in Alternative 2. The supplemental DQO process focused on the nature and extent of near-surface contamination to support the evaluation of the removal element and on the nature and extent of deeper contamination to evaluate the institutional controls/monitored natural attenuation element of this alternative.

3.3.6 Alternative 6 – Engineered Surface Barrier

The engineered surface barrier alternative consists of constructing surface barriers over contaminated waste sites to control the amount of water infiltrating into contaminated media to reduce or eliminate leaching of contamination to groundwater. In addition to hydrological performance, barriers also can function as physical barriers to prevent intrusion by human and ecological receptors, limit wind and water erosion, and attenuate radiation. Additional elements to the barrier alternative include institutional controls, discussed earlier, monitored natural attenuation, and surveillance and maintenance. The supplemental DQO process focused on the nature and extent of contamination in both the near-surface and deeper vadose zones to support FS alternative evaluation by providing information on FS-level barrier size and design estimates and to support modeling and risk assessment.

3.3.7 Alternative 7 – In Situ Treatment

As identified in Table 3-2, several in situ treatment options are applicable, depending on site conditions. As such, this alternative is not developed to the same extent as the other alternatives. In general, the in situ treatment will immobilize or remove contaminants within the vadose zone. Thus, the alternative would reduce or eliminate the potential of exposure or contaminant migration. Depending on the in situ treatment selected, and the waste-site conditions, it is likely that institutional controls would be required. The supplemental DQO process focused on the near-surface nature and extent of contamination to support FS alternative evaluation because most potentially effective in situ treatment alternatives are depth limited. Additionally, several other activities are identified in the Tri-Party Agreement change package (Ecology et. al. 2006) that will deal with deep vadose treatment.

4.0 WORK PLAN APPROACH AND RATIONALE

The work plan approach and rationale for the initial characterization activities are described in the RI/FS work plans for the individual OUs (see Table 1-1 for a document summary). The approach and rationale for this supplemental work plan builds off of the existing approved work plans, incorporating the desire for supplemental RIs for several of these waste sites. This chapter discusses the supplemental DQO and the overall SAP.

4.1 SUPPLEMENTAL DATA QUALITY OBJECTIVES

As previously stated, the Tri-Parties have reevaluated the RI data needs to support remedial decisions in the Central Plateau. Based on a DQO process that evaluated existing waste-site information and identified supplemental data-collection activities for the Model Groups 2 through 7 waste sites, the Tri-Parties have agreed that supplemental RIs should be completed before some cleanup decisions are made. The reasons for the supplemental investigations focused on the following data needs:

- The need to address data gaps, where the relationship between an analogous site and its assigned representative waste site could be strengthened
- The desire to accelerate confirmatory sampling, where obtaining data earlier would reduce uncertainty and better support final decision making
- The need to obtain additional information on the extent of contamination, where data could lead to a different remedy
- The need to obtain additional data to further characterize the deep vadose zone, where recent knowledge and thinking (e.g., groundwater, tank farm, vadose-zone integration, 200-UW-1 OU lessons learned) result in the need for more information.

Conducting a supplemental RI before remedial decision making provides a better understanding of the potential impacts from waste sites to the environment and/or groundwater. This approach is intended to provide greater confidence that remedial decisions are protective of human health and the environment and to reduce uncertainties in the decision-making process.

Following the grouping of the individual Central Plateau waste sites into conceptual model groups, the Tri-Parties initiated focused workshops for Model Groups 2 through 7. The purpose of these workshops was to evaluate the current waste-site knowledge, identify potential data needs, and determine an appropriate sampling strategy for each individual waste site, if needed. These focused workshops were developed in accordance with the EPA's DQO process (EPA/240/B-06/001, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4).

These focused workshops resulted in the identification and concurrence of waste-site-specific supplemental data-collection activities as documented in Appendix C. Appendix C includes two tables: one documenting DQO agreements on the need for supplemental data and one documenting the site-specific data needs and rationale.

During the supplemental investigation DQO process, the Tri-Parties recognized that for certain waste sites, either existing investigation activities still were under way and/or all of the RI results were not yet available for review and analysis. For these waste sites, the Tri-Parties agreed that once the supplemental data are gathered and evaluated, the Tri-Parties will meet to determine if a follow-on DQO is needed. If it is, separate DQO processes will be conducted to determine what type of supplemental characterization would be needed. These potential additional DQOs have been identified and will be included in the project schedule.

4.2 SUPPLEMENTAL SAMPLING AND ANALYSIS PLAN

Using the results of the supplemental DQO process and building from the existing RI/FS work plans and associated SAPs (see Table 1-1), a supplemental SAP was developed and is presented in Appendix A. This SAP provides the general elements for satisfying data needs, including types of investigative techniques that may be used. The site-specific details are, or will be, provided in the SSSP Addenda to this Work Plan. This supplemental SAP supports supplemental RI activities that the Tri-Parties have determined are necessary to make or augment remedial decisions for waste sites on the Central Plateau. This SAP contains the details for implementing supplemental data-collection activities in the field. Data collected under this SAP will be used to support completion of the RI/FS process for these waste sites. In addition, supplemental RI data may support analyses for other projects, such as Groundwater and Tank Farms. Conversely, this SAP includes supplemental data that will be obtained from planned groundwater well-drilling activities. Supplemental RI activities are detailed in the SSSP Addenda (Volume II) for waste sites in source OUs that have near-term Tri-Party Agreement milestones to submit FSs. Subsequent addenda for supplemental RIs can be added at any time and will require RL and lead-agency approval before implementation. The document review-and-comment process will follow the requirements set forth in Section 9.2 of the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al. 1989b).

The supplemental SAP contains three main components:

- The quality assurance project plan, which establishes quality requirements for the supplemental investigation activities

- The field-sampling plan, which describes data-collection activities that may be used to obtain supplemental data in support of the RI/FS process

- Volume II addenda, which detail the SSSP for each waste site requiring supplemental data. Sites identified for near-term supplemental RI activities are included in Revision 0 of Volume II of this RI/FS work plan. SSSPs for the remaining sites will be added to Volume II, in accordance with this chapter of the RI/FS work plan.

To accelerate field implementation of some of the supplemental RI activities, separate SAPs were prepared ahead of this overall SAP for the following field characterization activities:

Model Group 5 waste sites (DOE/RL-2006-57) (see Section 2.1); waste sites 216-A-4 Crib and 200-E-102 Trench (DOE/RL-2006-47, *Sampling and Analysis Plan for Additional Remedial Investigation Activities at the 216-A-4 Crib and the 200-E-102 Trench*); and waste sites 216-A-2 Crib and 216-A-21 Crib (DOE/RL-2006-77, in process, *Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at the 216-A-2 and 216-A-21 Cribs*). The waste sites covered in these separate SAPs were included in the supplemental DQO process. These separate SAPs are enforceable under the supplemental work plan.

4.3 POST-ROD SAMPLING

The RI sampling is one element of the overall remediation-sampling strategy. As remedy selection decisions are made, additional sampling and analyses activities will be required as follows.

- The no-action preferred remedy will require waste-site-specific verification sampling to ensure that remedial action goals are met.
- The RTD preferred remedy will require waste-site-specific observational and verification sampling to ensure that cleanup levels are met.
- Various preferred remedies (e.g., engineered surface barriers, in situ treatment) may require waste-site-specific design sampling.
- Various preferred remedies (e.g., in situ treatment, engineered barriers) will require operations and maintenance sampling.
- Confirmatory sampling may be required at analogous sites, where the remedial decision has been made using data from the representative site, to confirm that the representative conceptual model is appropriate to the analogous site.

While some of the supplemental RI activities represent acceleration of post-ROD confirmatory sampling, additional confirmatory sampling may be necessary at sites not initially identified for supplemental data collection.

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5.0 REMEDIAL INVESTIGATION PROCESS

The purpose of this chapter is to describe the role of the supplemental RI in the overall Central Plateau source OU RI/FS process (Figure 5-1). Additionally, this chapter describes the completion of the RI/FS process though integration of the existing information and RI data with the supplemental RI data, leading to final RODs for these Central Plateau source OUs. Figure 5-1 shows the RI/FS process for the Central Plateau source OUs, both the historical activities leading to the determination that supplemental RIs were needed, and the path forward for completing the RI/FS and decision process that incorporates the supplemental data. Chapter 1.0 discusses the Central Plateau source OU RI/FS process to date, beginning with the Implementation Plan (DOE/RL-98-28) and proceeding through RI field work and reporting and current versions of FSs. As described previously (Chapter 1.0), after a review of existing information, the Tri-Parties determined that additional data were needed to reduce uncertainty in decision making.

The supplemental DQO (Chapter 4.0) was performed using the conceptual model groups to identify data needs. However, the remainder of the RI/FS process and the decision making for the waste sites will occur as part of their assigned source OUs, as defined in Ecology et al. 2006. This means that the FSs will be prepared on an OU basis in accordance with their associated milestones.

5.1 SUPPLEMENTAL REMEDIAL INVESTIGATION

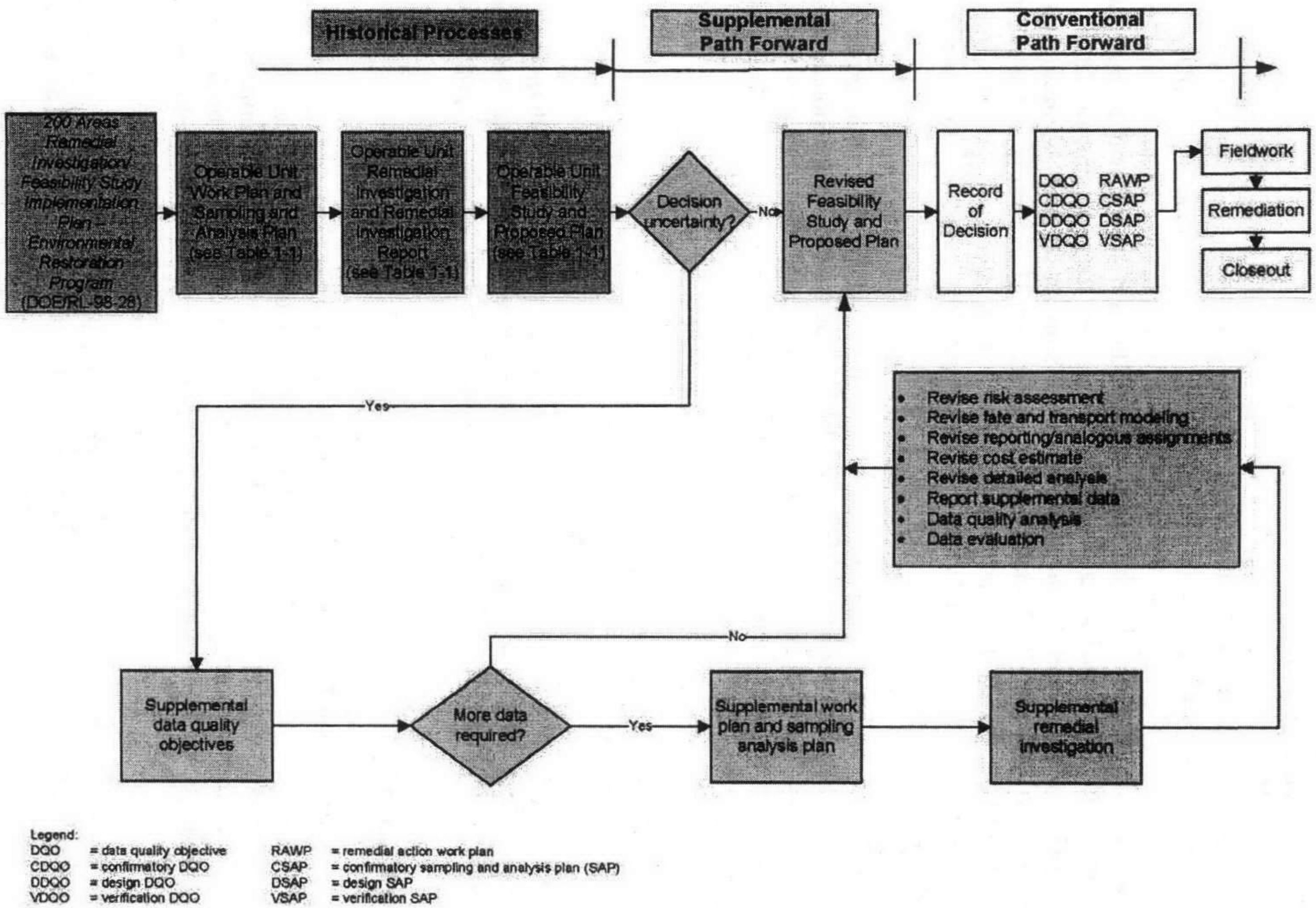
The planned supplemental RI activities that will be conducted in accordance with the SAP (Appendix A) and SSSPs (Volume II) are discussed in the following subsections. The associated supplemental RIs will include field planning, field investigation, and sample analysis/validation.

5.1.1 Field Planning

Field planning includes compiling, refining, and/or preparing the necessary documentation to accomplish field activities. These activities include excavation permits, waste designation DQOs summary reports, waste control plans, site-specific health and safety plans, preliminary hazard classifications, and other supporting documents. Some of these documents will be newly generated for each waste site or group of waste sites, while others will be updated from existing documents.

Waste designation DQOs have been completed to support the initial RI activities. As needed, based on differing constituents, the existing waste designation DQOs will be used as is or revised appropriately to support the supplemental RI activities.

Figure 5-1. Supplemental Remedial Investigation/Feasibility Study Process.



Waste generated during the RI will be managed in accordance with existing, revised, or new waste control plans. Waste control plans have been prepared for each of the OUs with approved work plans. Depending on the supplemental RI activities to be performed, the existing waste control plans will be used as is or revised appropriately. If no existing waste control plan is available, new plans will be prepared.

Worker safety is discussed briefly in the supplemental SAP (Appendix A) and will be addressed further in site-specific health and safety plans that will be prepared for all field activities.

5.1.2 Field Investigations

The field investigation task involves data-gathering activities performed in the field that are required to satisfy identified site-specific supplemental data needs from the DQO. The supplemental RI approach is summarized in Chapter 4.0, with additional details provided in the supplemental SAP and the SSSPs. The near-term scope, as identified in Volume II, Addenda 1 and the separate SAPs for 216-A-4, 200-E-102, 216-A-2, 216-A-21, and Model Group 5, includes shallow and deep boreholes, drive points, test pits, geophysical logging, and surface geophysical methods (e.g., high-resolution resistivity). (The overall scope, including longer term scope, is identified in Appendix C. Details will be added as additional addenda to Volume II.) Additional data-collection methods may be used depending on site conditions, data needs, and availability of technologies. The overall SAP is written to encompass other potential investigative techniques.

As the field investigations are completed, field reports will be prepared for each waste site or group of waste sites to summarize the activities performed and the information collected in the field. The report will include survey data for borehole locations, the number and types of samples collected, inventory of investigation-derived waste containers, geological logs, field-screening results, and geophysical-logging results.

5.1.3 Sampling Analysis/Validation

Samples collected from the supplemental RI activities will be analyzed for the site-specific analytes of interest and for select physical properties, based on the detailed sampling strategies in the SSSPs. Additional sampling, analysis, and validation details are presented in the overall SAP and SSSPs.

5.2 FEASIBILITY-STUDY PROCESS

The FS process identified in this section includes activities to support the preparation or revision of FSs for the Central Plateau source OUs. These activities include supplemental data reporting and overall data evaluation and preparation of FSs. The Tri-Parties agreed that the supplemental data will be included in the OU FSs as opposed to revising the RI reports to capture revisions in evaluation of nature and extent of contamination, risk assessment, and modeling.

5.2.1 Data Reporting and Evaluation

This section summarizes data reporting and data evaluation leading to the production of the FS.

5.2.1.1 Data Quality Assessment

A data quality assessment of the supplemental RI data will be performed in accordance with EPA/240/B-06/002, *Data Quality Assessment: A Reviewers Guide*, EPA QA/G-9R, to determine if the data are the right type, quality, and quantity to support the intended use. The supplemental data quality assessment completes the data life cycle of planning, implementation, and assessment that began with the identification of data needs. For this task, the data will be examined to determine if they meet the analytical quality criteria outlined in the SAP/SSSP and to determine if the data are adequate to support decision making for the source OUs.

5.2.1.2 Data Evaluation

Data evaluation includes integrating supplemental and existing data, compiling data to support risk assessment and modeling activities, and assessing data to evaluate the nature and extent of contamination and further refine the conceptual model.

Risk assessments and modeling have been conducted throughout the RI/FS process and will be updated and refined as necessary to incorporate the supplemental data.

5.2.2 Feasibility Studies

For several source OU groups, Draft A FSs have been submitted to the regulatory agencies, as identified in Table 1-1. Because the Tri-Parties have determined the need for supplemental data, these FSs will be reevaluated based on the results of supplemental data and in accordance with the Tri-Party Agreement milestones to provide information to support final decisions on the OUs.

The FS tasks include assessment of analogous site assignments; refinement of potential ARARs, RAOs, and preliminary remediation goals; refinement of technology screening; refinement of alternative screening; and detailed and comparative analysis of alternatives. The FSs will be prepared using the existing OU groupings as defined in Ecology et al. 2006.

The assessment of analogous sites originally was conducted in the existing FSs. Supplemental data will be incorporated into this assessment, and analogous site assignments will be refined accordingly. In several cases, sites may be reassigned to analogous sites where supplemental data collection is planned, because these analogous sites with supplemental data represent a better analysis fit than the original representative waste sites.

Potential ARARs, RAOs, and preliminary remediation goals have been defined through the Implementation Plan (DOE/RL-98-28) and refined in the existing OU FSs. Potential ARARs and RAOs are included in Chapter 3.0 and Appendix B to support the selection of appropriate analytical detection levels. In the FSs, potential ARARs, RAOs, and preliminary remediation goals will be refined to support alternative evaluation and the remedial decision-making process.

Technologies were preliminarily identified and screened in the Implementation Plan. Similarly, alternatives were preliminarily developed and screened in the Implementation Plan refinement through the FS process, which has resulted in screening of a broader list of technologies and a broader range of remedial alternatives in some of the existing FSs. A summary of the broader technology and remedial alternative lists is included in Chapter 3.0. Going forward, the FSs will include further refinement of the technology screening and alternative development tasks, based on the results of the integration of the existing and supplemental data.

Remedial alternatives will be reevaluated against the nine CERCLA criteria (40 CFR 300.430(e)(9)(iii), "Remedial Investigation/Feasibility Study and Selection of Remedy," "Feasibility Study"), based on the results of integration of the existing RI and other information and the supplemental RI information, including refinement of volume and cost estimates. The results of this reevaluation will be documented in the revised and/or new FS documents in accordance with the Tri-Party Agreement milestones established in the Tri-Party Agreement change package; the results also will be summarized in the associated Central Plateau source OU proposed plans.

5.3 TREATABILITY STUDIES

No treatability studies currently are planned as part of this supplemental RI work plan. However, treatability studies have been identified through Ecology et al. 2006 to investigate deep vadose-zone remedial technologies and waste-site excavation techniques. Information from these treatability studies may be used to support the detailed analysis of remedial alternatives in the FS as appropriate to the OU conditions (see Table 6-1 for milestones that have been identified for treatability studies). The treatability tests will provide information on effectiveness, implementability, and cost for groundwater protection techniques and on excavation risks and costs.

5.4 REMEDY SELECTION, RECORD OF DECISION, AND POST-RECORD OF DECISION ACTIVITIES

This section identifies the remedy selection, ROD, and post-ROD activities.

5.4.1 Remedy Selection and Record of Decision

Once the FS process for remedial alternative evaluation for a Central Plateau OU has been completed, a proposed plan will be developed that contains a summary of the key elements of the FS and presents the recommended selected final remedies for the OU. This proposed plan will undergo a public review and comment process (40 CFR 300.430(f)(3), "Remedial Investigation/Feasibility Study and Selection of Remedy," "Selection of Remedy"). After the public-comment period has been completed, a ROD will prepared (40 CFR 300.430(f)(5)) that documents the final remedial action decisions for the OU and the responses to the public comments.

5.4.2 Post-Record of Decision Activities

After the ROD is issued, a remedial design report (RDR) and RAWP will be prepared to detail the scope of the remedial action. The RDR/RAWP will include an integrated schedule of remedial activities for the OUs. Following the completion of the remedial activities, verification activities will be performed as specified in the ROD and the RDR/RAWP.

Post-ROD activities will include the preparation of SAPs, using the DQO process for confirmatory sampling to confirm that the proposed remedial action for an analogous waste site is appropriate; for design sampling to complete final designs of remedial alternatives; and for verification sampling to demonstrate that the appropriate remedial action goals have been achieved.

Fieldwork to implement the post-ROD SAPs and remediation of the waste site will follow the schedule as outlined in the RDR/RAWP. An operations and maintenance plan will be prepared for implemented remedies that, while still protective of human health and the environment, leave contamination in place. Finally, final closeout reports will be prepared to document that all of the remedial activities for the OU have been implemented in accordance with the approved CERCLA documents.

6.0 PROJECT SCHEDULE

The project schedule for activities discussed in this RI/FS work plan is shown in Figure 6-1. This schedule will serve as the baseline for the work planning process and will be used to measure the progress of the implementation of this process. These dates are consistent with and support Tri-Party Agreement Major Milestone M-15-00C for completion of all non-tank farm 200 Areas pre-ROD waste-site investigations, under approved RI/FS work plan schedules, by December 31, 2011. A Class II change form will be submitted to Ecology and EPA to request the change or addition of any interim milestones. Any updates to the project schedule or associated milestones will be reflected in the annual work-planning process and are not anticipated to require a revision to this RI/FS work plan. Field activity initiation is planned for fiscal year 2007, under DOE/RL-2006-47, DOE/RL-2006-57, and DOE/RL-2006-77. Field work and associated SSSPs for the other waste sites will follow Tri-Party approval of this RI/FS work plan in accordance with the schedule in Figure 6-1.

Table 6-1 provides a summary of the Tri-Party Agreement milestones for the Central Plateau source OUs.

Table 6-1. Summary of Tri-Party Agreement Central Plateau Milestones by Source Operable Unit. (2 Pages)

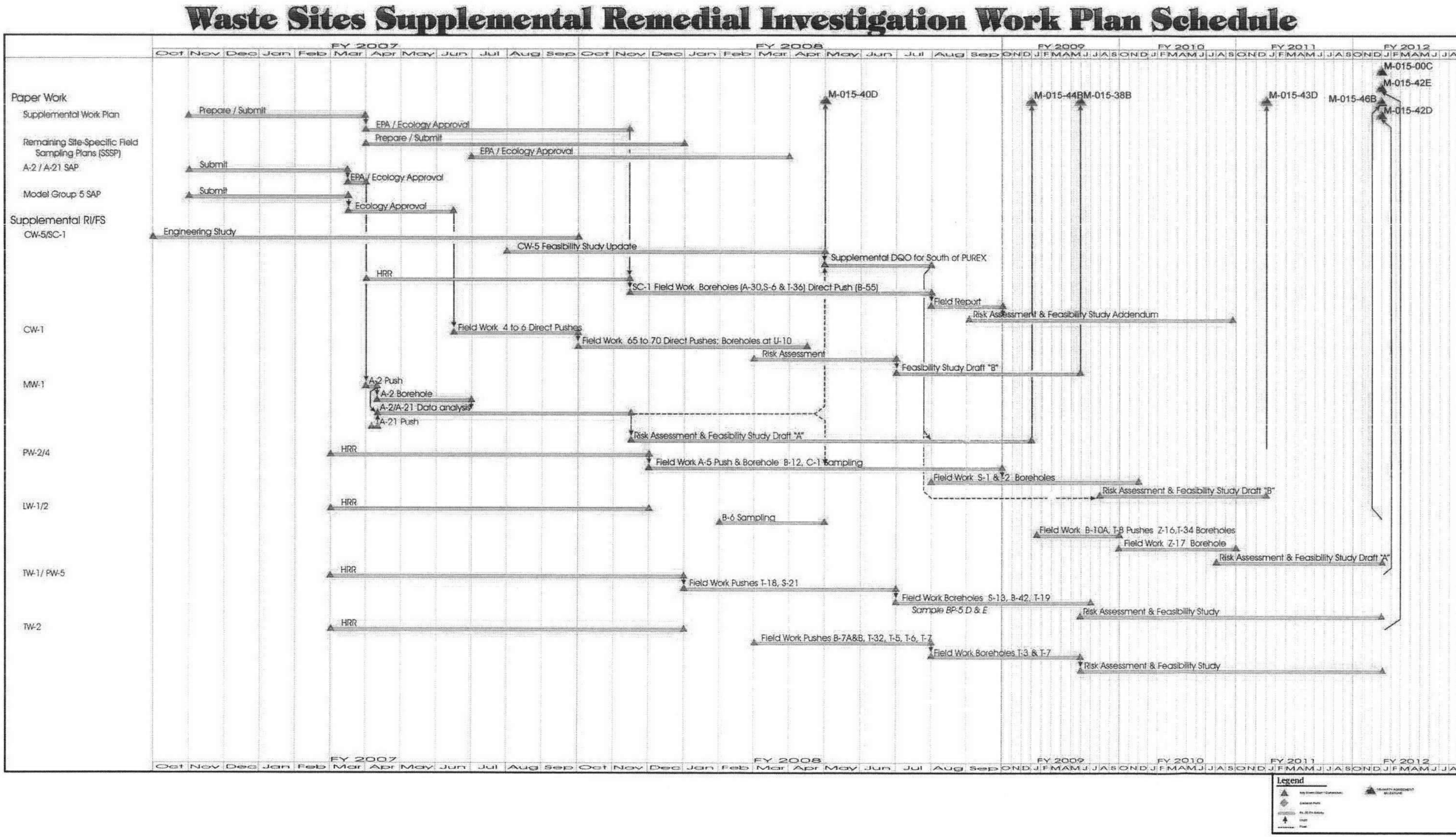
Operable Unit	Milestone Number	Milestone Summary	Milestone Due Date
General	M-013-50	Submit to Ecology and EPA one RI/FS work plan for all supplemental characterization required for 200 Area OUs.	03/31/2007
General	M-015-00C	Complete all 200 Area non-tank farm OU site investigations under approved work plan schedules through submittal of feasibility study reports and a recommended remedy(ies).	12/31/2011
200-CW-1 200-CW-3 200 North	M-015-38B	Submit a revised feasibility study report and revised proposed plans for 200-CW-1 to Ecology.	05/31/2009
200-CW-2 200-CW-4 200-CW-5 200-SC-1	M-015-40D	Submit a revised feasibility study report and revised proposed plan for 200-CW-2, 200-CW-4, 200-CW-5, and 200-SC-1 OUs to EPA.	04/30/2008
200-LW-1 200-LW-2	M-015-46B	Submit a feasibility study report and the recommended remedy for 200-LW-1 and 200-LW-2 OUs to Ecology.	12/31/2011
200-MW-1	M-015-44B	Submit the 200-MW-1 OU feasibility study report and proposed plan to EPA.	12/31/2008
200-PW-1 200-PW-3 200-PW-6	M-015-45B	Submit the feasibility study report and the proposed plan for 200-PW-1, 200-PW-3, and 200-PW-6 OUs to EPA.	09/30/2007
200-PW-2 200-PW-4	M-015-43D	Submit the feasibility study report and the revised recommended remedy(ies) for 200-PW-2 and 200-PW-4 OUs to Ecology.	12/31/2010

Table 6-1. Summary of Tri-Party Agreement Central Plateau Milestones by Source Operable Unit. (2 Pages)

Operable Unit	Milestone Number	Milestone Summary	Milestone Due Date
200-TW-1 200-TW-2 200-PW-5	M-013-51	Submit an addendum to the 200-TW-1/2 PW-5 OU Group RI/FS work plan for a treatability test at the 200 BC Cribs and Trenches to EPA. The remedial investigation information shall be incorporated into a revised feasibility study report and a revised proposed plan for the 200 BC Cribs and Trenches.	12/31/2006 (submitted on schedule)
200-TW-1 200-PW-5	M-015-42D	Submit a revised feasibility study report and revised proposed plan for 200-TW-1 and 200-PW-5 OUs to EPA.	12/31/2011
200-TW-2	M-015-42E	Submit a revised feasibility study report and revised recommended remedy(ies) for 200-TW-2 OU to Ecology.	12/31/2011
General	M-015-50	Submit a Treatability Test Work Plan for Deep Vadose Zone Technetium and Uranium to Ecology and EPA.	12/31/2007

Ecology = Washington State Department of Ecology.
EPA = U.S. Environmental Protection Agency.
OU = operable unit.
RI/FS = remedial investigation/feasibility study.

Figure 6-1. Project Schedule.



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APPENDIX A

OVERALL SAMPLING AND ANALYSIS PLAN

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CONTENTS

FIGURES

TABLES

TERMS

AEA	alpha energy analysis
aG	amber glass
ALARA	as low as reasonably achievable
bgs	below ground surface
COPC	contaminant of potential concern
CVAA	cold vapor atomic absorption
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
FSP	field-sampling plan
GC	gas chromatograph
GCMS	gas chromatograph/mass spectrometry
GEA	gamma energy analysis
GPC	gas proportional counting
HEIS	*Hanford Environmental Information System* database
HRR	high-resolution resistivity
IC	ion chromatography
ICP	inductively coupled plasma
ICP/MS	inductively coupled plasma mass spectrometer
N/A	not applicable
NWTPH-D	Washington total petroleum hydrocarbon-diesel
NWTPH-G	Washington total petroleum hydrocarbon-gas
OU	operable unit
PCB	polychlorinated biphenyl
QA	quality assurance
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RDL	required detection limit
RESRAD	RESidual RADioactivity (dose model)
RI	remedial investigation
RL	DOE, Richland Operations Office
SAP	sampling and analysis plan
SSSP	site-specific field-sampling plan
STOMP	Subsurface Transport Over Multiple Phases (code)
SVOA	semivolatile organic analyte
TBD	to be determined
Tri-Parties	DOE, EPA, and Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989a)

VOA	volatile organic analyte
WAC	*Washington Administrative Code*

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	25.40	millimeters	millimeters	0.0394	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 (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
pounds	0.453	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

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APPENDIX A

OVERALL SAMPLING AND ANALYSIS PLAN

A1.0 INTRODUCTION

This Sampling and Analysis Plan (SAP) supports supplemental remedial investigation (RI) activities directed by the Supplemental Work Plan. The U.S. Department of Energy, Richland Operations Office (RL), U.S. Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology) have determined in a data quality objective (DQO) process that these activities are necessary to make or augment remedial decisions for waste sites on the Central Plateau of the Hanford Site. The DQO results are integrated into the Supplemental Work Plan, overall SAP, and the associated addenda, which include site-specific data-collecting activities. The Work Plan presents scope, background, rationale, and framework for conducting supplemental RIs. The SAP contains the details for implementing these supplemental data-collection activities in the field. This SAP is consistent with EPA guidance and builds from the existing work plans (Volume 1, Table 1-1).

The SAP presents an overall sampling strategy for a range of sampling techniques that could be used at individual waste sites to obtain supplemental data and includes the following:

- The quality assurance project plan (QAPjP), which establishes quality requirements for the supplemental investigation activities
- The field-sampling plan (FSP), which describes data-collection activities that may be used to obtain supplemental data in support of the RI/feasibility study (FS) process
- Volume 2 Addenda, which detail the site-specific field-sampling plan (SSSP) for each waste site requiring supplemental data. Sites identified for near-term supplemental RI activities are included in Revision 0 of Volume 2 of this Work Plan. SSSPs for the remaining sites will be added to Volume 2 in accordance with Chapter 4.0 of the Work Plan.

To accelerate field implementation of some of the supplemental RI activities, separate SAPs were prepared ahead of this SAP. Model Group 5, large area ponds waste sites are investigated under DOE/RL-2006-57, *Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at Model Group-5, Large Area Ponds, Waste Sites.* The 216-A-4 Crib and 200-E-102 Trench are investigated under DOE/RL-2006-47, *Sampling and Analysis Plan for Additional Remedial Investigation Activities at the 216-A-4 Crib and the 200-E-102 Trench.* The 216-A-2 and 216-A-21 Cribs will be investigated under a SAP currently in preparation. These SAPs remain enforceable under the Supplemental Work Plan. The results of these separate SAP RI activities will be incorporated into the process described in Volume I, Figure 5-1.

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A2.0 QUALITY ASSURANCE PROJECT PLAN

The QAPjP establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The QAPjP has been updated from the QAPjPs in the approved RI/FS Work Plans because of changes in RL contractor and associated documentation. This QAPjP complies with the requirements of the following:

- DOE O 414.1C, *Quality Assurance*
- 10 CFR 830 Subpart A, "Quality Assurance Requirements"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5, as amended.

The following sections describe the quality requirements and controls applicable to the supplemental RI.

A2.1 PROJECT MANAGEMENT

This section addresses the basic areas of project management, and describes how project management will ensure that the project has a defined goal, that the participants understand the goal and approach to be used, and that the planned outputs have been appropriately documented.

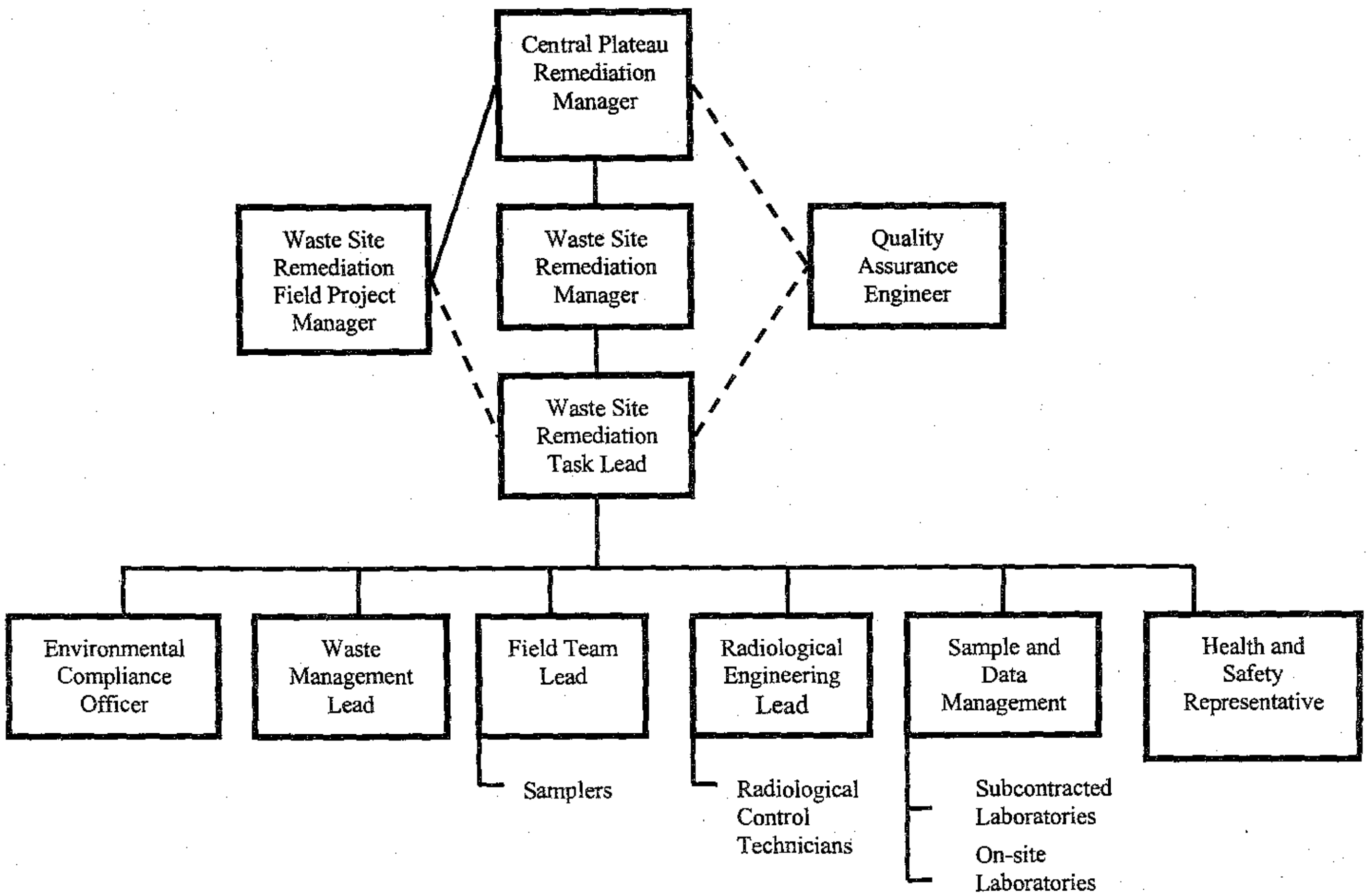
A2.1.1 Project/Task Organization

The Project Hanford Management Contractor is responsible for planning, coordinating, sampling, preparing, packaging, and shipping soil samples to the laboratory. The project organization is described in the subsections that follow and is shown graphically in Figure A2-1.

A2.1.1.1 Central Plateau Remediation Manager

The Central Plateau Remediation Manager has overall authority over the work scope in this Work Plan and SAP; the Manager provides project-level oversight and coordinates with RL and the regulators in support of Central Plateau remediation activities, including sampling activities. The Central Plateau Remediation Manager interfaces with the Groundwater Remediation Vice President and the Project Hanford Management Contractor Senior Vice President and President. The Central Plateau Remediation Manager provides support to the Waste Site Remediation Manager to ensure that the work is performed safely and cost effectively.

Figure A2-1. Project Organization.



A2.1.1.2 Waste Site Remediation Manager

The Waste Site Remediation Manager provides oversight for all activities and coordinates with the Central Plateau Remediation Manager, RL, and the regulators in support of sampling activities. In addition, the manager provides support to the Waste Site Remediation Task Lead to ensure that the work is performed safely and cost-effectively.

A2.1.1.3 Waste Site Remediation Task Lead

The Waste Site Remediation Task Lead is responsible for direct management of sampling documents and requirements, field activities, and subcontracted tasks. The task lead works closely with quality assurance (QA), health and safety, and the Field Team Lead to integrate these and the other lead disciplines in planning and implementing the work scope. The task lead also coordinates with, and reports to, RL and the Project Hanford Management Contractor on all sampling activities. The task lead supports RL in coordinating sampling activities with the regulators. The Waste Site Remediation Task Lead maintains the approved QAPjP.

A2.1.1.4 Waste Site Remediation Field Project Manager

The Waste Site Remediation Field Project Manager is responsible for coordinating field support resources and activities for the Waste Site Remediation Task Lead. The Field Project Manager ensures that field documentation is approved and properly implemented and that management is statused on daily activities. The Field Project Manager coordinates obtaining equipment, personnel, and site support and has real-time direction of field activities and field decisions that affect sampling. The Field Project Manager has real-time responsibility for ensuring the QAPjP and SAP are followed in the field.

A2.1.1.5 Quality Assurance Engineer

The Quality Assurance Engineer is matrixed to the Central Remediation Manager and the Waste Site Remediation Task Lead and is responsible for QA issues on the project. Responsibilities include oversight of project QA requirements implementation, review of project documents including SAPs (and the QAPjP), and participation in QA assessments on sample collection and analysis activities, as appropriate.

A2.1.1.6 Waste Management Lead

The Waste Management Lead communicates policies and procedures and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Other responsibilities include identifying waste management sampling/characterization requirements to ensure regulatory compliance interpretation of the characterization data to generate waste designations, profiles, and other documents that confirm compliance with waste acceptance criteria.

A2.1.1.7 Environmental Compliance Officer

The Environmental Compliance Officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work and develops appropriate mitigation measures with a goal of minimizing adverse environmental impacts. The Environmental Compliance Officer also reviews plans, procedures, and technical documents to ensure that all environmental requirements have been addressed, identifies environmental issues that affect operations and develops cost-effective solutions, and responds to environmental/regulatory issues or concerns raised by the DOE and/or regulatory staff.

A2.1.1.8 Field Team Lead

The Field Team Lead has the overall responsibility for the planning, coordination, and execution of the field characterization activities. Specific responsibilities include converting the sampling design requirements into field task instructions that provide specific direction for field activities. Responsibilities also include directing training, mock-ups, and practice sessions with field personnel to ensure that the sampling design is understood and can be performed as specified. The Field Team Lead communicates with the Waste Site Remediation Task Lead to identify field constraints that could affect the sampling design. In addition, the Field Team Lead directs the procurement and installation of sampling materials and equipment needed to support the fieldwork.

The Field Team Lead oversees field-sampling activities that include sample collection, packaging, provision of certified clean sampling bottles/containers, and documentation of sampling activities in controlled logbooks, chain-of-custody documentation, and packaging and transportation of samples to the laboratory or shipping center. The samplers collect all samples, including replicates/duplicates, and prepares all sample blanks according to the SAP and corresponding standard procedures and work packages.

The Field Team Lead, samplers, and others responsible for implementation of this SAP and QAPjP will be provided with current copies of this document and any revisions thereto by the Waste Site Remediation Task Lead.

A2.1.1.9 Radiological Engineering Lead

The Radiological Engineering Lead is responsible for the radiological engineering and health physics support to the project. Specific responsibilities include conducting as-low-as-reasonably-achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to the hazards ALARA. The Radiological Engineering Lead interfaces with the project Health and Safety representative and plans and directs radiological control technician support for all activities.

A2.1.1.10 Sample and Data Management

The Sample and Data Management organization selects the laboratories that perform the analyses. This organization also ensures that the laboratories conform to Hanford Site internal laboratory QA requirements, or their equivalent, as approved by RL, EPA, and Ecology. Sample and Data Management receives the analytical data from the laboratories, makes the data entry into the *Hanford Environmental Information System* database (HEIS), and arranges for data validation. Validation will be performed on completed data packages by Project Hanford Management Contractor personnel or by an independent contractor qualified to perform validation by meeting the requirements of applicable site procedures.

A2.1.1.11 Health and Safety Representative

Responsibilities include coordination of industrial health and safety support to the project as carried out through health and safety plans, activity job hazard analyses, and other pertinent safety documents required by Federal regulation or by internal Project Hanford Management Contractor work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personal protective clothing requirements are coordinated with Radiological Engineering.

A2.1.2 Problem Definition/Background

The problem being addressed by this SAP is the need for supplemental investigation data for the Central Plateau waste sites. These supplemental data will augment existing RI data leading to completion of the RI/FS process for the Central Plateau operable units (OU) addressed in the Work Plan. Additional details on the problem definition and background are provided in

Chapter 1.0 of the Work Plan. In addition, supplemental RI data may support analyses for other projects, such as Groundwater and Tank Farms.

A2.1.3 Project/Task Description

The overall Central Plateau Waste Site project description is to complete the RI/FS process for Central Plateau OUs. This SAP is directed at a subset of OUs and associated waste sites where the need for supplemental data has been identified by the DOE, EPA, and Ecology (the Tri-Parties). As identified in the site-specific addenda, a combination of intrusive data-collection techniques, such as deep boreholes, shallow boreholes, direct-push holes, and test pits, will be used to collect samples of vadose zone media for analysis. These analyses will include identifying radiological and nonradiological contamination and physical properties to aid in the understanding of the nature and extent of contamination at the waste sites. Non-intrusive activities, such as downhole geophysical logging and high-resolution resistivity (HRR) surveys, will be used to augment the intrusive data-collection activities.

This SAP and the associated addenda lay out the plan to complete supplemental data-collection activities. The supplemental data will be incorporated into FSs to support *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989a) (Tri-Party Agreement) major Milestone M-015-00C for completion of the RI/FS processes for the Central Plateau OUs by December 31, 2011. Chapter 6.0 of the Work Plan provides a schedule of the interim milestones for the OUs leading to the major milestone.

A2.1.4 Quality Objectives and Criteria for Measurement Data

The QA objective of this plan is to develop implementation guidance to data-collection activities that will provide data of known and appropriate quality. Data quality is assessed by data quality indicators, by evaluation against identified DQOs, and by evaluation against the work activities identified in the existing work plans, and this Supplemental Work Plan and SAP. The applicable quality control (QC) guidelines and quantitative target limits for assessing data quality are dictated by the intended use of the data and the nature of the analytical method. The following subsections identify the contaminants of potential concern (COPC) and their respective preliminary action levels in support of establishing analytical requirements, including analytical method target limits. The quantitative and qualitative data quality indicators are also described below.

A2.1.4.1 Development of Contaminants of Potential Concern and Preliminary Action Levels for Establishment of Analytical Requirements

This section identifies the 200 Areas Central Plateau waste-site COPCs and identifies the process for development of their corresponding preliminary action levels in support of establishing appropriate analytical requirements. The analytical performance requirements, including required detection limits, are contained in Tables A2-1 and A2-2.

A2.1.4.1.1 Development of Contaminants of Potential Concern

The COPCs for the 200 Areas Central Plateau waste sites to be investigated under this SAP were developed on an OU basis using information about historical Central Plateau operations, the results of characterization activities, and the DQO processes documented in the respective OU work plans (Volume I, Table 1-1). The comprehensive list of COPCs is identified on an OU basis in Table A2-3. Unless otherwise noted, the COPCs for the OU within which a waste site resides will apply to the waste site being sampled.

Based on additional historical research into crib discharges, Ni-63 and Sm-151 also have been identified as COPCs. No analytical method was identified for Sm-151, but concentrations can be estimated based on decay relationships with other radiological constituents.

A2.1.4.1.2 Development of Preliminary Action Levels

Preliminary action levels represent regulatory- or risk-based soil concentrations of nonradionuclide or radioactive constituents that are considered protective of human health, ecological receptors, and groundwater and could be used by the FS process to meet remedial action objectives. Identification of preliminary action levels is helpful in demonstrating that the analytical detection limits required of the laboratories will provide laboratory data that can be compared to final action levels and so is usable in making remedial decisions. Consequently, such levels should be detectable by laboratory analytical processes to ensure that data are useable in making remedial decisions. Use of preliminary action levels provides a technical basis for establishing analytical requirements found in Tables A2-1 and A2-2 for the COPCs identified in Table A2-3. The overall process identifies preliminary action levels that could be used as final action levels for protection of human health, ecological receptors, and groundwater at 200 Areas Central Plateau waste sites and then compares these levels to available Hanford Site soil background values to ensure that required detection limits do not exceed such levels and that the data are usable.

Nonradionuclide preliminary action levels. The preliminary action levels for human health, ecological receptors, and groundwater protection from exposure to nonradioactive chemical constituents listed in Table A2-2 were derived as follows.

- Preliminary action levels for nonradionuclide COPCs in shallow soils that are protective of human health from direct exposure are risk-based numeric levels expressed in terms of concentration (mg/kg) based on an industrial land-use scenario. Risk-based standards for industrial land use for carcinogenic and noncarcinogenic COPCs were calculated for shallow soils (the top 4.6 m [15 ft] of the soil column) using the Method C formulas of WAC 173-340-745, "Soil Cleanup Standards for Industrial Properties," or, Method A, WAC 173-340-900, "Tables," Table 745-1, for industrial sites, as applicable (e.g., lead).

- Preliminary action levels for nonradionuclide COPCs that are protective of terrestrial ecological receptors in shallow soils of industrial properties are derived from simplified terrestrial ecological evaluation procedures provided in WAC 173-340-7492, "Simplified Terrestrial Ecological Evaluation Procedures," and the Wildlife column of Table 749-3 in WAC 173-340-900.

- Preliminary action levels for nonradionuclide COPCs in deep soil (i.e., greater than 4.6 m [15 ft] deep) that are protective of groundwater were calculated using the fixed parameter three-phase partitioning model (Equation 746-1 of WAC 173-340-747(4), "Deriving Soil Concentrations for Ground Water Protection," "Fixed Parameter Three-Phase Partitioning Model").

Radionuclide preliminary action levels. The preliminary action levels for human health, ecological receptors, and groundwater protection from exposure to radionuclides listed in Table A2-1 were derived as follows.

- Preliminary action levels for radionuclides that are protective of human health from direct exposure to radionuclides in shallow soils of industrial properties were developed using the RESidual RADioactivity (RESRAD) model Version 6.3 (ANL 2005, *RESRAD for Windows*). These levels correspond to an operational direct-exposure dose rate guideline of 15 mrem/yr above background that equates to an achievement of a 10^{-4} to 10^{-6} carcinogenic risk range in accordance with EPA/540/R-99/006, *Radiation Risk Assessment At CERCLA Sites and Q & A*, Directive 9200.4-31P.

- Preliminary action levels for radionuclides in shallow soils that are protective of ecological receptors at industrial properties were obtained from the RESRAD-Biota model Version 1.2 and are Level 1 (screening level) values (ANL 2006, *RESRAD-Biota*) and the terrestrial radionuclide screening levels presented in DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota.*

- Preliminary action levels for individual radionuclides in deep soil that are protective of groundwater will be developed using STOMP (PNNL-12034, *STOMP, Subsurface Transport Over Multiple Phases, Version 2.0, User's Guide*) modeling; hence the groundwater action levels are listed as TBD (to be determined).

A2.1.4.2 Quantitative Analytical Parameters

The quantitative analytical parameters of precision and accuracy as described in the following sections will apply to analytical data analysis.

A2.1.4.2.1 Accuracy

Accuracy is an assessment of the closeness of the measured value to the true value. Accuracy of chemical test results is assessed through several standard methods. These methods include calibrating measurement systems using standards of known concentration (calibration); analyzing solutions known to contain no analytes of interest to verify that the sample processing and preparation process do not affect the measurement (blank analyses); routinely analyzing samples containing known concentrations of analyte(s) of interest (laboratory control sample analysis); and, spiking samples with known standards and establishing the average recovery (matrix spike analysis). Radionuclide measurements that require chemical separations use the matrix spike technique to measure method performance. For radionuclide measurements that are analyzed by gamma spectroscopy, laboratories typically compare results of blind audit samples against known standards to establish accuracy. Validity of calibrations is evaluated by comparing results from the measurement of a standard to known values and/or by generating in-house statistical limits based on three standard deviations (+/ 3 SD). Tables A2-1, A2-2, and A2-4 list the accuracy requirements for fixed laboratory analyses for the project.

An additional element of the accuracy objective is measurement method sensitivity, frequently described by the minimum detectable concentration, also referred to as the detection limit. The detection limit reflects the smallest concentration of an analyte that can be reliably measured in a sample and must be established to provide data at concentrations low enough for comparison against remedial action levels and remediation goals established during the RI/FS planning process. Detection limits are functions of the analytical method used to provide the data and the quantity of the sample available for analyses. Detection limits identified for the analytes for the soil and QC samples are listed in Tables A2-1 and A2-2 (see Required Detection Limits columns on the tables). The preliminary action levels are estimates of potential cleanup levels and are used in this SAP to ensure that detection limits are established to provide laboratory data at low enough concentrations to assess potential action limits during the feasibility study, where potential applicable or relevant and appropriate requirements are identified. Required detection limits are generally lower than the preliminary action levels so that any nondetect laboratory results can be used to demonstrate that the field concentrations do not, in fact, exceed target action levels. The detection limits presented in the tables are typical for clean media and trace-level analysis and should be achievable by a laboratory in the absence of interferences. A laboratory analyzing samples displaying more than trace level contamination may not be able to achieve these detection limits.

The general objective for detection limits is to establish a minimum detectable concentration that is below the action level to prevent generation of inconclusive data. The detection limits for the soil and QC sample analytes identified for this RI are listed in Tables A2-1, A2-2, and A2-4 as required detection limits and are generally lower than the preliminary action level to ensure that the data are useable.

A2.1.4.2.2 Precision

Precision is a measure of the data spread when more than one measurement has been taken on the same sample. Precision is assessed through analysis of multiple aliquots of the same sample in the laboratory (laboratory replicate analysis), through analysis of split samples prepared in the field and submitted to the laboratory as separate samples (field duplicate analysis), and through assessment of multiple analyses of laboratory control samples. Precision is typically expressed as the relative percent difference for duplicate measurements. Analytical precision requirements for fixed laboratory analyses are listed in Tables A2-1, A2-2, and A2-4. These are typical precision levels that a laboratory should be able to achieve on project liquid and solid samples. Inability to achieve the precision requirements is an indicator that there is a problem with the sampling process, analytical system, or sample matrix and requires further investigation.

A2.1.4.2.3 Completeness

Completeness is a measure of the amount of valid data needed to be obtained from a measurement system. This parameter compares the number of valid measurements completed to the minimum number of samples to be collected and analyzed to establish description/measurement of the system at a minimum confidence with those established by the project's quality criteria (DQOs or performance/acceptance criteria).

For this supplemental RI activity, the overall objective for completeness is 85 percent from all measurement techniques. The uncertain nature of subsurface sampling may result in limited sample returns and completeness objectives may not be met. Mitigating activities can include prioritization of the analyte list or sending minimum volumes for analysis. Impacts from these activities will be assessed in the data quality assessment (DQA).

A2.1.4.3 Qualitative Analytical Parameters

Qualitative analytical parameters identified in this section include representativeness and comparability. The degree to which these qualitative parameters will apply to collection of supplemental data at individual sites will be identified in the site-specific addenda. These parameters are described below.

A2.1.4.3.1 Representativeness

Representativeness refers to the degree to which a data set actually describes a sample of a population (e.g., the information presented by the data set can be extrapolated to describe the overall site or system). The measurements of a data set must be evaluated to determine whether the data are collected in such a manner that they represent the environment or condition being measured or studied (i.e., the actual concentration and distribution of the radiological constituents in the matrix sampled). Representativeness should be assessed on a gross (i.e., site or system) level and on an individual measurement level to ensure that the data user understands how the data set can be used to describe the target system. Sampling plan design, sampling techniques, and sample handling protocols (e.g., storage, preservation, transportation) have been developed and are discussed in subsequent sections of this document. Representativeness of the data set will be evaluated during the DQA.

A2.1.4.3.2 Comparability

Comparability is an expressed measure of confidence that one data set can be compared to previous and subsequent measurements and so can be combined for purposes of decision making. This parameter compares sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols. Data comparability will be maintained using standard procedures, consistent methods, and consistent units. Tables A2-1, A2-2, and A2-4 list applicable fixed-laboratory methods for analytes and target detection limits.

A2.1.5 Special Training/Certification Requirements

A graded approach is used to ensure that workers receive a level of training that is commensurate with their responsibilities and that complies with applicable DOE orders and government regulations. The Field Team Lead, in coordination with line management, will ensure that all field personnel meet all special training requirements.

Typical training requirements or qualifications have been instituted by the primary contractor management team to meet training requirements imposed by the Project Hanford Management Contract (DE-AC06-96RL13200, *Contract Between the U.S. Department of Energy, Richland Operations Office, and Fluor Hanford, Inc.*), regulations, DOE orders, DOE contractor requirements documents, American National Standards Institute/American Society of Mechanical Engineers, *Washington Administrative Code*, etc. For example, the environmental, safety and health training program provides workers with the knowledge and skills necessary to safely execute assigned duties. Field personnel typically will have completed the following training before starting work:

- Occupational Safety and Health Administration 40-hour hazardous waste worker training and supervised 24-hour hazardous waste-site experience
- 8-hour hazardous waste worker refresher training (as required)
- Hanford general employee radiation training
- Hanford general employee training
- Radiological worker training.

Project specific training includes the following.

- Training requirements or qualifications needed by sampling personnel will be in accordance with QA requirements.
- Samplers are required to have training and/or experience in the type of sampling that is being performed in the field (e.g., borehole sampling).
- Qualification requirements for radiological control technicians are established by the Radiation Protection Program; radiological control technicians assigned to these activities will be qualified through the prescribed training program and will undergo ongoing training and qualification activities.

Project-specific safety training, geared specifically to the project and the day's activity, will be provided. Pre-job briefings will be performed to evaluate an activity and its hazards by considering many factors including the following:

- Objective of the activities
- Individual tasks to be performed
- Hazards associated with the planned tasks
- Controls applied to mitigate the hazards
- The environment in which the job will be performed
- The facility where the job will be performed
- The equipment and material required
- The safety procedures applicable to the job
- The training requirements for individuals assigned to perform the work

- The level of management control
- The proximity of emergency contacts.

Training records are recorded for each individual in an electronic training record database. The Fluor Hanford training organization maintains the training records system. Line management will confirm that an individual employee's training is appropriate and up-to-date prior to performing any fieldwork.

A2.1.6 Documentation and Records

The Waste Site Remediation Task Lead is responsible for ensuring that the current version of the SAP is being used and for providing any updates to field personnel. Version control is maintained by the administrative document control process. Minor changes to the FSP and/or SSSP, such as location changes with depth due to sample recovery or obstructions, may be made in the field by the Waste Site Remediation Field Project Manager and Task Lead. Changes to the FSP and/or SSSP that affect the DQOs, such as overall borehole location or sampling method, will be reviewed and approved by RL and Ecology prior to implementation; this approval may be through actual revision of the Work Plan and/or SAP documents or may be documented through Unit Manager Meeting minutes under the Tri-Party Agreement. The Waste Site Remediation Task Lead and Field Project Manager are responsible for ensuring that the field instructions are maintained up to date and aligned with any revisions to the SAP. As appropriate, the document revision process will follow the requirements set forth in Section 9.3 of the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al. 1989b).

The project file will include the following, as appropriate:

- Field logbooks or operational records
- Global Positioning System data
- Chain-of-custody forms
- Sample receipt records
- Inspection or assessment reports and corrective action reports
- Interim progress reports
- Final reports.

The Waste Site Remediation Task Lead is responsible for ensuring that the data file is properly maintained. The project files will contain the records or references to their storage locations.

The laboratory is responsible for maintaining and having available upon request:

- Analytical logbooks
- Raw data and QC sample records
- Standard reference material and/or proficiency test sample data
- Instrument calibration information.

Records may be stored in either electronic or hard copy format. Documentation and records, regardless of medium or format, are controlled in accordance with internal work requirements and processes that ensure accuracy and retrievability of stored records. Records required by the Tri-Party Agreement will be managed in accordance with the requirements of the Agreement.

A2.2 MEASUREMENT/DATA ACQUISITION

This section presents the requirements for sampling methods, sample handling and custody, analytical methods, and field and laboratory QC. Instrument calibration, maintenance supply inspection, and data management requirements also are addressed.

A2.2.1 Sampling Process Design

The sampling process design describes the data-collection design for the project, including types and numbers of samples required, sampling locations and frequency, sample matrices, and the rationale for the design. The approved work plans (Table 1-1) describe the sampling process designs based on DQOs and sampling strategies for the initial RI work. Following review of the initial RI data, the Tri-Parties agreed to assess the need for supplemental data through a supplemental DQO process. A major effort in the supplemental DQO process was the Tri-Parties' review of the existing data for each waste site to determine if gaps existed that would influence the decision process. Data gap analysis focused on the following:

- The need to address data gaps where the relationship between an analogous site and its assigned representative site is weak
- The desire to accelerate confirmatory sampling where early data would facilitate decision making
- The need to obtain supplemental information on the extent of contamination where data could lead to a different remedy
- The need to obtain supplemental data to further characterize the deep vadose zone where recent knowledge and thinking (i.e., groundwater, tank farm, vadose zone integration, 200-UW-1 OU lessons learned) result in the need for more information.

Appendix C contains a summary of the amount and type of existing and supplemental data for each waste site. The Volume II addenda provide detailed information on each waste site, including the existing data, sampling strategy, sample location and frequency, and rationale for the sample design.

This SAP is aimed at collecting supplemental data to support the RI/FS process. Therefore, the sampling design for activities conducted under this SAP is mainly a focused (or judgmental) strategy aimed at addressing specific data gaps. The focused sampling is a result of having existing knowledge of waste-site contamination problems either from site-specific information or from representative sites. These data include construction information, effluent discharge volumes, contaminant inventories, information from nearby or similar sites, geophysical logging within or near sites, HRR surveys, and/or site-specific sampling (additional details on sampling are provided in Section A3.1).

Additional sampling is anticipated following the record of decision to collect confirmatory, design, and verification samples at sites as needed. Post-record of decision sampling needs will be identified through a series of DQO processes as described in Chapter 5.0 of the Supplemental Work Plan.

A2.2.2 Sampling Methods

This SAP provides information on a variety of intrusive and non-intrusive sampling methods that may be used during the supplemental RI. Data-collection methods include borehole sampling, direct-push sampling, test pit sampling, geophysical surveys, field screening, and other methods as warranted by the data needs. Intrusive, subsurface sampling of vadose zone soils is a main objective of the supplemental RI. In addition, water samples may be collected if encountered in perched zones and/or at the groundwater/vadose interface. Other types of sampling, such as surface sampling or soil vapor sampling, may be warranted in some cases. Non-intrusive data-collection techniques also will be used to augment the existing data and the intrusive supplemental data in evaluating the nature and extent of contamination during the RI/FS process. Details of sample and data-collection methods included in this SAP are provided in Section A3.1 and in Volume II addenda.

A2.2.2.1 Decontamination of Sampling Equipment

To prevent contamination of the samples, care should be taken to use clean equipment for each sampling activity. In general, disposable sampling equipment will be used where appropriate. Some sampling equipment, such as split-spoon samplers, may be decontaminated in accordance with decontamination procedures.

Special care should be taken to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers
- Contaminating the equipment or sample bottles by setting the equipment/sample bottle on or near potential contamination sources (e.g., uncovered ground)
- Handling bottles or equipment with dirty hands or gloves
- Improperly decontaminating equipment before sampling or between sampling events.

A2.2.3 Sample Handling and Custody Requirements

All field-sample handling, shipping, and custody requirements will be consistent with established procedures. Level I EPA pre-cleaned sample containers will be used for soil samples collected for chemical and radiological analysis. Container sizes may vary depending on laboratory-specific volumes/requirements for meeting analytical detection limits. The radiological control technician will measure the contamination levels and dose rates associated with the sample containers. This information, along with other data, will be used to select proper packaging, marking, labeling, and shipping paperwork and to verify that the sample can be received by the analytical laboratory in accordance with the laboratory's acceptance criteria. Preliminary container types and volumes are identified in Table A2-5. The final types and volumes will be indicated on the Sampling Authorization Form prepared by Sample and Data Management; however, field changes can be made if necessary. Field-determined radiological properties of the sample also may affect the container size. Each sample container will be labeled with the following information, using a waterproof marker on firmly affixed, water-resistant labels:

- Sampling Authorization Form
- HEIS number
- Sample collection date/time
- Name of person collecting the sample
- Analysis required
- Preservation method (if applicable).

Except for volatile organic analyte samples, a custody seal (i.e., evidence tape) will be affixed to the lid of each sample jar. The container seal will be inscribed with the sampler's initials and the date. Custody tape is not applied directly to volatile organic analyte bottles collected because of a potential for fouling the laboratory equipment.

Sample transportation will be in compliance with the applicable regulations for packaging, marking, labeling, and shipping hazardous materials, hazardous substances, and hazardous waste that are mandated by the U.S. Department of Transportation (49 CFR 171-177, Chapter 1, "Research and Special Programs Administration, Department of Transportation," Part 171, "General Information, Regulations, and Definitions," through Part 177, "Carriage By Public Highway") in association with the International Air Transportation Authority, DOE requirements, and applicable program-specific implementing procedures.

Sample custody during laboratory analysis is addressed in the applicable laboratory standard operating procedures. Laboratory custody procedures will ensure that sample integrity and identification are maintained throughout the analytical process. Storage of samples at the laboratory will be consistent with laboratory instructions prepared by Sample and Data Management.

The Fluor Hanford *Sample Data Tracking* database will be used to track the samples from the point of collection to through the laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for the project. Each radiological, nonradiological, and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook. All field-sample handling, shipping, and custody requirements will be consistent with established procedures.

A2.2.4 Analytical Methods Requirements

Analytical parameters and methods are listed in Tables A2-1, A2-2, and A2-4. These analytical methods are implemented in accordance with the laboratory's QA plan and the requirements of this QAPjP. The Project Hanford Management Contractor conducts oversight of offsite analytical laboratories to qualify them for performing Hanford Site analytical work.

Deviations from the analytical methods noted in Tables A2-1, A2-2, and A2-4 must be approved by the Waste Site Remediation Task Lead. If the laboratory uses a nonstandard or unapproved method, the laboratory must provide method validation data to confirm that the method is adequate for the intended use of the data. This includes information such as determination of detection limits, quantitation limits, typical recoveries, and analytical precision and bias.

Laboratories providing analytical services in support of this SAP will have in place a corrective action program that addresses analytical system failures and documents the effectiveness of any corrective actions. Errors reported by the laboratories are reported to the Sample and Data Management Project Coordinator, who is responsible to document analytical errors and to establish the resolution in coordination with the Waste Site Remediation Task Lead.

Communications with the laboratory will be managed by the Sample and Data Management organization. Sample and Data Management will be responsible for communicating status, issues, corrective actions, and other pertinent laboratory information to the Waste Site Remediation Task Lead and the Waste Site Remediation Manager.

A2.2.5 Quality Control Requirements

The QC procedures must be followed in the field and laboratory to ensure that reliable data are obtained. Field QC samples will be collected to evaluate the potential for cross-contamination and to provide information pertinent to field variability. Field QC for sampling will require the collection of field replicates (duplicates), trip or field blanks, and equipment blanks. Laboratory QC samples estimate the precision and bias of the analytical data. Quality control sampling is described here in general terms; actual QC samples and the required frequency for collection are described in the SSSPs for each waste site to be sampled.

The collection of QC samples for onsite measurements may be applicable to some of the field-screening techniques described in this SAP, such as organic vapor detection. Field-screening instrumentation will be calibrated and controlled as discussed in Sections A2.2.6 and A2.2.7, as applicable. Onsite measurement QC samples will be identified in the SSSP for specific sampling techniques as needed.

The laboratory method blanks, laboratory control sample/blank spike, and matrix spike are defined in Chapter 1 of SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A*, as amended, and will be run at the frequency specified in that reference.

To ensure sample and data usability, the sampling associated with this SAP will be performed in accordance with established sampling practices, procedures, and requirements pertaining to sample collection, collection equipment, and sample handling. The Field Team Lead and the Waste Site Remediation Task Lead are responsible for ensuring that all field procedures are followed completely and that field-sampling personnel are adequately trained to perform sampling activities under this SAP. The Waste Site Remediation Lead, or the Field Team Lead at the discretion of the Waste Site Remediation Task Lead, must document all deviations from procedures or other problems pertaining to sample collection, chain of custody, COPCs, sample transport, or noncompliant monitoring. As appropriate, such deviations or problems will be documented in the field logbook or on nonconformance report forms in accordance with internal corrective-action procedures. The Waste Site Remediation Lead, or the Field Team Lead at the discretion of the Waste Site Remediation Task Lead, will be responsible for communicating field corrective-action requirements and for ensuring that immediate corrective actions are applied to field activities.

A2.2.5.1 Field Duplicates

Field duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently.

A minimum of one field duplicate will be collected from each waste site where soil sampling is performed. The duplicate should be collected generally from an interval that is expected to have some contamination, so that valid comparisons between the samples can be made (i.e., at least some of the constituents will be above detection limit). When sampling is performed from a split spoon, volatile organic samples and volatile organic duplicate samples are collected directly from the sampler. The remaining soil is then composited in a stainless steel mixing bowl. The soil sample and duplicate sample are collected from this composited material.

A2.2.5.2 Field Splits

Field splits of soil samples are not considered necessary to be collected under this SAP. However, during sampling, sample personnel could identify a need to collect a soil split sample to verify the performance of the primary laboratory or an outside agency could request a split sample. If so, the sample medium will be homogenized, split into two separate aliquots in the field, and sent to two independent laboratories. The split sample will be obtained from a sample medium suitable for analysis at an offsite laboratory. The split sample will be analyzed for the analytes listed in the SSSPs in accordance with the analytical requirements listed in Tables A2-1, A2-2, and A2-4.

A2.2.5.3 Equipment Rinsate Blanks

A minimum of one equipment rinsate blank will be collected from each waste site where soil sampling is performed. The field geologist may request that additional equipment blanks be taken. Equipment blanks will consist of pure deionized water washed through decontaminated sampling equipment and placed in containers, as identified on the project Sampling Authorization Form. Note that the bottle and preservation requirements for water may differ from the requirements for soil.

Equipment rinsate blanks will be analyzed for the following:

- When characterization analysis is for radionuclides only
  - Gamma emitters
  - Gross alpha
  - Gross beta
- When characterization analysis is for radionuclides and chemical constituents
  - Gamma emitters
  - Gross alpha
  - Gross beta
  - Metals (excluding hexavalent chromium and mercury)
  - Anions
  - Semivolatile organic analytes
  - Volatile organic analytes.

A2.2.5.4 Field Blanks

The volatile organic field blanks will constitute approximately 5 percent of all samples designated for analysis of volatile organic compounds. A minimum of one volatile organic analyte field blank will be collected at each waste site where the samples will undergo volatile-organic-compound analysis. The field blank will consist of pure deionized water added to clean sample containers at the location where the volatile organic compound sample was collected. The field blank will be analyzed only for volatile organic compounds.

A2.2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

Measurement and testing equipment used in the field or in the laboratory that directly affects the quality of analytical data will be subject to preventive maintenance measures to ensure minimization of measurement system downtime. Laboratories and onsite measurement organizations must maintain and calibrate their equipment. Maintenance requirements (such as parts lists and documentation of routine maintenance) will be included in the individual laboratory and the onsite organization QA plan or operating procedures (as appropriate). Calibration of laboratory instruments will be performed in a manner consistent with SW-846, as amended, or with auditable DOE Hanford Site and contractual requirements. Consumables, supplies, and reagents will be reviewed in accordance with SW-846 requirements and will be appropriate for their use.

A2.2.7 Instrument Calibration and Frequency

All onsite environmental instruments are calibrated in accordance with the manufacturer's operating instructions, internal work requirements and processes, and/or work packages that provide direction for equipment calibration or verification of accuracy by analytical methods.

The results from all instrument calibration activities are recorded in logbooks and/or work packages.

Field instrumentation, calibration, and QA checks will be performed in accordance with the following.

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in their program documentation.
- Daily calibration checks will be performed and documented for each instrument used to characterize areas that are under investigation. These checks will be made on standard materials that are sufficiently like the matrix under consideration that direct comparison of data can be made. Analysis times will be sufficient to establish detection efficiency and resolution.

Analytical laboratory instruments and measuring equipment are calibrated in accordance with the laboratories' QA plan.

Calibration is conducted with equipment or standards with known valid relationships to nationally recognized performance standards. Field equipment used in this data-collection activity that requires calibration will be listed in the fieldwork package. Such equipment is uniquely identified and calibrated in accordance with the equipment-specific calibration procedure, including the program for maintaining calibration records traceable to the uniquely identified piece of equipment. The results from all instrument calibration activities are recorded in logbooks and/or work packages.

A2.2.8 Inspection/Acceptance Requirements for Supplies and Consumables

Supplies and consumables procured by Fluor Hanford that are used in support of sampling and analysis activities are procured in accordance with internal work requirements and processes that describe the Project Hanford Management Contractor acquisition system. The procurement process ensures that purchased items and services comply with applicable procurement specifications, thereby ensuring that structures, systems, and components, or other items and services procured/acquired for Fluor Hanford, meet the specific technical and quality requirements. Supplies and consumables are appropriately issued to the field and then checked and accepted before use.

Supplies and consumables procured by the analytical laboratories are procured, checked, and used in accordance with their QA plans.

A2.2.9 Data Acquisition Requirements for Nondirect Measurements

Nondirect measurements include data obtained from sources such as computer databases, programs, literature files, and historical databases. Nondirect measurements (e.g., historical records and reports) were used extensively in identification of data needs and DQOs for this supplemental RI. Nondirect measurements are not planned to be acquired as a portion of the supplemental data-collection activity under this SAP. However, any incidental nondirect measurement used as data acquired during this SAP activity (e.g., weather data from other sources) and used in decision-making will be documented.

A2.2.10 Data Management

Analytical data resulting from the implementation of this QAPjP will be managed and stored in accordance with the applicable programmatic requirements governing data management procedures. Electronic data access, when appropriate, will be via a database (e.g., HEIS or a project-specific database). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the Tri-Party Agreement (Ecology et al. 1989a).

Planning for sample collection and analysis will be in accordance with the programmatic requirements governing fixed-laboratory sample collection activities, as discussed in the sample team's procedures. In the event that specific procedures do not exist for a particular work evolution, or it is determined that additional guidance to complete certain tasks is needed, a work package will be developed to adequately control the activities, as appropriate. Examples of the sample team's requirements include activities associated with the following:

- Chain of custody/sample analysis requests
- Project and sample identification for sampling services
- Control of certificates of analysis
- Logbooks, checklists
- Sample packaging and shipping.

Approved work control packages and procedures will be used to document field activities, including radiological measurements when this SAP is implemented. All field activities will be recorded in field logbooks or appropriate forms invoked by procedure. Examples of the types of documentation for field radiological data include the following:

- Instructions regarding the minimum requirements for documenting radiological controls information in accordance with 10 CFR 835, "Occupational Radiation Protection"

- Instructions for managing the identification, creation, review, approval, storage, transfer, and retrieval of primary contractor radiological records

- The minimum standards and practices necessary for preparing, performing, and retaining radiological-related records

- The indoctrination of personnel on the development and implementation of sample plans

- The requirements associated with preparing and transporting regulated material
- Daily reports of radiological surveys and measurements collected during conduct of field investigation activities. Data will be cross-referenced between laboratory analytical data and radiation measurements to facilitate interpreting the investigation results.

Errors are reported to the Fluor Hanford Office of Sample and Data Management on a routine basis. Laboratory errors are reported to the Sample Management Project Coordinator, who initiates a Sample Disposition Record in accordance with Project Hanford Management Contractor procedures. This process is used to document analytical errors and to establish their resolution with the Waste Site Remediation Task Lead. The Sample Management Project Coordinator provides the Sample Disposition Record to the Task Lead for review and signature. The Sample Disposition Records become a permanent part of the analytical data package for future reference and for records management.

A2.3 ASSESSMENT/OVERSIGHT

This section identifies the activities for assessing project and associated QA and QC activities for compliance with QAPjP requirements.

A2.3.1 Assessments and Response Actions

The Project Hanford Management Contractor management, regulatory compliance, quality, and/or health and safety organizations may conduct random surveillances and assessments to verify compliance with the requirements outlined in this SAP, project work packages, the project quality management plan, procedures, and regulatory requirements. Project-specific management assessments will be conducted on an annual basis for activities conducted under this Work Plan and SAP. Other assessments may be conducted on a random or as-needed basis. Data obtained under this SAP will undergo DQA in accordance with Section A2.4.3.

If circumstances should arise in the field that would dictate the need for additional assessment activities, these activities would be performed and recorded in accordance with approved procedures. Deficiencies identified by these assessments will be reported in accordance with existing programmatic requirements. The project's line management chain coordinates the corrective actions/deficiencies in accordance with the Project Hanford Management Contractor Quality Assurance Program, the Corrective Management Action Program, and associated approved procedures that implement these programs.

Oversight activities in the analytical laboratories, including corrective action management, are conducted in accordance with the laboratories' QA plans. To ensure that laboratory QA requirements are met, Project Hanford Management Contractor personnel conduct periodic oversight activities for offsite analytical laboratories in accordance with Hanford Site QA program requirements to qualify them for performing Hanford Site analytical work.

A2.3.2 Reports to Management

Reports to management on data quality issues will be made if and when these issues are identified by self-assessments or other types of assessments. Errors reported by the laboratories are communicated to the Field Team Lead, who initiates a sample disposition record in accordance with primary contractor procedures. This process is used to document analytical errors and to establish resolution with the Waste Site Remediation Task Lead.

DQA reports will be prepared to evaluate whether the type, quality, and quantity of the data that were collected meet the quality objectives described in this SAP and in the SSSPs.

A2.4 DATA VALIDATION AND USABILITY

Data validation and usability activities occur after the data-collection phase of the project is completed. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying the project objectives.

A2.4.1 Data Review, Validation, and Verification

Data will be reviewed, and data verification and validation will be performed on analytical data sets. These activities confirm that sampling and chain-of-custody documentation is complete and sample numbers can be tied to the specific sampling location described in Section A2.2, that samples were analyzed within required holding times identified in Table A2-5, and that sample analyses met the data quality requirements specified in this QAPjP.

Data verification will be performed on analytical data sets to ensure and document that the reported results reflect what was actually done. The criteria for verification include, but are not limited to, review for completeness (i.e., all samples were analyzed as requested), use of the correct analytical method/procedure, transcription errors, correct application of dilution factors, appropriate reporting of dry weight versus wet weight, and correct application of conversion factors. Laboratory personnel may perform data verification.

Data validation will be performed on analytical data sets to ensure that the data quality goals established during the planning phase have been achieved. As recommended in EPA guidance (Bleyler 1988a, *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses*; Bleyler 1988b, *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses*), the criteria for data validation are based on a graded approach. Fluor Hanford has defined five levels of validation, A – E. Level A is the lowest level and is the same as verification. Level E is a 100 percent review of all data (e.g., calibration data; calculations of representative samples from the dataset). Validation will be performed to Level C.

Level C validation includes 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 spike/matrix spike duplicate; surrogate recoveries; duplicates; and analytical method blanks. Level C validation will be performed for up to 5 percent of the data by matrix and analyte group. Analyte group refers to categories, such as radionuclides, volatile chemicals, semivolatiles, polychlorinated biphenyls, metals, anions, etc. The goal is to cover the various analyte groups and matrices during the validation.

No validation of physical data and/or field-screening results will be performed. However, field QA/QC (Section A2.2) will be reviewed to ensure that the data are useable.

A2.4.2 Validation and Verification Methods

Validation activities will be based on EPA functional guidelines (Bleyler 1988a; Bleyler 1988b). Data validation may be performed by the analytical laboratory, Sample and Data Management, and/or by a party independent of both the data collector and the data user.

When outliers or questionable results are identified, additional data validation will be performed. The additional validation will be performed for up to 5 percent of the statistical outliers and/or questionable data. The additional validation will begin with Level C and may increase to Levels D and E as needed to ensure that the data are usable. Note that Level C validation is a review of the QC data, while Levels D and E include review of calibration data and calculations of representative samples from the dataset. Data validation will be documented in data validation reports, which will be provided to the Sample and Data Management organization and in the DQA report (see Section A2.4.3). At least one data validation package will be generated for each waste site or group of waste sites in the SSSPs. The Sample and Data Management organization is responsible for distributing the data validation report to the Waste Site Remediation Task Lead and to others as necessary. The determination of data usability will be documented in the DQA.

A2.4.3 Reconciliation with User Requirements

Following data verification and validation, the data need to be evaluated to see if they answer the original questions asked (e.g., DQOs). The DQA process compares completed field-sampling activities to those proposed in corresponding sampling documents and provides an evaluation of the resulting data. The purpose of the data evaluation is to determine if quantitative data are of the correct type and are of adequate quality and quantity to meet the project DQOs. The Waste Site Remediation Task Lead is responsible for ensuring that a DQA is performed. The results of the DQA will be reported to the Waste Site Remediation Task Lead and will be used in interpreting the data and determining if the objectives of this activity have been met.

The EPA DQA process, EPA/240/B-06/002, *Data Quality Assessment: A Reviewers Guide*, EPA QA/G-9R, and EPA/240/B-06/003, *Data Quality Assessment: Statistical Tools for Practitioners*, EPA QA/G-9S, identifies five steps for evaluating data generated from this project, as summarized below.

Step 1. Review DQOs and Sampling Design. This step requires a comprehensive review of the sampling and analytical requirements outlined in the project-specific DQO workbook and SAP.

Step 2. Conduct a Preliminary Data Review. In this step, a comparison is made between the actual QA/QC achieved (e.g., detection limits, precision, accuracy) and the requirements determined during the DQO. Any significant deviations will be documented. Basic statistics will be calculated from the analytical data at this point, as appropriate to the data set, including an evaluation of the distribution of the data and in accordance with the DQOs.

Step 3. Select the Statistical Test. Using the data evaluated in Step 2, an appropriate statistical hypothesis test is selected and justified.

Step 4. Verify the Assumptions. In this step, the validity of the data analyses is assessed by determining if the data support the underlying assumptions necessary for the analyses or if the data set must be modified (e.g., transposed, augmented with additional data) before further analysis. If one or more assumptions are questioned, Step 3 is repeated.

Step 5. Draw Conclusions from the Data. The statistical test is applied in this step, and the results either reject the null hypothesis or fail to reject the null hypothesis. If the latter is true, the data should be analyzed further. If the null hypothesis is rejected, the overall performance of the sampling design should be evaluated by forming a statistical power calculation to assess the adequacy of the sampling design.

A2.4.4 Follow-On Data Quality Objectives

Because this Work Plan and SAP address supplemental data-collection activities for OUs that have undergone an initial phase of RI sampling, assessment of the supplemental data in conjunction with the existing data is needed prior to proceeding to decision making. Data quality of the supplemental data will be evaluated as described in this QAPjP. In addition, the combined data sets will be reviewed for usability and to determine if data gaps identified through the DQO process have been adequately addressed by these combined data sets. The Tri-Parties will review the combined data sets to ensure that sufficient decision-making data are available prior to revising or preparing the FSs. If concerns exist about the ability to make decisions based on the combined existing and supplemental data, then the Tri-Parties can choose to conduct a follow-on DQO process to evaluate remaining decision-making data gaps and identify additional data-collection activities needed to complete the RI/FS process. The Supplemental Work Plan and SAP will serve as the foundation for any additional data-collection activities identified through the follow-on DQO process. The follow-on data-collection activities will be incorporated into the Work Plan and SAP through Volume 2 as SSSPs.

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A3.0 FIELD-SAMPLING PLAN

The supplemental RI FSP describes the field activities for collection of field observations, measurements, and samples for laboratory analysis. This FSP provides more detailed information on sampling methods, field-screening technologies, and waste management activities. All of the data-collection techniques may not be required at each waste site. Site-specific FSP addenda are included in Volume 2 that detail supplemental RI activities at each individual waste site.

The objective and purpose of the supplemental RI data collection and this overall FSP are identified in this Work Plan. The waste sites requiring supplemental data and the type of data needed are identified in Appendix C. Applicable sampling and data-collection techniques identified in this overall FSP will be specified in the SSSPs in Volume 2 of this Work Plan.

A3.1 DATA-COLLECTION TECHNIQUES

As discussed in Section A2.2, a variety of sample methods and measurements may be applicable to data-collection activities identified for the supplemental RI. The data needs identified through the supplemental DQO require sampling of different media, including the following:

- Surface soil
- Subsurface soil (at depths extending to groundwater)
- Groundwater (at the water table)
- Perched water (within the vadose zone)
- Soil vapor
- Residual waste materials.

This SAP includes a range of data-collection techniques that can be used to obtain vadose zone information, such as soil samples, physical soil properties, and geophysical surveys for radionuclides and moisture. Data-collection techniques can be either intrusive (i.e., penetrate the vadose zone deeper than 0.30 m [1 ft]) or nonintrusive. The following subsections present common intrusive and non-intrusive techniques that may be used under this SAP. The techniques discussed in this section are the most commonly used at the Hanford Site to collect vadose zone data and will represent the majority of the techniques used for supplemental data collection.

A supporting document, SGW-32606, *Characterization Technologies for Waste Site Model Groups*, has been developed that identifies and evaluates techniques that can be used to collect data. It provides additional technical details on potential data-collection techniques for waste-site RIs.

A3.1.1 Intrusive Collection Techniques

Intrusive techniques included in this plan are borehole drilling, direct-push techniques, and test pitting and trenching.

A3.1.1.1 Borehole Drilling and Sampling

A3.1.1.1.1 Borehole Drilling

Borehole drilling can be conducted using a variety of equipment depending on data needs. For application at the Central Plateau waste sites, drilling is commonly done with a cable tool rig, or a similar type rig that allows control of contaminated cuttings; permits spectral gamma, neutron moisture, and other types of downhole geophysical logging; and provides adequate soil return to support soil sampling, either through a split-spoon sampler or through a grab sample. Table A3-1 summarizes the different types of sample collection methods and their individual characteristics.

All drilling will be via a method approved by the project, and will conform to site-specific technical specifications for environmental drilling services. Drill rigs for deep boreholes will generally require a gravel pad and, in some cases, a gravel access road. Cleaning and decontamination requirements also will be performed in accordance with approved procedures and as described in the QAPjP, Section A2.2.2.1.

Multiple casing strings may be used by telescoping to reach the proposed total depth for the borehole and to minimize transport of contaminants in the vadose zone from the drilling operations. The casing sizes will be of sufficient size to accommodate a split-spoon sampler to the bottom of the borehole. Downsizing of the casing will be commensurate with the decrease in contamination levels with depth based on field screening. Actual conditions during drilling may warrant changes; the changes may be implemented after consultation with, and the approval of, the Field Team Lead and the Waste Site Remediation Task Lead.

After drilling, sampling, and logging the boreholes identified in this SAP, the casing will be removed and the boreholes will be decommissioned in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." For combined vadose zone and groundwater boreholes where the borehole will be drilled into the aquifer and completed as a groundwater monitoring well, completion activities will be conducted in accordance with a well design approved by the Field Team Lead. The design will conform to WAC 173-160 requirements or, if needed, a variance to that regulation will be obtained from Ecology prior to construction.

A3.1.1.1.2 Borehole Sampling

In general, the intent of the borehole sampling design in a waste site is to collect samples at key areas of interest with depth in the vadose zone. These key areas include, but are not limited to, the following:

- Within the 0 to 4.6 m (0 to 15-ft) zone to provide data to support risk assessment for human health and ecological screening and risk assessment
- At the bottom of the waste site to evaluate the high concentrations associated with the very low mobility constituents, such as plutonium and Cs-137

- At lithologic changes and on top of lower permeability zones where contaminants may be held up in the vadose zone

- Along the length of the borehole to look for more mobile constituents and to assess residual contamination left behind after discharges ceased

- At the outer edges of an HRR or geophysically identified plume or the boundary of the waste site to provide extent information.

Borehole sample collection will be guided by the sampling approaches outlined for the individual waste sites or groups of waste sites identified in Volume 2 SSSPs. Actual sampling intervals may vary from these approaches, depending on field-screening results and varying subsurface conditions. The intent of the sampling design is to generally begin sample collection at or just above the bottom of the waste site, depending on waste-site construction. For example, in a crib that is constructed with the crib bottom at 3.7 m (12 ft) below ground surface (bgs) and a 0.6 m (2-ft) stabilization cover, the mass of the low-mobility contaminants (e.g., Cs-137 and plutonium) would be expected to start approximately 4.3 m (14 ft) down. Field screening would be used to confirm correct crib bottom depth. Samples may be collected above the waste-site bottom to assess backfill material, to support waste site-specific ecological screening, and to augment human-health risk assessment if data are not currently available. These near-surface samples will be used to supplement ongoing ecological risk assessment for the entire Central Plateau.

Sampling would continue intermittently (based on the site's conceptual contaminant distribution model, results of nearby borehole logging events, and professional judgment of the field geologist) to total depth. Samples may be collected for Table A2-1 and Table A2-2 analysis, grab sample analysis, physical properties analysis, or focused analysis.

A3.1.1.1.3 Split-Spoon Sampling and Analysis

Split-spoon sampling and analysis will be used to evaluate all the identified COPCs for a waste site that were originally identified in the associated OU RI/FS approved work plans. These COPC lists form the COPC lists for the supplemental work (see Table A2-3). In some instances, a reduced COPC list will be used based on the amount and quality of the existing data. The COPC list for each waste site is included in the SSSPs; a list of COPCs by OU is included in Table A2-3. Radiological and nonradiological analytes identified for the Central Plateau and their associated analytical performance indicators are presented in Tables A2-1, A2-2, and A2-4.

The split-spoon samplers will be equipped with four separate liners, generally stainless steel or lexan.[1] Site personnel will not overdrive the sampling device. With the exception of the volatile organic analyte samples, soil will be transferred to a pre-cleaned, stainless steel mixing bowl, homogenized, and then containerized in accordance with contractor sampling procedures. Volatile organic analyte samples will be collected prior to homogenization of the soils.

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[1] Lexan is a registered trademark of General Electric Company, New York, New York.

A3.1.1.1.4 Grab Sampling and Analysis

To gain a better understanding of the distribution of mobile contaminants (e.g., Tc-99, uranium, nitrate, nitrite, chromium, tritium, I-129), grab samples may be collected from the drill cuttings. The purpose of the grab samples is to analyze the contaminants within the pore water of the vadose zone. These samples will be analyzed using leaching techniques to extract the contaminants, followed by analysis of the extracts (Table A3-2) for the contaminants listed in Table A2-3. Grab samples can be collected at short sampling intervals, typically 0.76 m (2.5 ft) and temporarily stored for analysis. Initially, analysis will be run on a subset of the grab samples; e.g., the 3 m (10-ft) samples. These results will be reviewed, and additional analysis will be performed using the intermediate sample intervals (e.g., 0.76 m [2.5-ft] samples) in areas of elevated concentrations or to refine the understanding of contaminant distribution.

Grab samples will be collected into jars directly from the drive barrel cuttings. Samples will be analyzed at an onsite laboratory. Pore water removal from the soils initially will be attempted by centrifuge to extract the pore water with pressure. Additionally, water, acid, or both may be used to leach contaminants from the soil. The soil also will be evaluated for gamma-emitting radionuclides and total carbon. These analyses will provide more detailed information to understand distribution and potential movement of mobile COPCs and to support future modeling efforts, as needed.

A3.1.1.1.5 Physical Properties Sampling and Analysis

Physical property samples will be collected from the boreholes to provide site-specific values to support the RESRAD dose model (ANL 2005), Subsurface Transport Over Multiple Phases (STOMP) (PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide)*, or other modeling. General soil properties of interest are pH, moisture content, grain-size distribution, specific conductivity, and soil density. Samples for soil density generally will be collected with a split-spoon sampler equipped with four separate stainless steel or LEXAN liners. Physical property samples will be analyzed in accordance with American Society for Testing and Materials methods. The physical property samples will be collected from lithologies that represent the major facies in the vadose zone. The samples will be collected coincident with nonradiological and radiological split-spoon sample intervals, where possible. Additional physical properties of interest may include distribution coefficient, porosity, specific conductivity, or other parameters. Site-specific physical property analyses are identified in the SSSPs.

A3.1.1.1.6 Focused Sampling and Analysis

Focused analysis may be used to look for specific constituents or to evaluate particular characteristics of a sample, such as plutonium concentration, distribution coefficient, or leachability. Focused analysis also may be used if the COPCs for a site have been reduced to contaminants of concern through a data-supported screening process (such as the risk assessment or FS processes) or if existing data are sufficient for all but a smaller set of constituents. Focused sampling analytes and/or parameters will be specified in the SSSPs.

If sample volume requirements cannot be met because of sample recovery issues, samples will be collected according to a priority based on the nature of the data gap being filled. For samples that are being collected to support protection of groundwater analysis, the sample priority will be given to the grab sample analysis. If plutonium is an identified data need, then priority would be given to the plutonium analytes. Priority will be established in the SSSPs.

Following drilling, the boreholes will be geophysically logged for gamma-emitting radionuclides, neutron moisture content, and/or passive neutron (see Section A3.1.2.3). These data will be collected in HEIS; a summary report also will be prepared by the logging contractor to document the logging activity and results. The logging summary reports will be documented in the field summary report so they can be referenced in the FS and other documents as necessary.

A3.1.1.2 Direct-Push Techniques and Sampling

Direct-push techniques use a pushing method, such as a diesel hammer, hydraulic hammer, cone penetrometer, or GeoProbe,[2] to penetrate the vadose zone to collect soil samples and to obtain downhole geophysical data (e.g., small-diameter spectral gamma, moisture). These methods generally are limited in the depth of penetration and in sample volume as compared to borehole drilling; they are generally less expensive than drilling, however.

Direct-push holes may be installed to obtain spectral gamma, neutron moisture, and/or passive neutron logs and/or vapor samples. Some direct-push technologies also permit sampling. The number of samples and the depth of sampling are limited and capabilities vary with each method. Table A3-3 identifies direct-push techniques and their associated capabilities. Direct-push holes are decommissioned the same as boreholes.

Sample collection from the direct-push techniques is done from a driven sampling device, similar to the split-spoon sampler discussed in the borehole drilling section. Sampling is conducted first for volatile organic analytes (if required), then soils are homogenized and sampled for the remainder of the analytes. Site-specific COPCs are identified in the SSSPs, along with analytical priority. Because of the limited sample size on some methods, focused analysis may be used to ensure the analytes of highest need to fill the data gap are analyzed. Maximum depth for these techniques is near 33 m (100 ft); some of the techniques are limited to even lower depths. Techniques are chosen to address data gaps and may be reevaluated with time to obtain the appropriate quality of data.

A3.1.1.3 Test Pitting/Trenching and Sampling

A3.1.1.3.1 Test Pitting/Trenching

Test pitting and trenching use excavation equipment to reach contaminated soil for sampling. Test pits are focused excavations, generally with a maximum depth of about 7.6 m (25 ft) bgs. Depending on site conditions, clean soil can be removed from the surface to gain some additional depth capability. Soils generally are sampled from the excavator bucket and can be field

[2] GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.

screened for volatiles or radioactivity. Trenching uses longer excavations to intercept the contaminated material.

Site-specific test pit/trenching locations may be adjusted in the field to account for site conditions. If basalt is encountered in the test pits, excavations will be halted. Test pits will be excavated in a manner that minimizes the generation of visible emissions (e.g., dust) from the site boundary during excavator operations by use of water or a fixant sprayed on the site before and during the activity. If visible emissions cannot be controlled, the activity will be postponed. When the slope of the sides is too steep for the safe use of heavy excavation equipment, a shallow test pit can be accessed using hand augers and shovels. Although not planned, a hollow-stem auger may be used as an alternative if it is more cost-effective and does not impact data quality.

A3.1.1.3.2 Test Pit/Trench Sampling

Generally, the samples will be collected at the bottom of the waste-site structure (i.e., discharge point; e.g., at the bottom of the crib structure or the originally excavated trench bottom), or upon the first detection of radiological contamination above background levels, whichever is encountered first. A general sampling scheme that has been used at other Central Plateau test pits/trenches is to sample at 0.75 m (2.5-ft) intervals to 3 m (10 ft) bgs, then at 1.5 m (5-ft) intervals to the desired sampling depth up to 7.6 m (25 ft) bgs. Actual site-specific sampling depths will be based on the site-specific conditions and data needs; these are specified in the Volume 2 SSSPs. Additional samples may be collected at the discretion of the geologist/sampler based on visual conditions, field-screening information, and professional judgment. Critical samples will be collected at 4.6 m (15 ft) bgs, at the waste-site structure bottom, and for ponds, at the organic layer that represents the pond bottom. If contamination is observed during the excavation process either visually (e.g., staining) or via field-screening equipment at the maximum sampling depth, an additional deeper sample may be attempted (depending on the limitations of the excavation equipment) for further resolution of the vertical contamination concentration profile. Samples may be collected in backfill material to support risk assessment and to verify the backfill material is clean.

Sampling from test pits and/or trenches will be performed in accordance with approved procedures. Samples from a test pit generally will be collected from the site sediment layer (e.g., pond bottom/organic mat) as identified through radiological field screening, visual observation, and judgment of the geologist/sampler or at the first detection of contamination (generally above background), whichever is encountered first. Where ALARA considerations allow, samples can be taken directly from the test pit strata. Alternatively, samples will be collected directly from the excavator bucket, which will target the interval 0.3 m (1 ft) below the specified sampling depth. This will help ensure that the sample target depth material is accessible in the bucket. Volatile samples will be collected first in accordance with approved procedures; they will be collected directly from the excavator bucket into appropriate sample containers to minimize loss to the atmosphere. For the remainder of the analytes, sample material will be scooped from the bucket into a pre-cleaned, stainless steel mixing bowl, homogenized, and then containerized in accordance with sampling procedures. Samples will be handled and managed as described in the QAPjP (see Section A2.2.3). Samples generally will not be collected to evaluate soil physical properties from test pit and trenches.

A3.1.1.4 Shallow Auger Drilling and Sampling

Shallow auger drilling uses an auger drilling method to obtain vadose zone samples. Samples are retrieved at the surface as cuttings, which can be sampled as described under the borehole sampling section or can be sampled from a split-spoon sampler. Augering represents a fast and inexpensive method of collecting focused samples for specific purposes. Depth discrete samples can be difficult with augers, however. In addition, physical property samples are not usually collected with this method because of the limited depth capability.

A3.1.1.5 Surface Sampling

Surface sampling is used to collect soil samples in the upper few inches to few feet of the vadose zone. Surface sampling is usually assumed to be limited to 0.6 to 0.9 m (2 to 3 ft) in depth, the area that can easily be reached with hand tools. Beyond these depths or for a lot of sample locations, direct-push techniques become more efficient. Surface samples can be collected by digging soils with hand tools and placing them into clean, stainless steel bowls for homogenization. In addition, surface soils also may be collected using a multi-incremental sampling technique, where small aliquots of soils are collected over the surface area and submitted for analysis. This technique results in mean concentrations for analytes within the sample area. While this type of sampling is not initially planned for the supplemental activities, future sampling activities may benefit from this technique. If so, the details, including QA information, will be included with the SSSP for that waste site or activity.

A3.1.2 Non-Intrusive Collection Techniques

Non-intrusive techniques can be used to augment the soil samples collected through the intrusive sampling techniques. These techniques consist of a broad range of geophysical, radiological, and field-screening applications that can provide data on radionuclides, physical parameters, chemicals, vapors, and other characteristics that add to the understanding of the nature and extent of contamination. Additional information on the range of techniques is provided in SGW-32606. The most common techniques are discussed in the following sections. Site-specific techniques are detailed in the Volume 2 SSSPs.

A3.1.2.1 Soil Vapor Measurements

Vapor samples may be collected from boreholes or direct-push holes at locations where volatile organics are a concern. As drilling or direct-push activities proceed, monitoring for volatile organics will be performed by an industrial hygiene technician. The industrial hygiene technician will monitor the air space immediately surrounding the borehole as the borehole drilling proceeds and during soil-sample removal. Soil-vapor samples will be collected using a commercial inflatable rubber packer, or test plug, with a vapor-sampling tube attached. The packer/test plug will be inserted to the required sample depth near the bottom of the casing. The packer/test plug will be inflated to seal off the casing and leave the end of the sampling tube exposed to soil vapor in or near the open portion of the borehole. An in-line high-efficiency particulate air filter will be installed in the air-sampling line for radiological screening. An air-sampling pump will be used to withdraw vapor from the sampling tube. Gross volatile organic compound concentration in the air stream will be measured using a handheld photo ionization detector. Measurements will be recorded. Once the sample line and borehole have been purged, an air sample will be collected in a Tedlar[3] bag. The packer/test plug will be deflated and removed, and the in-line high-efficiency particulate air filter will be radiologically screened. Once radiological screening is complete, volatile organic compound concentrations in the Tedlar bag will be analyzed using the Innova[4] multigas monitor or equivalent field-screening instrument.

A3.1.2.2 Surface Radiological Surveys

A surface radiation survey will be performed as part of the excavation permit process at each waste site to be investigated to locate and quantify the presence of surface radioactive contamination and verify process knowledge and to support worker health and safety during RI activities. Radiological surveys will be performed in accordance with radiological control procedures and documents. Instrument calibration and survey records will be completed in accordance with applicable radiological control procedures. Survey instruments will be calibrated, maintained, and operated in a manner that meets the performance requirements of this SAP. A post-sampling survey also will be performed at each sampling site to ensure that sampling activities have not contributed to surface contamination.

A3.1.2.3 Downhole Geophysical Logging

Boreholes and direct pushes generally will be logged with a high-resolution spectral gamma-ray logging system to provide continuous vertical logs of gamma-emitting radionuclides, and with a neutron moisture-logging system to identify moisture changes. In addition, existing boreholes may be logged with the spectral gamma and/or moisture-logging systems. The spectral gamma logging of existing wells in the vicinity of a waste site can be a cost-effective method of providing supplemental data on the vertical and lateral distribution of gamma-emitting radionuclides. The spectral gamma logging system uses instrumentation to identify and quantify gamma-emitting radionuclides in wells as a function of depth.

The spectral gamma logging system uses laboratory-grade high-purity germanium HPGe detectors to collect 4096-channel gamma energy spectra at discrete depth increments. Radionuclide identification and assay are based on characteristic gamma emissions associated with decay. At each depth increment, the gamma energy spectrum is analyzed to detect peaks, and to determine net count rate, counting error, and minimum detectable activity for each peak. The energy resolution capability of the detector varies between approximately 2 and 4 keV, depending on energy level and background activity. Net counts from individual gamma energy peaks are processed with the detector calibration function, dead time correction, casing correction, and water correction to determine the bulk concentration, the analytical error, and the minimum detectable level. All quantities are reported in pCi/g. For selected radionuclides specific regions of interest can be "forced" to determine the minimum detectable activity even when no peak is detected. Thus, the minimum detectable activity and analytical error are

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[3] Tedlar is a registered trademark of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

[4] Innova is a trademark of Innova AirTech Instruments S/S Naerum, Denmark.

calculated on a point-by point basis and shown on the log plot. The minimum detectable activity depends on the intensity (yield) of the characteristic gamma ray, detector efficiency, casing thickness, and background activity level.

A logging system is defined as a unique combination of downhole sonde (detector) and logging system (cable, winch, power supply, control system, and data acquisition system). The spectral gamma logging system and the neutron moisture logging system are calibrated on an annual basis, or after any significant repairs or modifications to either the sonde or the logging system. Calibration measurements are made at the Hanford Calibration Facility, located near the central weather station, just east of the Hanford 200 West Area. Each calibration is documented with a calibration certificate.

The neutron-moisture logging system that measures moisture employs a weak americium beryllium neutron source and neutron detector to provide a direct reading of hydrogen atom distribution in the soil surrounding the borehole. This detector will be used to measure continuous vertical moisture in the vadose zone. The spectral gamma logs will be used to supplement the laboratory radionuclide data to determine the vertical distribution of radionuclides in the vadose zone beneath the units and to aid in geological interpretation of subsurface stratigraphy. The deep boreholes will be logged through the casing before a new casing string is added and after the well has reached total depth. The spectral gamma logging equipment calibration is conducted annually, and the data acquired during the calibrations are used to derive factors that convert measured peak-area count rate to radionuclide concentrations in picocuries per gram. Corrections are applied to the data to compensate for the gamma ray attenuation by the casing.

Logging runs will be made before the casing sizes are changed and at the total depth of the borehole. The downhole tools and cable will be subject to the same rules as are the drill rig and equipment. The downhole tools and cable will be cleaned between boreholes. The upper part of each borehole will be the most contaminated and will be logged first.

Small-diameter direct-push holes can be logged using small-diameter spectral gamma and moisture logging instruments. These instruments function in the same manner as the instruments used in larger-diameter boreholes, but they have been adapted to work inside the smaller-diameter casings associated with the direct-push techniques.

Geophysical logging data will be collected in HEIS; a summary report also will be prepared by the logging contractor to document the logging activity and results. The logging summary reports will be documented in the field summary report so they can be referenced in the FS and other documents as necessary.

A3.1.2.4 High-Resolution Resistivity Description

The resistivity method is based on the capacity of earth materials to resist electrical current. Earth resistivity is a function of soil type, porosity, moisture, and dissolved salts. The concept behind applying the resistivity method is to detect and map changes or distortions in an imposed electrical field due to heterogeneities in the subsurface.

The objective of HRR surveys is to identify and characterize areas of high electrical conductivity beneath and adjacent to waste sites or groups of waste sites area that could be related to subsurface contaminant plumes. The HRR data can also be used to ascertain flow direction (if not vertical) of high ionic strength solutions that may be migrating downward, and presumably laterally but beyond the reach of other, more shallow geophysical methods.

The HRR technique has the capability of detecting and mapping sufficiently large active plumes and their footprints from near surface to the saturated zone. Initial efforts to establish relationships between HRR data and soil contaminant concentrations in the Central Plateau have shown strong correlation with soil pore water contamination and electrical conductivity.

HRR appears to be best suited for evaluation of the extent of relatively deep vadose zone contamination that has high mobility. Deeper active plumes are expected to consist of the more mobile contaminants. The shallow plumes are expected to consist of the less mobile constituents. The deeper the plume, however, the larger the sampling volume required to adequately resolve the plume. Highly sorbed contaminants, such as Cs-137, that are not associated with the soil pore water are not expected to contribute significantly to overall soil conductivity.

Interrogation depth is dependent on the length of the line of electrodes employed to collect the data. Capability to evaluate the Hanford Site Central Plateau entire vadose zone (i.e., to approximately 107 m [350 ft] bgs) is readily achieved.

A3.1.2.5 Field-Screening Techniques

Field screening can be used to identify the bottom of the waste site (i.e., crib/trench) and adjust sampling points, assist in determining sample shipping requirements, and support worker health and safety monitoring. This section will identify several field-screening instruments that may be used during the course of the field investigations. All field-screening instruments used will be maintained and calibrated in accordance with the manufacturer's specifications and approved procedures. The field geologist or sampling personnel will record field-screening results.

A3.1.2.5.1 Portable Radiological Detection Instruments

Radiological screening of samples and cuttings from RI activities will be conducted by the radiological control technician or other qualified personnel for evidence of radioactive contamination. Surveys of these materials will be conducted visually and with field instruments. The radiological control technician will record all field measurements, noting the depth of the sample and the instrument reading.

Before drilling begins, a local area background reading will be taken with the field-screening instruments at a background site to be selected in the field. The site geologists will use professional judgment and screening data to finalize sampling decisions in the field as needed.

The field action level for radionuclide screening is twice background. Intervals above this field action level will be assessed for sampling by the field geologist. If a waste site is determined to be a high and/or medium risk site for RI, then a temporary field storage area will be established at the site. Additionally, samples that exceed background will be stored in a temporary field storage area at the site until evaluated by waste management personnel. Radiological control requirements will be established on the samples as required.

A3.1.2.5.2 Portable Organic Detection Instruments and Other Field-Screening Techniques

Table A3-4 identifies common field-screening techniques for organic and metal constituents. Screening for volatile organics will be performed by the health and safety technician using a photoionization detector or other methods, if required by the site-specific health and safety plan. Monitoring for volatile organics also can be conducted during drilling, test pit excavation, or direct-push investigations to support possible soil gas vapor sampling.

In situ determination of organics and metals in soil generally is limited to qualitative or semi-quantitative analysis. The only technology identified for subsurface in situ analysis is laser-induced fluorescence, and this has only been applied to hydrocarbons. Handheld X-ray fluorescence can be used on surface soils for quantitative analysis of metals. These instruments have improved to the point where most metals can be determined in the tens of parts per million, but this may still not be low enough to meet desired remedial action goals.

Several field techniques for ex situ analysis of organic and inorganic analytes may be applicable to characterization of soils on the Central Plateau. Chemical and immunoassay colorimetric kits are available for a wide range of constituents and many have detection limits suitable to the project's needs. These techniques require the extra step of liquid extraction of constituents from soil and performing some simple wet chemistry. Detection limits for field X-ray fluorescence also may be improved by sample processing (i.e., soil sieving), but data from this technology represent the total species present in the sample, not only the dissolvable contaminants, so may not be directly comparable to laboratory analyses performed with EPA protocols.

Field instruments, while perhaps not sensitive or quantitative enough to demonstrate clean closure, can be valuable in looking at existing contamination distribution during initial characterization sampling, and/or directing some opportunistic sampling of "hot spots" or contamination extent.

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A4.0 HEALTH AND SAFETY PLAN

The purpose of this chapter is to identify hazards that may be encountered during implementation of the FSP and establish a preliminary framework of actions to mitigate those hazards in the field. All field operations will be performed in accordance with Project Hanford Management Contractor health and safety requirements and the appropriate project-specific procedures. In addition, work control packages will be prepared in accordance with procedures that will further control site operations. These packages will include activity job-hazard analyses, site-specific health and safety plans, and applicable radiological work permits. Work will be performed in accordance with site-specific health and safety plans and applicable radiological work permits.

The sampling procedures and associated activities will take into consideration exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team.

Health and safety personnel will use historical information, data collected during the previous RI activities, and real-time field screening as input to determine exposure levels to workers and to conduct health and safety assessments in accordance with the health and safety plan.

A4.1 HAZARD IDENTIFICATION AND MITIGATION

Performing field investigations at hazardous waste sites involves potential exposure to hazards related to the contaminants present at the site, the nature of the intended work, and the environment in which the work will be performed. This section identifies general physical, biological, chemical, and radiological hazards that may be encountered as this supplemental RI is implemented. Hazards that are specific to individual waste sites will be identified and addressed in site-specific job-hazard analyses and site-specific health and safety plans.

A4.1.1 Physical Hazards

Physical hazards associated with the planned work include machine or mechanical hazards, location hazards, and environmental hazards. These hazards are summarized in Table A4-1.

A4.1.2 Biological Hazards

Biological hazards may be presented by organisms in and near the work area. Biological hazards include venomous creatures (e.g., snakes, spiders, scorpions, bees, and wasps), poisonous plants (e.g., nettles, poison oak/ivy), and large animals (e.g., coyotes). Biological hazards also may include blood-borne pathogens in situations where exposure to human body fluids is possible. These hazards are generally mitigated by situational awareness and personal protective equipment.

A4.1.3 Chemical Hazards

The waste sites to be investigated during the supplemental RI are known to be contaminated with varying quantities of hazardous chemicals. Chemical hazards for each site will be assessed prior to starting field activities, and requirements for mitigating potential hazards will be identified. Real-time air-quality monitoring will be used as appropriate to identify changes in air quality and to determine whether health and safety action levels have been exceeded. The general types of chemical hazards that may be encountered during the supplemental RI field activities are summarized in Table A4-2.

A4.1.4 Radiological Hazards

Many of the sites that are the focus of the supplemental RI are known to be radiologically contaminated. Intrusive investigation into these sites (i.e., drilling, sampling, excavating) presents potential exposure to ionizing radiation. The radiological contaminants known to be present at these sites include alpha-, beta-, and gamma-emitting radionuclides. Potential hazards associated with these contaminants include direct exposure to ionizing radiation, contamination of skin, and ingestion/inhalation of airborne contaminants.

Sites with known or suspected radiological contamination will be evaluated prior to intrusive activities, and radiological work permits will be developed prior to work. The radiological work permits will address radiological monitoring requirements as well as protective clothing and respiratory protection requirements for the planned work.

A4.2 TRAINING AND MEDICAL MONITORING

Field personnel will be required to demonstrate current training as required by specific tasks. Training is expected to include 40- or 80-hour training to meet the requirements for hazardous waste operations and emergency response, and Hanford Site-specific access and radiation worker training at a minimum (also see Section A2.1.5). Additional training may be required for personnel operating specific equipment. Annual medical monitoring also will be required as well as respiratory protection training and a current respiratory protection equipment fit test.

A5.0 INVESTIGATION-DERIVED WASTE

Waste generated by sampling activities will be managed consistent with the existing approved waste control plans for the OUs, with revisions to these waste control plans to incorporate the supplemental data-collection activities, and/or with new waste control plan(s) yet to be developed for the activity.

Because offsite laboratories to be used for sample analysis are licensed to manage and dispose of unused sample material, returns from offsite laboratories are not expected. However, sample material from onsite or offsite laboratories will be managed as sample returns and will be dispositioned with the investigation-derived waste for the waste site in accordance with the approved waste control plan.

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A6.0 REFERENCES

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Table A2-1. Analytical Performance Requirements for Radionuclides. (3 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service No.	Preliminary Action Level[a] (pCi/g)				Hanford Site Background[f] pCi/g	Name/ Analytical Technology	Required Detection Limits		Soil[d] (%)		Water[d] (%)	
		Human Health (15 mrem/yr[b])		Ground-water Protection[c]	Ecological Protection								
		Industrial	Un-restricted					Water (pCi/L)	Soil (pCi/g)	Precision	Accuracy	Precision	Accuracy
Americium-241	14596-10-2	335	--	--	3,890	--	Americium isotopic – AEA	1	1	±30	70-130	±20	80-120
Antimony-125	14234-35-6	32.5	--	--	3520	--	GEA	50	0.2	±30	70-130	±20	80-120
Carbon-14	14762-75-5	97,300	--	--	--	--	Liquid scintillation	200	50	±30	70-130	±20	80-120
Cesium-134	13967-70-9	8.43		--	--	--	GEA	15	1	±30	70-130	±20	80-120
Cesium-137	10045-97-3	23.4	6.2	--	115	1.05	GEA	15	0.1	±30	70-130	±20	80-120
Cobalt-60	10198-40-0	4.9	--	--	692	0.00842	GEA	25	0.05	±30	70-130	±20	80-120
Europium-152	14683-23-9	11.4	--	--	1,520	--	GEA	50	0.1	±30	70-130	±20	80-120
Europium-154	15585-10-1	10.3	3	--	1,290	0.0334	GEA	50	0.1	±30	70-130	±20	80-120
Europium-155	14391-16-3	426	--	--	15800	0.0539	GEA	50	0.1	±30	70-130	±20	80-120
Iodine-129	15046-84-1	3080	--	--	5670	--	Chemical separation low-energy photon spectroscopy	5	2	±30	70-130	±20	80-120
Neptunium-237	13994-20-2	59.2	2.44	--	1,900	--	Np-237 – AEA	1	1	±30	70-130	±20	80-120
Nickel-63	13981-37-8	3070000	--	--	--	--	Ni-63 – liquid scintillation	15	30	±30	70-130	±20	80-120
Niobium-94	14681-63-1	8.25	--	--	--	--	GEA	50	1	±30	70-130	±20	80-120
Plutonium-238	13981-16-3	470	--	--	6230	0.00378	Pu isotopic – AEA	1	1	±30	70-130	±20	80-120

Table A2-1. Analytical Performance Requirements for Radionuclides. (3 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service No.	Preliminary Action Level[a] (pCi/g)				Hanford Site Background[f] pCi/g	Name/ Analytical Technology	Required Detection Limits		Soil[d] (%)		Water[d] (%)	
		Human Health (15 mrem/yr[b])		Ground-water Protection[c]	Ecological Protection								
		Industrial	Un-restricted					Water (pCi/L)	Soil (pCi/g)	Precision	Accuracy	Precision	Accuracy
Plutonium-239/240	Pu-239/240	425	33.9	--	6,110	0.0248	Pu isotopic – AEA	1	1	±30	70-130	±20	80-120
Radium-226	13982-63-3	7.03	--	--	50.6	0.815	GEA	1	0.1	±30	70-130	±20	80-120
Radium-228	15262-20-1	8.15	--	--	43.9	--	GEA	1	0.2	±30	70-130	±20	80-120
Strontium-90	10098-97-2	2,410	3.8	--	22.5	0.178	Total radioactive strontium – GPC	2	1	±30	70-130	±20	80-120
Technetium-99	14133-76-7	412,000	8.5	--	4,490	--	Gas Proportional counting/ Tc-99 – liquid scintillation	15	15	±30	70-130	±20	80-120
Thorium-232	7440-29-1	4.8	--	--	174,000	1.32	Th isotopic - AEA	1	1	±30	70-130	±20	80-120
Hydrogen-3 (tritium)	10028-17-8	139,500	--	--	174000	--	Tritium – liquid scintillation	400	400	±30	70-130	±20	80-120
Uranium-233/234[e]	U-233/234--	2,440	--	--	4830	1. 1[g]	U isotopic – AEA	1	1	±30	70-130	±20	80-120
Uranium-235/236[e]	U-235/236	101	--	TBD	2770	0.252[h]	U isotopic – AEA	1	1	±30	70-130	±20	80-120
Uranium-238	7440-61-1	504	90.0	TBD	1,580	1. 06	U isotopic – AEA	1	1	±30	70-130	±20	80-120
Gross alpha	NA	--	--	--	--	--	Gas Proportional counting	3	5	±30	70-130	±20	80-120
Gross beta	NA	--	--	--	--	--	Gas Proportional counting	4	15	±30	70-130	±20	80-120

Table A2-1. Analytical Performance Requirements for Radionuclides. (3 Pages)

Contaminants of Potential Concern	Chemical Abstracts Service No.	Preliminary Action Level[a] (pCi/g)				Hanford Site Background[f] pCi/g	Name/ Analytical Technology	Required Detection Limits		Soil[d] (%)		Water[d] (%)	
		Human Health (15 mrem/yr[b])		Ground-water Protection[c]	Ecological Protection								
		Industrial	Un-restricted					Water (pCi/L)	Soil (pCi/g)	Precision	Accuracy	Precision	Accuracy

- [a] The preliminary action level (from the data quality objectives process) is the regulatory- or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the sites.
- [b] 15 mrem/yr = nonradiological worker industrial exposure scenario; 2,000 h/yr onsite, 60% indoors, 40% outdoors. Industrial land-use values generally apply to locations within the industrial exclusive area (Core Zone) and are dependent on the nature and extent of contamination. Unrestricted land-use values that could be applied at some sites outside the industrial-exclusive land-use area are shown.
- [c] Groundwater protection radionuclide values are based on either RESRAD (ANL, 2005, *RESRAD for Windows*, Version 6.3, or STOMP (PNNL-12028, *STOMP Subsurface Transport Over Multiple Phases, Version 2.0, Application Guide*) modeling of drinking water exposure, with the entire vadose zone presumed to be contaminated. This modeling is yet to be completed and groundwater protection values are to be determined.
- [d] Precision and accuracy requirements as identified and defined in the referenced U.S. Environmental Protection Agency procedures implemented by laboratory analysis and quality assurance procedures.
- [e] If ICP/MS is used, analysis individual isotopes will be quantified.
- [f] Values are from DOE/RL-96-12, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, using the 95% upper confidence limit for a lognormal distribution.
- [g] Values are for U-234.
- [h] Values are for U-235.
-
- AEA = alpha energy analysis.
- GEA = gamma energy analysis.
- GPC = gas proportional counting.
- ICP/MS = inductively coupled plasma mass spectrometer.

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Table A2-2. Analytical Performance Requirements for Nonradionuclides. (7 Pages)

	Chemical Abstracts Service No.	Preliminary Action Level[a] (mg/kg)				Hanford Site Back-ground[h]	Name/ Analytical Technology	Required Detection Limits (mg/kg)[e]		Soil[e] (%)		Water[e] (%)	
		Direct Contact, WAC 173-340[b] (mg/kg)		Ground-water Protection[c]	Ecological Protection (mg/kg)								
		Method C Industrial	Method B Unrestricted					Water (mg/L)	Soil (mg/kg)[f]	Precision	Accuracy	Precision	Accuracy
Nonradioactive Metals and Ions													
Arsenic	7440-38-2	87.5	0.67	0.03	7	9	6010 ICP	0.1	10	±30	70-130	±20	80-120
							6010 ICP or EPA Method 200.8 (Trace)	0.01	1				
Ammonia/ ammonium	7664-41-7	--	--		--	28	350.1 or 300.7	0.05	--	--	--	±20	80-120
Antimony	7440-36-0	1400	32	5	--	--	6010 ICP or EPA Method 200.8	--	5	±30	70-130	--	--
Barium	7440-39-3	5600	5000	1650	102	171	6010 ICP or EPA Method 200.8	0.2	20	±30	70-130	±20	80-120
							6010 ICP (Trace)	0.005	0.5				
Beryllium	7440-41-7	7000	160	63	21	2	6010 ICP	0.005	0.5	±30	70-130	±20	80-120
Bismuth	7440-69-9	--	--		--	--	6010 ICP	0.1	10	±30	70-130	±20	80-120
Cadmium	7440-43-9	3500	80	0.69	0.36	--	6010 ICP or EPA Method 200.8	0.005	0.5	±30	70-130	±20	80-120
Chloride	16887-00-6	--		1000	--	763	EPA Method 300.0	0.2	2	±30	70-130	±20	80-120
Chromium (total)	7440-47-3	Un-limited	--	2,000[d]	34	26.8	6010 ICP or EPA Method 200.8	0.01	1	±30	70-130	±20	80-120
Chromium (VI)	18540-29-9	21[i]	--	7.7[k]	42	--	Chromium (hexavalent) – 7196 – colorimetric	0.02	0.5	±30	70-130	±20	80-120
Copper	7440-50-8	130000	29600	263	51	28	6010 ICP or EPA Method 200.8	0.025	2.5	±30	70-130	±20	80-120
Lead	7439-92-1	1,000[g]	250[g]	270	50	15	6010 ICP or EPA Method 200.8	0.01	0.5	±30	70-130	±20	80-120
Manganese	7439-96-5	490000	11200	65	1500	612	6010 ICP or EPA Method 200.8	--	5	±30	70-130		
Mercury	7439-97-6	1,050	24	2	5.5	1	Hg 7470 (water) or EPA Method 200.8	0.0005	NA	±30	70-130	±20	80-120

Table A2-2. Analytical Performance Requirements for Nonradionuclides. (7 Pages)

	Chemical Abstracts Service No.	Preliminary Action Level[a] (mg/kg)				Hanford Site Back-ground[h]	Name/ Analytical Technology	Required Detection Limits (mg/kg)[e]		Soil[f] (%)		Water[f] (%)	
		Direct Contact, WAC 173-340[b] (mg/kg)		Ground-water Protection[c]	Ecological Protection (mg/kg)								
		Method C Industrial	Method B Unrestricted					Water (mg/L)	Soil (mg/kg)[e]	Precision	Accuracy	Precision	Accuracy
							Hg 7471 (soil) or EPA Method 200.8	NA	0.25				
Nickel	7440-02-0	7000	1600	130	980	25	6010 ICP or EPA Method 200.8	0.04	4	±30	70-130	±20	80-120
pH (corrosivity)	--	--	--	--	--	--	9045	0.1 ph unit	0.1 ph unit	±30	70-130	±20	80-120
Selenium	7782-49-2	17500	400	5	0.3	--	6010 ICP	0.1	10	±30	70-130	±20	80-120
							6010 ICP or EPA Method 200.8 (Trace)	.01	1				
Silver	7440-22-4	17500	400	14	2	3	6010 ICP or EPA Method 200.8	0.02	2	±30	70-130	±20	80-120
							6010 ICP or EPA Method 200.8 (Trace)	0.005	0.5				
Sulfide	18496-25-8	--		--	5000	--	9030	0.5	5	±30	70-130	±20	80-120
Thallium	7440-28-0	245	6	2	1	--	6010 – ICP or EPA Method 200.8	--	0.5	±30	70-130	±20	80-120
Uranium (total)	7440-61-1	10,500[q]	240	1	5	--	U total – kinetic phosphorescence analysis or EPA Method 200.8	0.001	1	±30	70-130	±20	80-120
Vanadium	7440-62-2	24500	560	2240	2240	111	6010 ICP or EPA Method 200.8 (water)	0.025	2.5	±30	70-130	±20	80-120
Zinc	7440-66-6	1050000	24000	5970	360	79	6010 ICP	0.01	1	±30	70-130	±20	80-120
Inorganics													
Cyanide	57-12-5	70000	1600	0.80	--	--	Total cyanide – 9010 – colorimetric or EPA Method 335[r]	0.005	0.5	±30	70-130	±20	80-120
Fluoride	16984-48-8	210000	4800	24.1	--	2.8	Anions – EPA Method 300.0[r] – IC	0.5	5	±30	70-130	±20	80-120

Table A2-2. Analytical Performance Requirements for Nonradionuclides. (7 Pages)

	Chemical Abstracts Service No.	Preliminary Action Level[a] (mg/kg)				Hanford Site Background[b]	Name/ Analytical Technology	Required Detection Limits (mg/kg)[e]		Soil[f] (%)		Water[e] (%)	
		Direct Contact, WAC 173-340[b] (mg/kg)		Ground-water Protection[c]	Ecological Protection (mg/kg)								
		Method C Industrial	Method B Unrestricted					Water (mg/L)	Soil (mg/kg)[e]	Precision	Accuracy	Precision	Accuracy
Nitrate	14797-55-8	Un-limited	128000	40	--	52	Anions – EPA Method 300.0[f] – IC	0.25	2.5	±30	70-130	±20	80-120
Nitrite	14797-65-0	350000	--	4	--	--	Anions – EPA Method 300.0 – IC	0.25	2.5	±30	70-130	±20	80-120
Phosphate	14265-44-2	N/A	--	--	--	16	Anions – EPA Method 300.0 – IC	0.5	5	±30	70-130	±20	80-120
Sulfate	14808-79-8	N/A	--	1030	--	1320	Anions – EPA Method 300.0 – IC	0.5	5	±30	70-130	±20	80-120
Organics													
1,1,2-trichloroethane (TCA)	79-00-5	2303	18	0.00427	--	--	EPA Method 8260	0.005	0.005	±30	70-130	±20	80-120
1,2,4 trimethyl-benzene	95-63-6	175000	4000	15	--	--	EPA Method 8260	0.005	0.005	--	--	--	--
Acetone	67-64-1	Un-limited	--	29	--	--	VOC – 8260 – GCMS	0.02	0.02	±30	70-130	±20	80-120
Acetonitrile	75-05-8	21000	480	0	--	--	EPA Method 8260	0.01	0.1	±30	70-130	±20	80-120
Benzene	71-43-2	2390	--	0	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
n-butyl benzene	104-51-8	140000	--	110	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Butanol	35296-72-1												
n-butyl alcohol	71-36-3						VOC – 8260 – GCMS or 8015m-GC	0.02	0.100	±30	70-130	±20	80-120
Carbon tetrachloride	56-23-5	1010	8	0	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Chlorobenzene	108-90-7	70000	1600	1	40	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Chloroform (trichloro-methane)	67-66-3	21516	164	0	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120

Table A2-2. Analytical Performance Requirements for Nonradionuclides. (7 Pages)

	Chemical Abstracts Service No.	Preliminary Action Level[a] (mg/kg)				Hanford Site Background[d]	Name/ Analytical Technology	Required Detection Limits (mg/kg)[e]		Soil[f] (%)		Water[f] (%)	
		Direct Contact, WAC 173-340[b] (mg/kg)		Ground-water Protection[c]	Ecological Protection (mg/kg)								
		Method C Industrial	Method B Unrestricted					Water (mg/L)	Soil (mg/kg)[e]	Precision	Accuracy	Precision	Accuracy
Cyclohexane	110-82-7	--	--	253	--	--	VOC – 8260 – GCMS	±30	70-130	±20	80-120	±30	70-130
1,1-Dichloroethane	75-34-3	350000	--	4	--	--	VOC – 8260 – GCMS	0.01	0.01	±30	70-130	±20	80-120
1,2-Dichloroethane	107-06-2	1440	--	0.002 below RDL[n]	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Trans-1,2-Dichloro-ethylene	156-60-5	70,000	1,600	0.36	--	--	VOC – 8260 – GCMS	0.001	0.001	±30	70-130	±20	80-120
Cis-1,2-Dichloro-ethylene	156-59-2	35,000	800	0.350	--	--	VOC – 8260 – GCMS	0.001	0.001	±30	70-130	±20	80-120
Ethanol (ethyl alcohol)[j]	64-17-5	--	--	--	--	--	GC organic 8015	5	5	±30	70-130	±20	80-120
Ethylbenzene	100-41-4	350,000	--	6	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Ethylene glycol	107-21-1	Un-limited	160,000	129	--	--	GC organic 8015	5	5	±30	70-130	±20	80-120
Hexane	110-54-3	210,000	4,800	96	--	--	VOC – 8260 – GCMS	.0005	0005	±30	70-130	±20	80-120
Methyl ethyl ketone (MEK; 2-butanone)	78-93-3	Unlimited	48,000	20	--A	--	VOC – 8260 – GCMS	0.01	0.01	±30	70-130	±20	80-120
Methyl isobutyl ketone (MIBK, hexone)	108-10-1	280,000	6,400	3	--	--	VOC – 8260 – GCMS	0.01	0.01	±30	70-130	±20	80-120

Table A2-2. Analytical Performance Requirements for Nonradionuclides. (7 Pages)

	Chemical Abstracts Service No.	Preliminary Action Level[a] (mg/kg)				Hanford Site Background[h]	Name/ Analytical Technology	Required Detection Limits (mg/kg)[d]		Soil[f] (%)		Water[g] (%)	
		Direct Contact, WAC 173-340[b] (mg/kg)		Ground-water Protection[c]	Ecological Protection (mg/kg)								
		Method C Industrial	Method B Unrestricted					Water (mg/L)	Soil (mg/kg)[e]	Precision	Accuracy	Precision	Accuracy
Methylene chloride (dichloro-methane)	75-09-2	17500	4,800	0.0254	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Normal paraffin hydrocarbon (kerosene)	TPHKERO SENE	--	--	--	--	--	Use NWTPH-D extended to kerosene range	.05	5	±30	70-130	±20	80-120
Phenol	108-95-2	1,050,000	24000	22	--	--	8270 GCMS	0.01	0.33	±30	70-130	±20	80-120
Polychlorinated biphenyls (PCBs)	1336-36-3	66	.5	3.09[n]	0.65	--	PCBs – 8082 – GC	0.0005	0.0165	±30	70-130	±20	80-120
2-Propanol (isopropyl alcohol)	67-63-0	--	--	--	--	--	EPA Method 8260 (TIC)	NA	NA	NA	NA	NA	NA
Tetrachloro-ethylene	127-18-4	243	--	0.00086	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Tetrahydro-furan	109-99-9	3,500	80	--	--	--	EPA Method 8260	.05	.05	±30	70-130	±20	80-120
Toluene	108-88-3	700,000	16,000	7.2	200	--	VOC – EPA Method 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Dibutyl phosphate	107-66-4	--	--	--	--	--	--	--	--	--	--	--	--
Monobutyl phosphate	1623-15-0	--	--	--	--	--	--	--	--	--	--	--	--
Tributyl phosphate	126-73-8	24300	--	6.18	--	--	Semi-VOC – 8270 – GCMS	0.1	3.3	±30	70-130	±20	80-120
Trichloro-ethane; 1,1,1	71-55-6	Un-limited	--	1.58	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Trichloro-ethylene	79-01-6	11,900	90	.02	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Vinyl chloride	75-01-4	88	.6	0.0002	--	--	VOC – 8260 GCMS	--	0.01	±30	70-130	±20	80-120

Table A2-2. Analytical Performance Requirements for Nonradionuclides. (7 Pages)

	Chemical Abstracts Service No.	Preliminary Action Level[a] (mg/kg)				Hanford Site Background[h]	Name/ Analytical Technology	Required Detection Limits (mg/kg)[f]		Soil[g] (%)		Water[g] (%)	
		Direct Contact, WAC 173-340[b] (mg/kg)		Ground-water Protection[c]	Ecological Protection (mg/kg)								
		Method C Industrial	Method B Unrestricted					Water (mg/L)	Soil (mg/kg)[e]	Precision	Accuracy	Precision	Accuracy
Xylene (total)	1330-20-7	700,000	16,000	14.6	--	--	VOC – 8260 – GCMS	0.005	0.005	±30	70-130	±20	80-120
Normal paraffin (Grease; heavy oils)	Oil and grease	2,000	2,000	--	--	--	EPA Method 413.N 9070 or 1664A	2	200	±30	70-130	±20	80-120
Volatile organic compounds	Varies	--	--	--	--	--	VOC – 8260 – GCMS	--	--	--	--	--	--
Semivolatile organic compounds	Varies	--	--	--	--	--	Semi-VOC – 8270 – GCMS	--	--	--	--	--	--
Methyl chloride	74-87-3	10096	77	0.033	--	--	8260 GCMS	0.005	0.005	±30	70-130	±20	80-120
Total petroleum hydrocarbons – diesel to oil range (kerosene)	TPHDIESEL	2,000[l]	--	2,000[l]	460	--	NWTPH-D[o]	0.5	5	±30	70-130	30	70-130
Total petroleum hydrocarbons – gasoline range	TPH GASOLINE	30[l]	--	30[l]	200	--	NWTPH-G[o]	0.5	5	±30	70-130	30	70-130
Soil Physical Properties													
Bulk density	N/A	N/A	--	N/A	N/A	--	D2937[q]	--	wt%	N/A	N/A	N/A	N/A
Moisture content	N/A	N/A	--	N/A	N/A	--	D2216[q]	--	wt%	N/A	N/A	N/A	N/A
Particle size distribution	N/A	N/A	--	N/A	N/A	--	D422[q]	--	wt%	N/A	N/A	N/A	N/A

Table A2-2. Analytical Performance Requirements for Nonradionuclides. (7 Pages)

	Chemical Abstracts Service No.	Preliminary Action Level[a] (mg/kg)				Hanford Site Back-ground[h]	Name/ Analytical Technology	Required Detection Limits (mg/kg)[s]		Soil[e] (%)		Water[e] (%)	
		Direct Contact, WAC 173-340[b] (mg/kg)		Ground-water Protection[c]	Ecological Protection (mg/kg)			Water (mg/L)	Soil (mg/kg)[s]	Precision	Accuracy	Precision	Accuracy
		Method C Industrial	Method B Unrestricted										

- [a] The preliminary action level (from the data quality objectives process) is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the sites.
- [b] Method C industrial is WAC 173-340-745(5), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels" and Method B residential is WAC 173-340-740(3), "Unrestricted Land Use Soil Cleanup Standards," "Method B Soil Cleanup Levels for Unrestricted Land Use," values from Ecology 94-145, *Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation; CLARC, Version 3.1*, tables, updated November 2001.
- [c] Calculated using WAC 173-340, "Model Toxics Control Act – Cleanup," three-phase model for soil concentrations protective of groundwater per WAC 173-340-747(4), "Deriving Soil Concentrations for Ground Water Protection," "Fixed Parameter Three-Phase Partitioning Model."
- [d] Value is the lowest concentration for each analyte (adjusted for background) from Tables 749-2 and 749-3 of WAC 173-340-900, "Tables," amended February 12, 2001.
- [e] Precision and accuracy requirements as defined in EPA procedures and implemented by laboratory analysis and Quality Assurance procedures. Precision criteria for batch laboratory replicate sample analyses. Accuracy criteria for associate batch laboratory control sample percent with additional evaluations also performed for matrix spikes, tracers, and carriers as appropriate to the method.
- [f] All four-digit numbers are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A*. EPA Method 200.8 is found in EPA/600/4-91/010, Methods for the Determination of Metals in Environmental Samples.
- [g] Based on WAC 173-340 Method A values from Tables 740-1 and 745-1 of WAC 173-340-900.
- [h] Values are from DOE/RL-92-24, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, using the 90th percentile with a lognormal distribution.
- [i] Calculated using air cleanup standards from WAC 173-340-750(3)(b)(ii)(B), "Cleanup Standards to Protect Air Quality," "Method B Air Cleanup Levels," "Standard Method B Air Cleanup Levels," "Human Health Protection," "Carcinogens," page 210, equation 750-2, with Washington State Department of Health mass loading of particulates in air of 10^{-4} g/m^3.
- [j] Not regulated under WAC 173-340
- [k] Calculated using standards for surface water protection (40 CFR 131, "Water Quality Standards," and WAC 173-201A-040, "Water Quality Standards for Surface Waters of the State of Washington," "Toxic Substances") as inputs to the three-phase model for protection of drinking water (WAC 173-340-747[4], February 12, 2001).
- [l] Based on Method A values from WAC 173-340-900, Tables 740-1 and 745-1, amended February 12, 2001.
- [m] Cleanup value is less than Hanford Site soil background. Therefore, the soil background concentration is used as the preliminary action level.
- [n] Because the calculated groundwater protection action level is less than the soil detection limit, the calculated value is replaced with the target quantitation limit required of the laboratory.
- [o] From Ecology 97-602, *Analytical Methods for Petroleum Hydrocarbons*.
- [q] Value based on nickel or uranium soluble salts value.
- [r] From EPA/600/4-79/020, *Methods for Chemical Analysis of Water and Wastes*.
- [s] Required Target Quantitation Limit for setting laboratory detection limits is generally established using the preliminary action levels or background whichever is lowest.
- CFR = *Code of Federal Regulations*.
- EPA = U.S. Environmental Protection Agency.
- GC = gas chromatograph.
- GCMS = gas chromatograph/mass spectrometry.
- IC = ion chromatography.
- N/A = not available.
- NWTPH-D = Washington total petroleum hydrocarbon diesel.
- NWTPH-G = Washington total petroleum hydrocarbon gas.
- RDL = required detection limit.
- WAC = *Washington Administrative Code*.

Table A2-3. Combined List of Contaminants of Potential Concern. (5 pages)

CAS Number	Compound Name	200-CS-1	200-CW-1, 200-CW-3, and 200 North	200-CW-5, 200-CW-2, 200-CW-4, 200-SC-1	200-LW-1, 200-LW-2	200-MW-1	200-PW-1	200-PW-3	200-PW-2	200-PW-4	200-TW-1	200-TW-2	200-UR-1
Radionuclides													
14596-10-2	Americium-241	x	X	x	x	x	x	x	x	x	x	x	x
14762-75-5	Carbon-14				x			x	x	x	x	x	x
10045-97-3	Cesium-137	x	x	x	x	x	x	x	x	x	x	x	x
10198-40-0	Cobalt-60	x	x	x	x	x	x	x	x	x	x	x	x
14683-23-9	Europium-152	x	x	x	x	x		x	x	x	x	x	x
15585-10-1	Europium-154	x	x	x	x	x		x	x	x	x	x	x
14391-16-3	Europium-155	x	x	x	x	x		x	x	x	x	x	x
10028-17-8	Hydrogen-3 (tritium)	x	x	x	x	x	x	x	x	x	x	x	x
15046-84-1	Iodine-129					x		x	x	x			
13994-20-2	Neptunium-237	x	x	x	x		x		x	x	x	x	x
13981-37-8	Nickel-63	x	x	x	x	x			x	x	x	x	x
14681-63-1	Niobium-94			x									x
13981-16-3	Plutonium-238	x	x	x	x	x	x	x	x	x	x	x	x
15117-48-3	Plutonium-239	x	x	x	x	x	x	x	x	x	x	x	x
14119-33-6	Plutonium-240	x	x	x	x	x	x	x	x	x	x	x	x
13982-63-3	Radium-226			x					x	x	x	x	
15262-20-1	Radium-228	x		x					x	x	x	x	
N/A	Samarium-151					x							
10098-97-2	Strontium-90	x	x	x	x	x	x	x	x	x	x	x	x
14133-76-7	Technetium-99	x	x	x	x	x	x	x	x	x	x	x	x
7440-29-1	Thorium-232	x	x	x	x		x		x	x	x	x	
13968-55-3	Uranium-233	x	x		x	x		x	x	x			x
13966-29-5	Uranium-234	x	x	x	x	x	x	x	x	x	x	x	x
15117-96-1	Uranium-235	x	x	x	x	x	x	x	x	x	x	x	x
13982-70-2	Uranium-236	x	x	x	x	x			x	x			x
7440-61-1	Uranium-238	x	x	x	x	x	x	x	x	x	x	x	x

Table A2-3. Combined List of Contaminants of Potential Concern. (5 pages)

CAS Number	Compound Name	200-CS-1	200-CW-1, 200-CW-3, and 200 North	200-CW-5, 200-CW-2, 200-CW-4, 200-SC-1	200-LW-1, 200-LW-2	200-MW-1	200-PW-1	200-PW-3	200-PW-2	200-PW-4	200-TW-1	200-TW-2	200-UR-1
Nonradioactive Metals and Ions													
7440-38-2	Arsenic	x	x	x	x		x	x	x	x			x
7664-41-7	Ammonia	x	x		x		x	x	x	x	x	x	
7440-36-0	Antimony				x				x	x			x
7440-39-3	Barium	x	x	x	x			x	x	x			x
7440-41-7	Beryllium	x	x	x	x				x	x			x
7440-69-9	Bismuth				x								
7440-43-9	Cadmium	x	x	x	x	x	x	x	x	x	x	x	x
16887-00-6	Chloride	x	x		x		x		x	x	x	x	
7440-47-3	Chromium	x	x	x	x	x	x	x	x	x	x	x	x
18540-29-9	Chromium (VI)	x	x	x	x	x	x	x	x	x	x	x	x
7440-50-8	Copper	x	x	x	x	x	x		x	x	x	x	x
57-12-5	Cyanide	x	x		x	x			x	x		x	x
16984-48-8	Fluoride	x	x	x	x	x	x		x	x	x	x	x
7439-92-1	Lead	x	x	x	x	x	x	x	x	x	x	x	x
7439-96-5	Manganese		x										
7439-97-6	Mercury	x	x	x	x	x	x	x	x	x	x	x	x
7440-02-0	Nickel	x	x	x	x		x		x	x	x	x	x
14797-55-8	Nitrate	x	x	x	x	x	x	x	x	x	x	x	x
14797-65-0	Nitrite	x	x		x	x	x		x	x	x	x	x
NA	pH	x	x										
14265-44-2	Phosphate	x	x		x	x	x		x	x	x	x	
7782-49-2	Selenium	x	x	x	x		x	x	x	x			x
7440-22-4	Silver	x	x	x	x	x	x	x	x	x	x	x	x
14808-79-8	Sulfate	x	x	x	x	x	x		x	x	x	x	x
18496-25-8	Sulfide	x	x	x	x								
7440-28-0	Thallium												x
7440-61-1	Uranium (total)		x			x							x
7440-62-2	Vanadium	x	x										x

Table A2-3. Combined List of Contaminants of Potential Concern. (5 pages)

CAS Number	Compound Name	200-CS-1	200-CW-1, 200-CW-3, and 200 North	200-CW-5, 200-CW-2, 200-CW-4, 200-SC-1	200-LW-1, 200-LW-2	200-MW-1	200-PW-1	200-PW-3	200-PW-2	200-PW-4	200-TW-1	200-TW-2	200-UR-1
7440-66-6	Zinc	x	x	x									x
Organics													
75-34-3	1,1-dichloroethane				x	x	x			x			x
107-06-2	1,2-dichloroethane				x	x	x			x			x
156-59-2	Cis-1,2-dichloroethylene				x	x	x			x			x
156-60-5	Trans-1,2-dichloroethylene				x	x	x			x			x
71-55-6	1,1,1-trichloroethane (TCA)	x	x		x	x	x			x			x
79-00-5	1,1,2-trichloroethane (TCA)	x	x		x								x
95-63-6	1,2,4 trimethylbenzene			x									
67-64-1	Acetone	x	x	x	x	x	x			x			x
75-05-8	Acetonitrile			x									x
71-43-2	Benzene				x	x	x			x			x
104-51-8	n-butyl benzene				x	x	x			x			
35296-72-1	Butanol				x								
71-63-3	n-butyl alcohol	x	x			x							x
56-23-5	Carbon tetrachloride	x	x	x	x		x			x			x
108-90-7	Chlorobenzene			x	x		x			x			x
67-66-3	Chloroform (trichloromethane)	x	x	x	x		x			x			
110-82-7	Cyclohexane												x
75-09-2	Dichloromethane (methylene chloride)	x	x	x	x	x	x			x			x
NA	Diesel fuel	x	x										x
64-17-5	Ethanol (ethyl alcohol)	x	x										
100-41-4	Ethylbenzene				x	x	x			x			x
107-21-1	Ethylene glycol				x					x			
110-54-3	Hexane			x									x
78-93-3	Methyl ethyl ketone	x	x	x	x	x	x			x			x
108-10-1	Methyl iso butyl ketone (MIBK, hexone)	x			x	x	x	x		x			x

Table A2-3. Combined List of Contaminants of Potential Concern. (5 pages)

CAS Number	Compound Name	200-CS-1	200-CW-1, 200-CW-3, and 200 North	200-CW-5, 200-CW-2, 200-CW-4, 200-SC-1	200-LW-1, 200-LW-2	200-MW-1	200-PW-1	200-PW-3	200-PW-2	200-PW-4	200-TW-1	200-TW-2	200-UR-1
8008-20-6	Normal paraffin hydrocarbon (kerosene)	x	x	x	x	x	x	x	x	x	x		x
108-95-2	Phenol				x		x			x			x
1336-36-3	Polychlorinated biphenyls	x	x	x	x	x	x	x		x			x
76-63-0	2-Propanol (isopropyl alcohol)	x	x										
127-18-4	Tetrachloroethylene			X	x	x	x			x			x
109-99-9	Tetrahydrofuran			X									x
108-88-3	Toluene	x	x	X	x	x	x			x			x
107-66-4	Dibutyl phosphate					X	X				x		x
1623-15-0	Monobutyl phosphate					x	x				x		x
126-73-8	Tributyl phosphate	x	x	x	x	x	x	x	x	x	x		X
79-01-6	Trichloroethylene				x	x	x			x			X
75-01-4	Vinyl chloride			X									X
1330-20-7	Xylene	x		X	X	x	x			x			X
	Volatile Organic Compounds							x					
	Semivolatile Organic Compounds							x					

Table A2-3. Combined List of Contaminants of Potential Concern. (5 pages)

CAS Number	Compound Name	200-CS-1	200-CW-1, 200-CW-3, and 200 North	200-CW-5, 200-CW-2, 200-CW-4, 200-SC-1	200-LW-1, 200-LW-2	200-MW-1	200-PW-1	200-PW-3	200-PW-2	200-PW-4	200-TW-1	200-TW-2	200-UR-1

- 200-CS-1 is based Chapter 3.0, DOE/RL-99-44, *200-CS-1 Operable Unit RI/FS Work Plan and RCRA TSD Unit Sampling Plan.*
- 200-CW-1, 200-CW-3, and 200 North are based on Chapter 3.0, DOE/RL-99-07, *200-CW-1 Operable Unit RI/FS Work Plan and 216-B-3 RCRA TSD Unit Sampling Plan.*
- 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 are based on Chapter 3.0, DOE/RL-99-66, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units.*
- 200-LW-1 and 200-LW-2 are based on Chapter 3.0, DOE/RL-2001-66, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units.*
- 200-MW-1 is based on Chapter 3, DOE/RL-2001-65, *200-MW-1 Miscellaneous Waste Group Operable Unit RI/FS Work Plan.*
- 200-PW-1 and 200-PW-3 are based on Chapter 3.0, DOE/RL-2001-01, *Plutonium/Organic-Rich Process Condensate/Process Waste Group Operable Unit RI/FS Work Plan, Includes: 200-PW-1, 200-PW-3, and 200-PW-6 Operable Units.*
- 200-PW-2 and 200-PW-4 are based on Chapter 3.0 DOE/RL-2000-60, *Uranium-Rich/General Process Condensate and Process Waste Group Operable Units RI/FS Work Plan and RCRA TSD Unit Sampling Plan; Includes 200-PW-2 and 200-PW-4 Operable Units.*
- 200-TW-1 and 200-TW-2 are based on Chapter 3.0, DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group Operable Unit and 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan.*
- 200-UR-1 is based on Chapter 3.0, DOE/RL-2004-39, *200-UR-1 Unplanned Release Waste Group Operable Unit Remedial Investigation/Feasibility Study Work Plan and Engineering Evaluation/Cost Analysis.*
-
- CAS = Chemical Abstracts Service.
- N/A = not available.

Table A2-4. Analytical Performance Requirements for Grab Samples. (2 Pages)

Parameter	Reason for Measuring	Method [a]	Contract-Required Detection Limit	Precision Required	Accuracy Required
Vadose Sediments					
Calcium carbonate content (more correctly includes total carbon, inorganic carbon, and organic carbon by difference)	This parameter influences the pH buffering capacity of the sediment. Calcium carbonate also is a cementing material in porous sediments that influences the hydraulic conductivity and porosity. Organic carbon content influences bioremediation technologies.	ASTM E1915, EPA 9060A (SW-846) or EPA Method 415.1	N/A	N/A	N/A
Pore water or 1:1 water extract	Vadose sediments generally do not have drainable water that can be readily obtained for analysis. Existing pore water must be "squeezed" out by overcoming the capillary forces holding the water in the partially saturated pores or by adding deionized water to "flush" out the pore water. Dependent on the size of vadose zone sample available, its field moisture content and particle size, either ultracentrifugation or 1:1 water extraction technique are used to obtain the pore water for further analysis, as described below.	Ultracentrifuge (ideal equipment is unsaturated flow apparatus) or 1:1 water extract (American Society of Agronomy (Rhoades 1996).	N/A	N/A	N/A
Vadose Sediment Pore Water					
Major cations (e.g., sodium, potassium, magnesium, calcium)	Useful for understanding overall geochemical conditions that control contaminant-sediment interactions.	ASTM C1111-04 or EPA Method 6010B (SW-846)	N/A	N/A	N/A
Specific electrical conductivity	An inexpensive indicator of the total dissolved ion concentration of groundwater.	ASTM D112595 (2005) or EPA Method 9050A	N/A	N/A	N/A
pH	Key parameter for controlling acid-base buffering capacity or aquifer-sediment system. Generally influences most remediation technologies.	ASTM D1293 or EPA Method 9045D (SW-846)	0.1 pH unit	±0.1 pH unit	±0.1 pH unit
Major anions in sediment pore water (e.g., sulfate, chloride, fluoride, nitrate, phosphate, bicarbonate/ carbonate)	Influences remediation techniques that rely on anion-exchange resins (U(VI), Tc-99) and is useful for understanding overall geochemical conditions that control contaminant-sediment interactions.	Use ion chromatography; the following two methods are equivalent: ASTM D4327-03 or EPA Method 9056 (SW-846)		30%	30%

Table A2-4. Analytical Performance Requirements for Grab Samples. (2 Pages)

Parameter	Reason for Measuring	Method [a]	Contract-Required Detection Limit	Precision Required	Accuracy Required
Contaminant of concern concentrations (includes RCRA metals, Tc-99, I-129, and U-238)	Provides dissolved concentrations of each contaminant of concern at each depth in the borehole; provides detailed information to evaluate high-resolution resistivity data and to evaluate remedial alternatives.	Various techniques dependent on contaminant of concern; today most RCRA metals and long-lived radionuclides (e.g., uranium, Tc-99, I-129, Pu-239) are measured with inductively coupled plasma/mass spectroscope using ASTM D5673-05 or EPA Method 6020 (SW-846). See Tables A2-1 and A2-2 for specific methods and analytical requirements for the specified constituents.	see Tables A2-1 and A2-2	see Tables A2-1 and A2-2	see Tables A2-1 and A2-2
Gamma-emitting radionuclides	Correlates with other laboratory data for borehole and with geophysical logs	Gamma energy analysis	see Tables A2-1 and A2-2	see Tables A2-1 and A2-2	see Tables A2-1 and A2-2

- [a]4-digit EPA Methods are from SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A* (available on the Internet at www.epa.gov/SW-846/main.htm .
- EPA Method 415.1 is found in EPA/600/4-79/020, *Methods of Chemical Analysis of Water and Wastes.*
- ASTM C1111-04, *Standard Test Method for Determining Elements in Waste Streams by Inductively Coupled Plasma-Atomic Emission Spectroscopy.* ASTM D1125-95(2005), *Standard Test Methods for Electrical Conductivity and Resistivity of Water.* ASTM D1293-99 (2005), *Standard Test Methods for pH of Water.* ASTM D4327-03, *Standard Test Method for Anions in Water by Chemically Suppressed Ion Chromatography.* ASTM D5673-05, *Standard Test Method for Elements in Water by Inductively Coupled Plasma-Mass Spectrometry.* ASTM E1915-05, *Standard Test Methods for Analysis of Metal Bearing Ores and Related Materials by Combustion Infrared Absorption Spectrometry.*
- Rhoades, J. D., "Salinity: Electrical Conductivity and Total Dissolved Solids."
- EPA = U.S. Environmental Protection Agency.
- N/A = not applicable.
- RCRA = *Resource Conservation and Recovery Act of 1976.*

1

Table A2-5. Sample Preservation, Container, and Holding-Time Guidelines. (2 Pages)

Analytes*	Matrix	Bottle Number	Bottle Type	Amount [a,b,c]	Preservation	Packing Requirements	Holding Time [e]
Radionuclides							
Americium-241	Soil	1	G/P	10-1000 g	None	None	6 months
Cesium-137	Soil	1	G/P	100-1500 g	None	None	6 months
Europium-154	Soil						
Neptunium-237	Soil	1	G/P	10 g	None	None	6 months
Plutonium-239/240	Soil	1	G/P	10-1000 g	None	None	6 months
Strontium-90							
Technetium-99							
Uranium-238							
Chemicals							
IC anions – EPA Method 300.0	Soil[d]	1	G/P	50-500 g	Cool 4 °C	Cool 4 °C	28 days/ 48 hours [d]
ICP metals – 6010A	Soil	1	G/P	10-500 g	Cool 4 °C	Cool 4 °C	6 months
Mercury – 7471 – (CVAA)	Soil	1	G	5-125 g	Cool 4 °C+/-2 °C	Cool 4 °C	28 days
Total cyanide – 9010	Soil	1	G	10-1000 g	Cool 4 °C	Cool 4 °C	14 days
SVOA – 8270A	Soil	1	AG	125-1000 g	Cool 4 °C	Cool 4 °C	14/40 days [e]
VOA – low level – 5035A/8260	Soil	5	AG	5 g	Freeze -7 °C to -20 °C	Freeze -7 °C to -20 °C	14 days
VOA – high level - 5035A/8260	Soil	3	AG	5 g	Cool 4 °C	Cool 4 °C	14 days

- *4-digit EPA methods are found in SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update III-A*, as amended. EPA Method 300.0 is found in EPA/600/R-93/100, *Methods for the Determination of Inorganic Substances in Environmental Samples*.
- [a]Optimal volumes, which may be adjusted downward to accommodate the possibility of retrieval of a small amount of sample. Minimum sample size will be defined on the Sampling Authorization Form.
- [b]Should samples be liquid rather than soils, the following volumes need to be collected:
- Radionuclides – 4 L for all radionuclides (except C-14, tritium, and Tc-99; they require approximately 500 mL for each sample).
- Chemicals – All liquid samples require the amount listed for soil samples. Preservation and holding times also are affected if liquid samples are collected. Consult Sample Management staff for details.
- [c]Mixed soil samples may be obtained and submitted to the analytical laboratory for analyses for specific analytes, including the following:
- Radionuclides – 100 g of soil for all radionuclides (except C-14, tritium, and Tc-99; they require approximately 10 g for each sample).
- Chemicals – A 10 g soil sample is required for all ICP analysis, 10 g soil sample is required for IC anion analysis, 5 g soil sample for hexavalent chromium analysis, 10 g soil sample for 8015 analysis, and 125 g soil samples for each 8270 and total organic carbon analyses.
- [d]The EPA Method 300.0 nitrate, nitrite, and phosphate holding time is 48 hours after sample extraction preparation. The holding time of 28 days applies to all other anions quantified by EPA Method 300.0.
- [e]The first number shown is the number of days to extract and the second number is the number of days to analyze the extract.
- aG = amber glass.
- CVAA = cold vapor atomic absorption.
- EPA = U.S. Environmental Protection Agency.
- G = glass.
- IC = ion chromatography.
- ICP = inductively coupled plasma.
- P = plastic.
- SVOA = semivolatile organic analyte.
- VOA = volatile organic analyte.

Table A3-1. Summary of Sample Collection Techniques. (2 Pages)

Media	Sampling Technique	Applicability	Comment
Surface soil	Shovel or hand trowel	Surface to 1 ft bgs	No power equipment required
Subsurface soil	Hand auger	Surface to less than 10 ft bgs	Simple technique, no powered equipment required
	Hollow stem auger w/ split-spoon sampler	Surface to about 50 ft bgs	Rapid technique, provides intact core samples. May not work well in soil with high gravel/cobble content
	Cable tool with split-spoon sampler	Surface to water table (no depth limit)	Slower technique, provides relatively intact cores, generally provides adequate sample volume for analysis, controls spread of contamination, generates larger waste volume as all cuttings are brought to the surface, can sample from cuttings as well
	Test pit with excavator	Surface to less than 25 ft bgs	Simple, provides simultaneous access to soil profile
	Direct-push sampler	Surface to about 100 ft bgs	Rapid, in some applications and depths can provide continuous core sample
Surface water	Direct collection into container	Accessible surface water	Simple but requires direct approach to open water
	Peristaltic pump	Accessible surface water, limited to about 25 ft vertical lift	Allows collection of sample at a distance from open water
Groundwater	Submersible pump in monitoring well	No depth limit	Produces high quality/reproducible samples
	Bailer in monitoring well	No depth limit	Produces high quality/reproducible samples
Perched water	Submersible pump in open borehole, temporary well, or monitoring well	No depth limit	Samples from open borehole or temporary wells may contain high suspended solids, may require filtration
	Bailer in open borehole, temporary well, or monitoring well	No depth limit	Samples from open borehole or temporary wells may contain high suspended solids, may require filtration
Soil vapor	Air sampling pump and Tedlar bag or sample canister	No depth limit	May require samples from multiple levels to assess stratification of dense vapors

Table A3-1. Summary of Sample Collection Techniques. (2 Pages)

Media	Sampling Technique	Applicability	Comment
Residual waste materials	Direct sample collection into container	Openly accessible materials	Simple, but requires direct approach to the material
	Drill rig with drive point sampler	Waste in tanks or subsurface locations	Techniques and hardware used for tank waste sampling at Hanford Site is available
	Direct sample collection with coliwasa or other sampling device	Waste in tanks or other containers	Simple, but requires direct approach to the material

- Tedlar is a registered trademark of E. I. du Pont de Nemours and Company, Wilmington, Delaware.

Table A3-2. Leaching Analysis Sample Analyses by Medium.

Analysis	Water Extractant	Acid Extractant	Solids
pH	X		
Specific electrical conductivity	X		
Major anions in sediment pore water (e.g., sulfate, chloride, fluoride, nitrate, phosphate, bicarbonate/carbonate)	X		
RCRA metals	X	X	
Tc-99 and U-238	X	X	
I-129	X		
Major cations (e.g., sodium, potassium, magnesium, calcium)	X	X	
Gamma-emitting radionuclides	X	X	X
Carbon content – total, inorganic, and organic			X
Gross alpha/beta	X	X	

- X = sample to be analyzed for listed media.
- RCRA = *Resource Conservation and Recovery Act of 1976.*

Table A3-4. Direct Push Technologies (2 Pages)

Technology	Penetration Depth	Sample Size	State of Development	Comments	Relative Cost
Conventional Drilling					
Cable tool	Deep (500+ ft)	2.5 to 5 in. dia. split-spoon	Commercial – widely available and routinely used	Typically used in radiologically contaminated areas	Medium to high
Air rotary	Deep	2.5 to 5 in. dia. split-spoon	Commercial – widely available	Cannot be used to characterize volatiles	Medium to high
Percussion (Becker hammer, other types of drive casing)	Medium (<200 ft, depending on geology)	2.5 to 5 in. dia. split-spoon	Commercial – widely available and routinely used		Medium
Sonic	Medium (<300 ft, depending on geology)	2.5 to 5 in. dia. split-spoon	Commercial – widely available	Stratigraphy in split spoon may not be representative; can heat formation and sample to high temperatures	Medium
Hollow-stem auger	Shallow (<50 ft)	2.5 to 5 in. dia. split-spoon	Commercial – widely available	Brings soil to surface, so not for use in radiological areas	Low
Directional drilling	Deep	Unknown	Commercial – widely available	Requires a drilling mud, which could mobilize contamination. Only demonstrated at Hanford Site.	High

Table A3-4. Direct Push Technologies (2 Pages)

Technology	Penetration Depth	Sample Size	State of Development	Comments	Relative Cost
Other Technologies					
Cone penetrometer	Medium (<150 ft, depending on geology)	1 in dia., 2 ft long	Commercial – widely available	Stymied by competent sediments, cobbles/boulders	Medium
Enhanced Access Penetration System	Medium to Deep (250 ft, depending on geology)	1 in dia., 2 ft long	Mature – some refinement needed for difficult conditions	Cone penetrometer that can also drill through fine sediments, boulders	Medium
GeoProbe	Shallow (<100 ft)	1 in dia., 1 ft long	Commercial – widely available	Stymied by competent sediments, cobbles/boulders	Low to Medium
Test pit/trench	Shallow (<30 ft)	Huge	Commercial – widely available	Brings soil to surface, so not for use in radiological areas	Low

- GeoProbe is a registered trademark of GeoProbe Systems, Salina, Kansas.
- FH = Fluor Hanford.

Table A3-4. Field Survey Technologies for Organics and Metals.

Technology	Capabilities	Interferences/ Limitations	Other Considerations	Relative Data Quality/Interpretation
X-ray fluorescence	Measures metal concentration by direct contact with soil	Soil texture/moisture may affect performance; some inter-element interferences	Turnaround time in minutes, good for screening, adequate for characterization, adequate for monitoring	Quantitative; instrument has built-in calibrations. Soil: moderate. Water: Not applicable
Chemical Colorimetric kits	Measures many organic and inorganic analytes after soil digestion	Inter-element interferences not uncommon	Must react soil with solutions, then measure color change	Quantitative to semi-quantitative, depending on analyte
Immunoassay colorimetric kits	Measures many organic and inorganic analytes after soil digestion	Multi-step procedure, not available for some contaminants of concern	Must react soil with solutions, then measure color change	Quantitative; very low detection limits for some analytes

Table A4-1. Summary of Physical Hazards.

Type of Hazard	Specific Hazard	Potential Impact	Mitigation Approach
Mechanical	Powered Equipment/moving parts	Pinchpoints/ entanglement	Use trained operators, inspect and maintain equipment
	Electrical hazards	Electrocution	Use ground fault circuit interrupters on portable equipment
	Material handling	Strains, sprains, physical injuries	Use appropriate manpower and powered equipment as necessary
	Overhead and underground utilities	Electrocution, explosion, toxic effects	Identify and avoid utilities during investigation, hand-dig where underground utility location is uncertain.
Location	Steep/uneven terrain	Slip, trip and fall, vehicle and equipment rollover	Walk and drive on identified travel paths, prepare level work area if necessary
	Open water	Drowning	Establish barriers and/or use individual personal protective equipment
	Open Excavations	Sidewall collapse, burial	Inspect and maintain excavations, maintain access/egress
	Traffic	Collision with vehicles and pedestrians	Establish work areas, use traffic control
Environmental	Heat stress	Reduced productivity, heat injury, death	Establish heat stress work regimens based on ambient conditions, nature of work, and required personal protective equipment. Monitor workers.
	Cold stress	Reduced productivity, heat injury, death	Establish cold stress work regimens based on ambient conditions, nature of work, and required personal protective equipment. Monitor workers.
	Severe weather	Threats posed by strong wind, heavy rain/snow, lightning, flash floods.	Monitor weather conditions during field operations and respond appropriately.

Table A4-2. Summary of Chemical Hazards.

Type of Hazard	Specific Hazard	Potential Impact	Mitigation Approach
Airborne toxic chemicals	Volatile organic compounds (e.g., carbon tetrachloride)	Acute or chronic toxic effects by inhalation	Perform real-time air monitoring and implement respiratory protection as indicated.
	Suspended particulate in dust (e.g., toxic metals)	Acute or chronic toxic effects by inhalation	Perform real-time air monitoring and implement respiratory protection as indicated.
	Volatile inorganic compounds (e.g., ammonia)	Acute or chronic toxic effects by inhalation	Perform real-time air monitoring and implement respiratory protection as indicated.
Direct contact with toxic chemicals	Corrosive chemicals (e.g., acids and caustics)	Chemical injury to exposed skin or tissues	Use protective clothing, gloves, and eyewear when potential exposure exists.
	Acutely toxic chemicals (e.g., hydrofluoric acid)	Acute toxic effects by inhalation or absorption	Use protective clothing, gloves, and eyewear when potential exposure exists.
	Ingestion of contaminated soil	Acute toxic effects by ingestion	Avoid ingestion of contaminated soil, use protective clothing, maintain hygiene. Do not eat or drink in contaminated areas.
Flammable and/or reactive chemicals	Fire and/or explosion hazards	Burns and physical injury, equipment damage	Assess site conditions, monitor for the presence of combustible gases if indicated. If reactive chemicals may be present, implement contaminant-specific handling protocols.

APPENDIX B

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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CONTENTS

TABLES

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TERMS

ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
EPA	U.S. Environmental Protection Agency
MCL	maximum contaminant level
OU	operable unit
PCB	polychlorinated biphenyl
RCRA	*Resource Conservation and Recovery Act of 1976*
TBC	to be considered
TSD	treatment, storage, and disposal (unit)
WAC	*Washington Administrative Code*

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APPENDIX B

POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

B1.0 IDENTIFICATION OF CENTRAL PLATEAU OPERABLE UNITS POTENTIAL ARARS

This appendix identifies and evaluates potential applicable or relevant and appropriate requirements (ARAR) for waste site remediation within the Central Plateau operable units (OU). The potential ARARs identified in this appendix have been used to form the basis for the levels to which contaminants must be remediated to protect human health and the environment. The *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) provides for the identification of to be considered (TBC) nonpromulgated advisories, criteria, guidance, or proposed standards that may be consulted to interpret remediation goals when ARARs do not exist or are insufficient. Independent of the TBC and ARARs identification process at the Hanford Site, the requirements of U.S. Department of Energy directives must be met.

Because the waste sites in the Central Plateau OUs will be remediated under a CERCLA decision document, remedial and corrective actions at the sites will be required to meet ARARs. This appendix identifies and evaluates potential ARARs for these sites. Future feasibilities studies for the various Central Plateau OUs will develop a set of preliminary ARARs that will be used in the evaluation process. Final ARARs for remediation will be established in the record of decision. In many cases, the ARARs form the basis for the preliminary remediation goals to which contaminants must be remediated to protect human health and the environment. In other cases, the ARARs define or restrict how specific remedial measures can be implemented.

The ARARs identification process is based on CERCLA guidance (EPA/540/G-89/006, *CERCLA Compliance with Other Laws Manual: Interim Final*, and EPA/540/G-89/004, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final*, OSWER 9355.3-01). Section 121 of CERCLA as amended, requires, in part, that any applicable or relevant and appropriate standard, requirement, criterion, or limitation promulgated under any Federal environmental law, or any more stringent state requirement promulgated pursuant to a state environmental statute, be met (or a waiver justified) for any hazardous substance, pollutant, or contaminant that will remain on site after completion of remedial action.

An "applicable" requirement is a requirement that a private party would have to comply with by law if the same action were being undertaken apart from CERCLA authority. All jurisdictional prerequisites of the requirement must be met for the requirement to be applicable.

"Relevant and appropriate" requirements means those cleanup standards that address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (40 CFR 300.5, "National Oil and Hazardous Substances Pollution

Contingency Plan," "Definitions"). An ARAR may not meet one or more jurisdictional prerequisites for applicability but still may make sense at the site, given the circumstances of the site and the release. In evaluating the relevance and appropriateness of a requirement, the eight comparison factors in 40 CFR 300.400(g)(2), "Identification of Applicable or Relevant and Appropriate Requirements," are considered:

(i) The purpose of the requirement and the purpose of the CERCLA action

(ii) The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site

(iii) The substances regulated by the requirement and the substances found at the CERCLA site

(iv) The actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site

(v) Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site

(vi) The type of place regulated and the type of place affected by the release or CERCLA action

(vii) The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action

(viii) Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the CERCLA site.

In addition, potential ARARs were evaluated to determine if they fall into one of three categories: chemical specific, location specific, or action specific. These categories are defined as follows.

- Chemical-specific requirements are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of public and worker safety levels and site cleanup levels.

- Location-specific requirements are restrictions placed on the concentration of dangerous substances or the conduct of activities solely because they occur in special geographic areas.

- Action-specific requirements are usually technology- or activity-based requirements or limitations triggered by the remedial actions performed at the site.

In summary, a requirement is applicable if the specific terms or jurisdictional prerequisites of the law or regulations directly address the circumstances at a site. If not applicable, a requirement may nevertheless be relevant and appropriate if (1) circumstances at the site are, based on best professional judgment, sufficiently similar to the problems or situations regulated by the requirement and (2) the requirement's use is well suited to the site. Only the substantive requirements (e.g., use of control/containment equipment, compliance with numerical standards) associated with ARARs apply to CERCLA on-site activities. ARARs associated with administrative requirements, such as permitting, are not applicable to CERCLA on-site activities (CERCLA, Section 121[e][1]). In general, this CERCLA permitting exemption will be extended to all remedial and corrective action activities conducted at the OU, with the exception of the *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and/or disposal units, which will be incorporated into WA7890008967, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8, for the Treatment, Storage, and Disposal of Dangerous Waste.*

TBC information is nonpromulgated advisories or guidance issued by Federal or state governments that is not legally binding and does not have the status of potential ARARs. In some circumstances, TBCs will be considered along with ARARs in determining the remedial action necessary for protection of human health and the environment. The TBCs complement the ARARs in determining protectiveness at a site or implementation of certain actions. For example, because soil cleanup standards do not exist for all contaminants, health advisories, which would be TBCs, may be helpful in defining appropriate remedial action goals.

Potential Federal and state ARARs are presented in Tables B-1 and B-2, respectively.

B2.0 ARAR WAIVERS

The U.S. Environmental Protection Agency (EPA) may waive ARARs and select a remedial action that does not attain the same level of site cleanup as that identified by the ARARs. Section 121 of the *Superfund Amendments and Reauthorization Act of 1986* identifies six circumstances in which the EPA may waive ARARs for on-site remedial actions. The six circumstances are as follows:

- The remedial action selected is only a part of a total remedial action (such as an interim action), and the final remedy will attain the ARAR upon its completion
- Compliance with the ARAR will result in a greater risk to human health and the environment than alternative options
- Compliance with the ARAR is technically impracticable from an engineering perspective
- An alternative remedial action will attain an equivalent standard of performance through the use of another method or approach

- The ARAR is a state requirement that the state has not consistently applied (or demonstrated the intent to apply consistently) in similar circumstances
- In the case of Section 104 (Superfund financed remedial actions), compliance with the ARAR will not provide a balance between protecting human health and the environment and the availability of Superfund money for response at other facilities.

No waivers are being requested for the Central Plateau OU waste sites in this work plan.

B3.0 REFERENCES

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Title 40, *Code of Federal Regulations*, Part 61, as amended.

- 40 CFR 61, Subpart M, "National Emission Standards for Asbestos."
- 40 CFR 61.140, "Applicability."
- 40 CFR 61.145, "Standard for Demolition and Renovation."
- 40 CFR 61.150, "Standard for Waste Disposal for Manufacturing, Fabricating, Demolition, Renovation, and Spraying Operations."

40 CFR 141, "National Primary Drinking Water Regulations," Title 40, *Code of Federal Regulations*, Part 141, as amended.

- 40 CFR 141.61, "Maximum Contaminant Levels for Organic Contaminants."
- 40 CFR 141.62, "Maximum Contaminant Levels for Inorganic Contaminants."
- 40 CFR 141.66, "Maximum Contaminant Levels for Radionuclides."

40 CFR 268, "Land Disposal Restrictions," Title 40, *Code of Federal Regulations*, Part 268, as amended.

40 CFR 300.5, "National Oil and Hazardous Substances Pollution Contingency Plan," "Definitions," Title 40, *Code of Federal Regulations*, Part 300.5, as amended.

40 CFR 300.400, "National Oil and Hazardous Substances Pollution Contingency Plan," "General," Title 40, *Code of Federal Regulations*, Part 300.400, as amended.

- 40 CFR 300.400(g), "Identification of Applicable or Relevant and Appropriate Requirements."

40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," Title 40, *Code of Federal Regulations*, Part 761, as amended.

- 40 CFR 761.50(b), "Applicability," "PCB Waste."
- 40 CFR 761.50(c), "Applicability," "Storage for Disposal."

Archeological and Historic Preservation Act (1960), 16 USC 469a, et seq.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 USC 9601, et seq.

Endangered Species Act of 1973, 16 USC 1531, et seq.

EPA/540/G-89/004, 1988, *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Interim Final*, OSWER 9355.3-01, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C.

EPA/540/G-89/006, 1988, *CERCLA Compliance with Other Laws Manual: Interim Final*, U.S. Environmental Protection Agency, Washington, D.C.

National Historic Preservation Act of 1966, 16 USC 470, et seq.

Native American Graves Protection and Repatriation Act, 25 USC 3001, et seq.

Resource Conservation and Recovery Act of 1976, 42 USC 6901, et seq.

Superfund Amendments and Reauthorization Act of 1986, 42 USC 103, et seq.

WA7890008967, 2004, *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion, Revision 8, for the Treatment, Storage, and Disposal of Dangerous Waste*, Washington State Department of Ecology, Richland, Washington, as amended.

WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-160-161, "How Shall Each Water Well be Planned and Constructed?"
- 173-160-171, "What are the Requirements for the Location of the Well Site and Access to the Well?"
- 173-160-181, "What are the Requirements for Preserving the Natural Barriers to Ground Water Movement Between Aquifers?"
- 173-160-191, "What are the Design and Construction Requirements for Completing Wells?"
- 173-160-201, "What are the Casing and Liner Requirements?"
- 173-160-221, "What are the Standards for Sealing Materials?"
- 173-160-231, "What are the Standards for Surface Seals?"
- 173-160-241, "What are the Requirements for Formation Sealing?"
- 173-160-271, "What are the Special Sealing Standards for Driven Wells, Jetted Wells, and Dewatering Wells?"
- 173-160-281, "What are the Construction Standards for Artificial Gravel Packed Wells?"
- 173-160-291, "What are the Standards for the Upper Terminal of Water Wells?"
- 173-160-301, "What are the Requirements for Temporary Capping?"
- 173-160-311, "What are the Well Tagging Requirements?"
- 173-160-321, "How do I Test a Well?"

- 173-160-331, "How do I Make Sure My Equipment and the Water Well are Free of Contaminants?"
- 173-160-341, "How do I Ensure the Quality of Drilling Water?"
- 173-160-351, "What are the Standards for Pump Installation?"
- 173-160-371, "What are the Standards for Chemical Conditioning?"
- 173-160-381, "What are the Standards for Decommissioning a Well?"
- 173-160-400, "What are the Minimum Standards for Resource Protection Wells and Geotechnical Soil Borings?"
- 173-160-420, "What are the General Construction Requirements for Resource Protection Wells?"
- 173-160-430, "What are the Minimum Casing Standards?"
- 173-160-440, "What are the Equipment Cleaning Standards?"
- 173-160-450, "What are the Well Sealing Requirements?"
- 173-160-460, "What is the Decommissioning Process for Resource Protection Wells?"

WAC 173-303, "Dangerous Waste Regulations," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-303-016, "Identifying Solid Waste."
- 173-303-017, "Recycling Processes Involving Solid Waste."
- 173-303-040, "Definitions."
- 173-303-050, "Department of Ecology Cleanup Authority."
- 173-303-070(3), "Designation of Dangerous Waste," "Designation Procedures."
- 173-303-071, "Excluded Categories of Waste."
- 173-303-073, "Conditional Exclusion of Special Wastes."
- 173-303-077, "Requirements for Universal Waste."
- 173-303-120, "Recycled, Reclaimed, and Recovered Wastes."
- 173-303-140, "Land Disposal Restrictions."
- 173-303-140(4), "Land Disposal Restrictions," "Land Disposal Restrictions and Prohibitions."
- 173-303-170, "Requirements for Generators of Dangerous Waste."
- 173-303-200, "Accumulating Dangerous Waste On Site."
- 173-303-573, "Standards for Universal Waste Management."
- 173-303-610, "Closure and Post-Closure."
- 173-303-630, "Use and Management of Containers."
- 173-303-640, "Tank Systems."
- 173-303-650, "Surface Impoundments."
- 173-303-665, "Landfills."
- 173-303-960, "Special Powers and Authorities of the Department."

WAC 173-304, "Minimum Functional Standards for Solid Waste Handling," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-304-200(2), "On Site Containerized Storage, Collection and Transportation Standards for Solid Waste," "On-Site Storage Standards."

WAC 173-340, "Model Toxics Control Act -- Cleanup," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-340-745, "Soil Cleanup Standards for Industrial Properties."
- 173-340-745(5)(b), "Soil Cleanup Standards for Industrial Properties," "Method C Industrial Soil Cleanup Levels," "Standard Method C Industrial Soil Cleanup Levels."

WAC 173-350, "Solid Waste Handling Standards," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-350-300, "On-Site Storage, Collection, and Transportation Standards."

WAC 173-400, "General Regulations for Air Pollution Sources," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-400-040, "General Standards for Maximum Emissions."
- 173-400-113, "Requirements for New Sources in Attainable or Unclassifiable Areas."

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-460-030, "Requirements, Applicability and Exemptions."
- 173-460-060, "Control Technology Requirements."
- 173-460-070, "Ambient Impact Requirement."

WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides," *Washington Administrative Code*, as amended, Washington State Department of Ecology, Olympia, Washington.

- 173-480-050, "Standards."
- 173-480-070, "Emission Monitoring and Compliance Procedures."

WAC 246-247, "Department of Health," "Radiation Protection – Air Emissions," *Washington Administrative Code*, as amended, Washington State Department of Health, Olympia, Washington.

- 246-247-040, "General Standards."
- 246-247-075, "Monitoring, Testing, and Quality Assurance."

Table B-1. Identification of Potential Federal Applicable or Relevant and Appropriate Requirements and To Be Considered for the Remedial Action Sites. (3 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Chemical-Specific			
"National Primary Drinking Water Regulations," 40 CFR 141			
"Maximum Contaminant Levels for Organic Contaminants," 40 CFR 141.61	ARAR	Establishes MCLs that are drinking water criteria designed to protect human health from the potential adverse effects of organic contaminants in drinking water.	The groundwater in the Central Plateau is not currently used for drinking water. However, Central Plateau groundwater may be considered a potential drinking water source and, because the groundwater discharges to the Columbia River (which is used for drinking water), the substantive requirements in 40 CFR 141.61 for organic constituents are relevant and appropriate.
"Maximum Contaminant Levels for Inorganic Contaminants," 40 CFR 141.62	ARAR	Establishes MCLs that are drinking water criteria designed to protect human health from the potential adverse effects of inorganic contaminants in drinking water.	The groundwater in the Central Plateau is not currently used for drinking water. However, Central Plateau groundwater may be considered a potential drinking water source and because the groundwater discharges to the Columbia River (which is used for drinking water), the substantive requirements in 40 CFR 141.62 for inorganic constituents are relevant and appropriate.
"Maximum Contaminant Levels for Radionuclides," 40 CFR 141.66	ARAR	Establishes MCLs that are drinking water criteria designed to protect human health from the potential adverse effects of radionuclides in drinking water.	The groundwater in the Central Plateau is not currently used for drinking water. However, Central Plateau groundwater may be considered a potential drinking water source and because the groundwater discharges to the Columbia River (which is used for drinking water), the substantive requirements in 40 CFR 141.66 for radionuclides are relevant and appropriate.
"Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," 40 CFR 761			
"Applicability," 40 CFR 761.50(b)(1) 40 CFR 761.50(b)(2) 40 CFR 761.50(b)(3) 40 CFR 761.50(b)(4) 40 CFR 761.50(b)(7) 40 CFR 761.50(c)	ARAR	These regulations establish standards for the storage and disposal of PCB wastes.	The substantive requirements of these regulations are applicable or relevant and appropriate to the storage and disposal of PCB liquids, items, remediation waste, and bulk product waste at ≥ 50 p/m. The specific subsections identified from 40 CFR 761.50(b) reference the specific sections for the management of PCB waste type. The disposal requirements for radioactive PCB waste are addressed in 40 CFR 761.50(b)(7).

Table B-1. Identification of Potential Federal Applicable or Relevant and Appropriate Requirements and To Be Considered for the Remedial Action Sites. (3 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Location-Specific			
Archeological and Historic Preservation Act, 16 USC 469aa-mm	ARAR	Requires that remedial actions at Central Plateau operable unit waste sites do not cause the loss of any archaeological or historic data. This act mandates preservation of the data and does not require protection of the actual waste site or facility.	Archeological and historic sites have been identified within the Central Plateau; therefore, the substantive requirements of this act are applicable to actions that might disturb these sites.
National Historic Preservation Act of 1966, 16 USC 470, Section 106	ARAR	Requires Federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation and mitigation processes, and consultation with interested parties.	Cultural and historic sites have been identified within the 200 Areas; therefore, the substantive requirements of this act are applicable to actions that might disturb these types of sites.
Native American Graves Protection and Repatriation Act, 25 USC 3001, et seq.	ARAR	Establishes Federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony.	Substantive requirements of this act are applicable if remains and sacred objects are found during remediation and will require Native American Tribal consultation in the event of discovery.
Endangered Species Act of 1973, 16 USC 1531 et seq., Subsection 16 USC 1536(c)	ARAR	Prohibits actions by Federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification or critical habitat. If remediation is within critical habitat or buffer zones surrounding threatened or endangered species, mitigation measures must be taken to protect the resource.	Substantive requirements of this act are applicable if threatened or endangered species are identified in areas where remedial actions will occur.

Table B-1. Identification of Potential Federal Applicable or Relevant and Appropriate Requirements and To Be Considered for the Remedial Action Sites. (3 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Action-Specific			
"National Emission Standard for Asbestos," 40 CFR 61, Subpart M; "Applicability," 40 CFR 61.140			
"Standard for Demolition and Renovation," 40 CFR 61.145	ARAR	Specifies that facilities be inspected for the presence of asbestos before demolition. The standard defines regulated asbestos-containing materials and establishes removal requirements based on quantity present and handling requirements. These requirements also specify handling and disposal requirements for regulated sources that have the potential to emit asbestos. Specifically, no visible emissions are allowed during handling, packaging, and transport of asbestos-containing materials.	Although asbestos-containing materials are not anticipated, substantive requirements of this standard are applicable, should this remedial action include abatement of asbestos and asbestos-containing materials on pipelines or buried asbestos. As a result, there is a potential to emit asbestos to unrestricted areas, and the requirements for the removal, handling, and packaging of asbestos apply.
"Standard for Waste Disposal for Manufacturing, Fabricating, Demolition, Renovation, and Spraying Operations," 40 CFR 61.150	ARAR	Identifies the requirements for the removal and disposal of asbestos from demolition and renovation activities.	Although asbestos-containing materials are not anticipated, the substantive requirements of this standard are applicable, should asbestos-containing material be located during remedial action activities of associated pipelines and buried asbestos.
Regulations pursuant to the *Resource Conservation and Recovery Act of 1976* and implemented through WAC 173-303, "Dangerous Waste Regulations" (see Table B-2).			

ARAR = applicable or relevant and appropriate requirement.
CFR = *Code of Federal Regulations*.
MCL = maximum contaminant level.
PCB = polychlorinated biphenyl.
TBC = to be considered.
WAC = *Washington Administrative Code*.

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Chemical-Specific			
"Model Toxics Control Act – Cleanup," WAC 173-340			
"Soil Cleanup Standards for Industrial Properties," WAC 173-340-745(5)(b)	ARAR	Identifies the methods used to identify risk-based concentrations and their use in the selection of a cleanup action. Cleanup and remediation levels are based on protection of human health and the environment, the location of the site, and other regulations that apply to the site. The standard specifies cleanup goals that implement the strictest Federal or state cleanup criteria.	The State-established risk-based concentrations for soils and protection of groundwater are relevant and appropriate to the OU waste-site remedial actions, because no Federal standard exists.
Action-Specific			
"Dangerous Waste Regulations," WAC 173-303			
"Identifying Solid Waste," WAC 173-303-016	ARAR	Identifies those materials that are and are not solid wastes.	Substantive requirements of these regulations are applicable, because these define how to determine which materials are subject to the designation regulations. Specifically, materials that are generated for removal from the CERCLA site during the remedial action would be subject to the procedures for identification of solid waste to ensure proper management.
"Recycling Processes Involving Solid Waste," WAC 173-303-017	ARAR	Identifies materials that are and are not solid wastes when recycled.	Substantive requirements of these regulations are applicable, because these define how to determine which materials are subject to the designation regulations. Specifically, materials that are generated for removal from the CERCLA site during the remedial action would be subject to the procedures for identification of solid waste to ensure proper management.
"Designation of Dangerous Waste," WAC 173-303-070(3)	ARAR	Establishes the method for determining whether a solid waste is, or is not, a dangerous waste or an extremely hazardous waste.	Substantive requirements of these regulations are applicable to materials encountered during the remedial action. Specifically, solid waste that is generated for removal from the CERCLA site during this remedial action would be subject to the dangerous waste designation procedures to ensure proper management.

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Excluded Categories of Waste," WAC 173-303-071	ARAR	Describes those categories of wastes that are excluded from the requirements of WAC 173-303 (excluding WAC 173-303-050).	The conditions of this requirement are applicable to remedial actions in the OU, should wastes identified in WAC 173-303-071 be encountered.
"Conditional Exclusion of Special Wastes," WAC 173-303-073	ARAR	Establishes the conditional exclusion and the management requirements of special wastes, as defined in WAC 173-303-040.	Substantive requirements of these regulations are applicable to materials encountered during the remedial action. Specifically, the substantive standards for management of special waste are applicable to the interim management of certain waste that will be generated during the remedial action.
"Requirements for Universal Waste," WAC 173-303-077	ARAR	Identifies those wastes exempted from regulation under WAC 173-303-140 and WAC 173-303-170 through 173-303-9907 (excluding WAC 173-303-960). These wastes are subject to regulation under WAC 173-303-573.	Substantive requirements of these regulations are applicable to materials encountered during the remedial action. Specifically, the substantive standards for management of universal waste are applicable to the interim management of certain waste that will be generated during the remedial action.
"Recycled, Reclaimed, and Recovered Wastes," WAC 173-303-120 Specific Subsections: WAC 173-303-120(3) WAC 173-303-120(5)	ARAR	These regulations define the requirements for recycling materials that are solid and dangerous waste. Specifically, WAC 173-303-120(3) provides for the management of certain recyclable materials, including spent refrigerants, antifreeze, and lead-acid batteries. WAC 173-303-120(5) provides for the recycling of used oil.	Substantive requirements of these regulations are applicable to certain materials that might be encountered during the remedial action. Recyclable materials that are exempt from regulation as dangerous waste and that are not otherwise subject to CERCLA as hazardous substances can be recycled and/or conditionally excluded from certain dangerous waste requirements.
"Land Disposal Restrictions," WAC 173-303-140(4)	ARAR	This regulation establishes state standards for land disposal of dangerous waste and incorporates, by reference, Federal land-disposal restrictions of 40 CFR 268, "Land Disposal Restrictions," that are applicable to solid waste that is designated as dangerous or mixed waste in accordance with WAC 173-303-070(3).	The substantive requirements of this regulation are applicable to materials encountered during the remedial action. Specifically, dangerous/mixed waste that is generated and removed from the CERCLA site during the remedial action for off-site (as defined by CERCLA) land disposal would be subject to the identification of applicable land-disposal restrictions at the point of generation of the waste. The actual off-site treatment of such waste would not be ARAR to this remedial action, but instead would be subject to all applicable laws and regulations.

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Requirements for Generators of Dangerous Waste," WAC 173-303-170	ARAR	Establishes the requirements for dangerous waste generators.	Substantive requirements of these regulations are applicable to materials encountered during the remedial action. Specifically, the substantive standards for management of dangerous/mixed waste are applicable to the interim management of certain waste that will be generated during the remedial action. For purposes of this remedial action, WAC 173-303-170(3) includes the substantive provisions of WAC 173-303-200 by reference. WAC 173-303-200 further includes certain substantive standards from WAC 173-303-630 and -640 by reference.
"Closure and Post-Closure," WAC 173-303-610	ARAR	This regulation establishes the closure performance standards applicable to all Hanford Site TSD units.	These requirements are applicable to the closure of RCRA TSD unit OUs.
"Surface Impoundments," WAC 173-303-650	ARAR	Specifies closure and postclosure requirements for surface impoundments.	This regulation is applicable to TSD units that are permitted as a "Surface Impoundment" and subject to the requirements identified in WAC 173-303-665.
"Landfills," WAC 173-303-665	ARAR	Specifies closure and post-closure requirements for landfills.	This regulation is applicable to TSD units that are permitted as a "landfill" and subject to the requirements identified in WAC 173-303-665.
"Minimum Functional Standards for Solid Waste Handling," WAC 173-304			
"On-Site Containerized Storage, Collection and Transportation Standards for Solid Waste," WAC 173-304-200(2)	ARAR	Establishes the requirements for the on-site storage of solid wastes that are not radioactive or dangerous wastes.	Substantive requirements of these regulations are applicable to materials encountered during the remedial action. Specifically, nondangerous, nonradioactive solid wastes (i.e., hazardous substances that are only regulated as solid waste) that will be containerized for removal from the CERCLA site would be managed on site according to the substantive requirements of this standard.

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Solid Waste Handling Standards," WAC 173-350			
"On-Site Storage, Collection, and Transportation Standards," WAC 173-350-300	ARAR	Establishes the requirements for the temporary storage of solid waste in a container on site and the collecting and transporting of the solid waste.	The substantive requirements of this newly promulgated rule are relevant and appropriate to the on-site collection and temporary storage of solid wastes at the OU remediation waste sites. Compliance with this regulation is being implemented in phases for existing facilities.
"Minimum Standards for Construction and Maintenance of Wells," WAC 173-160			
WAC 173-160-161	ARAR	Identifies well planning and construction requirements.	The substantive requirements of this regulation are applicable to actions that include construction of wells used for groundwater extraction, monitoring, or injection of treated groundwater or wastes.
WAC 173-160-171	ARAR	Identifies the requirements for locating a well.	
WAC 173-160-181	ARAR	Identifies the requirements for preserving natural barriers to groundwater movement between aquifers.	
WAC 173-160-191	ARAR	Identifies the design and construction requirements for completing wells.	
WAC 173-160-201	ARAR	Identifies the casing and liner requirements for water supply wells.	
WAC 173-160-221	ARAR	Identifies the requirements for sealing materials.	
WAC 173-160-231	ARAR	Identifies the requirements for surface seals on water wells.	
WAC 173-160-241	ARAR	Identifies the requirements for formation sealing.	
WAC 173-160-271	ARAR	Identifies the special sealing standards for driven wells, jetted wells, and dewatering wells.	
WAC 173-160-281	ARAR	Identifies the construction standards for artificial gravel-packed wells.	
WAC 173-160-291	ARAR	Identifies the standards for the upper terminal of water wells.	
WAC 173-160-301	ARAR	Identifies the requirements for the temporary surface barrier.	
WAC 173-160-311	ARAR	Identifies the requirements for well tagging.	

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
WAC 173-160-321	ARAR	Identifies the standards for testing a well.	
WAC 173-160-331	ARAR	Identifies the method for keeping equipment and the water well free of contaminants.	
WAC 173-160-341	ARAR	Identifies the method for ensuring the quality of the well water.	
WAC 173-160-351	ARAR	Identifies the standards for the installation of a pump.	
WAC 173-160-371	ARAR	Identifies the standard for chemical conditioning.	
WAC 173-160-381	ARAR	Identifies the standard for decommissioning a well.	
WAC 173-160-400	ARAR	Identifies the minimum standards for resource protection wells and geotechnical soil borings.	
WAC 173-160-420	ARAR	Identifies the general construction requirements for resource protection wells.	
WAC 173-160-430	ARAR	Identifies the minimum casing standards.	
WAC 173-160-440	ARAR	Identifies the equipment cleaning standards.	
WAC 173-160-450	ARAR	Identifies the well sealing requirements.	
WAC 173-160-460	ARAR	Identifies the decommissioning process for resource protection wells.	
"General Regulations for Air Pollution Sources," WAC 173-400			
"General Standards for Maximum Emissions," WAC 173-400-040 WAC 173-400-113	ARAR	Methods of control shall be employed to minimize the release of air contaminants associated with fugitive emissions resulting from materials handling, construction, demolition, or other operations. Emissions are to be minimized through application of best available control technology.	Substantive requirements of these standards are relevant and appropriate to this remedial action, because there may be visible, particulate, fugitive, and hazardous air emissions and odors resulting from decontamination, demolition, and excavation activities. As a result, standards established for the control and prevention of air pollution are relevant and appropriate.

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Controls for New Sources of Toxic Air Pollutants," WAC 173-460			
"Control Technology Requirements," WAC 173-460-030 WAC 173-460-060	ARAR	Requires that new sources of air emissions provide the emission estimates identified in this regulation.	Substantive requirements of these standards are applicable to this remedial action, because there is the potential for toxic air pollutants to become airborne as a result of decontamination, demolition, and excavation activities. As a result, standards established for the control of toxic air contaminants are relevant and appropriate.
"Ambient Impact Requirement," WAC 173-460-070	ARAR	Requires that when applying for a notice of construction, the owner/operator of a new toxic air pollutant source that is likely to increase toxic air pollutant emissions shall demonstrate that emissions from the source are sufficiently low to protect human health and safety from potential carcinogenic and/or other toxic effects.	The substantive requirements of this standard are applicable to remedial actions in the OU, should the remedial action result in the treatment of the soil or debris that contains contaminants of concern identified in the regulation as a toxic air pollutant.
"Ambient Air Quality Standards and Emission Limits for Radionuclides," WAC 173-480			
"Standards," WAC 173-480-050	ARAR	Whenever another Federal or state regulation or limitation in effect controls the emission of radionuclides to the ambient air, the more stringent control of emissions shall govern.	The substantive requirements of this standard are applicable in that the more stringent aspect of Federal or state emission limitation is specified as governing.
"Compliance," WAC 173-480-070(2)	ARAR	Requires that radionuclide emissions compliance shall be determined by calculating the dose to members of the public at the point of maximum annual air concentration in an unrestricted area where any member of the public may be.	The substantive requirements of this standard are applicable to remedial actions involving disturbance or ventilation of radioactively contaminated areas or structures, because airborne radionuclides may be emitted to unrestricted areas where any member of the public may be.

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Radiation Protection – Air Emissions," WAC 246-247			
"General Standards," WAC 246-247-040(1)	ARAR	Requires that emissions of radionuclides to the ambient air from U.S. Department of Energy facilities shall not exceed amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr.	Substantive requirements of this standard are applicable, because this remedial action may include activities such as decontamination and stabilization of contaminated structures, treatment of sludge, and operation of exhausters and vacuums, each of which may provide airborne emissions of radioactive particulates to unrestricted areas. As a result, requirements limiting emissions apply. This is a risk-based standard for the purposes of protecting human health and the environment.
"Monitoring, Testing, and Quality Assurance," WAC 246-247-075(1)	ARAR	Specifies that radionuclide emission measurements shall be made at all release points that have the potential to discharge radionuclides to the air in quantities that cause an effective dose equivalent in excess of 1% of the standard. The regulation also requires that all radionuclides be measured that could contribute greater than 10% of the potential dose equivalent for a release point.	Substantive requirements of this standard are applicable, because major point-source emissions of radionuclides to the ambient air may result from activities performed during the remedial action, such as decontamination and stabilization of contaminated structures, treatment of sludge, and operation of exhauster and vacuums. This standard exists to ensure compliance with emission standards.
"General Standards," WAC 246-247-040 "BARCT," WAC 246-247-040(3) "ALARACT," WAC 246-247-040(4)	ARAR	Emissions shall be controlled on an ALARA basis, at a minimum, to ensure that emission standards are not exceeded.	Substantive requirements of this standard are applicable, because fugitive, diffuse, and point-source emissions of radionuclides to the ambient air may result from activities performed during the remedial action, such as open-air demolition of contaminated structures, excavation of contaminated soils, and operation of exhauster and vacuums. This standard exists to ensure enhanced compliance with emission standards.

Table B-2. Identification of Potential State Applicable and Relevant or Appropriate Requirements and To Be Considered for the Remedial Action Sites. (8 Pages)

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Monitoring, Testing, and Quality Assurance," WAC 246-247-075(1), (2) WAC 246-247-075(8)	ARAR	Establishes the monitoring, testing, and quality assurance requirements for radioactive air emissions. Facility (site) emissions resulting from non-point and fugitive sources of airborne radioactive material shall be measured. Measurement techniques may include ambient air measurements, or in-line radiation detector or withdrawal of representative samples from the effluent stream, as determined by the lead agency.	Substantive requirements of this standard are applicable, because fugitive and non-point-source emissions of radionuclides to the ambient air may result from activities performed during the remedial action, such as open-air demolition of contaminated structures and excavation of contaminated soils. This standard exists to ensure compliance with emission standards.

ALARA = as low as reasonably achievable.
ARAR = applicable or relevant and appropriate requirement.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
CFR = *Code of Federal Regulations.*
OU = operable unit.
RCRA = *Resource Conservation and Recovery Act of 1976.*
TBC = to be considered.
TSD = treatment, storage, and disposal.
WAC = *Washington Administrative Code.*

APPENDIX C

DATA QUALITY OBJECTIVES SUMMARY TABLES

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TABLES

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Table C-1. Data Quality Objectives Site Data Needs Agreements. (3 Pages)

No.	Agreement	Agree Date
1.	Supplemental data are NOT required for the Model Group waste sites listed in Agreement #1	
	Model Group 2	
	216-S-20	11/20/06
	216-A-31 (No pre-ROD data required)	11/20/06
	216-B-10B (Opportunistic HRR)	11/15/06
	216-C-2 (Opportunistic HRR)	11/15/06
	216-T-2	11/15/06
	216-Z-5	11/28/06
	216-S-7	01/11/07
	216-S-23	01/11/07
	Model Group 3	
	216-Z-11	11/08/06 (Agreement per Note 1)
	216-Z-19	
	216-Z-1D	
	216-Z-20	
	UPR-200-W-110	
	Model Group 4	
	216-Z-18	11/08/06
	216-Z-1A	11/08/06
	216-Z-3	11/08/06
	216-Z-9	11/08/06
	216-Z-361	11/08/06
	216-Z-8	11/08/06
	241-Z-8	11/08/06
	241-T-361	11/08/06
	UPR-200-W-36 (Reassigned from Model Group 2 and included with 216-S-1&2 per Note 2)	11/15/06
	UPR-200-E-144	11/08/06
	241-B-361	11/08/06
	216-Z-1&2	11/08/06
	200-W-52 (see 216-T-7)	11/08/06
	216-Z-12 (No pre-ROD data required)	1/28/06
	Model Group 5	
	216-B-3A	11/20/06
	216-B-3B	11/20/06
	216-B-3C	11/20/06
	216-T-4A (Reassigned to a different OU per Note 2)	11/20/06
	216-S-10	11/28/06
	Model Group 6	
	UPR-200-E-56	11/28/06
	216-S-14 (Reassigned to a different OU per Note 2)	11/28/06
	UPR-200-E-9 (Reassigned to a different OU per Note 2)	12/04/06
	216-A-6 (Opportunistic HRR)	12/04/06
	UPR-200-E-19	12/04/06

Table C-1. Data Quality Objectives Site Data Needs Agreements. (3 Pages)

No.	Agreement	Agree Date
	UPR-200-E-21	12/04/06
	UPR-200-E-29	12/04/06
	216-A-27	12/04/06
	216-B-9	12/11/06
	216-S-26 (Reassigned to a different OU per Note 2)	12/11/06
	Model Group 7	
	216-Z-10	12/04/06
	216-B-5	1/16/07
2.	Proposed data collection strategy is ACCEPTABLE for the Model Group waste sites listed in Agreement #2:	
	Model Group 2	
	216-B-6	11/20/06
	216-B-10A	11/20/06
	216-B-12	11/20/06
	216-A-10	11/20/06
	216-A-15	11/13/06
	216-B-4	11/13/06
	216-B-43	11/13/06
	216-B-44	11/13/06
	216-B-45	11/13/06
	216-B-46	11/13/06
	216-B-47	11/13/06
	216-B-48	11/13/06
	216-B-49	11/13/06
	216-B-50	11/13/06
	216-T-26	11/13/06
	216-T-27	11/13/06
	216-T-28	11/13/06
	216-B-57	11/29/06
	216-S-13 (Reassigned to a different OU per Note 2)	11/28/06
	216-B-11A&B	11/29/06
	Model Group 4	
	216-B-7A&B	11/08/06
	216-Z-7	11/08/06
	200-E-102	11/08/06
	216-A-4	11/08/06
	216-A-2 (Reassigned to a different OU per Note 2)	11/08/06
	216-T-18	11/08/06
	216-S-1&2	11/13/06
	Model Group 5	
	216-T-4B Pond	11/20/06
	216-B-3 Pond	11/20/06
	216-S-16	11/20/06
	216-S-17	11/20/06

Table C-1. Data Quality Objectives Site Data Needs Agreements. (3 Pages)

No.	Agreement	Agree Date
	UPR-200-W-24 (Data collection contingent on results of data collection activities at 216-S-17)	11/20/06
	216-U-10 Pond	11/28/06
	216-U-11 Trench	11/28/06
	Model Group 6	
	216-A-19	11/28/06
	216-A-24	11/28/06
	216-A-7 (Can proceed with feasibility study without HRR or geophysical logging data)	11/28/06
	216-A-8 (Can proceed with feasibility study without HRR data)	11/28/06
	216-S-5	11/28/06
	216-S-6	11/28/06
	216-B-62	11/29/06
	216-B-55	11/29/06
	216-Z-16	11/29/06
	216-T-19 (Reassigned to a different OU per Note 2)	12/04/06
	216-A-30	12/04/06
	216-A-37-2	12/04/06
	216-T-36	12/04/06
	216-C-1	12/11/06
	216-T-8	12/11/06
	216-A-21	01/10/07
	216-S-9	01/11/07
	216-T-14 through 17	01/16/07
	Model Group 7	
	200-E-45	1/16/07
3.	216-T-3	1/16/07

Notes:

1. Model Group 3 sites require no further data based on an underlying M-15 agreement.
2. Data quality objective decision makers agreed to relocate the following sites to a different operable unit as indicated below:

- 216-A-2 (Model Group 4): Reassigned from 200-PW-3 to 200-MW-1 (11/28/06)
- 216-T-19 (Model Group 6): Reassigned from 200-PW-1 to 200-TW-1 (11/28/06)
- 216-S-13 (Model Group 2): Reassigned from 200-PW-3 to 200-PW-5 (11/28/06)
- 216-S-14 (Model Group 6): Reassigned from 200-PW-3 to 200-PW-5 to allow analogous relationship with 216-S-14 (11/28/06)
- UPR-200-E-9 (Model Group 6): Reassigned from 200-TW-1 to Model Group 1 (200-MG-2) (12/04/06)
- 216-T-4A (Model Group 5): Reassigned from 200-CW-4 to Model Group 1 (200-MG-1) (11/20/06)
- 216-S-26 (Model Group 6): Reassigned from 200-LW-1 to Model Group 1 (200-MG-1) (12/11/06)
- UPR-200-W-36 reassigned from Model Group 2 and included with 216-S-1&2 (Model Group 4) (11/15/06).

HRR = high-resolution resistivity.
OU = operable unit.
ROD = record of decision.

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Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-S-10P	200-CS-1	5	1			4									No	Existing data are sufficient for decision making.
200-CS-1 Total			**1**			**4**				**0**	**0**	**0**	**0**	**0**	**0**	
216-A-25	200-CW-1	5	1			16	3					2			No	Existing data are sufficient for decision making; however, Ecology indicated stakeholder concern for the overflow area on the northwest edge of the pond; these data would respond to these stakeholder concerns.
216-B-3	200-CW-1	5	1			5						6+			No	These data would augment existing data and support a more detailed evaluation of a partial removal of the hotspot area around test pit location BP-1; these data may influence the remedy selection.
216-B-3A RAD	200-CW-1	5		1				30							No	Existing data are sufficient for decision making.
216-B-3B RAD	200-CW-1	5		1				26							No	Existing data are sufficient for decision making.
216-B-3C RAD	200-CW-1	5		1				21							No	Existing data are sufficient for decision making.
216-S-16P	200-CW-2	5						50				21			No	These activities would provide site-specific data and would allow a more definitive evaluation of partial removal alternative; the data may influence the remedy selection.
216-S-17	200-CW-2	5										15			No	These activities would provide site-specific data and would allow a more definitive evaluation of partial removal alternative; the data may influence the remedy selection.
UPR-200-W-124	200-CW-2	5										3			No	These activities would be contingent on finding contamination at the drive point location near the west end of 216-S-17.
216-T-4A	200-CW-4	5													No	The pond bottom was scraped and placed in Trench 27 of Burial Ground 218-W-2A; this would represent the majority of the small inventory received by the pond; remaining contamination is expected to be minimal and could be addressed through the action at the burial ground; no data collection activities are recommended or considered required for decision making; the waste site will be moved to Model Group 1.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-4B	200-CW-4	5										4			No	The pond and trench leading to the pond (within the area of the 218-W3-AE Burial Ground) are expected to have minimal contamination; these activities would provide site-specific data that could be used to support a CERCLA decision for the pond separate from the RCRA decision for the burial ground TSD.
216-U-10	200-CW-5	5		1	10	1	3	5			1 (140 ft)	8	3		No	The borehole would help resolve data quality issues associated with the previous borehole; the test pits would permit a visual inspection and sampling of the organic layer associated with the bottom of the pond that tends to concentrate the contamination; the direct pushes would provide data on the rest of the pond to give a pond-wide data set that could be used to address stakeholder concerns and uncertainties on inventory.
216-U-11	200-CW-5	5						2				14			No	These data would augment existing data and support a more detailed evaluation of a partial removal alternative; the data may influence the remedy selection
200-CW-1 Total (M-015-38B, 05/31/2009)			**2**	**4**	**10**	**22**	**6**	**134**		**0**	**1**	**73**	**3**	**0**	**0**	
216-Z-11	200-CW-5	3	1		20		2								No	Early agreement was reached that supplemental data are not required.
216-Z-19	200-CW-5	3						272							No	Early agreement was reached that supplemental data are not required.
216-Z-1D	200-CW-5	3						90							No	Early agreement was reached that supplemental data are not required.
216-Z-20	200-CW-5	3													No	Early agreement was reached that supplemental data are not required.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-30	200-SC-1	6								1					Yes	The analogous relationship with 216-U-10 is somewhat uncertain. Inventory information would suggest potential for groundwater impacts associated with chromium, fluoride, and/or nitrate. HRR would support evaluation of the lateral extent of potential elevated conductivity and a deep borehole would provide site-specific data on nature and vertical extent and correlation data for the HRR survey results. The data from the 216-A-30 borehole would be used as analogous for 216-A-37-2 and 216-A-6 and associated unplanned releases because 216-A-37-2 and 216-A-6 received the same waste as 216-A-30. 216-A-6 was ultimately replaced by 216-A-30 and 216-A-37-2 replaced 216-A-30.
216-A-37-2	200-SC-1	6												299-E25-21, 299-E25-23, 299-E25-24	Yes	Data collected from 216-A-30 will be used to evaluate this trench; logging of existing wells will provide opportunistic site-specific information on contaminant nature and distribution
216-A-6	200-SC-1	6													Yes (opportunistic)	Existing data and data from 216-A-30 will be used to evaluate this site
216-B-55	200-SC-1	6										6		299-E28-13	No	This crib is assigned to 216-U-10, which has a larger inventory of several constituents. While the analogous relationship with 216-U-10 would bound the decision process, supplemental data at 216-B-55 may permit a stronger analysis of no action and MESC/MNA/IC alternatives and may permit lesser alternative than the analogous evaluation. Supplemental data would provide information on the nature and extent of contamination; because the crib is large, the supplemental data would allow assessment of partial removal alternative and permit a more accurate evaluation of contaminant volume and cost.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-S-5	200-SC-1	6					1								Yes	Existing information is sufficient for decision making for the shallow zone; HRR would provide information on elevated conductivity that may be associated with deeper contamination; the borehole at 216-S-6 would provide information to validate the HRR and to evaluate protection of groundwater at 216-S-5 as well.
216-S-6	200-SC-1	6									1				Yes	The analogous relationship between 216-U-10 (representative site) and 216-S-6 is somewhat uncertain; while inventory, geophysical logs, and analogous relationships may support shallow vadose zone decision making, HRR surveys would provide indication of deeper zones of elevated conductivity that may be associated with contamination. A shallow borehole would help correlate with the HRR, would provide information on pore water contamination, and would support the protection of groundwater evaluation for both the 216-S-6 and 216-S-5 Cribs. Supplemental data would provide site-specific information on remaining inventory of uranium and nitrate in the soil column that may impact groundwater.
216-T-36	200-SC-1	6							Yes	1*	TBD				Complete	Uncertainty in the inventory would be resolved by a borehole at this crib; information on nature and vertical extent would be used to better understand the current groundwater plume in the area and the protection of groundwater from contaminants remaining in the vadose zone
UPR-200-E-19	200-SC-1	6													Yes (opportunistic)	See 216-A-6; this unplanned release site is associated with and will be addressed with 216-A-6
UPR-200-E-21	200-SC-1	6													Yes (opportunistic)	See 216-A-6; this unplanned release site is associated with and will be addressed with 216-A-6.
UPR-200-E-29	200-SC-1	6													Yes (opportunistic)	See 216-A-6; this unplanned release site is associated with and will be addressed with 216-A-6.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
200-CW-5 Total (M-015-40D, 4/30/2008)			**1**		**20**		**3**	**362**	**1**	**2**	**2**	**6**	**0**	**4**	**8**	
216-T-27	200-LW-1	2					1							299-W14-53	Yes	Newer log in well 299-W14-53 would provide information on contaminant movement; HRR would provide information on deeper contaminants that may be associated with groundwater plume in area and would help resolve modeling issues for the area; analogous relationship with 216-T-26 and 216-T-28 is sufficient for decision making.
216-T-28	200-LW-1	2	1				5								Yes	See 216-T-27.
216-T-34	200-LW-1	6									1				Yes	Existing data and inventory support decision making; however, the representative site (216-Z-7) for the 216-T-34 Crib has greater Cs-137, plutonium, and uranium inventory. HRR would provide information to address uncertainty on groundwater protection due to nitrate inventory; shallow borehole would provide information on nature of contamination, including plutonium, in the shallow zone to support risk assessment; data also would support evaluation at 216-T-35 as an analogous site to 216-T-34.
216-T-35	200-LW-1	6												299-W11-18	Yes	Existing geophysical logging data and supplemental data collected from 216-T-34 will be used to support decision making at 216-T-35.
216-A-15	200-LW-2	2							Yes					Vent riser, if possible	Complete	Low volume and inventory; geophysical logging is opportunistic method to gain site-specific data; decision can be made on analogous relationships and inventory.
216-B-10A	200-LW-2	2										1			Yes (opportunistic)	The 216-B-10A site received a lot of effluent with a small inventory; however, site-specific data may help support evaluation and selection of a lesser alternative, such as MESC/MNA/IC, and would provide better data for balancing the decision making between leave in place and remove alternatives.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-B-10B	200-LW-2	2													Yes (opportunistic)	Received only 28,000 L; analogous to 216-B-10A; so data from 216-B-10A would support decision making at 216-B-10B
216-B-6	200-LW-2	2								1*					Yes	Uncertainty associated with the current groundwater contamination and the potential for groundwater impacts due to vadose zone contamination are not adequately addressed by the analogous relationship, because the assigned representative site does not have a similar chromium inventory. A monitoring well is needed near this site; this well will provide vadose zone data that can be used to support the groundwater protection evaluation in the FS. HRR will help locate the well and will provide information on the lateral extent.
216-S-20	200-LW-2	2	1				4								No	Existing data are sufficient to support decision making.
216-S-26	200-LW-2	6													No	Site is identified in preliminary FS as an RTD site; no supplemental data are required to support RTD determination.
216-T-2	200-LW-2	2													No	Analogous relationship is sufficient for decision making; received 6,000 m^3 of waste and a small inventory.
216-T-8	200-LW-2	6										2			No	This crib is preliminarily assigned to 216-T-28, which has a larger inventory of several constituents. While the analogous relationship with 216-T-26 would bound the decision process, supplemental data at 216-T-8 may permit a stronger analysis of no action and MESC/MNA/IC alternatives and may permit lesser alternative than the analogous evaluation.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-Z-16	200-LW-2	6					1			1					Yes	SIM inventory indicates a large volume of fluoride went to this crib; the impacts to groundwater associated with fluoride are uncertain; HRR would provide an indication of potential elevated conductivity that may be associated with vadose zone contamination and elevated moisture; based on the HRR, additional data collection activities may be required to assess the impacts.
216-Z-17	200-LW-2	6												299-W15-204 moisture log	No	This site will be evaluated based on data collected at 216-Z-16, which received a similar inventory of fluoride.
216-Z-7	200-LW-2	4	1		6		7							Neutron in W15-62, -63, -64, -76, -77, and -78	Yes	Existing data are sufficient for decision making; supplemental data further define extent and help refine cost estimates related to high plutonium removal and disposal.
200-LW-1/200-LW-2 Total (M-015-46B,			**3**		**6**		**18**			**2**	**1**	**3**	**0**	**9**	**9**	
200-E-102	200-MW-1	4							Yes			1			Complete	200-E-102 is analogous to 216-A-4 in terms of contaminants because it was used to dispose of soils contaminated when 216-A-4 plugged. Groundwater impacts are not expected to be significant because the waste discharged was soils. Therefore, the analogous relationship is sufficient for decision making; supplemental data support evaluation of HRR in area south of PUREX and provide information on the use and depth of investigation of hydraulic hammer south of PUREX.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-2	200-PW-3	4					1		Yes	1		1			Complete	216-A-2 Crib is very near to and was constructed around the same time as 216-A-4. Investigation activities initiated at 216-A-4 identified uncertainty associated with unexpectedly high contamination that was not in line with the inventory information. Based on the uncertainty in the contamination at 216-A-4 and its proximity to 216-A-2, site-specific supplemental data from 216-A-2 will help reduce potential uncertainty at that site associated with the nature of contamination and will provide a better understanding of crib risks than the analogous relationship to either 216-A-4 or 216-A-8 (analogous assignment has not been made for 216-A-2, but 216-A-4 and 216-A-8 are likely representative sites for 216-A-2); supplemental data would be considered acceleration of confirmatory sampling. HRR and data from 216-A-4 will provide additional information on extent of contamination for the area south of PUREX and will be used to help evaluate alternatives at 216-A-2 as well as 216-A-4.
216-A-21	200-MW-1	6					1		Yes			1			Complete	Analogous relationship with 216-A-4 is bounding for 216-A-21, which was built to replace 216-A-4. Because of the uncertainty at 216-A-4, a direct push at 216-A-21 will provide site-specific information to better define the relationship with 216-A-4.
216-A-27	200-MW-1	6					2		Yes						Complete	Existing information and analogous relationship are sufficient to support decision making; this site is the replacement crib for 216-A-21, which replaced 216-A-4.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-4	200-MW-1	4		1	1		1		Yes	1					Complete	Data are needed with depth to meet requirements of existing work plan. Samples have been collected in the 0 to 15-ft zone; these data are augmented with geophysical logging data. No additional data are needed for this zone. The SAP for the step-off borehole at 216-A-4 specifies additional data collection down the borehole that will support future modeling efforts and provide detailed assessment of contamination in pore water with depth and its potential impact on groundwater. The need for additional data beyond the 216-A-4 borehole will be assessed once the data are available for review. Data on plutonium extent exist from the sampling and logging already conducted at the site. Additional information will be gained from the step-off borehole and passive neutron logging will be attempted in the 299-E24-54 borehole in the northeast corner of the crib. These data will provide an understanding of the distribution of the plutonium. Additional needs will be assessed once these data are collected.
216-B-4	200-MW-1	2												Log reverse well if possible	Yes (opportunistic)	Low volume and inventory; opportunistic method to gain site-specific data; decision can be made on analogous relationships and inventory
216-C-2	200-MW-1	2		1 (sediment sample from reverse well											Yes (opportunistic)	Existing data are sufficient to support decision making
200-MW-1 Total (M-015-44B, 12/31/2008)				2	1		4		4	2	0	2	0	1	2	
216-Z-1&2	200-PW-1	4													No	Existing data sufficient for decision making.
216-Z-12	200-PW-1	4	3				9								No	Existing data sufficient for decision making; supplemental data further defines extent and helps refine understanding of potential impacts to groundwater

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-Z-18	200-PW-1	4					4								No	Existing data sufficient for decision making.
216-Z-1A	200-PW-1	4	2	14	15+		3								No	Existing data sufficient for decision making.
216-Z-3	200-PW-1	4					2								No	Existing data sufficient for decision making.
216-Z-9	200-PW-1	4	7	2	15+		3								No	Existing data sufficient for decision making.
241-Z-361	200-PW-1	4						Sludge							No	Sludge has been sampled; minimal likelihood of leaks; no supplemental data needed.
UPR-200-W-110	200-PW-1	3													No	Early agreement that supplemental data are not required.
216-A-24	200-PW-3	6					23								Yes	The relationship with 216-A-8, a representative site for this OU group, is strong enough to support decision making at 216-A-24. Inventories and types of contaminants are similar and the 216-A-24 Crib was used to replace the 216-A-8 Crib. Information on nature and extent of contamination can be assessed using the information from the 216-A-8 Crib. To augment the understanding of deeper contamination at 216-A-8 and 216-A-24, along with other sites in the same area, HRR is proposed for evaluating the presence of potential deeper zones of elevated conductivity.
216-A-31	200-PW-3	2							Yes						Complete	Very low volume and inventory received.
216-A-7	200-PW-3	6												299-E25-54	Yes	Uncertainty exists in the organic inventory, the current concentration, and potential impact on groundwater. This site has a large Cs-137 inventory as well as the organic, which is a unique combination. This site is similar to 216-A-8 in inventory, but did receive a different waste stream. The impacts on contaminant distribution should be investigated to support the remedial decision making. Because well 299-E25-54 is located within the site boundaries, logging this well would provide site-specific spectral gamma data in the shallow zone.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-8	200-PW-3	6	1		5		6								Yes	Existing data are sufficient to support decision making. Data on the nature of contamination were collected during the RI from the borehole; information on the extent of organics was evaluated through vapor sampling from new and existing holes. Information on the extent of Cs-137 and other gamma emitters also was collected through geophysical logging activities. HRR surveys are being proposed by both groundwater and waste sites for this area. HRR surveys will provide information on zones of elevated conductivity, if present, that may be indicative of potential impacts to groundwater. The HRR can be evaluated using the existing data from the borehole at 216-A-8.
UPR-200-E-56	200-PW-3	6													No	See 216-A-24; site is associated with and will be addressed by 216-A-24
216-Z-10	200-PW-6	7													No	Inventory and analogous data could be used to support decision making. Plutonium and americium are not expected to impact groundwater and the contamination is too deep for surface exposure by humans or biota. Because of low inventory and site type (i.e., reverse well with 6-in. diameter), potential for intrusion is very low.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-Z-5	200-PW-6	2					6								No	The analogous site relationship with 216-Z-7 is strong because the waste stream that went to 216-Z-5 was diverted to 216-Z-7; therefore, the analogous site relationship supports decision making. However, supplemental data to assess the plutonium concentration could influence the remedial action evaluation, especially the cost estimate. According to SIM, 216-Z-7 received 504.8 g of Pu-239 and 39.97 g Pu-240 versus the 29.63 g Pu-239 and 1.999 g Pu-240 for 216-Z-5. The maximum concentration found at 216-Z-7 was 470,000 pCi/g Pu-239/240. Based on these ratios, Pu concentrations at 216-Z-5 should be an order of magnitude less than 216-Z-7; therefore, concentrations may be below 100 nCi/g, which can strongly influence decision making.
216-Z-8	200-PW-6	4	3				7								No	Small site; contaminants to ~30 ft; no supplemental data needed for decision making
241-Z-8	200-PW-6	4						Sludge							No	Sludge has been sampled; minimal likelihood of leaks; no supplemental data needed
200-PW-1 Total (M-015-45B, 9/30/2007)			**16**	**16**	**35**		**63**	**2**	**2**	**0**	**0**	**0**	**0**	**1**	**3**	
216-A-10	200-PW-2	2	1		5		4		Partial						Yes	Existing data from remedial investigation is sufficient for decision making for the upper vadose zone; however, the HRR south of PUREX indicates potentially high conductivity in the area of the 216-A-10 Crib; HRR over the rest of the crib would provide better understanding of the distribution of the conductivity plume; data from 216-A-4 and A-5 Cribs would be used in conjunction with the 216-A-10 Crib data to better understand potential for deep contamination and associated risks to groundwater.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-19	200-PW-2	6	1												Yes	Existing information are sufficient to support decision making. HRR surveys are proposed for the 216-A-8 and 216-A-24 sites; these surveys would cover 216-A-19 and would help reduce uncertainty associated with deeper vadose zone contamination. Based on the preferred alternative of RTD, lateral extent can be determined during design or through the observational approach. Supplemental data would not likely change the preferred alternative.
216-A-36A	200-PW-2	2							Yes						Complete	HRR already run over the northern part of the 216-B-36A&B Cribs; HRR would be completed over the entire crib area to define the outer limit of the conductivity plume south of PUREX; the need for additional data will be assessed following completion of the 216-A-4 and 216-A-2 boreholes.
216-A-36B	200-PW-2	2	1				3		Partial						Yes	Existing data from remedial investigation are sufficient for decision making for the upper vadose zone; however, the HRR south of PUREX indicates potentially high conductivity in the area of the A-36A&B Cribs; HRR has been run over a portion of the 216-A-36A&B cribs; HRR over the rest of the crib area would provide better understanding of the distribution of the conductivity plume; see 216-A-36A

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-5	200-PW-2	2					4		Yes	1		1			Complete	Because of the contamination uncertainties identified at the 216-A-4 Crib and the apparent contribution by 216-A-5 to the elevated conductivity plume identified by HRR surveys on the western side of the south of PUREX area, supplemental data would help provide a better understanding of deep zone contaminants and potential to impact groundwater. These data also would support validation of the HRR results and development of a south of PUREX conceptual site model to support all the FS efforts in this area. A drive point will be installed before the borehole to obtain spectral gamma information to support health and safety and radiological control planning, and to provide some additional data on extent.
216-B-12	200-PW-2	2	1				3			1*					Yes	The reported inventory for total uranium is 15,112 kg and for nitrate is 2.8 million kg. This inventory could present a substantial risk to groundwater; however, few groundwater monitoring wells are available for analysis. The data collected during the remedial investigation are not reflective of the inventory, so an uncertainty exists between inventory and sampling data. The need for a groundwater monitoring well in the area has been identified through the 200-BP-5 OU DQO efforts. Opportunistic data collection associated with a planned groundwater monitoring well, including assessment of pore water contamination in the vadose zone, will be used to augment the FS evaluation of protection of groundwater. HRR surveys will be used to evaluate extent and to help locate the monitoring well. The results from the borehole will help resolve the inconsistencies between the existing borehole data and the inventory information.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-C-1	200-PW-2	6								1*					Yes	This site has one of the largest identified chromium inventories; the 216-C-1 chromium inventory is an order of magnitude higher than the chromium inventory of its representative site (216-A-10). Additional data on nature and extent of potential vadose plumes of mobile contaminants is needed to assess protection of groundwater in this area. The combination of HRR and a deep borehole will provide information on nature and on vertical and lateral extent, which will support a stronger modeling effort and risk assessment in the RI/FS documents. Analogous relationships and inventory are sufficient to support decision making on the shallow contamination.
216-S-1&2	200-PW-2	4		11			1			1		2		W22-67	Yes	A large inventory of mobile contaminants was discharged to these cribs. An assessment of the extent of deeper contaminants is needed to support protection of groundwater evaluation. HRR will give an indication of the presence of a conductivity plume that likely will be associated with the nitrate and other mobile constituents. A follow-on DQO process to evaluate the need for further characterization needs based on the results of the HRR will be conducted as needed. The inventory of plutonium discharged to these cribs may result in concentrations above 100 nCi/g. This is an uncertainty that can influence the evaluation of alternatives. Determining the extent of the plutonium contamination will support a better evaluation of protectiveness, disposal options, and costs. Three direct pushes are proposed to evaluate the extent of plutonium at these cribs.
216-S-7	200-PW-2	2	1				5								No	Existing data are sufficient to support decision making.
UPR-200-W-36	200-PW-2	2													Yes (opportunistic)	Included with 216-S-1&2 in Model Group 4.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-A-37-1	200-PW-4	6	1				3								Yes	Existing data are sufficient for decision making.
216-A-45	200-PW-4	2					3							299-E17-12, -13, -53, and -54	Yes	Very low volume and inventory received; logs would provide site-specific information for remedial alternative evaluation.
216-S-23	200-PW-4	2					4								No	Site received large volume with very low inventory;
200-PW-2/200-PW-4 Total (M-015-43D,			**6**	**11**	**5**		**30**		**1**	**4**	**0**	**3**	**0**	**5**	**9**	
216-B-11A&B	200-PW-5	6					2								Yes*	Existing data are sufficient for decision making.
216-B-50	200-PW-5	2		3											Yes*	Part of BY Cribs; see 216-B-43.
216-B-57	200-PW-5	2	1	2											Yes*	Site is covered with Hanford Barrier; data collected under 200-BP-1 and as part of barrier monitoring are sufficient for decision making.
216-B-62	200-PW-5	6					8							299-E28-85, 299-E28-86, 299-E28-87, 299-E28-88, 299-E28-90; 299-E28-18 and 299-E28-21, if possible	No	Existing information in concert with logging of existing wells provides sufficient data for decision making as Cs-137 is the major contaminant at this site; this site is directly analogous to 216-B-12, which was characterized under 200-PW-2/4 Work Plan.
216-S-13	200-PW-3	2								1				299-W22-21	Yes	Analogous relationships with other sites (such as 216-S-7 or other 200-PW-1/3/6 sites) and inventory data would support decision making; however, uncertainty exists in the chromium data between current SIM inventory and inventory data from past estimates. Supplemental data could help alleviate the uncertainty and would be used to support a better evaluation of protection of groundwater, especially for the chromium.
216-S-14	200-PW-3	6													No	Existing information and data from 216-S-13 borehole will be used to evaluate waste site; hexone was the main contaminant and is not expected to remain in the soils; 216-S-13 also received hexone along with other contaminants.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-S-21	200-PW-5	2										1		299-W23-63	No	The analogous relationship and inventory data are sufficient to support decision making; however, supplemental data may support a lesser alternative (such as MESC/MNA/IC). Inventory data do not suggest groundwater protection issue. Cesium-137 is the main contaminant identified in the SIM inventory. Nearby borehole logging indicates background levels for gamma emitters. Logging the existing borehole in the crib and sampling at the crib bottom would provide confirmatory data that may support stronger evaluation and potential selection of a lesser remedy.
216-S-9	200-PW-5	6												299-W22-25, 299-W22-26	Yes	Existing information is sufficient for decision making for the shallow zone; HRR would provide information on elevated conductivity in the deeper vadose zone that may be associated with nitrate contamination; geophysical logging of existing boreholes would provide additional data on extent of contamination.
216-B-42	200-TW-1	6					1			1					Yes*	A borehole at this site would reduce uncertainty associated with differences in waste streams between 216-B-42 and 216-B-38; depth of borehole to be dependent on HRR results.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-B-43	200-TW-1	2	1	2			1			2*					Yes*	The upper vadose zone was extensively investigated; data on the deeper vadose zone were collected but were not as extensive. Existing data are likely sufficient to support decision making for the waste sites; however, the groundwater in the area has some uncertainties associated with increasing contamination levels. To obtain a better understanding of the deep vadose zone and the groundwater, supplemental information on deep vadose zone nature and extent would reduce uncertainty. HRR will supply extent information and will help support placement of boreholes that will be used to obtain deep vadose zone information on nature and extent and provide groundwater monitoring points. The HRR activities were initiated in the fall of 2006. The data from these activities will be used to augment the evaluation of this set of cribs in the FS process. These data would constitute an acceleration of confirmatory sampling for the BY Cribs
216-B-44	200-TW-1	2		3			2								Yes*	Part of BY Cribs; see 216-B-43.
216-B-45	200-TW-1	2		3			2								Yes*	Part of BY Cribs; see 216-B-43.
216-B-46	200-TW-1	2		3			2								Yes*	Part of BY Cribs; see 216-B-43.
216-B-47	200-TW-1	2		3			1								Yes*	Part of BY Cribs; see 216-B-43.
216-B-48	200-TW-1	2		3			1								Yes*	Part of BY Cribs; see 216-B-43.
216-B-49	200-TW-1	2	1	2											Yes*	Part of BY Cribs; see 216-B-43.
216-BY-201	200-TW-1	7													Yes*	Existing data are sufficient to support decision making.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-18	200-TW-1	4					1					4			Yes	The analogous relationship with 216-T-26 is sufficient to support decision making. Inventory does not imply significant groundwater risks; however, opportunity exists to extend the HRR proposed for 216-T-26, 216-T-27, and 216-T-28 to cover 216-T-18. This would provide confirmatory information on the deeper vadose zone for 216-T-18. In addition, 216-T-18 only received a small volume, which would not indicate a substantial threat to groundwater. Supplemental information on the nature and extent of plutonium may provide a stronger evaluation of protectiveness, disposal options, and cost. The direct pushes would help establish the extent of plutonium at the crib. These data also may permit selection of a lesser or different alternative. These data collection activities would constitute accelerated confirmatory sampling activities.
216-T-19	200-PW-1	6					1			1					Yes	Supplemental data on the nature and extent of contamination are needed to address uncertainties associated with protection of groundwater and with unexpected contamination from a nearby borehole (found during drilling); HRR will provide extent of elevated conductivity and borehole will provide information on nature of contamination in the crib and in the pore water.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-26	200-TW-1	2	1				2								Yes	Existing data are sufficient for decision making; however, supplemental data may provide information on lateral extent and support a stronger basis for protection of groundwater evaluation. HRR surveys would provide information on lateral extent of potential elevated conductivity plume. The nature of the conductivity plume would be assessed based on the existing borehole data. Because well 299-W14-53 was logged before waste discharge, a new geophysical log would provide information on the impacts of the waste discharge on vadose contaminant concentrations.
UPR-200-E-9	200-TW-1	6													Yes* (Opportunistic)	Regulators agreed no supplemental data needed to support decision making; requested site be moved to 200-MG-2.
200-TW-1/200-PW-5 Total (M-015-42D,			**4**	**24**			**24**		**2**	**5**	**0**	**5**	**0**	**11**	**18**	
200-E-45	200-TW-2	7													Yes*	Site is associated with 216-B-8 and will be addressed with 216-B-8; no supplemental data are needed for 200-E-45.
200-W-52	200-TW-2	4							Yes						Complete	Site is associated with 216-T-7; supplemental activities are identified under 216-T-7.
216-B-35	200-TW-2	6					1								Yes*	See 216-B-38; existing information and HRR would provide sufficient information on nature and extent of contamination.
216-B-36	200-TW-2	6					2								Yes*	See 216-B-38; existing information and HRR would provide sufficient information on nature and extent of contamination.
216-B-37	200-TW-2	6					3								Yes*	See 216-B-38; existing information and HRR would provide sufficient information on nature and extent of contamination.
216-B-38	200-TW-2	6	1		5		2								Yes*	See 216-B-38; existing information and HRR would provide sufficient information on nature and extent of contamination.
216-B-39	200-TW-2	6													Yes*	See 216-B-38; existing information and HRR would provide sufficient information on nature and extent of contamination.
216-B-40	200-TW-2	6													Yes*	See 216-B-38; existing information and HRR would provide sufficient information on nature and extent of contamination.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-B-41	200-TW-2	6					1								Yes*	See 216-B-38; existing information and HRR would provide sufficient information on nature and extent of contamination.
216-B-5	200-TW-2	7													No	Existing data are sufficient to support decision making.
216-B-7A&B	200-TW-2	4	1				5					3		E33-18	Yes*	The extent of plutonium at concentrations above 100 nCi/g is significant to the decision process in terms of balancing costs for removal and disposal against costs for capping and long-term maintenance and for balancing worker risk against long-term risks. Logs in nearby existing wells show Cs-137 has spread beyond the waste-site boundaries. Supplemental data collection activities would define the extent of plutonium movement and provide a better understanding of plutonium distribution and volume, especially in relation to concentrations above 100 nCi/g. HRR would provide information on potential elevated conductivity, which may be indicative of elevated moisture and associated contamination. This information would support an understanding of the extent of deeper constituents.
216-B-8	200-TW-2	6					7			2*		1			Yes*	Groundwater wells being planned near 216 B-8 will be sampled to obtain vadose zone information; a direct push will provide information on the extent of contamination; the HRR information will help locate both the groundwater wells and the direct push.
216-B-9	200-TW-2	6					12								No	Existing data are sufficient for decision making.
216-T-14	200-TW-2	6					1		Yes						Complete	See 216-T-15.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-15	200-TW-2	6							Yes			4			Complete	Existing logging data provide some information on the extent of the shallow contamination. Direct pushes in the 216-T-15 Trench would augment the existing information and provide a stronger analysis of the partial removal alternative. Recently drilled groundwater wells will provide information on the deeper contamination; existing HRR surveys will be used in coordination with other data sources to enhance the understanding of the contamination problem at the 216-T-14 through 216-T-17 trenches.
216-T-16	200-TW-2	6							Yes						Complete	See 216-T-15.
216-T-17	200-TW-2	6							Yes						Complete	See 216-T-15.
216-T-21	200-TW-2	6					1								Yes	Existing logging data provide information on the extent of the shallow contamination. The analogous relationship to the 216-T-15 and 216-B-38 waste sites would be used in combination with the HRR to evaluate the 216-T-21 through 216-T-25 trenches.
216-T-22	200-TW-2	6					2								Yes	See 216-T-21.
216-T-23	200-TW-2	6					1								Yes	See 216-T-21.
216-T-24	200-TW-2	6					2								Yes	See 216-T-21.
216-T-25	200-TW-2	6					1								Yes	See 216-T-21.
216-T-3	200-TW-2	7								1					Yes (opportunistic)	Existing data for this site are limited; a deep borehole would provide information on the plutonium concentrations and would support a better risk assessment and evaluation of protectiveness.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-32	200-TW-2	4					1		Yes			4			Complete	The uncertainty associated with the plutonium inventory and resulting soil concentrations could impact the remedial alternative and should be resolved through supplemental data collection. The presence of high plutonium may influence the evaluation of remedial alternatives, especially in terms of protectiveness, disposal options, and cost. Identifying the plutonium concentrations also may permit assessment and use of a lesser alternative if concentrations are lower than the associated representative site. The uncertainty associated with the elevated conductivity plume in this area will be addressed through a borehole at 216-T-7; data collected at 216-T-7 will include an assessment of pore water contamination to support the protection of groundwater evaluation. Based on the results of that borehole, a follow-on DQO process may be conducted if uncertainties remain.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-5	200-TW-2	4					2		Yes			4			Complete	Supplemental data will help resolve uncertainties associated with the nature of the plutonium contamination near the bottom of the crib structure and below, and will support evaluation of a broader range of alternatives, including disposal options. HRR data do not indicate a conductivity plume beneath this site. No supplemental data collection activities are required at this time for this crib. Data with depth in the area will be collected through a boring at 216-T-7, which will provide data for use in assessing the deep vadose zone in the area, including at 216-T-5. The 216-T-7 data will be evaluated and if needed, a follow-on DQO for the area will be conducted. The extent of contamination at the crib is defined well enough by the analogous site approach, by the small size of the crib, by geophysical logging of nearby wells, and by the proposed boring. No supplemental data on extent are required to support decision making.
216-T-6	200-TW-2	4					15					4			Yes	Analogous relationships and inventory can be used for decision making. However, more refined data on plutonium concentrations could reduce uncertainty in evaluation of disposal options and associated costs. Because of the large nitrate inventory, HRR would help resolve extent of deeper mobile contaminants.

Table C-2. Supplemental Data Collection Activities by Operable Unit - Model Groups 2 through 7. (26 Pages)

Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	
216-T-7	200-TW-2	4					1		Yes	1*	1	1			Complete	The plutonium concentration is uncertain and should be resolved to support a stronger evaluation of protectiveness, disposal options, and cost. Eight borings in 216-T-7 and 200-W-52 have recently been geophysically logged; however, the data from these logs were not available for this review. Analysis of these logging results should be conducted before further activities at the crib and tile field and to locate supplemental data collection activities. A borehole to groundwater would provide site-specific information for the waste sites and would provide additional information on the nature of the conductivity plume. A combined borehole to address waste site and groundwater needs may be an opportunity but would need to be drilled adjacent to the waste sites. If so, a shallow borehole through the waste site (located based on the results of the geophysical logging of the eight borings) would provide site-specific information on the plutonium concentrations.
241-B-361	200-TW-2	4					2	Sludge							No	Sludge has been sampled; minimal likelihood of leaks; no supplemental data needed.
241-T-361	200-TW-2	4					1	Sludge							Complete	Sludge has been sampled; minimal likelihood of leaks; no supplemental data needed.
200-TW-2 Total (M-015-42E, 12/31/2011)			2		5		63	2	15	4	1	21	0	1	17	
UPR-200-E-144	200-UR-1	4					8			(See 216-B-7A&B)					No	Consolidated material over 216-B-7A and other nearby sites; only minor contamination; no supplemental data required.
UPR-200-W-166	200-UR-1	6													No	Unplanned release associated with the 216-T-14 through 216-T-17 Cribs; UPR will be addressed with the cribs, so no supplemental data required.
200-UR-1 Total							8			0	0	0	0	0	0	
Supplemental Work Plan Total			35	57	82	26	219	500	25	19	5	113	3	32	66	

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Waste Site	Operable Unit	Model #	Existing Data							Proposed Supplemental Data Collection Activities						Rationale for Proposed Supplemental Data Collection Activities
			Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	Surface Sampling	HRR	Deep Boreholes	Shallow Boreholes	Drive Points	Test Pits	Geophysical Logging of Existing Boreholes	HRR	

*** Denotes work planned by Groundwater Project. For wells, data will be collected in the vadose zone to support evaluation of waste sites.**

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
DQO = data quality objective.
Ecology = Washington State Department of Ecology.
FS = feasibility study.
HRR = high-resolution resistivity.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.
OU = operable unit.
PUREX = Plutonium-Uranium Extraction (Plant or process).
RCRA = *Resource Conservation and Recovery Act of 1976* .
RI = remedial investigation.
RTD = removal, treatment, and disposal.
SAP = sampling and analysis plan.
SIM = Soil Inventory Model.
TSD = treatment, storage, and/or disposal (unit).

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Draft A
Volume II

Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units

Volume II: Site-Specific Field-Sampling Plan Addenda

Prepared for the U.S. Department of Energy
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United States Department of Energy
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Draft A
Volume II

Supplemental Remedial Investigation/Feasibility Study Work Plan for the 200 Areas Central Plateau Operable Units

Volume II: Site-Specific Field-Sampling Plan Addenda

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Assistant Secretary for Environmental Management

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ADDENDA

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1.0 INTRODUCTION

This Volume II of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan consists of addenda that contain site-specific field-sampling plans (SSSP) for the 200 Areas Central Plateau waste sites that will be investigated under this Work Plan. The overall Work Plan scope includes supplemental investigation activities for the 200 Areas Central Plateau waste sites listed in Volume I, Table 1-2 for which the U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology (the Tri-Parties), through the data quality objective process (Volume I, Appendix C), have identified a need for additional data to reach a final record of decision. Each Volume II addendum may include one or more SSSPs, each of which can address one or more waste sites. The SSSPs will contain the detailed site-specific sampling strategies, such as number and location of samples, analytes, and sampling and analytical methods. These SSSPs, along with the Work Plan Volume I, Appendix A SAP (which provides the general elements for satisfying data needs and includes the quality assurance project plan, overarching field sampling plan, and health and safety plan), provide the necessary information and approvals for supplemental data collection at these specified sites.

Generally, an addendum will address waste sites that are regulated by one lead agency, either the Washington State Department of Ecology or the U.S. Environmental Protection Agency, depending on which is the lead agency for the operable unit in which the waste site resides. An addendum will require approval by DOE, Richland Operations Office (RL) and the lead agency. Approval will be documented by RL and the agency signature on the addendum approval page. The addendum approval process will be similar to that for primary documents under the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989a) (Tri-Party Agreement) and will follow the document review and comment requirements set forth in Section 9.2 of the *Hanford Federal Facility Agreement and Consent Order Action Plan* (Ecology et al. 1989b).

Volume II, Revision 0, includes Addendum 1 and approval of Revision 0 constitutes Addendum 1 approval. Addendum 1 contains SSSPs for supplemental investigation of some of the waste sites in source operable units that have near-term (fiscal year 2007 and fiscal year 2008) Tri-Party Agreement milestones to submit feasibility studies. This near-term scope is identified in Volume I, Table 1-2, and includes waste sites addressed under the following documents:

- Volume II, Addendum 1 (216-S-5, 216-S-6, 216-T-36, 216-B-55, 216-A-37-2, and 216-A-30 Cribs)
- DOE/RL 2006-47, *Sampling and Analysis Plan for Additional Remedial Investigation Activities at the 216-A-4 Crib and the 200-E-102 Trench* (216-A-4 Crib and 200-E-102 Trench)

- DOE/RL-2006-57, *Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at Model Group-5, Large Area Ponds, Waste Sites* (Model Group 5 Large Area Ponds)
- DOE/RL 2006-77, in work, *Sampling and Analysis Plan for Additional Remedial Investigation Activities at the 216-A-2 Crib* (216-A-2 and 216-A-21 Cribs).

Future Volume II addenda will be developed to provide SSSPs for the remaining waste sites to be investigated under this Work Plan. As SSSPs are developed and approved, they will be incorporated into Volume II in accordance with Volume I, Chapter 4.0 and this chapter. Approved addenda can be added to Volume II at any time by updating the Volume II table of contents without formal Work Plan revision.

2.0 REFERENCES

DOE/RL-2006-47, 2006, *Sampling and Analysis Plan for Additional Remedial Investigation Activities at the 216-A-4 Crib and the 200-E-102 Trench*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2006-57, 2006, *Sampling and Analysis Plan for Supplemental Remedial Investigation Activities at Model Group-5, Large Area Ponds, Waste Sites*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2006-77, in work, *Sampling and Analysis Plan for Additional Remedial Investigation Activities at the 216-A-2 Crib*, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE, 1989a, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

Ecology, EPA, and DOE, 1989b, *Hanford Federal Facility Agreement and Consent Order Action Plan*, Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington.

VOLUME II ADDENDA

(Each addendum consists of one or more site-specific field-sampling plans)

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ADDENDUM 1

SITE-SPECIFIC FIELD-SAMPLING PLANS FOR 216-S-5, 216-S-6, 216-T-36, 216-B-55, 216-A-37-2, AND 216-A-30 CRIBS

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Addendum 1 – Site-Specific Field-Sampling Plans for 216-S-5, 216-S-6, 216-T-36, 216-B-55, 216-A-37-2, and 216-A-30 Cribs

Approval: U.S. Department of Energy, Richland Operations Office

Signature ______________________ Date __________

Lead Regulatory Agency:

☒ U.S. Environmental Protection Agency
☐ Washington State Department of Ecology

Signature ______________________ Date __________

The approval signatures on this page indicate that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

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TERMS

bgs	below ground surface
DG	downhole geophysics
GL	geologic log
HRR	high-resolution resistivity
MESC/MNA/IC	Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls
N/A	not applicable
PH	process history
PUREX	Plutonium-Uranium Extraction (Plant or process)
REDOX	Reduction-Oxidation (Plant or process)
RS	representative site
SIM	Soil Inventory Model
TBD	to be determined
TD	total depth
WIDS	*Waste Information Data System* database

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	25.40	millimeters	millimeters	0.0394	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 (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
Acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
Pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
Teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
Tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
Cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
Pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
Picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

AD1-1.0 INTRODUCTION

Addendum 1 of Work Plan Volume II contains the site-specific field sampling plans (SSSP) for the 216-S-5, 216-S-6, 216-T-36, 216-B-55, 216-A-37-2, and 216-A-30 Cribs. The SSSPs in this addendum provide site-specific information regarding the waste sites conceptual model, data needs, data-collection strategy, and associated analytical and quality control requirements arrived at during the agency data quality objectives (DQO) process as documented in the data-needs priority summary tables (Volume I, Appendix C). Together with the elements of the overall SAP (Volume I, Appendix A), the SSSPs presented in Chapters 2.0 through 6.0 of this addendum complete the Sampling and Analysis Plan for these waste sites.

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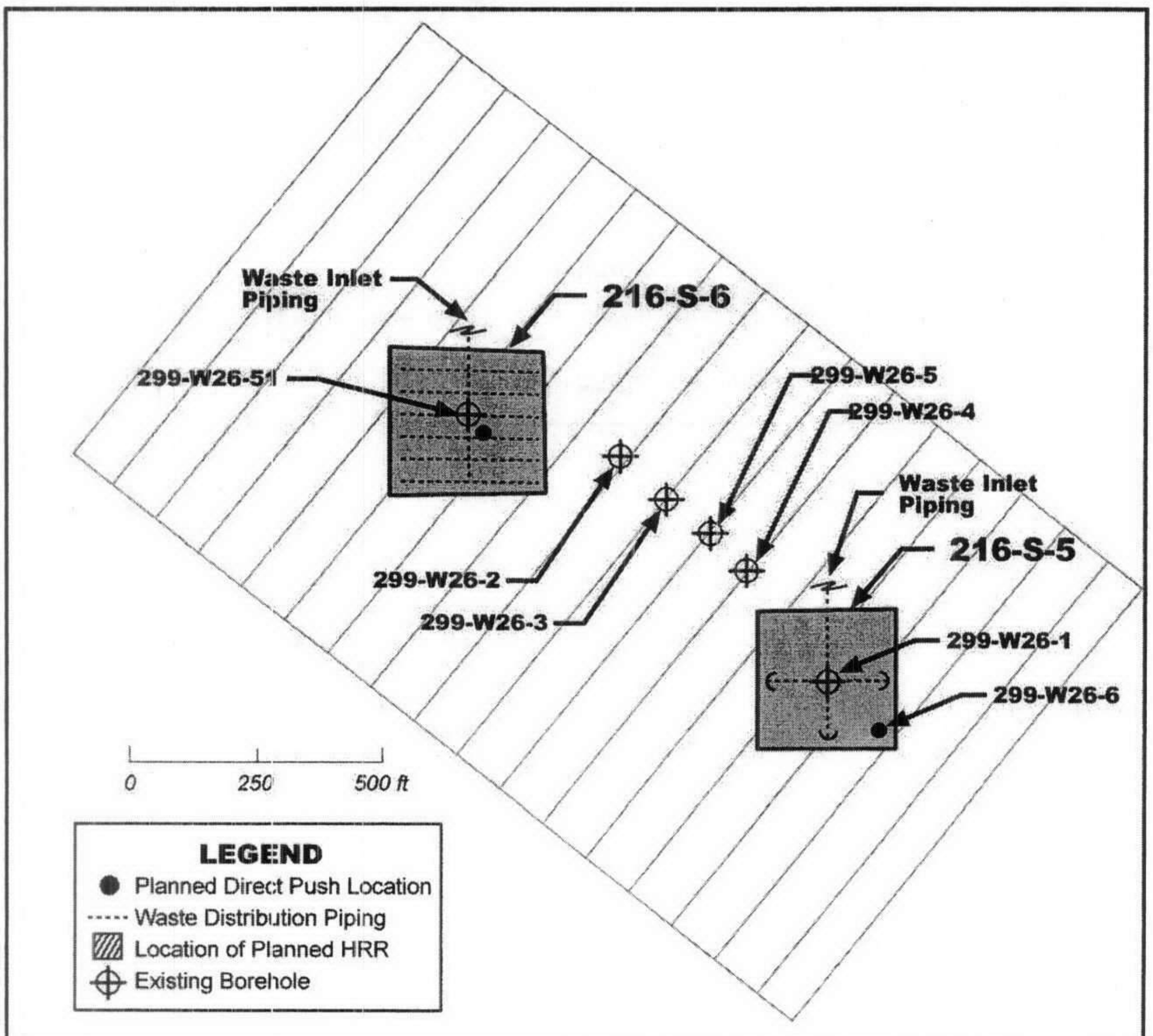
AD1-2.0 216-S-5 AND 216-S-6 CRIBS SITE-SPECIFIC FIELD-SAMPLING PLAN

The following figures and tables provide the site-specific field-sampling plan for the 216-S-5 and 216-S-6 Cribs.

Figure AD-1. 216-S-5 and 216-S-6 Cribs Data-Collection Locations.



FG2179.4

HRR = high-resolution resistivity.

Figure AD-2. 216-S-6 Crib Stratigraphy and Sample-Collection Intervals.

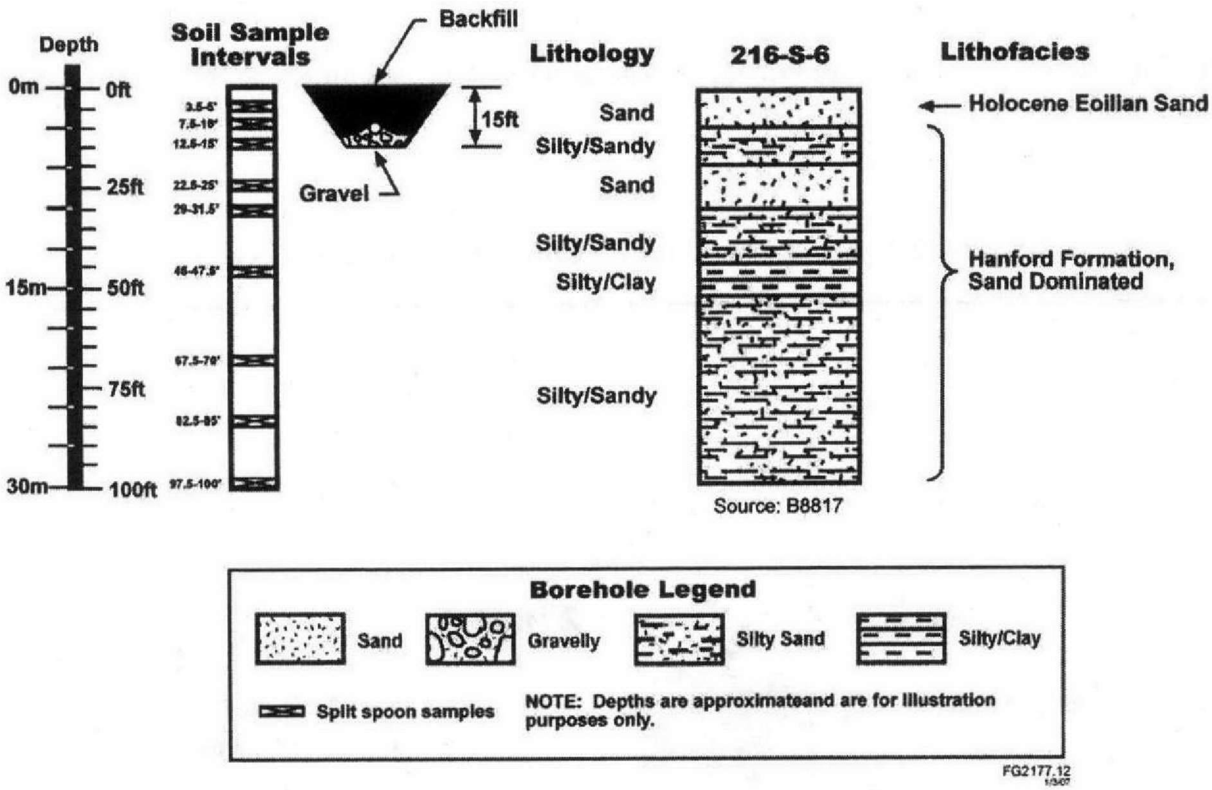


Table AD-1. 216-S-6 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Shallow borehole and sampling	One shallow borehole to evaluate HRR	100 ft bgs	Sample at depths of: 3.5 – 5 ft bgs 7.5 – 10 ft bgs 12.5 – 15 ft bgs 22.5 – 25 ft bgs 29 – 31.5 ft bgs 45 – 47.5 ft bgs 67.5 – 70 ft bgs 82.5 – 85 ft bgs 97.5 – 100 ft bgs	Analytes are presented in Volume I, Tables A2-3, the 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 columns.	One sample at each change in stratigraphy. Sample interval at Hanford formation, sand dominated. Other samples taken at fine-grained intervals.	pH, specific conductance, bulk density, moisture, particle size distribution

Number of split-spoon samples	9
Approximate number of field quality-control samples [c]	3
Approximate number of physical-property samples	2
Approximate total number of soil samples collected	14
Approximate total number of soil samples analyzed	14

Non-Sample Data Collection	Maximum Depth of Investigation
High-resolution resistivity	Not defined (HRR survey of area continuous with 216-S-5 Crib)

[a] Actual sampling depths may vary depending on the amount of backfill/overburden used in interim-stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b] See Volume 1, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.

[c] One duplicate, one split, and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.

bgs = below ground surface.
HRR = high-resolution resistivity.

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Figure AD-3. 216-S-5 Crib
Conceptual Model and Data Summary.

200-SC-1 Operable Unit
Waste Type: Steam Condensate

216-S-5 Crib

Model Group 6
200-W Ponds Zone

History

216-S-5 Crib is a liquid waste disposal site that received process cooling water and REDOX steam condensate from the 202-S Building. The waste water was acidic. The structure was allowed to overflow for some months in 1956 and surrounding contamination ranged from 100 millirad/hr to 17 rad/hr.

CONSTRUCTION: A square pit 210 ft by 210 ft by 15 ft deep, filled with gravel and two corrugated perforated metal pipes that form a cross in the center of the structure.

WASTE VOLUME: 4,100,000,000 liters

DURATION: 1954 to 1957.

ESTIMATED INVENTORY OF SELECTED HIGH-MOBILITY CONSTITUENTS

	WIDS	SIM
Uranium	270 Kg	1098 Kg
Tritium	0 Ci	3.3 Ci
Nitrate	100 Kg	232,600 Kg
Nitrite	--	203,400 Kg
Fluoride	--	5.15 Kg

ESTIMATED INVENTORY OF SELECTED MEDIUM/ LOW MOBILITY CONSTITUENTS

	WIDS	SIM
Co-60	0.002 Ci	0.002 Ci
Cs-137	28.8 Ci	56.2 Ci
Sr-90	59.4 Ci	31.4 Ci
Pu-239/240	42 Ci	0.018 Ci
Plutonium (total)	580 g	0.014 Ci
Total Beta Emitters	174 Ci	--

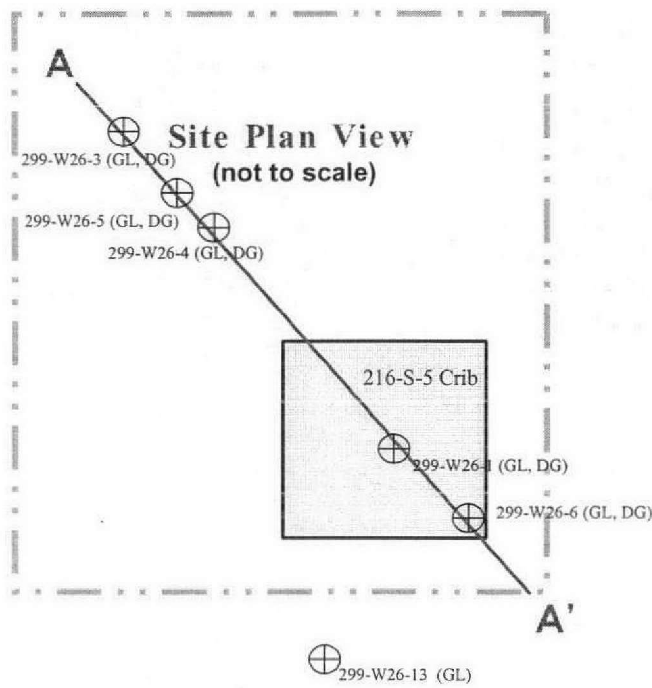
Note: "--" indicates inventory not estimated.

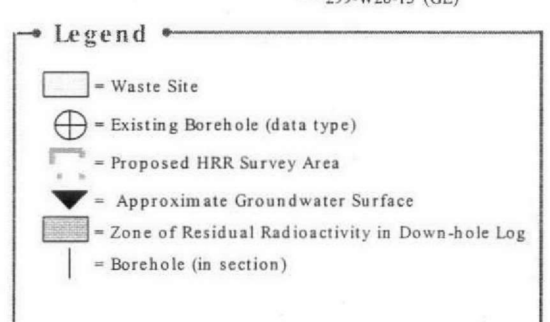
REFERENCES:

WIDS general summary reports
Hanford Soil Inventory Model, Rev 1 (RPP-26744)

Basis of Knowledge

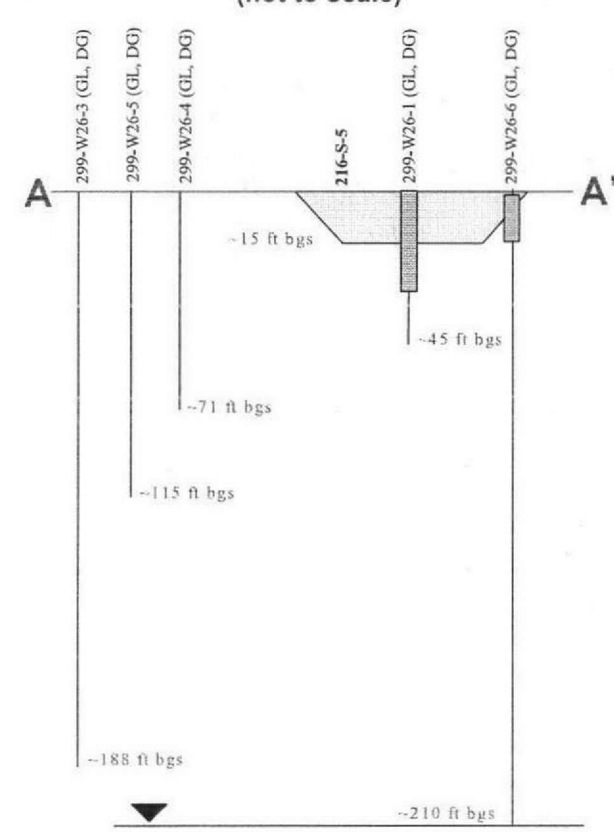
- Process History (PH)
- Interpretation of Downhole Geophysics (DG)
- Geologic Logs (GL)
- Extrapolation from Representative Site (RS)





Characterization Summary

- Scintillation probe and spectral gamma profiles from wells 299-W26-1, -3, -4, -5, and -6 indicate residual gamma emitters to about 30 feet bgs within the crib footprint.
- Process history including data from discharge stream.
- Assigned to representative site 216-U-10.



Data Needs, Rationale, and Investigation Approach

No additional data are needed for 216-S-5. Decisions will be made using the following information:

- Existing site-specific information
- Information to be collected from 216-S-6 Crib
- High-resolution resistivity (HRR) survey of 216-S-5 and 216-S-6 combined area to identify potential conductivity plume that may be associated with contamination.

Potential Viable Alternatives

- REMOVE/ TREAT/ DISPOSE
- PARTIAL REMOVAL/ TREATMENT/ BARRIER
- MESC/ MNA/ IC
- BARRIER

Table AD-2. Data-Needs Priority Summary – Model Group 6 – 216-S-5 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Background	
Site Identification	216-S-5
Site Location	200 West Area; 200 West Ponds Zone, southwest of 207-S Retention Basin west of the 216-S-10 Ditch
Type of Site	Crib
Operating History	The site consists of a gravel-filled crib containing two lengths of corrugated, perforated metal pipe that form a cross. The crib has been surface stabilized. It is marked and posted with Underground Radioactive Material signs. This unit received subsurface liquid disposal for the 202-S Building process vessel cooling water and steam condensate via an underground clay pipeline. The crib was built to replace the 216-S-17 Pond. The site is associated with the 202-S Building, the 207-S Retention Basin, and 216-S-6 Crib. The unit (originally called an underground swamp) was built as a temporary replacement for the grossly contaminated 216-S-17 Pond. In November 1954, the 216-S-6 Crib was built to receive condensate and cooling water with a high potential for contamination. Effluent with a low potential for contamination was sent to the 216-S-5 Crib. In 1957, the site was deactivated by valving out and locking the pipeline to the unit. The effluent was rerouted to the 216-S-16 Pond. The 207-S Retention Basin was bypassed in April 1954 due to being grossly contaminated. The basin later was backfilled with soil to prevent contamination migration. In 1956, the large cooling water discharge volumes made it necessary to cut a hole along the top edge of the crib to discharge overflow cooling water to a trench immediately southwest of the crib structure rather than allowing the crib to flood. The overflow of 50 to 100 gal/min represented approximately 5% of the total flow to the 216-S-5 Crib. The emergency overflow continued throughout the summer of 1956. In September 1956, the REDOX A-2 dissolver and H-4 coils failed. The dose rates along the edge of the crib overflow area increased from 100 millirad/h to 350 millirad/h with some spots reading up to 17 rad/h. The emergency crib overflow pond was used until the 216-S-16 Pond was completed in September 1957. In 1974, action was taken to fill in four cave-in depressions at the 216-S-5 Crib. This site is monitored by groundwater wells 299-W26-1, 299-W26-3, 299-W26-4, 299-W26-5, and 299-W26-6. Visual and radiological surveys are performed at the site. (WIDS) The crib is 64 by 64 m (210 by 210 ft) and 4.6 m (15 ft) deep. The crib operated from 1954 to 1957. (WIDS) Site Inventory Model – 216-S-5 (RPP-26744) (some constituents of interest are highlighted)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
5.331E+04	2.053E+01	1.366E+00	3.583E+00	0.000E+00	0.000E+00	3.987E+00	0.000E+00	1.160E-03
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
1.526E-01	3.107E-03	1.682E-01	2.116E+02	4.642E+03	2.326E+05	2.034E+05	6.028E-01	5.550E+01
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
1.342E+00	9.037E+02	5.154E+00	2.419E+00	0.000E+00	1.043E-03	0.000E+00	0.000E+00	1.859E-01
Fe(CN)6 (kg)	H-3 (Ci)	C-14 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Co-60 (Ci)	Se-79 (Ci)	Sr-90 (Ci)	Y-90 (Ci)
0.000E+00	3.297E+00	1.075E-03	2.888E-04	2.627E-02	1.751E-03	5.187E-05	3.142E+01	3.166E+01
Zr-93 (Ci)	Nb-93m (Ci)	Tc-99 (Ci)	Ru-106 (Ci)	Cd-113m (Ci)	Sb-125 (Ci)	Sn-126 (Ci)	I-129 (Ci)	Cs-134 (Ci)
3.109E-03	2.671E-03	2.585E-02	6.351E-10	2.224E-03	1.767E-04	2.103E-04	3.151E-05	7.226E-06
Cs-137 (Ci)	Ba-137m (Ci)	Sm-151 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	Eu-155 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Ac-227 (Ci)
5.625E+01	5.328E+01	2.086E+00	2.187E-04	1.465E-02	6.065E-03	3.007E-09	1.754E-14	1.285E-08
Pa-231 (Ci)	Th-229 (Ci)	Th-232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)
1.909E-08	6.025E-11	1.891E-14	5.476E-06	4.488E-07	3.591E-01	1.589E-02	4.885E-03	3.665E-01
U-Total (kg)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Am-241 (Ci)	Am-243 (Ci)
1.098E+03	1.367E-04	2.783E-04	1.450E-02	2.851E-03	9.832E-03	8.463E-08	1.022E-02	3.791E-06
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
7.791E-06	1.503E-07	3.605E-06						

Table AD-2. Data-Needs Priority Summary – Model Group 6 – 216-S-5 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Vicinity Waste Sites	216-S-6, 216-S-11, and 216-S-17						
Status	Analogous site; assigned to 216-U-10; evaluated in 200-CW-5/2/4/200-SC-1 feasibility study (DOE/RL-2004-24); capping identified as preferred alternative in feasibility study						
Potential Remedial Alternatives							
X for Viable Alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal/Barrier	In Situ Treatment	Other
		X	X	X	X		

Data Evaluation and Gaps Analysis			
Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Geophysical Logging 299-W26-06 (209.65 ft) (spectral gamma log 2003)	Located in the southeast corner of the crib. Cesium-137 detected from 3 to 16 ft in concentrations ranging from 0.4 to 2.5 pCi/g. The maximum concentration of Cs-137 was at 8 ft. Cesium-137 also was detected at 53 and 62 ft, with concentrations ~0.4 pCi/g.	Potential for impacts to groundwater	No. Existing information is sufficient for decision making for the shallow zone; HRR would provide information on elevated conductivity that may be associated with deeper contamination; the shallow borehole sampling at 216-S-6 would provide information to correlate the HRR and to evaluate protection of groundwater at 216-S-5 as well.
299-W26-3 (188 ft) (scintillation log 1976)	Located 378 ft northwest of the center of the crib. Scintillation probe profiles show background level radiation.		
299-W26-4 (71 ft) (scintillation log 1976)	Located 287 ft northwest of the center of the crib. Scintillation probe profiles show background-level radiation.		
299-W26-1 (87 ft) (scintillation log 1976) (spectral gamma log 2006)	Located in the center of the crib area. Scintillation probe profiles indicate radioactive contaminants from 1.5 to 12.8 m (5 to 42 ft) bgs. The spectral gamma log identified Cs-137 in the same depth range as the scintillation log with a maximum concentration of 12,000 pCi/g at 5.8 m (19 ft) bgs.		
299-W26-5 (115 ft) (scintillation log 1976)	Located northwest of the center of the crib area between 299-W26-3 and 299-W26-4; scintillation probe profiles show background-level radiation.		

Proposed Activities and Path Forward:

Conduct HRR surveys to evaluate potential for elevated conductivity plume that may be associated with contamination; use to help evaluate extent of contamination with depth.

Use existing information and information from data collection activities at 216-S-6 to support remedial decision making for 216-S-5.

The following provides a list of the references/bibliography used during this evaluation:

DOE/RL-2004-24, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste Group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units.*
RHO-CD-673, *Handbook 200 Areas Waste Sites.*
RPP-26744, *Hanford Soil Inventory Model, Rev. 1.*
Waste Information Data System, Hanford Site database.

bgs = below ground surface.
HRR = high-resolution resistivity.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.
NPH = normal paraffin hydrocarbon.
TBP = tributyl phosphate.
WIDS = *Waste Information Data System* database.

1

Figure AD-4. 216-S-6 Crib Conceptual Model and Data Summary.

200-SC-1 Operable Unit
Waste Type: Steam Condensate

216-S-6 Crib

Model Group 6
200-W Ponds Zone

History

216-S-6 Crib is a liquid waste disposal site that received process cooling water and REDOX steam condensate from the 202-S Building. The waste stream was neutral to basic.

CONSTRUCTION: A square pit 210 ft by 210 ft by 15 ft deep, filled with gravel and a corrugated perforated metal pipe down the center with six pipes branching off perpendicular to the main pipe at 7 ft below the surface. The site is backfilled with 116,333 cu yd of gravel, 12,000 cu m contaminated soil and 13,000 cu m of "overburden" soils.

WASTE VOLUME: 4,470,000,000 liters

DURATION: 1954 to 1972

ESTIMATED INVENTORY OF SELECTED HIGH-MOBILITY CONSTITUENTS

	WIDS	SIM
Uranium	272 Kg	853 Kg
Tritium	0.00 Ci	3.549 Ci
Nitrate	140 Kg	253,500 Kg
Nitrite	--	221,100 Kg
Fluoride	--	3.9 Kg

ESTIMATED INVENTORY OF SELECTED MEDIUM/ LOW MOBILITY CONSTITUENTS

	WIDS	SIM
Co-60	0.258 Ci	0.0008 Ci
Cs-137	125.0 Ci	11.3 Ci
Sr-90	224.0 Ci	5.8 Ci
Pu-239/240	34.3 Ci	0.3 Ci
Plutonium	473 g	--
Total Beta Emitters	901 Ci	--

Note: "--" indicates inventory not estimated

REFERENCES:

WIDS general summary reports
Hanford Soil Inventory Model, Rev 1 (RPP-26744)

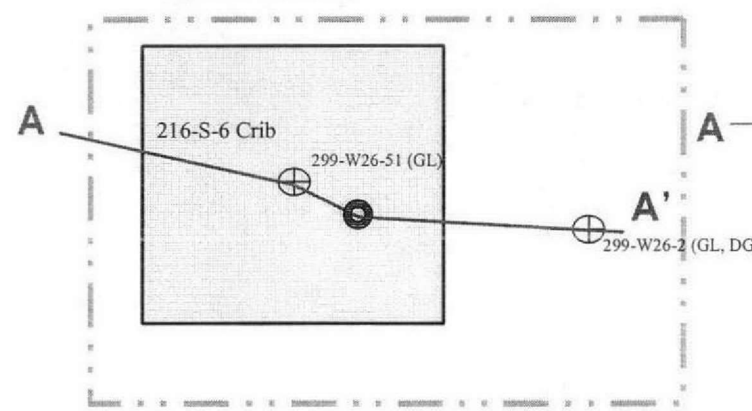
Basis of Knowledge

- Process History (PH)
- Interpretation of Downhole Geophysics (DG)
- Interpretation of Surface Geophysics (SG)
- Geologic Logs (GL)
- Extrapolation from Representative Site (RS)

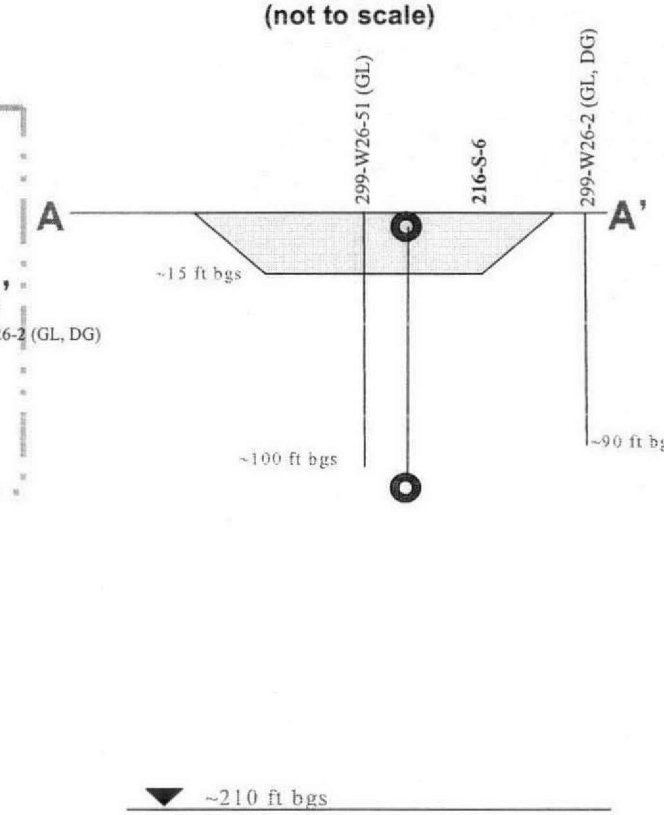
Characterization Summary

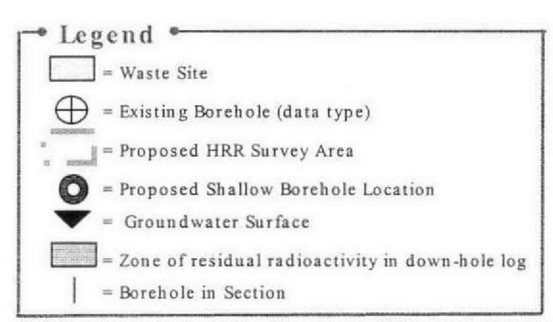
- One scintillation probe profile from well 299-W26-2 to approximately 90 ft bgs indicates no detectable gamma emitters.
- Process history including data from discharge stream.
- Surface scans identified contaminated plants growing on the site.
- Assigned to representative site 216-U-10.

Site Plan View
(not to scale)



Site Section View
(not to scale)





Potential Viable Alternatives

- REMOVE/ TREAT/ DISPOSE
- PARTIAL REMOVAL/ TREATMENT/ BARRIER
- MESC/ MNA/ IC
- BARRIER

Data Needs, Rationale, and Investigation Approach

Additional information is required for the following reasons:

- The analogous relationship to 216-U-10 is uncertain.
- The potential exists for deeper contamination associated with mobile contaminants that may impact groundwater (e.g., nitrate, uranium).

The supplemental investigation strategy incorporates the following elements:

- High-resolution resistivity (HRR) survey to identify the presence of subsurface conductivity plumes that may indicate subsurface contaminants.
- Install one shallow borehole to a depth of about 100 feet bgs. Collect subsurface soil samples and analyze them as specified.
- Correlate the soil sample analyses to results of HRR survey to obtain site-specific data to reduce the uncertainty between 216-S-6 and the representative site.
- Data collected at 216-S-6 will also be used to support decision making for 216-S-5.

Table AD-3. Data-Needs Priority Summary – Model Group 6 – 216-S-6 Crib (200-CW-5/2/4/ 200-SC-1)(RL/FH) CPP) (EPA). (2 Pages)

Background	
Site Identification	216-S-6
Site Location	200 West Area, 200-W Ponds, northwest of the 216-S-5 Crib and north of 216-S-17 Pond.
Type of Site	Crib
Operating History	This unit consists of a square pit filled with gravel with corrugated, perforated metal pipe running down the center, and six pipes branching off perpendicular to the main pipe. The site is backfilled and marked with Underground Radioactive Material signs. This unit received subsurface process cooling water and steam condensate from the 202-S Building waste via an underground pipeline. The site is associated with the 202-S Building, the 207-S Retention Basin, the 2904-S-171 Control Structure, and the 215-S-5 Crib. This site operated from November 1954 to July 1972. The crib was constructed as part of the Segregation Project. REDOX effluent with a high potential for contamination was diverted to the 216-S-6 Crib. Effluent with a low potential for contamination was sent to the 216-S-5 Crib. After July 1967, the site received the steam condensate from the D-12 and D-14 Waste Concentrators in the 202-S Building. The waste is low salt, neutral to basic and contains nitrates. In September 1955, both the 216-S-5 and 216-S-6 Cribs were operated at greater-than-capacity levels. Temporary relief was provided by blading off the corner of the 216-S-6 Crib and cutting a run off ditch. The overflow was considered a better option than allowing the crib to flood and damage the roof seal. No contamination problems were noted in the overflow area in 1955. (WIDS) The crib is 64 by 64 m (210 by 210 ft) and 4.6 m (15 ft) deep. The crib operated from 1954 to 1972. (WIDS) Soil Inventory Model – 216-S-6 (RPP-26744) (some constituents of interest are highlighted)

Na (kg) 5.789E+04	Al (kg) 1.346E+01	Fe (kg) 2.525E-02	Cr (kg) 1.837E-01	Bi (kg) 0.000E+00	La (kg) 0.000E+00	Hg (kg) 4.332E+00	Zr (kg) 0.000E+00	Pb (kg) 1.261E-03
Ni (kg) 1.568E-02	Ag (kg) 3.273E-06	Mn (kg) 2.657E-03	Ca (kg) 2.283E+02	K (kg) 4.223E+03	NO3 (kg) 2.535E+05	NO2 (kg) 2.211E+05	CO3 (kg) 1.481E-02	PO4 (kg) 4.242E+01
SO4 (kg) 1.312E-01	Si (kg) 9.821E+02	F (kg) 3.939E+00	Cl (kg) 1.967E-01	CCl4 (kg) 0.000E+00	Butanol (kg) 7.973E-04	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 1.814E-02
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 3.549E+00	C-14 (Ci) 9.230E-05	Ni-59 (Ci) 7.043E-05	Ni-63 (Ci) 6.715E-03	Co-60 (Ci) 8.266E-04	Se-79 (Ci) 1.600E-04	Sr-90 (Ci) 5.831E+00	Y-90 (Ci) 5.838E+00
Zr-93 (Ci) 2.373E-03	Nb-93m (Ci) 3.198E-04	Tc-99 (Ci) 1.600E-02	Ru-106 (Ci) 6.588E-10	Cd-113m (Ci) 3.538E-04	Sb-125 (Ci) 6.437E-05	Sn-126 (Ci) 2.609E-05	I-129 (Ci) 2.804E-03	Cs-134 (Ci) 5.945E-06
Cs-137 (Ci) 1.130E+01	Ba-137m (Ci) 1.067E+01	Sm-151 (Ci) 5.880E-01	Eu-152 (Ci) 1.037E-04	Eu-154 (Ci) 1.175E-02	Eu-155 (Ci) 6.839E-04	Ra-226 (Ci) 3.789E-07	Ra-228 (Ci) 3.186E-12	Ac-227 (Ci) 1.579E-06
Pa-231 (Ci) 2.311E-06	Th-229 (Ci) 2.585E-09	Th-232 (Ci) 3.264E-12	U-232 (Ci) 4.552E-06	U-233 (Ci) 1.508E-06	U-234 (Ci) 2.803E-01	U-235 (Ci) 1.237E-02	U-236 (Ci) 3.877E-03	U-238 (Ci) 2.848E-01
U-Total (kg) 8.529E+02	Np-237 (Ci) 1.740E-03	Pu-238 (Ci) 9.023E-03	Pu-239 (Ci) 2.467E-01	Pu-240 (Ci) 5.135E-02	Pu-241 (Ci) 2.629E-01	Pu-242 (Ci) 2.124E-06	Am-241 (Ci) 5.488E-02	Am-243 (Ci) 2.067E-05
Cm-242 (Ci) 3.471E-05	Cm-243 (Ci) 7.276E-07	Cm-244 (Ci) 1.756E-05						

Table AD-3. Data-Needs Priority Summary – Model Group 6 – 216-S-6 Crib (200-CW-5/2/4/ 200-SC-1)(RL/FH) CPP) (EPA). (2 Pages)

Vicinity Waste Sites	216-S-17; 216-S-16D; 216-S-5
Status	Analogous site; assigned to 216-U-10; evaluated in 200-CW-5/2/4/200-SC-1 feasibility study (DOE/RL-2004-24); capping identified as preferred alternative in feasibility study

Potential Remedial Alternatives

X for Viable Alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal/Barrier	In Situ Treatment	Other
		X	X	X	X		

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Geophysical logging 299-W26-2 (230 ft) (scintillation log 1976) 299-W26-51 (106 ft) (spectral gamma log 2006) (moisture log 2006)	Located east of and outside of the crib. Scintillation probe profiles indicate background radiation levels. Located in center of crib. Cs-137 was detected from 2.1 to 18.9 m (7 to 62 ft) bgs with a maximum concentration of 3,800 pCi/g at 13.7 m (45 ft) bgs. The moisture detected in the well was variable due to the presence of a grout seal from the surface to 6 m (20 ft) bgs. Below this depth, moisture appears to increase at about 11.9, 14, 18, 20.7, 23.8 m (39, 46, 59, 68, 78 ft), and from 28 m (92 ft) to the bottom of the borehole at 32.3 m (106 ft).	Potential for impacts to groundwater from mobile contaminants such as nitrate and uranium	Yes. The analogous relationship between 216-U-10 (representative site) and 216-S-6 is somewhat uncertain. While inventory, geophysical logs, and analogous relationships may support shallow vadose zone decision making, HRR surveys would provide indication of deeper zones of elevated conductivity that may be associated with contamination. A shallow borehole would help correlate with the HRR by providing samples that can be evaluated for pore water contamination (similar to the 216-B-26 borehole drilled in the BC Cribs and Trenches area). These analyses would support the protection of groundwater evaluation for both the 216-S-6 and 216-S-5 Cribs. Supplemental data would provide site-specific information on remaining inventory of mobile contaminants, such as uranium and nitrate, in the soil column that may impact groundwater.

Proposed Activities and Path Forward:

Conduct HRR surveys to evaluate the presence of subsurface conductivity that may be associated with mobile contaminants that could impact groundwater.

Install shallow borehole to correlate results of HRR and to obtain site-specific data needed because of differences between the representative site and 216-S-6.

Data collected at 216-S-6 also would be used to support 216-S-5 decision making because these two sites received similar waste streams, with the higher concentration effluent going to 216-S-6. 216-S-6 is bounding for 216-S-5 decision making.

Additional Notes: Soil Inventory Model inventory identifies >800 kg uranium and >200,000 kg each of nitrate and nitrite.

References: The following provides a list of the references/bibliography used during this evaluation:

DOE/RL-2004-24, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste Group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units.*

RHO-CD-673, *Handbook 200 Areas Waste Sites.*

RPP-26744, *Hanford Soil Inventory Model, Rev. 1.*

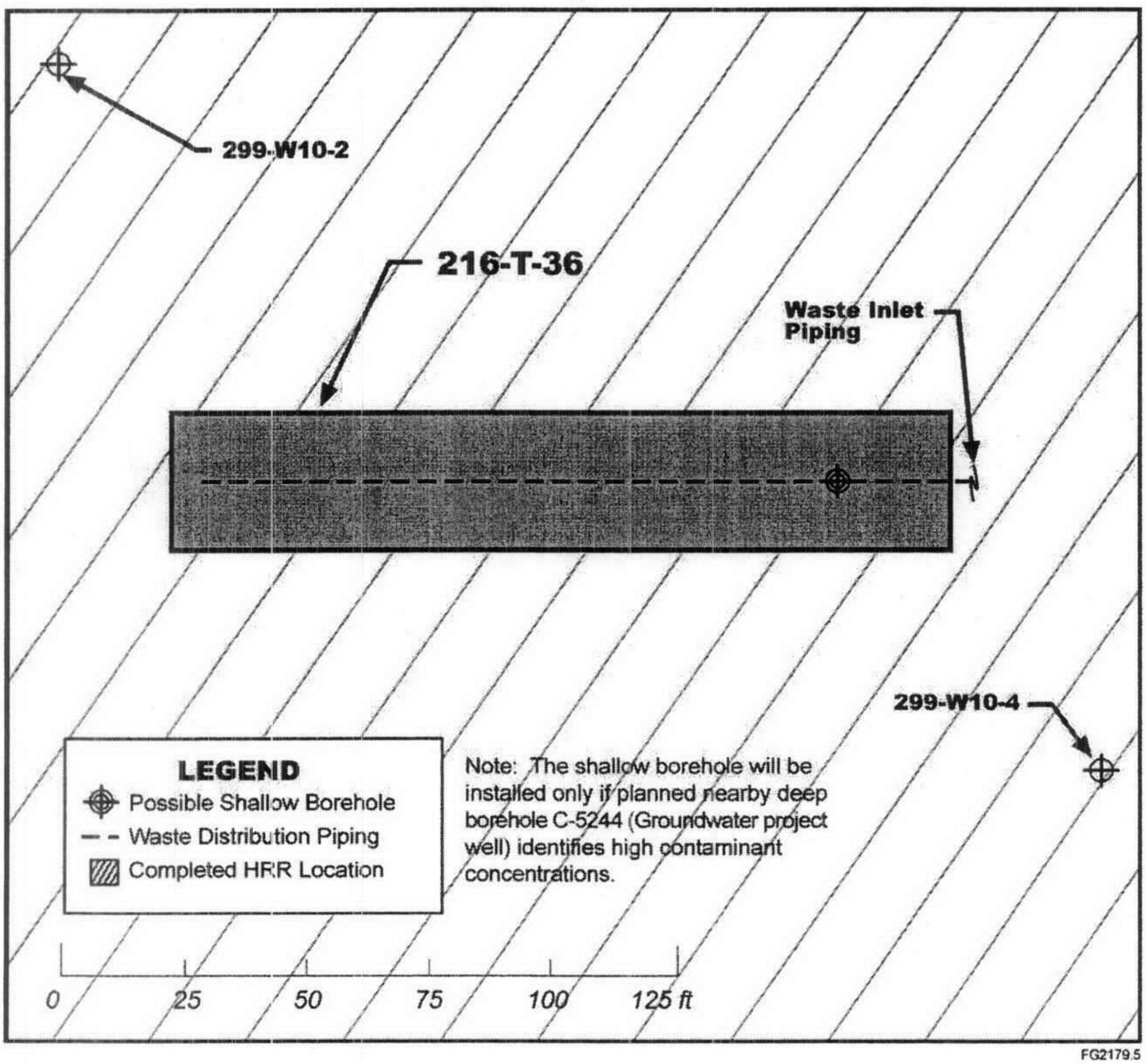
Waste Information Data System, Hanford Site database.

HRR = high-resolution resistivity.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.
WIDS = *Waste Information Data System* database.

AD1-3.0 216-T-36 CRIB SITE-SPECIFIC FIELD-SAMPLING PLAN

The following figures and tables provide the site-specific field-sampling plan for the 216-T-36 Crib.

Figure AD-5. 216-T-36 Crib Data-Collection Locations.



HRR = high-resolution resistivity.

Figure AD-6. 216-T-36 Crib Stratigraphy and Sample-Collection Intervals.

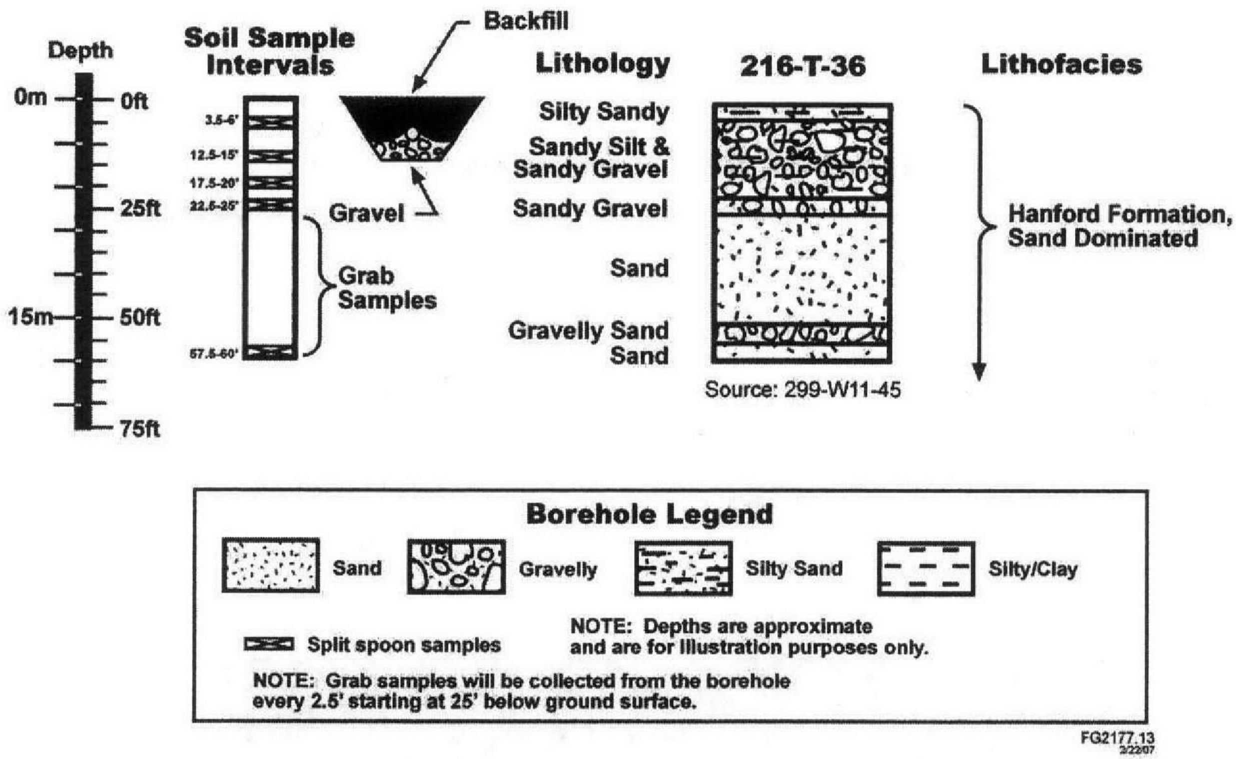


Table AD-4. 216-T-36 Crib Data Collection Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Borehole drilling and sampling	One shallow borehole if indicated by monitoring well data	60 ft bgs	Sample at depths of: 3.5 – 6 ft bgs 12.5 – 15 ft bgs 17.5 – 20 ft bgs 22.5 – 25 ft bgs 57.5 – 60 ft bgs	Analytes are presented in Volume I, Table A2-3, the 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 columns.	One sample at each change in stratigraphy. Sample interval at Hanford formation, sand dominated. Other samples taken at fine-grained interval(s).	pH, specific conductance, bulk density, moisture, particle size distribution
			Grab sample collected every 2.5 ft starting at 25 ft bgs to TD; initial analysis on 5-ft samples.	See Volume I, Table A2-3.		
Number of split-spoon samples		5				
Approximate number of field quality-control samples [c]		3				
Approximate number of physical-property samples		2				
Approximate number of grab samples		15				
Approximate total number of soil samples collected		25				
Approximate total number of soil samples initially analyzed [d]		18				

[a] Actual sampling depths may vary depending on the amount of backfill/overburden used in interim-stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b] See Volume I, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.

[c] One duplicate, one split, and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.

[d] Number of samples analyzed includes five split-spoon samples, three field quality-control samples, two physical-property samples, and eight grab samples.

bgs = below ground surface.
TD = total depth.

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Figure AD-7. 216-T-36 Conceptual Model and Data Summary.

200-SC-1 Operable Unit
Waste Type: Steam Condensate

216-T-36 Crib

Model Group 6
T Farm Zone

History

216-T-36 Crib is a liquid waste disposal site that received process steam condensate, equipment decontamination waste and miscellaneous radioactive waste from 221-T and 221-U buildings and decontamination waste from 2706-T building. The waste stream was an alkaline aqueous waste.

CONSTRUCTION: The 216-T-36 crib consists of a clay distribution pipe placed in a rectangular trench with bottom dimensions of 160 ft by 10 ft by 15 ft deep, filled with gravel and soil.

WASTE VOLUME: 522,000 liters

DURATION: 1967 to 1969 (end of use not clearly identified).

ESTIMATED INVENTORY OF SELECTED HIGH-MOBILITY CONSTITUENTS

	WIDS	SIM
Uranium	1.18 Kg	172 Kg
Tritium	0.00 Ci	0.001 Ci
Nitrate	0.00 Kg	4,950 Kg
Nitrite	0.00 Kg	563 Kg
Fluoride	0.0 Kg	0.0 Kg
Chromium	--	212 Kg

ESTIMATED INVENTORY OF SELECTED MEDIUM/ LOW MOBILITY CONSTITUENTS

	WIDS	SIM
Co-60	--	0.00008 Ci
Cs-137	0.06 Ci	0.07 Ci
Sr-90	0.05 Ci	0.6 Ci
Pu-239/240	0.0 Ci	22.8 Ci
Pu-241	0.0 Ci	111 Ci
Plutonium	0.24 Ci	--
Total Beta Emitters	0.72 Ci	--
Total Alpha Emitters	22.7 Ci	--

Note: "--" indicates inventory not estimated.

REFERENCES:

WIDS general summary reports
Hanford Soil Inventory Model, Rev 1 (RPP-26744)

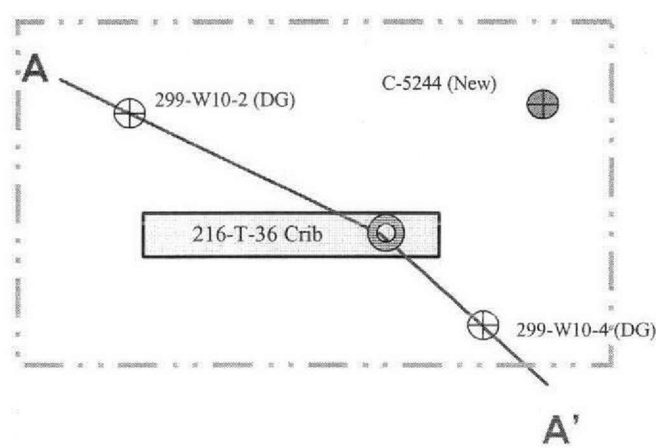
Basis of Knowledge

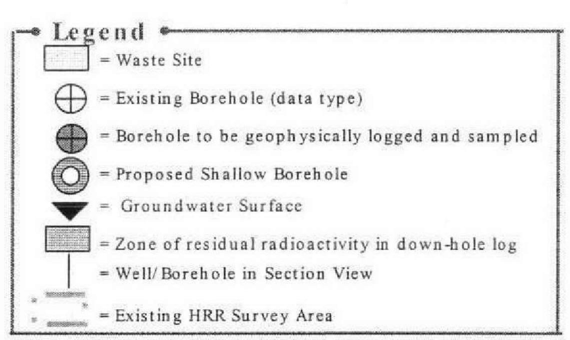
- Process History (PH)
- Interpretation of Downhole Geophysics (DG)
- Extrapolation from Representative Site (RS)

Characterization Summary

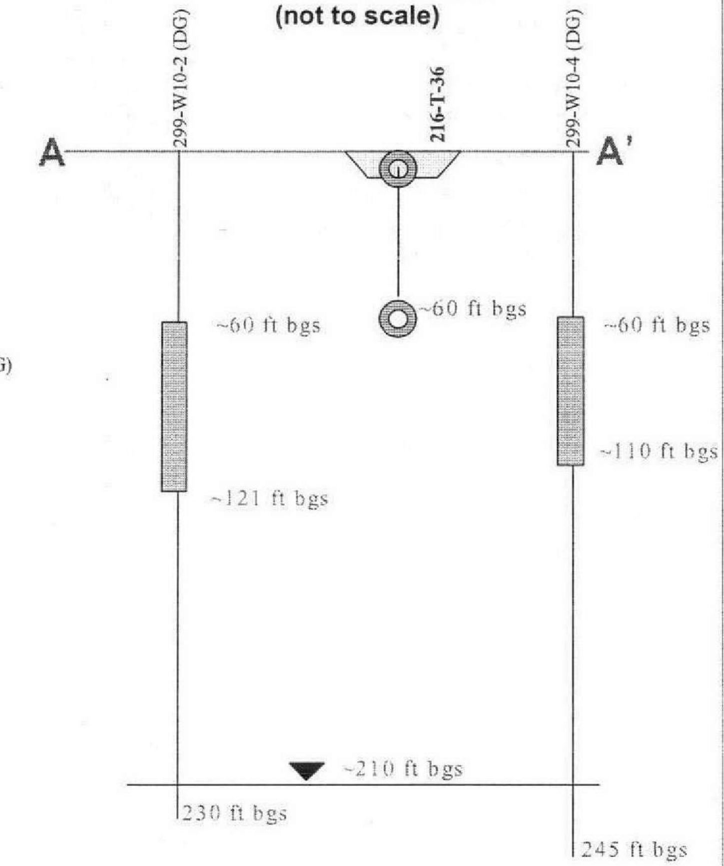
- No site-specific measurements. Process history only.
- Assigned as analogous to representative site 216-T-26.
- Downhole geophysics from two nearby wells (299-W10-2 and 299-W10-4) indicate subsurface contamination by gamma emitting nuclides pre-dating 216-T-36. Tc-99 groundwater plume in this area.
- HRR survey indicates areas of elevated conductivity near the east side of the crib and limited conductivity directly below the crib.

Site Plan View
(not to scale)





Site Section View
(not to scale)



Potential Viable Alternatives

- REMOVE/ TREAT/ DISPOSE
- PARTIAL REMOVAL/ TREATMENT/ BARRIER
- MESC/ MNA/ IC
- BARRIER

Data Needs, Rationale, and Investigation Approach

Additional Information may be required for the following reasons:

- Based on current groundwater conditions (e.g., Tc-99) in the vicinity of this site, the inventory for 216-T-36 may be uncertain.

The supplemental investigation incorporates the following elements:

- A new deep borehole (to be installed by the groundwater program) will be installed and sampled.
- Sampling and analysis results and downhole geophysics from the new borehole will be evaluated.
- If the new borehole indicates soil contamination that suggests contribution from 216-T-36, then a shallow borehole (to about 60 feet bgs) will be placed within the crib footprint and subsurface soil samples will be collected and analyzed as specified.
- The sampling and analysis results from the new borehole(s) will be correlated to existing HRR survey data.

Table AD-5. Data-Needs Priority Summary – Model Group 6 – 216-T-36 Crib (200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Background	
Site Identification	216-T-36 Crib
Site Location	200 West Area, T Farm Zone, south of 241-T Tank Farm; north of 241-TY Tank Farm
Type of Site	Crib
Operating History	The site consists of an interim stabilized crib posted as Underground Radioactive Material. The site consists of a single vitreous clay distribution pipe resting in a gravel layer that is in a rectangular trench. Backfill covers the pipe and gravel. The crib also has a gage well riser and a filter riser. This site provided subsurface liquid disposal for steam condensate, equipment decontamination waste, and miscellaneous waste from the 221-T and 221-U Buildings. The site also received decontamination waste from the 2706-T Building. Associated structures are the 221-T, 221-U, and 2706-T Buildings and the 200-W-79 Pipeline. The site started operation in May 1967. The end date is unclear. However, a shutdown date between 1970 and 1973 is likely based on available documentation. One WIDS source indicates the 216-T-36 Crib was built to replace the 216-T-28 Crib. (WIDS)

Soil Inventory Model – 216-T-36 (RPP-26744) (some constituents of interest are highlighted)

Na (kg) 2.29E+03	Al (kg) 0.00E+00	Fe (kg) 5.33E+01	Cr (kg) 2.12E+02	Bi (kg) 0.00E+00	La (kg) 0.00E+00	Hg (kg) 0.00E+00	Zr (kg) 0.00E+00	Pb (kg) 0.00E+00
Ni (kg) 9.44E+01	Ag (kg) 0.00E+00	Mn (kg) 0.00E+00	Ca (kg) 2.45E+02	K (kg) 1.38E+01	NO3 (kg) 4.95E+03	NO2 (kg) 5.63E+02	CO3 (kg) 1.52E+02	PO4 (kg) 0.00E+00
SO4 (kg) 2.00E+02	Si (kg) 0.00E+00	F (kg) 0.00E+00	Cl (kg) 5.73E+01	CCl4 (kg) 0.00E+00	Butanol (kg) 0.00E+00	TBP (kg) 0.00E+00	NPH (kg) 0.00E+00	NH3 (kg) 0.00E+00
Fe(CN)6 (kg) 0.00E+00	H-3 (Ci) 1.24E-03	C-14 (Ci) 1.19E-05	Ni-59 (Ci) 1.12E-04	Ni-63 (Ci) 1.08E-02	Co-60 (Ci) 8.02E-05	Se-79 (Ci) 5.04E-07	Sr-90 (Ci) 6.16E-01	Y-90 (Ci) 6.16E-01
Zr-93 (Ci) 2.96E-05	Nb-93m (Ci) 2.23E-05	Tc-99 (Ci) 2.15E-04	Ru-106 (Ci) 2.25E-08	Cd-113m (Ci) 4.41E-05	Sb-125 (Ci) 3.92E-05	Sn-126 (Ci) 2.16E-06	I-129 (Ci) 2.98E-04	Cs-134 (Ci) 5.70E-06
Cs-137 (Ci) 7.26E-01	Ba-137m (Ci) 6.87E-01	Sm-151 (Ci) 1.95E-02	Eu-152 (Ci) 1.24E-05	Eu-154 (Ci) 9.02E-04	Eu-155 (Ci) 3.32E-04	Ra-226 (Ci) 4.31E-11	Ra-228 (Ci) 4.39E-08	Ac-227 (Ci) 1.15E-07
Pa-231 (Ci) 1.78E-07	Th-229 (Ci) 2.69E-08	Th-232 (Ci) 3.46E-08	U-232 (Ci) 1.95E-02	U-233 (Ci) 1.17E+00	U-234 (Ci) 8.54E-02	U-235 (Ci) 3.26E-03	U-236 (Ci) 3.70E-03	U-238 (Ci) 5.73E-02
U-Total (kg) 1.72E+02	Np-237 (Ci) 4.52E-07	Pu-238 (Ci) 1.92E+00	Pu-239 (Ci) 1.69E+01	Pu-240 (Ci) 5.91E+00	Pu-241 (Ci) 1.11E+02	Pu-242 (Ci) 1.03E-03	Am-241 (Ci) 7.96E-04	Am-243 (Ci) 7.59E-07
Cm-242 (Ci) 1.27E-06	Cm-243 (Ci) 1.36E-07	Cm-244 (Ci) 3.41E-06						

Table AD-5. Data-Needs Priority Summary – Model Group 6 – 216-T-36 Crib (200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Vicinity Waste Sites	200-W-79; 216-T-13; 241-T Tank Farm						
Status	Analogous site; assigned to 216-T-26; evaluated in the 200-CW-5/2/4/200-SC-1 feasibility study (DOE/RL-2004-24); capping identified as the preferred alternative in the feasibility study.						
Potential Remedial Alternatives							
X for Viable Alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal/Barrier	In Situ Treatment	Other
		X	X	X	X		

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Scintillation Logs (ARH-ST-156):		Based on current groundwater conditions, the inventory for this site may be uncertain.	Potentially. A deep borehole is planned for fiscal year 2007 to evaluate the Tc-99 plume in the groundwater in this area. The borehole will be located to the northeast of the 216-T-36 Crib. Based on the information from the groundwater borehole, a shallow borehole may be needed in the 216-T-36 Crib to resolve uncertainties in the inventory and resulting contaminant concentrations. If the groundwater borehole indicates substantial vadose zone contamination, then a shallow borehole will be drilled in the 216-B-36 Crib to obtain site-specific information to correlate with HRR and to support site-specific risk assessment and the decision making for the 216-T-36 Crib.
299-W10-2 (230 ft) (1976)	Located 10 m (33 ft) north of the northwest corner of the 216-T-36 Crib. Scintillation log from 1976 indicates minor (10^4 cpm) at ~30 m (100 ft) bgs. ARH-ST-156 implies this contamination is associated with 216-T-7 rather than 216-T-36.		
299-W10-4 (245 ft) (1976)	Located 10 m (33 ft) south of the southeast corner of the 216-T-36 Crib. Scintillation logs from 1959, 1963, and 1976 indicate minor (10^3 to 10^4 cpm) at ~30 m (100 ft) bgs. ARH-ST-156 implies this contamination is associated with 216-T-7 rather than 216-T-36. The 216-T-36 Crib is located in an area of increasing Tc-99 concentrations in the groundwater.		
HRR surveys (2006)	HRR surveys show some areas of higher conductivity near the east side of this crib. The area directly below the crib shows limited conductivity to a depth of >40 m (130 ft) bgs (RPP-RPT-28955)		

Proposed Activities and Path Forward:

Evaluate data from the groundwater borehole to be drilled to the northeast of the 216-T-36 Crib in fiscal year 2007.

Install a contingent shallow borehole if the vadose information from the groundwater well indicates substantial contamination.

Additional Notes:
The following provides a list of the references/bibliography used during this evaluation:

ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells.*
DOE/RL-2004-24, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste Group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units.*
DOE/RL-2006-46, *Sampling and Analysis Plan for Deep Groundwater Wells 299-W11-48 (C5243) and 299-W10-32 (C5244) Near Waste Management Area T in the 200-ZP-1 Operable Unit, Fiscal Year 2006.*
RPP-26744, *Hanford Soil Inventory Model, Rev. 1.*
RPP-RPT-28955, *Surface Geophysical Exploration of T Tank Farm at the Hanford Site.*
Waste Information Data System, Hanford Site database.

bgs = below ground surface.
HRR = high-resolution resistivity.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.
WIDS = *Waste Information Data System* database.

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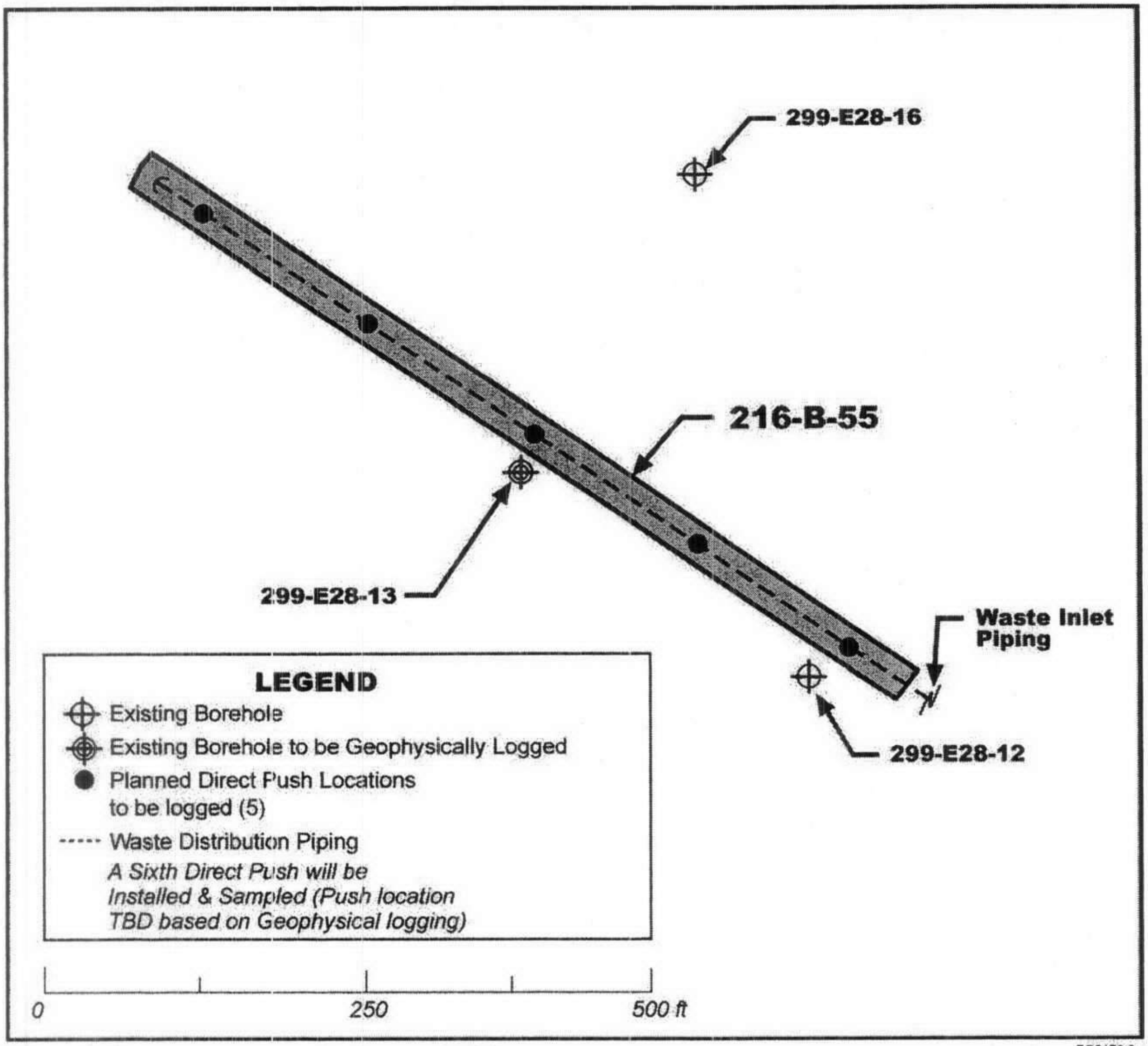
AD1-4.0 216-B-55 CRIB SITE-SPECIFIC FIELD-SAMPLING PLAN

The following figures and tables provide the site-specific field-sampling plan for the 216-B-55 Crib.

Figure AD-8. 216-B-55 Crib Data-Collection Locations.



TBD = to be determined.

Figure AD-9. 216-B-55 Crib Stratigraphy and Sample-Collection Intervals.

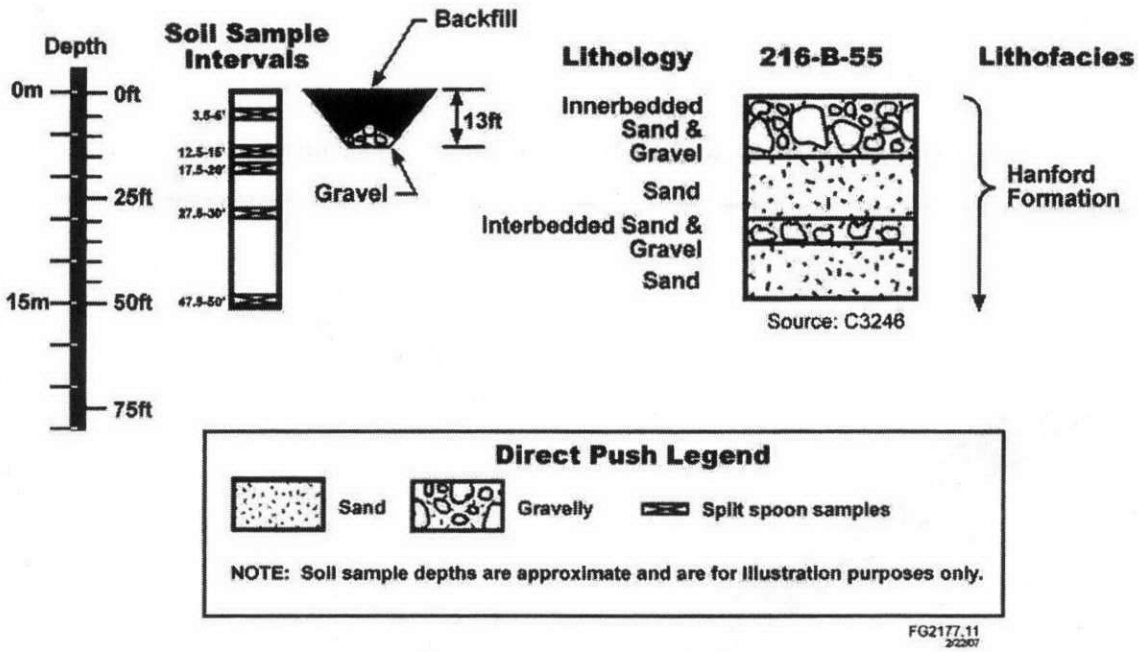


Table AD-6. 216-B-55 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Direct push with sampling	Five direct-push holes [e]	50 ft bgs	12.5 – 15 ft bgs	Analytes are presented in Volume I, Table A2-3, the 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 columns.	N/A	N/A
	One direct-push hole [f]	50 ft bgs	Sample at depths of: 3.5 – 6 ft bgs 12.5 – 15 ft bgs 17.5 – 20 ft bgs 27.5 – 30 ft bgs 47.5 – 50 ft bgs	Analytes are presented in Volume I, Table A2-3, the 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 columns.	N/A	N/A
Number of split-spoon samples		10				
Approximate number of field quality-control samples [c]		3				
Approximate total number of soil samples collected		13				
Approximate total number of soil samples initially analyzed [d]		8				
Non-Sample Data Collection	**Maximum Depth of Investigation**					
Downhole gamma-spectroscopy log, neutron moisture, passive neutrons	Surface to TD in five direct-push holes to 50 ft bgs and one existing well E28-13 to 230 ft bgs					

[a] Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b] See Volume I, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.

[c] One duplicate, one split, and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.

[d] Number of samples analyzed includes five split-spoon samples and three field quality-control samples. Five additional split spoons associated with five direct pushes will be analyzed in accordance with footnote e.

[e] Analyze these samples only if geophysical logging shows no contamination.

[f] Install sixth direct push at location of highest contamination from the initial five pushes, to collect and analyze soil samples. If the logging results of the first five pushes do not indicate contamination, install sixth direct push at the head end of the ditch and sample throughout the push to obtain vertical distribution of contaminants.

bgs = below ground surface. N/A = not applicable. TD = total depth.

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Figure AD-10. 216-B-55 Crib Conceptual Model and Data Summary.

216-B-55 Crib

200-SC-1 Operable Unit
Waste Type: Steam Condensate

Model Group 6
B Plant Zone

History

216-B-55 Crib is a liquid waste disposal site that received contaminated steam condensate from the 221-B Building.

CONSTRUCTION: A covered, gravel-filled trench with bottom dimensions of 750 feet long by 10 feet wide and about 13 feet deep. A perforated 30-inch diameter galvanized pipe runs the length of the unit.

WASTE VOLUME: 1,230,000,000 liters

DURATION: 1967 to 1991.

ESTIMATED INVENTORY OF SELECTED HIGH-MOBILITY CONSTITUENTS

	WIDS	SIM
Uranium	<0.54 Kg	0.0003 Kg
Tritium	3.74 Ci	0.0002 Ci
Nitrate	--	604 Kg
Fluoride	--	159 Kg

ESTIMATED INVENTORY OF SELECTED MEDIUM/ LOW MOBILITY CONSTITUENTS

	WIDS	SIM
Co-60	0.38 Ci	0.0004 Ci
Cs-137	21.1 Ci	0.14 Ci
Sr-90	<11.1 Ci	0.0002 Ci
Plutonium	<0.46 g	0.00014 Ci
Total Beta Emitters	150 Ci	--

Note: "--" indicates inventory not estimated

REFERENCES:

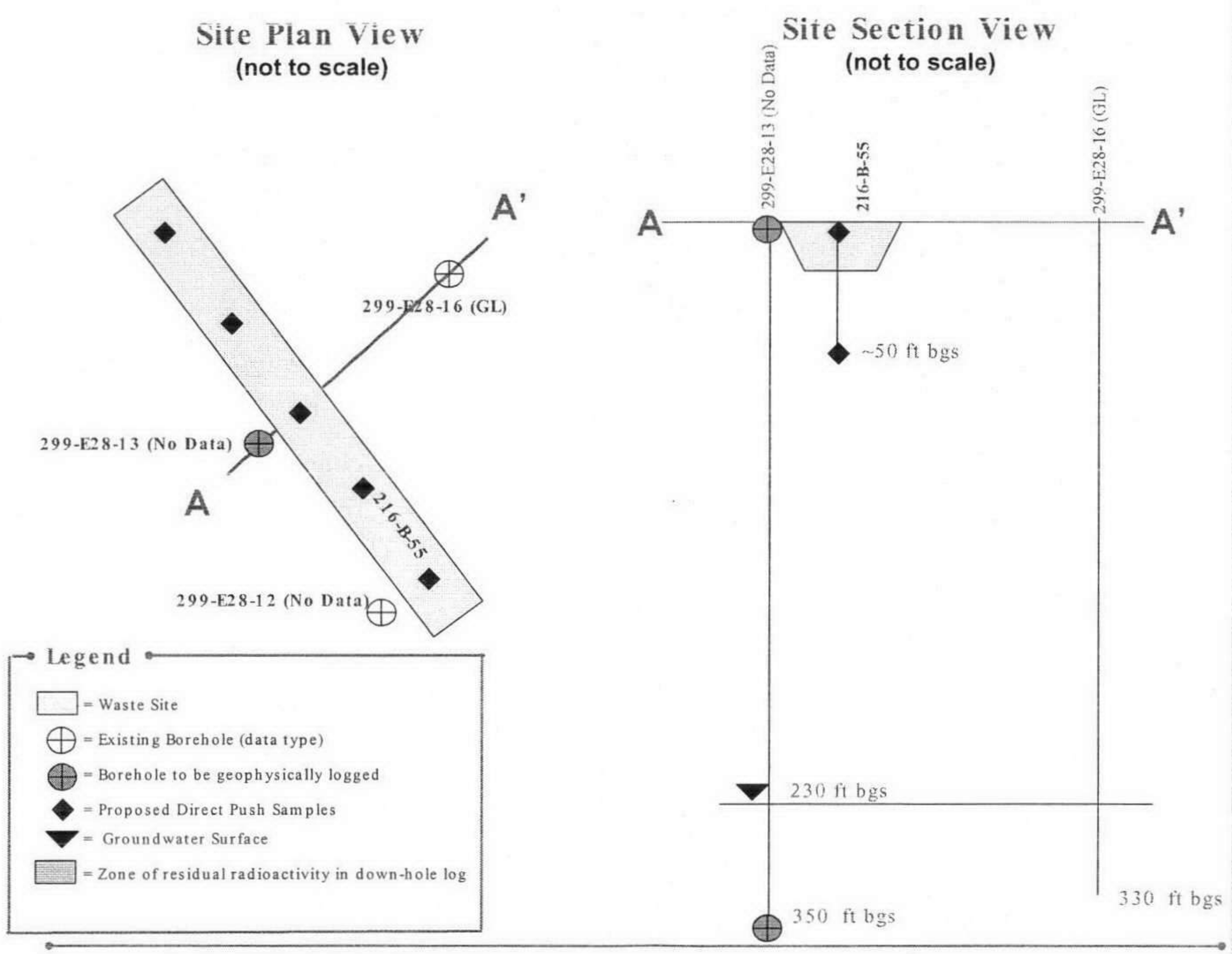
WIDS general summary reports
Hanford Soil Inventory Model, Rev 1 (RPP-26744)

Basis of Knowledge

- Process History (PH)
- Geologic Logs (GL)
- Extrapolation from Representative Site (RS)

Characterization Summary

- One geologic log from well 299-E28-16
- Process history including data from discharge stream
- Assigned to representative site 216-U-10.



Data Needs, Rationale, and Investigation Approach

No additional data are required to support a decision based on the analogous relationship; however additional information is useful for the following reasons:

- The analogous relationship with 216-U-10 is expected to be bounding; however, the actual inventory at this facility may be substantially lower, providing the opportunity to support a no action alternative, or other non-intrusive alternatives.
- Supplemental information may also support reducing the scope of intrusive remediation (e.g., partial removal/ treatment/ barrier).

The supplemental investigation strategy incorporates the following elements:

- Geophysically log existing well 299-E28-13, using gamma spectroscopy, neutron moisture, and passive neutron logging techniques.
- Install 5 direct push holes along the axis of the crib and geophysically-log the holes and collect soil samples at the elevation of the crib bottom. Identify locations of elevated gamma activity.
- Collect subsurface soil samples from one direct push hole located at the point of highest gamma activity identified in the five logged holes. If no gamma response is found in the first five holes, then locate the sixth hole near the head end of the trench, collect soil samples and analyze as specified.

Potential Viable Alternatives

- NO ACTION
- REMOVE/ TREAT/ DISPOSE
- PARTIAL REMOVAL/ TREATMENT/ BARRIER
- MESC/ MNA/ IC
- BARRIER

Table AD-7. Data-Needs Priority Summary – Model Group 6 – 216-B-55 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Background	
Site Identification	216-B-55 Crib
Site Location	200 East Area; B Plant Zone; west of 225-B and north of 7th Street
Type of Site	Crib
Operating History	The site is marked with concrete AC-540 markers and posted with Underground Radioactive Material signs. The unit is filled with approximately 1380 m^3 (1,800 yd^3) of gravel. A perforated 30 cm (30-in.) diameter galvanized pipe runs the length of the unit, 0.9 m (3 ft) above the bottom. The site had two gage wells of 20 cm (8-in.) steel pipe with a galvanized sheet metal cap. Each well extended from the crib bottom to approximately 0.9 m (3 ft) above grade. The crib was constructed with 19,500 ft^2 of membrane barrier. The site received 1.23 billion liters of steam condensate from 221-B. The crib is adjacent to an area of reoccurring, spreading contamination known as UPR-200-E-64. (WIDS) The crib is 228 m long by 3.1 m wide (750 ft by 10 ft) (WIDS). The depth is uncertain, but appears to be approximately 13 ft deep (H-2-60330). The crib operated from 1967 to 1991 (WIDS). Soil Inventory Model – 216-B-55 (RPP-26744)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
2.490E+03	9.318E-02	4.231E+01	1.474E-02	9.513E-06	0.000E+00	2.936E-06	1.259E-06	6.649E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
9.903E-04	0.000E+00	6.044E+00	2.273E+04	8.958E+02	6.045E+02	3.579E-01	9.067E+04	5.572E-03
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
1.245E+04	2.974E+03	1.596E+02	1.058E+03	0.000E+00	1.754E-08	0.000E+00	0.000E+00	3.772E-03
Fe(CN)6 (kg)	H-3 (Ci)	C-14 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Co-60 (Ci)	Se-79 (Ci)	Sr-90 (Ci)	Y-90 (Ci)
0.000E+00	1.770E-04	3.399E-05	6.417E-06	6.098E-04	3.926E-04	4.049E-06	2.197E-04	2.197E-04
Zr-93 (Ci)	Nb-93m (Ci)	Tc-99 (Ci)	Ru-106 (Ci)	Cd-113m (Ci)	Sb-125 (Ci)	Sn-126 (Ci)	I-129 (Ci)	Cs-134 (Ci)
2.412E-04	1.947E-04	1.291E-03	3.687E-10	2.523E-04	5.996E-05	1.683E-05	7.634E-07	1.353E-07
Cs-137 (Ci)	Ba-137m (Ci)	Sm-151 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	Eu-155 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Ac-227 (Ci)
1.433E-01	1.354E-01	5.316E-02	9.925E-06	7.391E-04	3.411E-04	1.890E-10	8.757E-09	1.119E-09
Pa-231 (Ci)	Th-229 (Ci)	Th-232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)
3.058E-09	4.858E-11	1.353E-10	2.324E-09	1.434E-07	9.993E-08	4.173E-09	2.723E-09	9.357E-08
U-Total (kg)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Am-241 (Ci)	Am-243 (Ci)
2.805E-04	4.206E-06	1.969E-06	4.575E-05	1.061E-05	8.933E-05	7.363E-10	6.433E-05	3.694E-08
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
2.269E-07	6.970E-09	1.739E-07						

Table AD-7. Data-Needs Priority Summary – Model Group 6 – 216-B-55 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Vicinity Waste Sites	216-B-12, UPR-200-E-64						
Status	Analogous site; assigned to 216-U-10 in 200-CW-5/2/4/200-SC-1 feasibility study (DOE/RL-2004-24); capping identified as preferred alternative in feasibility study.						
Potential Remedial Alternatives							
X for Viable Alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal/Barrier	In Situ Treatment	Other
	X	X	X	X	X		

Data Evaluation and Gaps Analysis			
Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Well 299-E28-12 (349 ft) (scintillation logs 1968, 1970, and 1976)	Located 4 m (13 ft) from the crib edge on the southeast end. Only background radioactivity was detected	Nature and extent of contamination is uncertain; however, contaminant concentrations are expected to be low based on Soil Inventory Model inventory estimate. Analogous relationship with representative site is a bounding relationship. Site-specific data may indicate no action or MESC/MNA/IC are more appropriate.	No. Analogous relationship and inventory data could be used to support decision making. However, this crib is assigned to 216-U-10, which has a larger inventory of several constituents. While the analogous relationship with 216-U-10 would bound the decision process, supplemental data at 216-B-55 may permit a stronger analysis of the no action and MESC/MNA/IC alternatives and may permit a lesser alternative than the analogous evaluation. Supplemental data would provide site-specific confirmatory information on the nature and extent of contamination; because the crib is large, the supplemental data would allow assessment of partial removal alternative and permit a more accurate evaluation of contaminant volume and cost.

Proposed Activities and Path Forward:

Geophysically log well 299-E28-13.

Install five direct pushes along length of crib; geophysically log the holes; collect soil samples at bottom of crib.

Install sixth direct push at location of highest contamination from the initial five pushes to collect and analyze soil samples. If the logging results of the first five pushes do not indicate contamination, install sixth direct push at the head end of the ditch and sample throughout the push to obtain vertical distribution of contaminants.

Additional Notes:

The following provides a list of the references/bibliography used during this evaluation:

ARH-947, *200 Areas Disposal Sites for Radioactive Liquid Waste.*
ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells.*
BHI-00179, *B Plant Aggregate Area Management Study Technical Baseline Report.*
DOE/RL-2004-24, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste Group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units.*
H-2-60330, *Trench 216-B-55 Cond Waste Lines 221-B to Trench 216-B-55 & B-12 Crib Plan & Profile.*
RHO-CD-673, *Handbook 200 Areas Waste Sites.*
RHO-RE-SR-84-24 P, *Results of the Separations Area Groundwater Monitoring Network for 1983.*
RPP-26744, *Hanford Soil Inventory Model,* Rev. 1.
Waste Information Data System, Hanford Site database.

MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.
WIDS = *Waste Information Data System* database.

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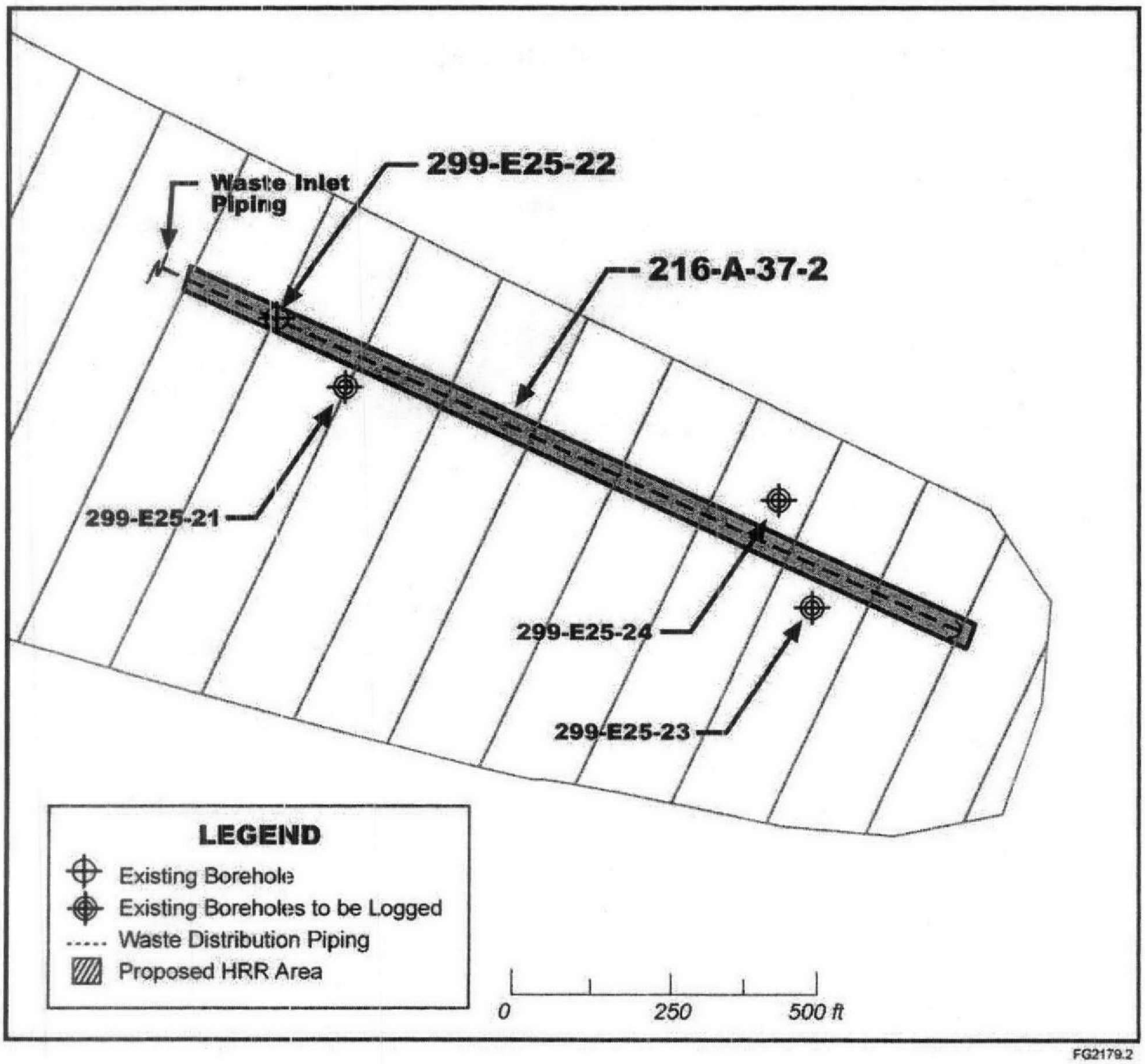
AD1-5.0 216-A-37-2 CRIB SITE-SPECIFIC FIELD-SAMPLING PLAN

The following figures and tables provide the site-specific field-sampling plan for the 216-A-37-2 Crib.

Figure AD-11. 216-A-37-2 Crib Data-Collection Locations.



NOTE: Downhole logging from surface to total depth of existing boreholes. Downhole logging includes gamma spectroscopy, neutron moisture, and passive neutron.

Figure AD-12. East Plutonium-Uranium Extraction Plant High-Resolution Resistivity Data-Collection Study Area (including the 216-A-37-2 Crib).

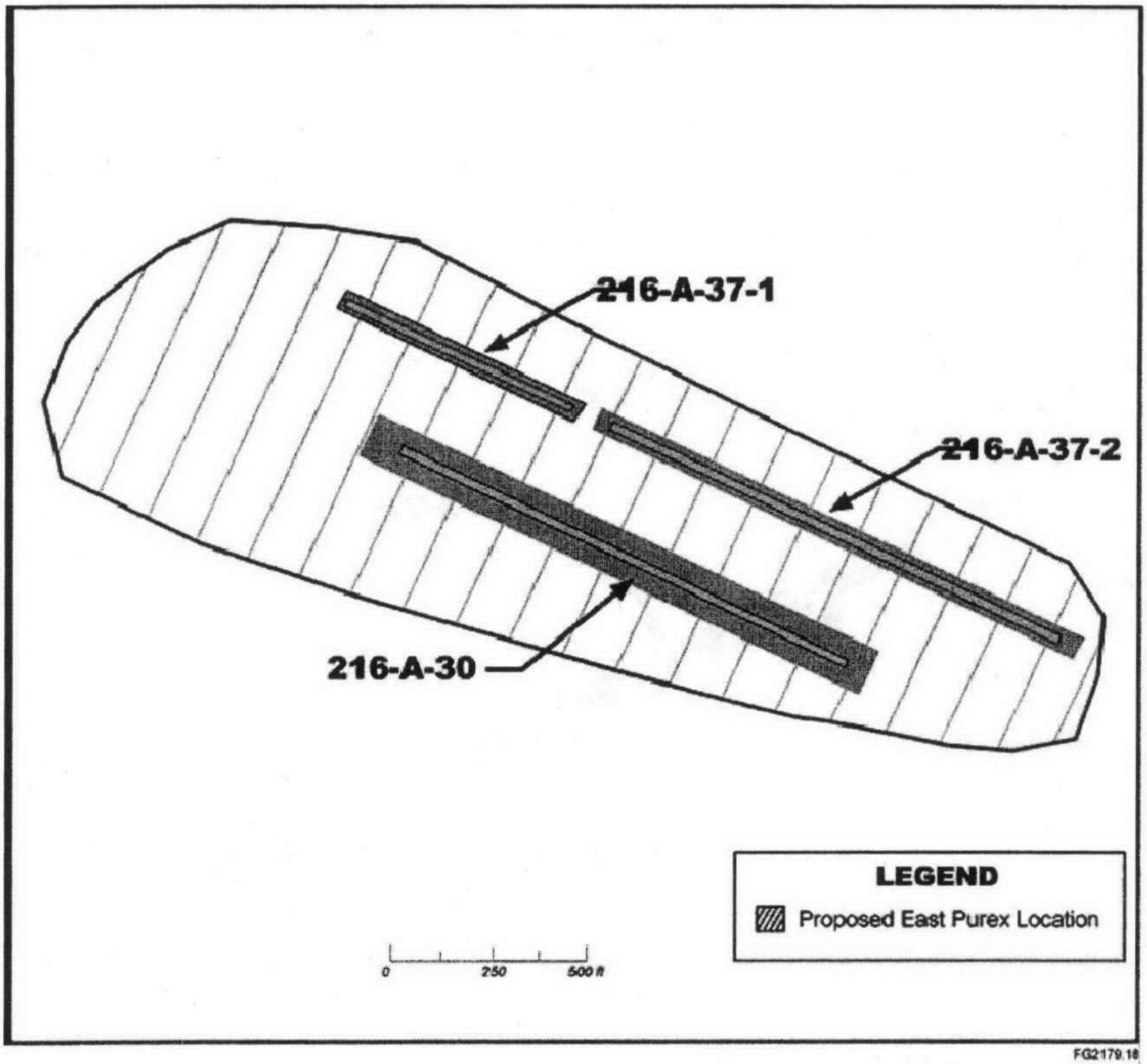


Figure AD-13. 216-A-37-2 Crib Conceptual Model and Data Summary.

200-SC-1 Operable Unit
Waste Type: Steam Condensate

216-A-37-2 Crib

Model Group 6
PUREX Zone

History

216-A-37-2 Crib is a liquid waste disposal site constructed as a replacement for 216-A-30 Crib and received contaminated steam condensate, equipment disposal tunnel floor and water-filled door drainage, and fuel slug storage basin overflow from the 202-A Building (PUREX).

CONSTRUCTION: A covered, gravel-filled trench with bottom dimensions of 1,400 feet long by 10 feet wide and about 16 feet deep. Two perforated galvanized pipes run the length of the unit.

WASTE VOLUME: 1,290,000,000 liters

DURATION: 1983 to 1995.

ESTIMATED INVENTORY OF SELECTED HIGH-MOBILITY CONSTITUENTS

	WIDS	SIM
Uranium	0.005 Ci	47.6 Kg
U-234	--	0.02 Ci
Tritium	5.08 Ci	9.5 Ci
Nitrate	--	617 Kg
Fluoride	--	149 Kg

INVENTORY OF MEDIUM/ LOW MOBILITY CONSTITUENTS

	WIDS	SIM
Cs-137	0.102 Ci	--
Sr-90	0.132 Ci	0.06 Ci
Plutonium	--	1.34 Ci
Total Beta Emitters	0.672 Ci	--

Note: "--" indicates inventory not estimated.

REFERENCES:

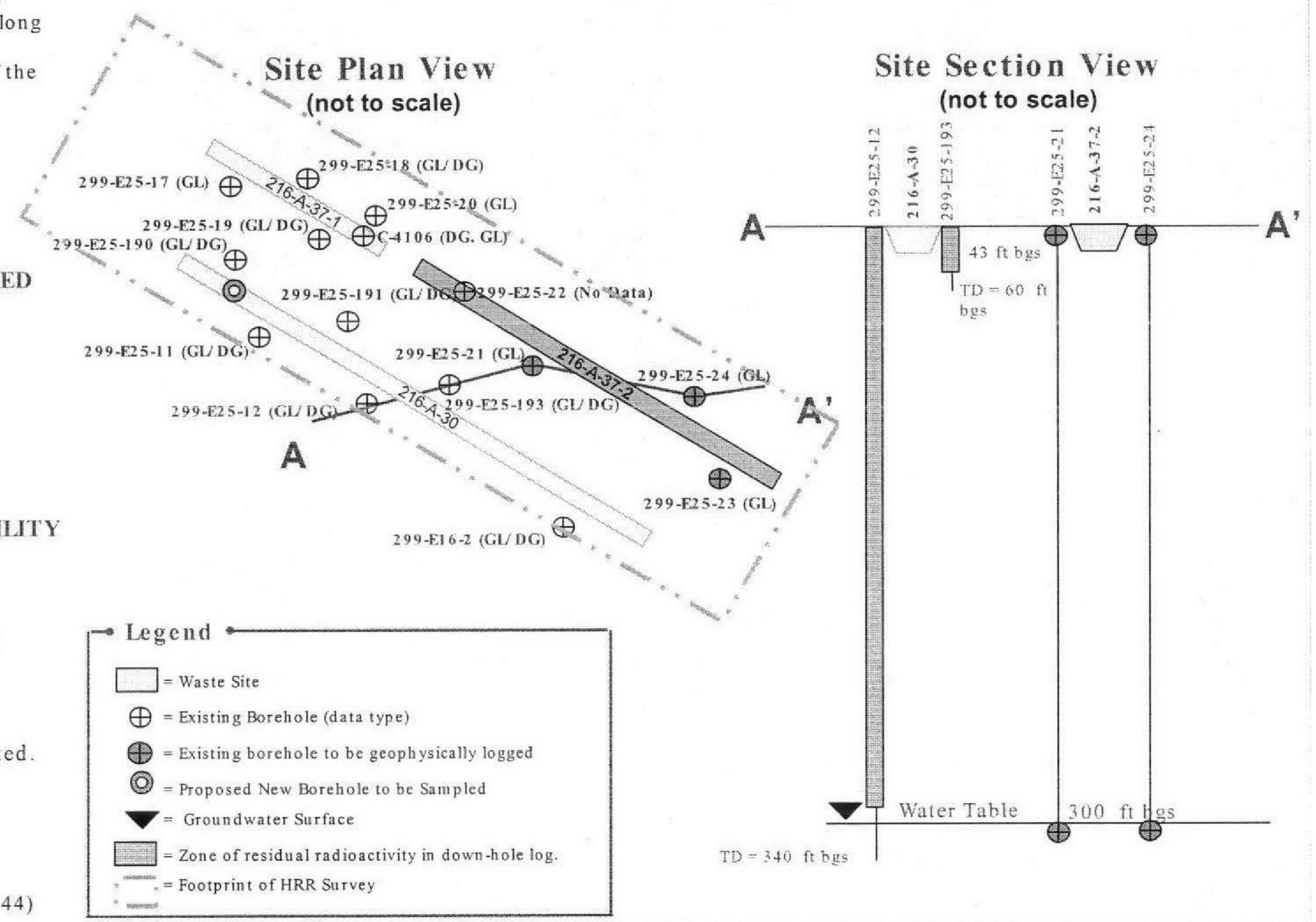
WIDS general summary reports
Hanford Soil Inventory Model, Rev 1 (RPP-26744)

Basis of Knowledge

- Process History (PH)
- Interpretation of Downhole Geophysics (DG)
- Geologic Logs (GL)
- Extrapolation from Representative Site (RS)

Characterization Summary

- Operating history and scintillation log of well 299-E25-12 (adjacent to 216-A-30) suggests potential for deep contamination at relatively low concentrations under 216-A-30.
- Assigned to representative site 216-U-10.



Data Needs, Rationale, and Investigation Approach

No additional data are needed for 216-A-37-2. Decisions at this site will be made using the following information:

- The estimated inventory for the site is relatively low.
- The site received the same waste stream as 216-A-30 Crib and the information derived from that site can be used to describe conditions at 216-A-37-2. 216-A-30 should provide bounding conditions for 216-A-37-2.
- 216-A-37-2 will be included in the conductivity survey to be conducted at 216-A-30.
- Conduct downhole geophysical logging (gamma spectroscopy, neutron moisture, and passive neutron) at three nearby existing wells to supplement information.
- Results of sampling and analysis of subsurface soil from a new deep borehole to be placed within 216-A-30 Crib will be evaluated in association with 216-A-37-2.

Potential Viable Alternatives

- NO ACTION
- REMOVE/ TREAT/ DISPOSE
- PARTIAL REMOVAL/ TREATMENT/ BARRIER
- MESC/ MNA/ IC
- BARRIER

Table AD-8. Data-Needs Priority Summary – Model Group 6 – 216-A-37-2 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Background	
Site Identification	216-A-37-2 Crib
Site Location	200 East Area; PUREX Zone; outside 200 East Area perimeter fence, east of the 202-A Building
Type of Site	Crib
Operating History	The crib is marked with concrete AC-540 posts and Underground Radioactive Material signs. The crib was built as a replacement for the 216-A-30 crib. The crib received PUREX steam condensate waste. There are two steel drain pipes. One is perforated and runs the length of the unit, and the other is unperforated and runs from west to east only to the center of the unit, 1.5 m (5 ft) above the bottom. Two vents are located at the center and at the east end. Two liquid-level gage wells are located 106 m (350 ft) from the ends of the unit. A bed of gravel on the bottom has been covered with a 20-mil polyvinyl chloride barrier cover. The crib is 1,400 ft long, 10 ft wide at the bottom, and 16 ft deep. The waste site received 1,090,033 m^3 of liquid effluent and operated from 1983 to 1995. Site Inventory Model – 216-A-37-2 Crib (RPP-26744) (some constituents of interest are highlighted)

Na (kg) 2.366E+03	Al (kg) 0.000E+00	Fe (kg) 5.664E+01	Cr (kg) 0.000E+00	Bi (kg) 0.000E+00	La (kg) 0.000E+00	Hg (kg) 1.155E-02	Zr (kg) 0.000E+00	Pb (kg) 5.555E-01
Ni (kg) 0.000E+00	Ag (kg) 0.000E+00	Mn (kg) 7.728E+00	Ca (kg) 1.181E+04	K (kg) 8.178E+02	NO3 (kg) 6.177E+02	NO2 (kg) 0.000E+00	CO3 (kg) 7.469E+04	PO4 (kg) 0.000E+00
SO4 (kg) 1.163E+04	Si (kg) 2.757E+03	F (kg) 1.487E+02	Cl (kg) 1.168E+03	CCl4 (kg) 0.000E+00	Butanol (kg) 1.389E+02	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 0.000E+00
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 9.505E+00	C-14 (Ci) 4.528E-01	Ni-59 (Ci) 0.000E+00	Ni-63 (Ci) 0.000E+00	Co-60 (Ci) 0.000E+00	Se-79 (Ci) 0.000E+00	Sr-90 (Ci) 5.556E-02	Y-90 (Ci) 5.560E-02
Zr-93 (Ci) 0.000E+00	Nb-93m (Ci) 0.000E+00	Tc-99 (Ci) 0.000E+00	Ru-106 (Ci) 0.000E+00	Cd-113m (Ci) 0.000E+00	Sb-125 (Ci) 0.000E+00	Sn-126 (Ci) 0.000E+00	I-129 (Ci) 5.437E-05	Cs-134 (Ci) 0.000E+00
Cs-137 (Ci) 0.000E+00	Ba-137m (Ci) 0.000E+00	Sm-151 (Ci) 0.000E+00	Eu-152 (Ci) 0.000E+00	Eu-154 (Ci) 0.000E+00	Eu-155 (Ci) 0.000E+00	Ra-226 (Ci) 5.406E-07	Ra-228 (Ci) 3.249E-11	Ac-227 (Ci) 2.712E-06
Pa-231 (Ci) 6.243E-06	Th-229 (Ci) 3.566E-09	Th-232 (Ci) 3.729E-11	U-232 (Ci) 7.605E-06	U-233 (Ci) 2.411E-06	U-234 (Ci) 2.300E-02	U-235 (Ci) 8.816E-04	U-236 (Ci) 2.222E-03	U-238 (Ci) 1.586E-02
U-Total (kg) 4.764E+01	Np-237 (Ci) 5.757E-04	Pu-238 (Ci) 1.435E-02	Pu-239 (Ci) 1.386E-01	Pu-240 (Ci) 3.908E-02	Pu-241 (Ci) 1.158E+00	Pu-242 (Ci) 4.931E-06	Am-241 (Ci) 3.599E-02	Am-243 (Ci) 9.959E-06
Cm-242 (Ci) 1.838E-05	Cm-243 (Ci) 2.780E-06	Cm-244 (Ci) 7.111E-05						

Table AD-8. Data-Needs Priority Summary – Model Group 6 – 216-A-37-2 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Vicinity Waste Sites	216-A-30, 216-A-37-1						
Status	Analogous site; assigned to 216-U-10; evaluated in 200-PW-2/4 feasibility study (DOE/RL-2004-24); capping identified as preferred alternative in feasibility study.						
Potential Remedial Alternatives							
X for Viable Alternatives	No Action	MESC//MNA/IC	Removal/Disposal	Barrier	Partial Removal/Barrier	In Situ Treatment	Other
	X	X	X	X	X		
Data Evaluation and Gaps Analysis							
Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?				
No site-specific sampling or geophysical logging information Borehole C4106 at 216-A-37-1 was drilled to the water table and provides information on deeper contamination in the area of the 216-A-37-1 and 216-A-37-2 Cribs.		Nature and extent of contamination at 216-A-37-2; inventory indicates minor contamination.	No. Inventory data and data from supplemental investigation activities at 216-A-30 (proposed) will support decision making at the 216-A-37-2 Crib (216-A-37-2 replaced the 216-A-30 Crib). Because existing wells are located within the waste site, geophysical logging is an opportunistic method of collecting site-specific data to help confirm inventory knowledge for gamma-emitting radionuclides and to support decision making. HRR surveys in this area also will provide information on the potential for deeper mobile contaminants.				
Proposed Activities and Path Forward: No supplemental data collection activities are required. Data collected from 216-A-30 will be used to support evaluation of 216-A-37-2. Geophysically log 299-E25-21, -23, and -24 to obtain opportunistic site-specific information. Reevaluate data needs following assessment of the 216-A-30 supplemental investigation data and any additional information collected for 216-A-37-1 (a Washington State Department of Ecology treatment, storage, and/or disposal site).							

Additional Notes:
The following provides a list of the references/bibliography used during this evaluation:

DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/ Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units.*
DOE/RL-2004-24, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste Group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units.*
HNF-1744, *Radioactive Inventories of Liquid Waste Disposal Sites on the Hanford Site.*
RHO-CD-673, *Handbook 200 Areas Waste Sites.*
RHO-RE-SR-84-24 P, *Results of the Separation Area Groundwater Monitoring Network for 1983.*
RPP-26744, *Hanford Soil Inventory Model, Rev. 1.*
Waste Information Data System, Hanford Site database.

MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls..
PUREX = Plutonium-Uranium Extraction (Plant or process).
WIDS = *Waste Information Data System* database.

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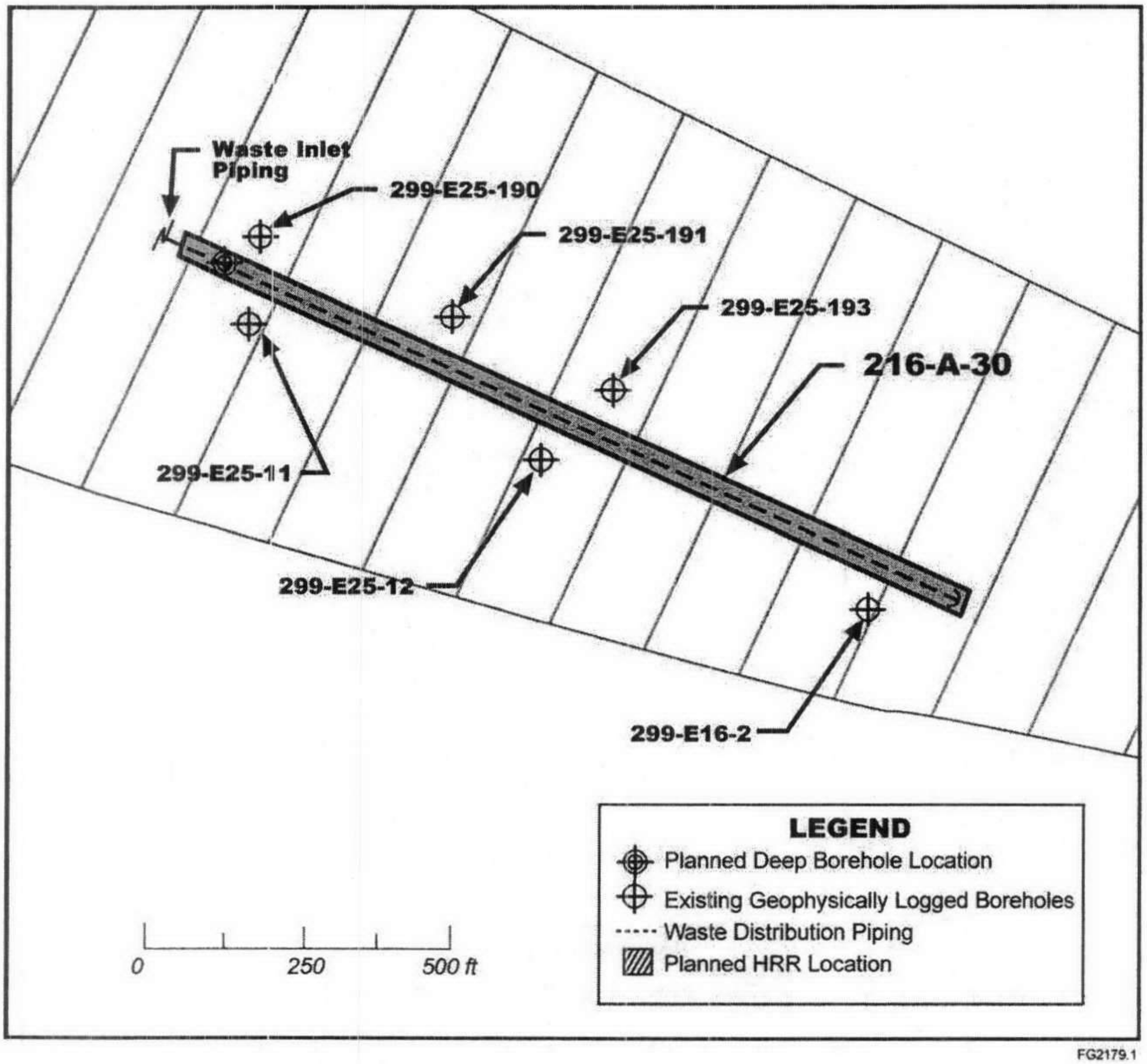
AD1-6.0 216-A-30 CRIB SITE-SPECIFIC FIELD-SAMPLING PLAN

The following figures and tables provide the site-specific field-sampling plan for the 216-A-30 Crib.

Figure AD-14. 216-A-30 Crib Data-Collection Locations.



NOTE: Full extent of high-resolution resistivity (HRR) shown on Figure AD-12.

Figure AD-15. 216-A-30 Crib Stratigraphy and Sample-Collection Intervals.

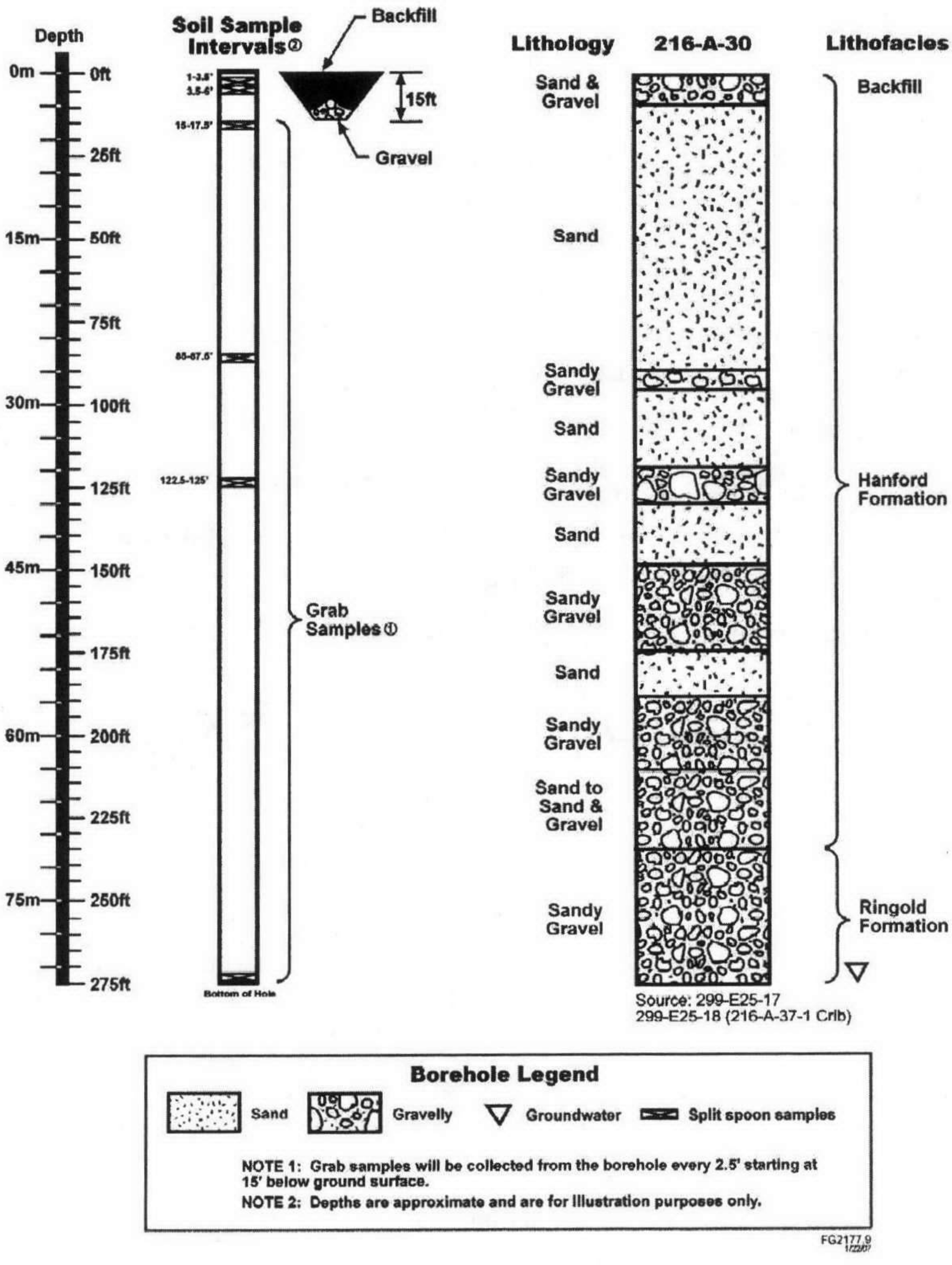


Table AD-9. 216-A-30 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Borehole drilling and sampling	One new borehole near the inlet end of crib	To water table (~275 ft bgs)	Split-spoon sample intervals: 1 – 3.5 ft bgs 3.5 – 6 ft bgs 15 – 17.5 ft bgs 85 – 87.5 ft bgs 122.5 – 125 ft bgs TD (~272.5 – 275 ft bgs)	Analytes are presented in Volume I, Table A2-3, the 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 columns.	All split-spoon samples	pH, specific conductance, bulk density, moisture, particle-size distribution
			Collect grab samples every 2.5 ft from depth 15 ft bgs to TD. Perform extraction analysis on grab samples, starting with samples every 10 ft.	See Volume I, Table A2-3	N/A	N/A
Number of split-spoon samples		6				
Approximate number of field quality-control samples [c]		3				
Approximate number of grab samples		105				
Approximate total number of soil samples collected		113				
Approximate total number of soil samples initially analyzed [d]		36				
Non-Sample Data Collection		**Maximum Depth of Investigation**				
High-resolution resistivity		Not defined				
Downhole gamma-spectroscopy log, neutron moisture, and passive neutron logs		Surface to TD in new borehole at ~275 ft bgs				

[a] Actual sampling depths may vary depending on the amount of backfill/overburden used in interim-stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b] See Volume I, Appendix A, Tables A2-1, A2-2, A2-3, and A3-2 for detection limits and other analytical parameters.

[c] One duplicate, one split, and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.

[d] Samples analyzed include 6 split spoon samples, 27 grab samples, and 3 quality-control samples.

bgs = below ground surface. N/A = not applicable. TD = total depth.

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Figure AD-16. 216-A-30 Crib Conceptual Model and Data Summary.

200-SC-1 Operable Unit
Waste Type: Steam Condensate

216-A-30 Crib

Model Group 6
PUREX Plant Zone

History

216-A-30 Crib is a liquid waste disposal site that received contaminated steam condensate, equipment disposal tunnel floor and water-filled door drainage, and fuel slug storage basin overflow from the 202-A Building (PUREX). In 1972, contaminated salt crust formed on the surface of the crib. Contaminated tumbleweeds were subsequently found growing on the crib.

CONSTRUCTION: A covered, gravel-filled trench with bottom dimensions of 1,400 feet long by 10 feet wide and about 15 feet deep. Two perforated galvanized pipes run the length of the unit.

WASTE VOLUME: 7,500,000,000 liters

DURATION: 1961 to 1992.

ESTIMATED INVENTORY OF SELECTED HIGH-MOBILITY CONSTITUENTS

	WIDS	SIM
Uranium	<41 Kg	656 Kg
U-233	<7.48 g	2.05 Ci
Tritium	10.7 Ci	0.02 Ci
Nitrate	--	208,200 Kg
Chromium	--	6,045 Kg
Fluoride	--	1,128 Kg

ESTIMATED INVENTORY OF SELECTED MEDIUM/ LOW MOBILITY CONSTITUENTS

	WIDS	SIM
Co-60	16.6 Ci	0.0002 Ci
Cs-137	220 Ci	2.79 Ci
Sr-90	<11.1 Ci	1.10 Ci
Plutonium	<72 g	247.8 Ci
Pu-239/-240	--	41.45 Ci
Pu-241	--	202.7 Ci
Total Beta Emitters	5,440 Ci	--

Note: "--" indicates inventory not estimated.

REFERENCES:

WIDS general summary reports
Hanford Soil Inventory Model, Rev 1 (RPP-26744)

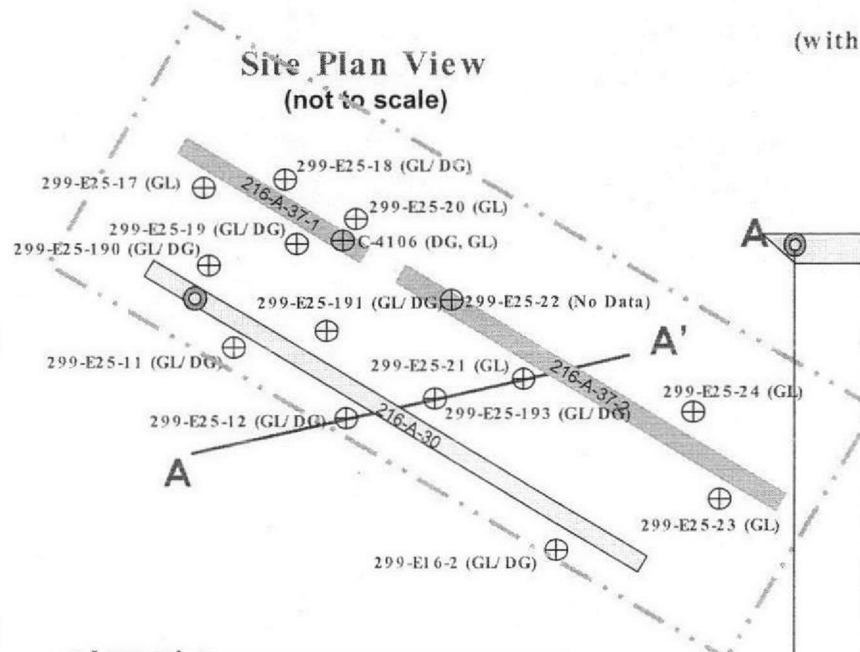
Basis of Knowledge

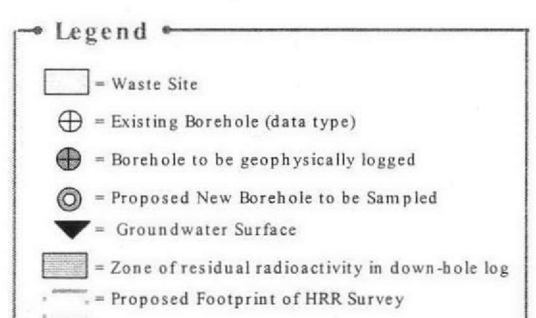
- Process History (PH)
- Interpretation of Downhole Geophysics (DG)
- Geologic Logs (GL)
- Extrapolation from Representative Site (RS)

Characterization Summary

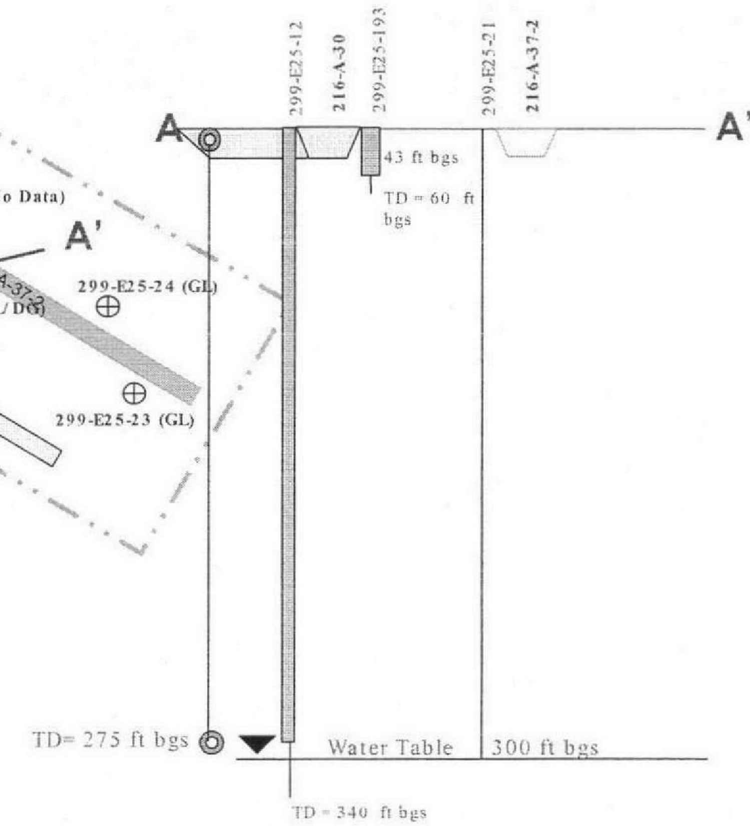
- Operating history and scintillation log of well 299-E25-12 (adjacent to 216-A-30) suggests potential for deep contamination at relatively low concentrations under 216-A-30.
- Operating history indicates surface contamination along full length of crib.
- Assigned to representative site 216-U-10.

Site Plan View
(not to scale)





Site Section View
(with proposed borehole projected)
(not to scale)



Potential Viable Alternatives

- REMOVE/ TREAT/ DISPOSE
- PARTIAL REMOVAL/ TREATMENT/ BARRIER
- MESC/ MNA/ IC
- BARRIER

Data Needs, Rationale, and Investigation Approach

Additional information is required for the following reasons:

- There are uncertainties in the relationship to the representative site (216-U-10) based on geology and inventory.
- Groundwater protection could be a concern based on the site-specific inventory; the full nature and extent of contaminants that may impact groundwater are uncertain (e.g., chromium, fluoride, nitrate).

The supplemental investigation strategy incorporates the following elements:

- A high-resolution resistivity (HRR) survey will support identification of areas of elevated conductivity that may be associated with mobile contaminants.
- One deep borehole will be installed near the head end of the 216-A-30 Crib to collect subsurface soil samples for analysis as specified.
- Data collected from this site will be used to describe expected conditions at 216-A-37-2 and 216-A-6. This is appropriate because these sites all received the same waste; 216-A-6 was replaced by 216-A-30, which was subsequently replaced by 216-A-37-2.

Table AD-10. Data-Needs Priority Summary – Model Group 6 – 216-A-30 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Background	
Site Identification	216-A-30 Crib
Site Location	200 East; PUREX Zone; south of 202-A Building inside the PUREX Exclusion Fence, immediately east of 216-Z-6 Crib and adjacent to 216-A-37-1 and 216-A-37-2.
Type of Site	Crib
Operating History	The crib is surrounded with concrete AC-540 markers and posted with Underground Radioactive Material signs. The unit includes two distribution pipes: one 15-in (38 cm) corrugated perforated pipe running approximately 4 ft (1.2 m) below grade to the center of the unit, the other a 16-in (41 cm) steel pipe running parallel to the other, 4 ft (1.2 m) below grade to the center of the unit, then angling 45 degrees and changing to a 15-in (38 cm) corrugated, perforated pipe running 7 to 8 ft (2.1 to 2.4 m) below grade to the end of the unit. It is filled with 5 ft (1.5 m) or a total of 123,000 cu ft (3,480 m^3) of gravel, and the site has been backfilled. The side slope is 1.5:1. The crib is associated with PUREX operations. Two 8-inch (20 cm) carbon steel gage wells extending from the bottom to 3 ft (0.9 m) above grade. A 15-inch (38 cm) diameter vent riser extends from the distribution pipe to 3 ft (0.9 m) above grade. Two 16-in (41 cm) by 16-inch (41 cm) by 8-inch (20 cm) concrete pads support the gage wells. 47,720 square feet (4430 square meters) of polyethylene sheets were added. The site is associated with the 216-A-6 Crib. The site received waste between 1961 and 1992. From 1961 to 1966, the 216-A-6 and 216-A-30 Cribs were used in parallel; in 1970, the 216-A-6 Crib was abandoned and the effluent was routed to the 216-A-30 Crib. The 216-A-37-2 Crib subsequently was constructed to replace 216-A-30. During the winter of 1971 and early 1972, an alkaline deposit formed over the surface of the 216-A-30 Crib. A radiation survey found the residue to have between 4000 to 6000 disintegrations per minute beta/gamma on the surface. A few tumbleweeds were found measuring 12,000 disintegrations per minute beta/gamma. An exploratory excavation was made into the crib in 1972. Dose rates up to 800 mrad/h were encountered at a depth of 1.2 m (4 ft). It appeared to be a salt deposit condensing out of vapors being emitted from the unit through the porous soil. Corrective actions were taken in June 1972, including covering the ground with layers of sand and plastic. This crib has a history of tumbleweed growing on it and becoming contaminated by absorbing the radionuclides from the crib through their roots. In November 2002, an area measuring approximately 12 by 12 m (40 by 40 ft) was found to have growing contaminated tumbleweeds reading up to 120,000 disintegrations per minute. (WIDS) The crib is 1,400 ft long, and 10 ft wide at the bottom. Construction and historical information would suggest contamination as shallow as 4 to 5 ft bgs. The waste site received approximately 7.5 million m^3 of liquid effluent. (WIDS) Soil Inventory Model – 216-A-30 (RPP-26744) – 216-A-30 (some constituents of interest are highlighted)

Na (kg) 8.123E+04	Al (kg) 1.521E+01	Fe (kg) 1.894E+03	Cr (kg) 6.045E+03	Bi (kg) 0.000E+00	La (kg) 0.000E+00	Hg (kg) 7.350E-03	Zr (kg) 1.704E-05	Pb (kg) 3.680E-01
Ni (kg) 1.628E+03	Ag (kg) 2.081E-07	Mn (kg) 4.681E+01	Ca (kg) 8.274E+04	K (kg) 8.285E+04	NO3 (kg) 2.082E+05	NO2 (kg) 1.603E+04	CO3 (kg) 5.583E+05	PO4 (kg) 2.981E+04
SO4 (kg) 9.867E+04	Si (kg) 1.865E+04	F (kg) 1.128E+03	Cl (kg) 9.680E+03	CCl4 (kg) 0.000E+00	Butanol (kg) 2.292E-03	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 9.615E-03
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 1.809E-02	C-14 (Ci) 2.889E-02	Ni-59 (Ci) 2.208E-04	Ni-63 (Ci) 2.124E-02	Co-60 (Ci) 2.517E-04	Se-79 (Ci) 2.044E-06	Sr-90 (Ci) 1.101E+00	Y-90 (Ci) 1.102E+00
Zr-93 (Ci) 1.213E-04	Nb-93m (Ci) 9.425E-05	Tc-99 (Ci) 7.391E-04	Ru-106 (Ci) 1.235E-05	Cd-113m (Ci) 1.528E-04	Sb-125 (Ci) 1.709E-04	Sn-126 (Ci) 8.631E-06	I-129 (Ci) 8.912E-03	Cs-134 (Ci) 1.240E-04
Cs-137 (Ci) 2.795E+00	Ba-137m (Ci) 2.638E+00	Sm-151 (Ci) 5.697E-02	Eu-152 (Ci) 2.628E-05	Eu-154 (Ci) 1.925E-03	Eu-155 (Ci) 7.655E-04	Ra-226 (Ci) 5.643E-06	Ra-228 (Ci) 1.392E-07	Ac-227 (Ci) 2.723E-05
Pa-231 (Ci) 4.887E-05	Th-229 (Ci) 8.803E-08	Th-232 (Ci) 6.180E-08	U-232 (Ci) 3.467E-02	U-233 (Ci) 2.052E+00	U-234 (Ci) 2.997E-01	U-235 (Ci) 1.186E-02	U-236 (Ci) 1.633E-02	U-238 (Ci) 2.185E-01
U-Total (kg) 6.564E+02	Np-237 (Ci) 3.315E-03	Pu-238 (Ci) 3.444E+00	Pu-239 (Ci) 3.072E+01	Pu-240 (Ci) 1.073E+01	Pu-241 (Ci) 2.027E+02	Pu-242 (Ci) 1.812E-03	Am-241 (Ci) 1.469E-03	Am-243 (Ci) 1.359E-06
Cm-242 (Ci) 2.373E-06	Cm-243 (Ci) 2.477E-07	Cm-244 (Ci) 6.057E-06						

Table AD-10. Data-Needs Priority Summary – Model Group 6 – 216-A-30 Crib (200-CW-5/2/4/200-SC-1) (RL/FH) (CPP) (EPA). (2 Pages)

Vicinity Waste Sites	216-A-6 Crib; 216-A-37-1 and 216-A-37-2 Cribs						
Status	Analogous site; assigned to 216-U-10; evaluated in 200-CW-5/2/4/200-SC-1 feasibility study (DOE/RL-2004-24); capping identified as preferred alternative in feasibility study.						
Potential Remedial Alternatives							
X for Viable Alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal/Barrier	In Situ Treatment	Other
	No (inventory suggests contamination that could exceed the no action criteria)	X	X	X	X		

Data Evaluation and Gaps Analysis			
Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Scintillation Logs for Wells: 299-E16-2 (340 ft) (1963, 1968, and 1976) 299-E25-11 (340 ft) (1963, 1968, and 1976) 299-E25-12 (340 ft) (1963, 1976) Spectral Gamma Logs for Wells: 299-E25-190 (50 ft) (2006) 299-E25-191 (50 ft) (2006) 299-E25-193 (60 ft) (2006)	All three wells are located along the southern edge of the crib. Low-level radioactive contaminants were detected in wells E25-11 and E25-12 in 1963. In 1976, the scintillation probe profiles showed minor activity in all three wells. (ARH-ST-156) All three wells are located along the northern edge of the crib. All three wells had minor amounts of Cs-137, mostly above 20 ft. Each well had total gamma anomalies beginning ~15 ft deep, which do not correlate with the observed Cs-137 concentrations. Assessment of the logging results indicated the potential for Sr-90 concentrations in excess of 500 pCi/g in these wells. Elevated concentrations extended to a maximum depth of ~43 ft bgs. A moisture log in 299-E25-191 shows elevated moisture content associated with the lower interval of Sr-90 contamination in that well. (Stoller 2006)	Relationship with representative site has some uncertainties related to geology and inventory. Protection of groundwater could be a concern based on the inventory; site-specific nature and extent of contaminants that may impact groundwater are uncertain.	Yes. The analogous relationship with 216-U-10 is somewhat uncertain. Inventory information would suggest potential for groundwater impacts associated with chromium, fluoride, and/or nitrate. HRR would support evaluation of the lateral extent of potential elevated conductivity that may be associated with mobile contaminants that could impact groundwater. A deep borehole would provide site-specific data on nature and vertical extent and correlation data for the HRR survey results. The data from the 216-A-30 borehole would be used as analogous for 216-A-37-2 and 216-A-6 and associated unplanned releases (these unplanned releases are associated with spills or overflows at the 216-A-6 Crib) because 216-A-37-2 and 216-A-6 received the same waste as 216-A-30. 216-A-6 ultimately was replaced by 216-A-30 and 216-A-37-2 replaced 216-A-30.

Proposed Activities and Path Forward:

- Conduct HRR surveys to evaluate potential for elevated conductivity that may be associated with mobile contaminants and lateral extent of contamination.
- Install deep borehole to obtain site-specific data that will be used to define nature and vertical extent of contamination and to correlate HRR data.
- Use data as analogous for 216-A-37-2 and 216-A-6 and associated unplanned releases at 216-A-6 because 216-A-37-2 and 216-A-6 received the same waste as 216-A-30. 216-A-6 ultimately was replaced by 216-A-30 and 216-A-37-2 replaced 216-A-30.

Additional Notes:

The following provides a list of the references/bibliography used during this evaluation:

ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells.*
BHI-00178, *PUREX Plant Aggregate Area Management Study Technical Baseline Report.*
DOE/RL-99-66, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units.*
DOE/RL-2003-11, *Remedial Investigation for the 200-CW-5 U Pond/ Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units.*
DOE/RL-2004-24, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste Group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units.*
RHO-CD-673, *Handbook 200 Areas Waste Sites.*
RHO-RE-SR-84-24 P, *Results of the Separations Area Groundwater Monitoring Network for 1983.*
RPP-26744, *Hanford Soil Inventory Model,* Rev 1.
Stoller, 2006, "Contract No. 30475-1, Stoller Geophysical Log Results in the 216-A-30 Trench."
Waste Information Data System, Hanford Site database.

bgs = below ground surface.
HRR = high-resolution resistivity.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, and Institutional Controls.
PUREX = Plutonium-Uranium Extraction (Plant or process).
WIDS = Waste Information Data System database.

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AD1-7.0 REFERENCES

ARH-ST-156, 1977, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*, Atlantic Richfield Hanford Company, Richland, Washington.

BHI-00178, 1995, *PUREX Plant Aggregate Area Management Study Technical Baseline Report*, Rev. 00, Bechtel Hanford, Inc., Richland, Washington.

BHI-00179, 1995, *B Plant Aggregate Area Management Study Technical Baseline Report,* Rev. 00, Bechtel Hanford, Inc., Richland, Washington.

DOE/RL-99-66, 2003, *Steam Condensate/Cooling Water Waste Group Operable Units RI/FS Work Plan; Includes: 200-CW-5, 200-CW-2, 200-CW-4, and 200-SC-1 Operable Units*, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2003-11, 2004, *Remedial Investigation for the 200-CW-5 U Pond/ Z Ditches Cooling Water Group, the 200-CW-2 S Pond and Ditches Cooling Water Group, the 200-CW-4 T Pond and Ditches Cooling Water Group, and the 200-CS-1 Steam Condensate Group Operable Units*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2004-24, 2004, *Feasibility Study for the 200-CW-5 (U Pond/Z Ditches Cooling Water Waste Group), 200-CW-2 (S Pond and Ditches Cooling Water Waste Group), 200-CW-4 (T Pond and Ditches Cooling Water Waste Group), and 200-SC-1 (Steam Condensate Waste Group) Operable Units*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

H-2-60330, *Trench 216-B-55 Cond Waste Lines 221-B to Trench 216-B-55 & B-12 Crib Plan & Profile*, Hanford Site Drawing.

HNF-1744, 1999, *Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site,* Fluor Daniel Hanford, Inc., Richland, Washington.

RH-CD-673, 1979, *Handbook 200 Areas Waste Sites*, 3 vols., Rockwell Hanford Operations, Richland, Washington.

RHO-RE-SR-84-24 P, 1984, *Results of the Separations Area Groundwater Monitoring Network for 1983*, Rockwell Hanford Operations, Richland, Washington.

RPP-26744, 2005, *Hanford Soil Inventory Model, Rev. 1*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-28955, 2006, *Surface Geophysical Exploration of T Tank Farm at the Hanford Site*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

Stoller, 2006, "Contract No. 30475-1, Stoller Geophysical Log Results in the 216-A-30 Trench," (letter to Chris Wright, Fluor Hanford, from Brian W. Mathis), Stoller Hanford Office, Richland, Washington, November 15.

Waste Information Data System, Hanford Site database.

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