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Rev. 5

Remedial Design Report/ Remedial Action Work Plan for the 100 Area

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

K. A. Klein, Manager
Richland Operations Office

Date

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Remedial Design Report/ Remedial Action Work Plan for the 100 Area

September 2004

United States Department of Energy

P.O. Box 550, Richland, Washington 99352

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ACRONYMS AND ABBREVIATIONS

AMP	air monitoring plan
AOC	area of contamination
ARAR	applicable or relevant and appropriate requirements
AWQC	Ambient Water Quality Criteria
BHI	Bechtel Hanford, Inc.
BMP	best management practice
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CTF	container transfer facility
CWFM	conceptual waste form model
DAF	dilution attenuation factor
DCG	derived concentration guide
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DWP	detailed work plan
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor
ERDF	Environmental Restoration Disposal Facility
ESD	explanation of significant difference
ETF	Effluent Treatment Facility
H&S	health and safety
IDW	investigation-derived waste
LDR	land disposal restriction
MCL	maximum contaminant level
MCLG	maximum contamination level goal
MTCA	*Model Toxics Control Act*
NCP	National Oil and Hazardous Substances Contingency Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NPL	National Priorities List
NRC	U.S. Nuclear Regulatory Commission
OU	operable unit
RAG	remedial action goal
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1976*
RDL	required detection limit
RDR/RAWP	remedial design report/remedial action work plan
RESRAD	RESidual RADioactivity (dose model)
RFP	request for proposal
RL	DOE, Richland Operations Office
ROD	record of decision
RTD	remove, treat, and dispose
SAP	sampling and analysis plan
SDWA	*Safe Drinking Water Act*
SSWMI	Site-Specific Waste Management Instruction
TBC	to be considered

TCLP	toxicity characteristic leaching procedure
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
UCL	upper confidence limit
UMM	Unit Manager's Meeting
WAC	*Washington Administrative Code*
WBS	work breakdown structure
WIDS	Waste Information Data System

100 Area Burial Grounds ROD: *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units* (EPA 2000b)

100 Area Burial Grounds SAP: *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (DOE-RL 2001a)

100 Area SAP: *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2004)

Interim Action ROD: *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (EPA 1995)

Remaining Sites ESD: *Explanation of Significant Difference for the 100 Area Remaining Sites ROD* (EPA 2000a)

Remaining Sites ROD: *Interim Action Record of Decision for the 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-2, 100-IU-6, and 200-CW-3 Operable Units* (EPA 1999)

ERDF ROD Amendment: *Amended Record of Decision, Decision Summary and Responsiveness Summary for the Environmental Restoration Disposal Facility, Hanford Site – 200 Area, Benton County, Washington* (EPA 2002)

ROD Amendment: *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (EPA 1997a)

1.0 INTRODUCTION

The Hanford Site is a 1,450-km^2 (560-mi^2) federal facility located along the Columbia River in southeastern Washington State. From 1943 until 1990, the primary mission of the Hanford Site was to produce nuclear materials for the nation's defense mission. In July 1989, the Hanford Site was listed on the National Priorities List (NPL) under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Act of 1986*. The Hanford Site was divided up and listed as four NPL sites: the 100 Area, the 200 Area, the 300 Area, and the 1100 Area. The 100 Area is the subject of this document.

The 100 Area, which encompasses approximately 68 km^2 (26 mi^2) bordering the southern shore of the Columbia River, is the site of six reactor areas that contained a total of nine reactors (i.e., the 100-B/C, 100-D/DR, 100-F, 100-H, 100-KE/KW, and 100-N Reactor). Each of these reactor areas has several operable units (OUs). The OUs are currently in various stages of the CERCLA process. This document addresses the remedial designs and remedial actions for waste sites in the 100-B/C, 100-D, 100-H, 100-F, and 100-K Areas, and the 100-IU-2, 100-IU-6, and 200-CW-3 OUs. It is expected that this document will form the basis for remedial actions at contaminated sites across the 100 Area.

1.1 PURPOSE AND OBJECTIVES

The primary purpose of this remedial design report/remedial action work plan (RDR/RAWP) is to describe the design and the implementation of the remedial action processes required by the following:

- *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington* (hereinafter referred to as the Interim Action Record of Decision [ROD]) (EPA 1995)

- *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (hereinafter referred to as the ROD Amendment) (EPA 1997a)

- *Interim Action Record of Decision for the 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-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (hereinafter referred to as the Remaining Sites ROD) (EPA 1999)

- *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington* (hereinafter referred to as the 100 Area Burial Grounds ROD) (EPA 2000b).

1.2 SCOPE

The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1998) specifically lists the RDR and the RAWP as two separate documents. However, this document streamlines the requirements; the RDR and RAWP are combined to cover both the remedial designs and remedial actions. This document pertains to all of the waste sites included in the Interim Action ROD, the ROD Amendment, the Remaining Sites ROD, and the 100 Area Burial Grounds ROD (as described in Section 1.3), and provides a basis that could be followed, with minimal additions, by future 100 Area source OU RODs.

1.3 INTERIM ACTION ROD, ROD AMENDMENT, REMAINING SITES ROD, AND 100 AREA BURIAL GROUND ROD WASTE SITES AND OPERABLE UNITS

The Interim Action ROD and the ROD Amendment define the remedial actions for selected radioactive liquid effluent waste disposal sites located in the 100 Area (EPA 1995, 1997a). The Remaining Sites ROD defines the remedial actions for selected remaining sites (EPA 1999). The 100 Area Burial Grounds ROD defines the remedial actions for burial ground sites located in the 100 Area (EPA 2000b). It is expected that remedial action will also address sites adjacent to and within the area affected by remediation of the waste sites listed in the Interim Action ROD, the ROD Amendment, the Remaining Sites ROD, and the 100 Area Burial Grounds ROD. These additional sites will be identified during detailed design and remediation activities for each group of sites. (Detailed design includes estimating the dimensions of the excavated waste sites and identifying potential overlap of excavated areas with other waste sites.) Before any of these additional sites are remediated, the U.S. Department of Energy (DOE), Richland Operations Office (RL) will obtain concurrence from the appropriate regulatory agencies. Appendix A lists all the waste sites identified in the RODs and provides information for each waste site.

1.3.1 Interim Action ROD and ROD Amendment Waste Sites in the 100-D Area

Three OUs are associated with the 100-D/DR Area at the Hanford Site. 100-DR-1 and 100-DR-2 are source OUs. The third OU, 100-HR-3, is the groundwater OU for the 100-D/DR and 100-H Areas. The 100-D/DR Area contains two reactors: the D Reactor within the 100-DR-1 OU and the DR Reactor within the 100-DR-2 OU. The D Reactor operated from 1944 to 1967, and the DR Reactor operated from 1950 to 1964. The 100-D Area includes former radioactive liquid waste disposal sites and buried debris resulting from demolition of some reactor support facilities. Interim remedial actions for the 100-D Area focus on the 22 waste sites shown in Figure 1-1.

1.3.2 Interim Action ROD and ROD Amendment Waste Sites in the 100-B/C Area

Three OUs are associated with the 100-B/C Area at the Hanford Site. 100-BC-1 and 100-BC-2 are source OUs. The third OU, 100-BC-5, is the groundwater OU for the 100-B/C Area. The 100-B/C Area contains two reactors: the B Reactor within the 100-BC-1 OU and the C Reactor within the 100-BC-2 OU. The B Reactor operated from 1944 to 1968, and the C Reactor

operated from 1952 to 1969. In general, the area contains waste units associated with the original plant facilities constructed to support B and C Reactor operations, as well as the cooling water retention basin systems for both B and C Reactors. Interim remedial actions for the 100-B/C Area focus on the 20 waste sites shown in Figure 1-2.

1.3.3 Interim Action ROD and ROD Amendment Waste Sites in the 100-H Area

Three OUs are associated with the 100-H Area at the Hanford Site. The 100-HR-1 and 100-HR-2 are source OUs. The third OU, 100-HR-3, is the groundwater OU for the 100-H Area. The 100-H Area contains one reactor that operated from 1949 to 1965. In general, the area contains waste units associated with the original plant facilities constructed to support H Reactor operation. Interim remedial actions for the 100-H Area focus on the eight waste sites shown in Figure 1-3.

1.3.4 Interim Action ROD and ROD Amendment Waste Sites in the 100-F Area

Three OUs are associated with the 100-F Area at the Hanford Site. 100-FR-1 and 100-FR-2 are source OUs. The third OU, 100-FR-3, is the groundwater OU for the 100-F Area. The 100-F Area contains one reactor that operated from 1945 to 1965. In general, the area contains waste units associated with the original plant facilities constructed to support F Reactor operation. Interim remedial actions for the 100-F Area focus on the 14 waste sites shown in Figure 1-4.

1.3.5 Interim Action ROD and ROD Amendment Waste Sites in the 100-K Area

Three OUs are associated with the 100-K Area at the Hanford Site. 100-KR-1 and 100-KR-2 are source OUs. The third OU, 100-KR-4, is the groundwater OU for the 100-K Area. The 100-K Area contains two reactors, 105-KE that operated from 1955 to 1971 and 105-KW that operated from 1955 to 1970. In general, the area contains waste units associated with the original plant facilities constructed to support K Reactor operation. Interim remedial actions for the 100-K Area focus on the 11 waste sites shown in Figure 1-5.

1.3.6 Remaining Sites ROD

The Remaining Sites ROD (EPA 1999) contains provisions for removal, treatment, and disposal of miscellaneous sites not covered under prior RODs. Waste sites 600-23 and JA Jones No. 1 were added to the Remaining Sites ROD (as part of the 100-IU-6 OU) by an explanation of significant difference (ESD) (EPA 2000a) issued in June 2000. Another 28 newly discovered waste sites were added to the Remaining Sites ROD by an ESD issued in March 2004 (EPA 2004). The Remaining Sites ROD also contains provisions for confirmatory sampling at sites identified as candidates for no action. This designation is based on an evaluation of the sites that determined that there is a high level of confidence that these sites comply with remedial action objectives (RAOs) (DOE-RL 1998a). Furthermore, the Remaining Sites ROD provides the guidelines by which newly discovered sites may be designated for removal, treatment, and disposal (RTD sites) or categorized as candidates for no action.

1.3.7 100 Area Burial Grounds ROD

The 100 Area Burial Grounds ROD (EPA 2000b) presents the selected interim remedial actions for burial grounds in the 100 Area. Figures 1-6 through 1-10 show the 100 Area burial grounds.

Figure 1-1. 100-D Area Radioactive Liquid Effluent Waste Sites.

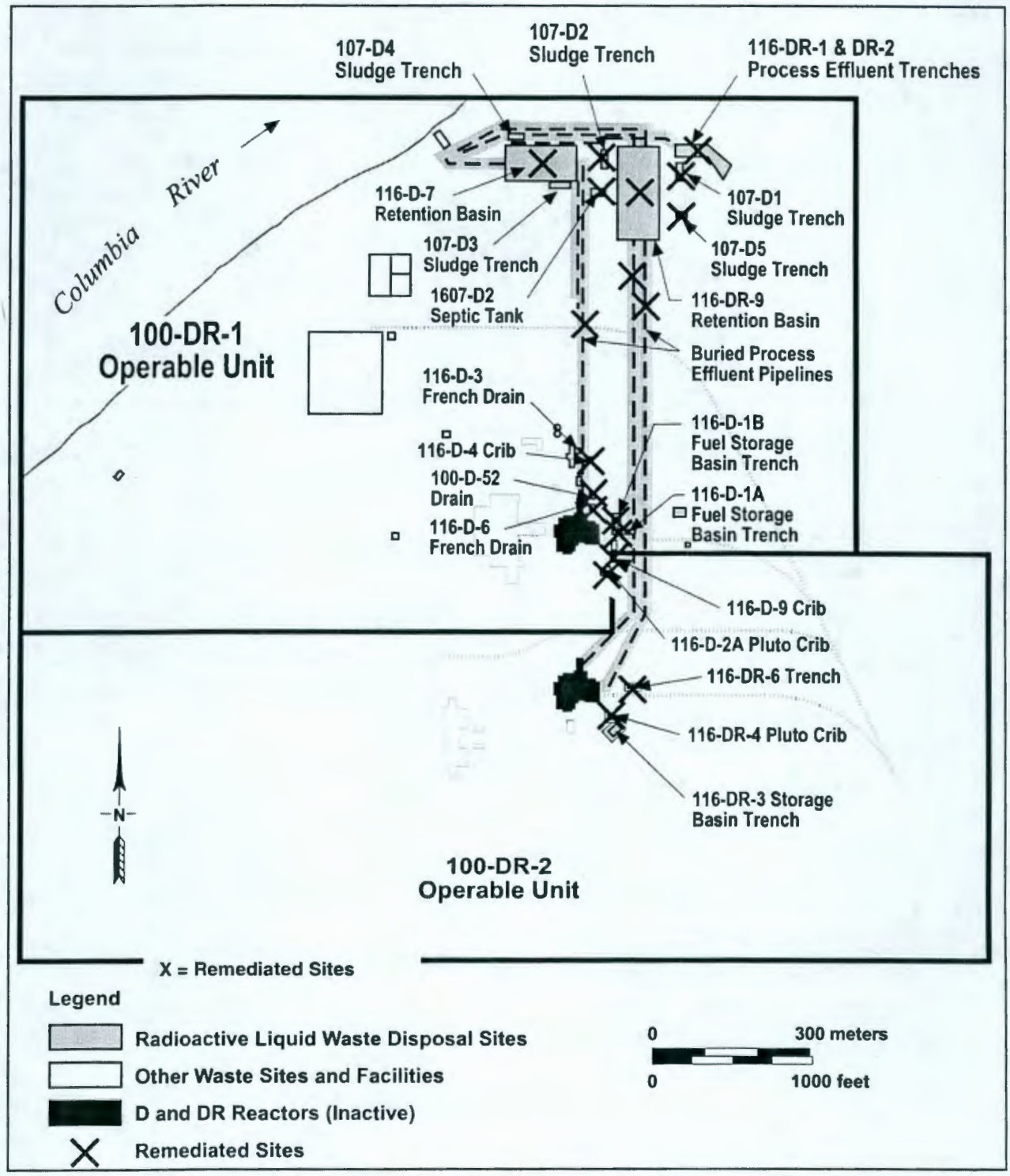

Figure 1-2. 100-B/C Area Radioactive Liquid Effluent Waste Sites.

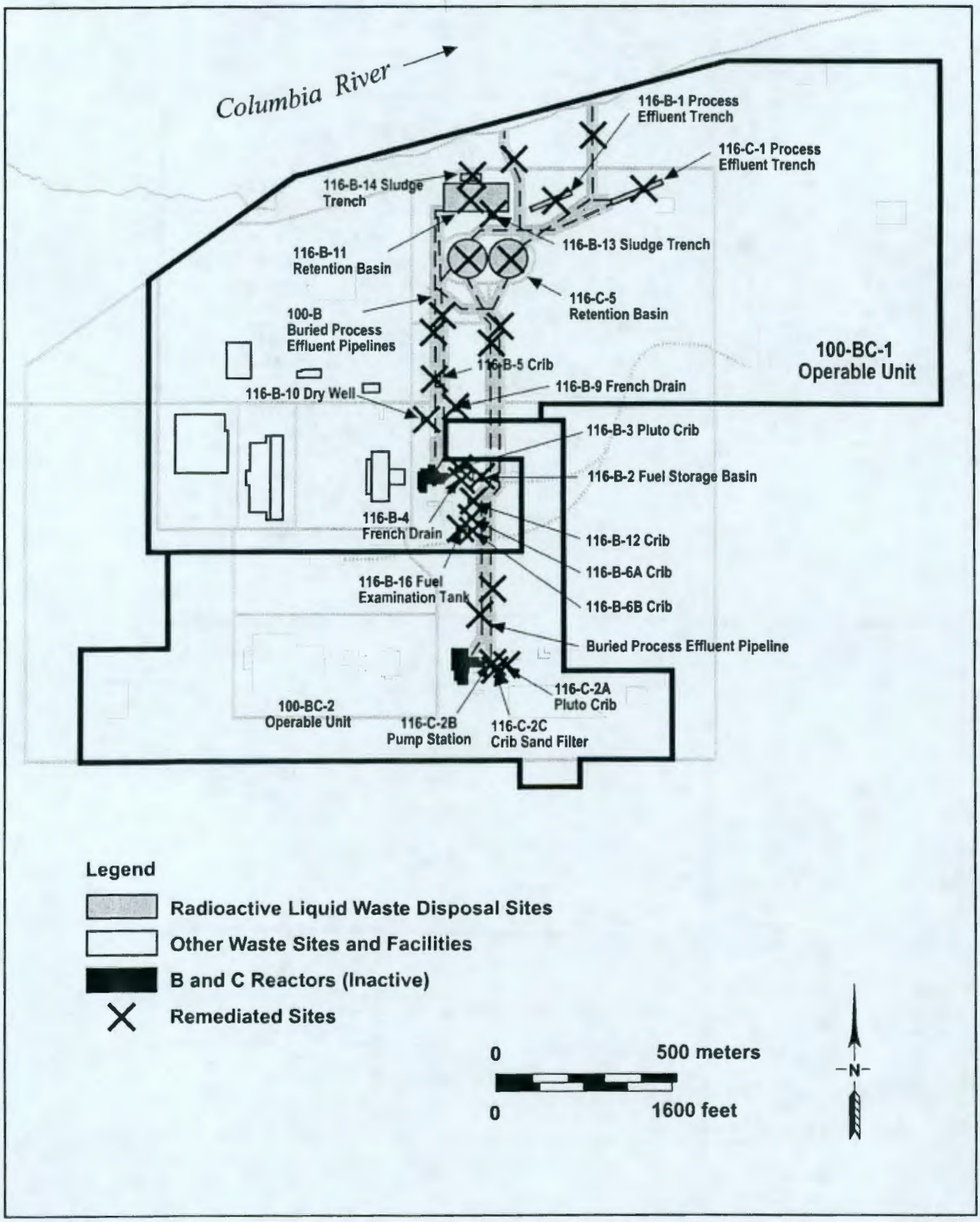

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Figure 1-3. 100-H Area Radioactive Liquid Effluent Waste Sites.

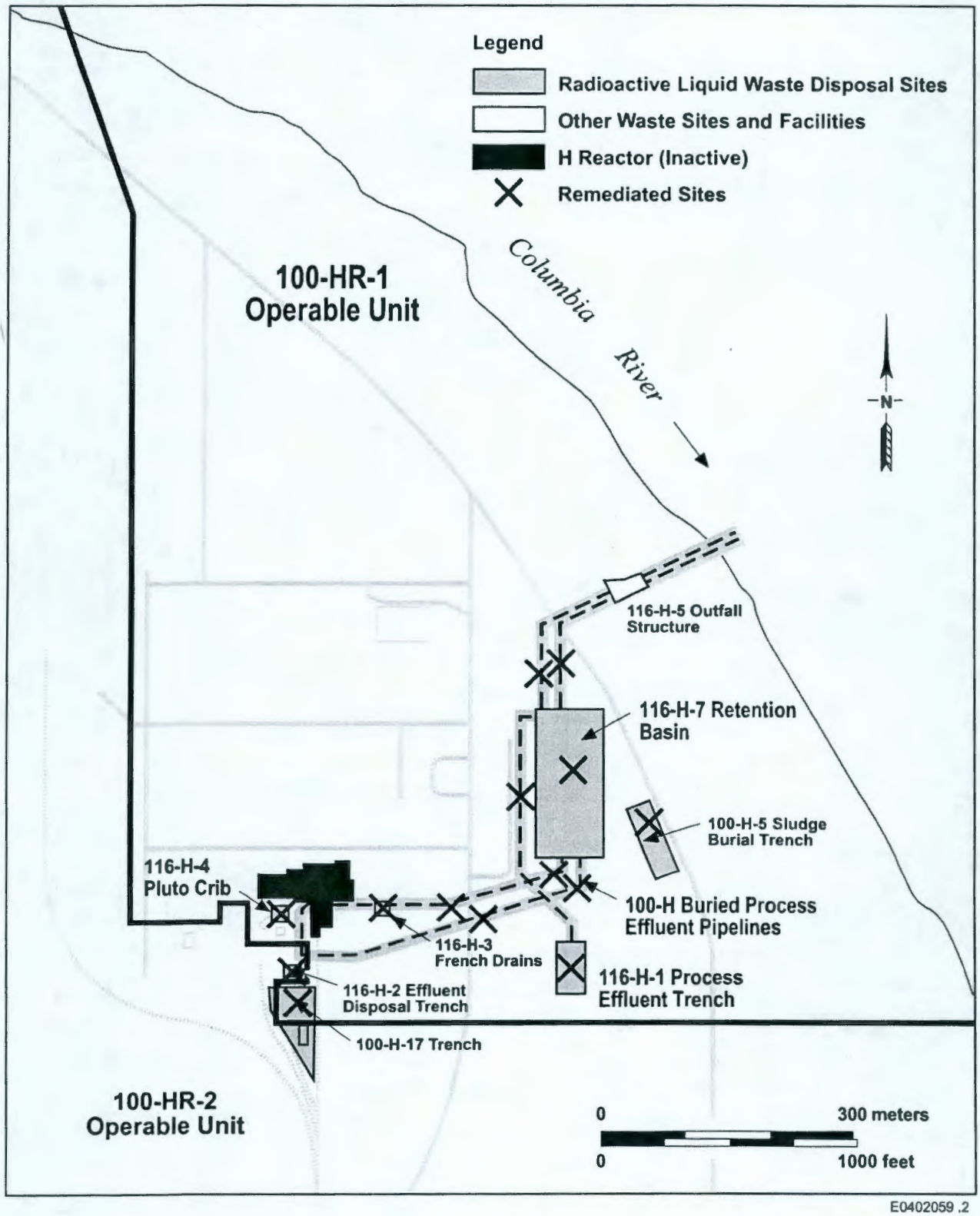

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Figure 1-4. 100-F Area Radioactive Liquid Effluent Waste Sites.

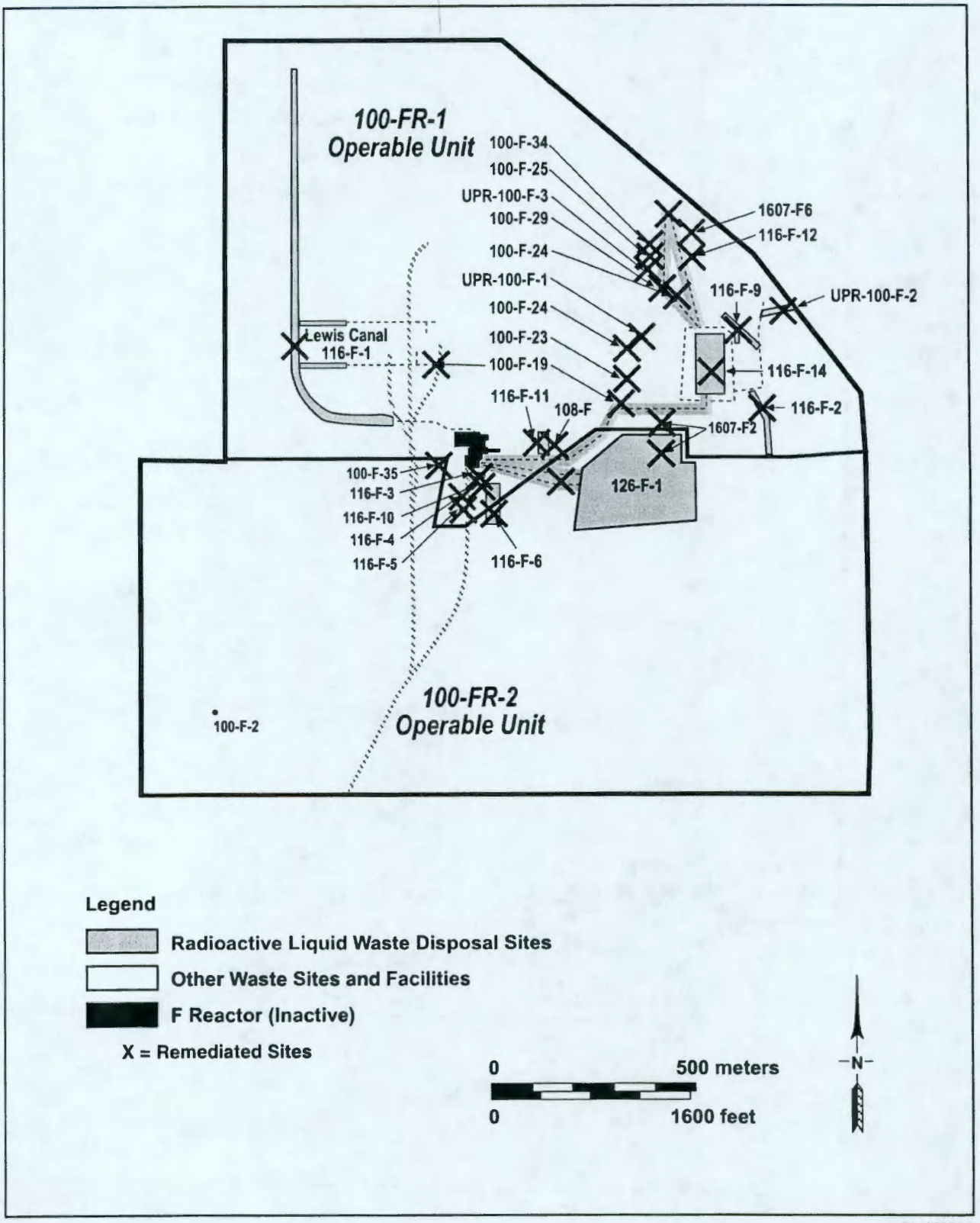


Figure 1-5. 100-K Area Radioactive Liquid Effluent Waste Sites.

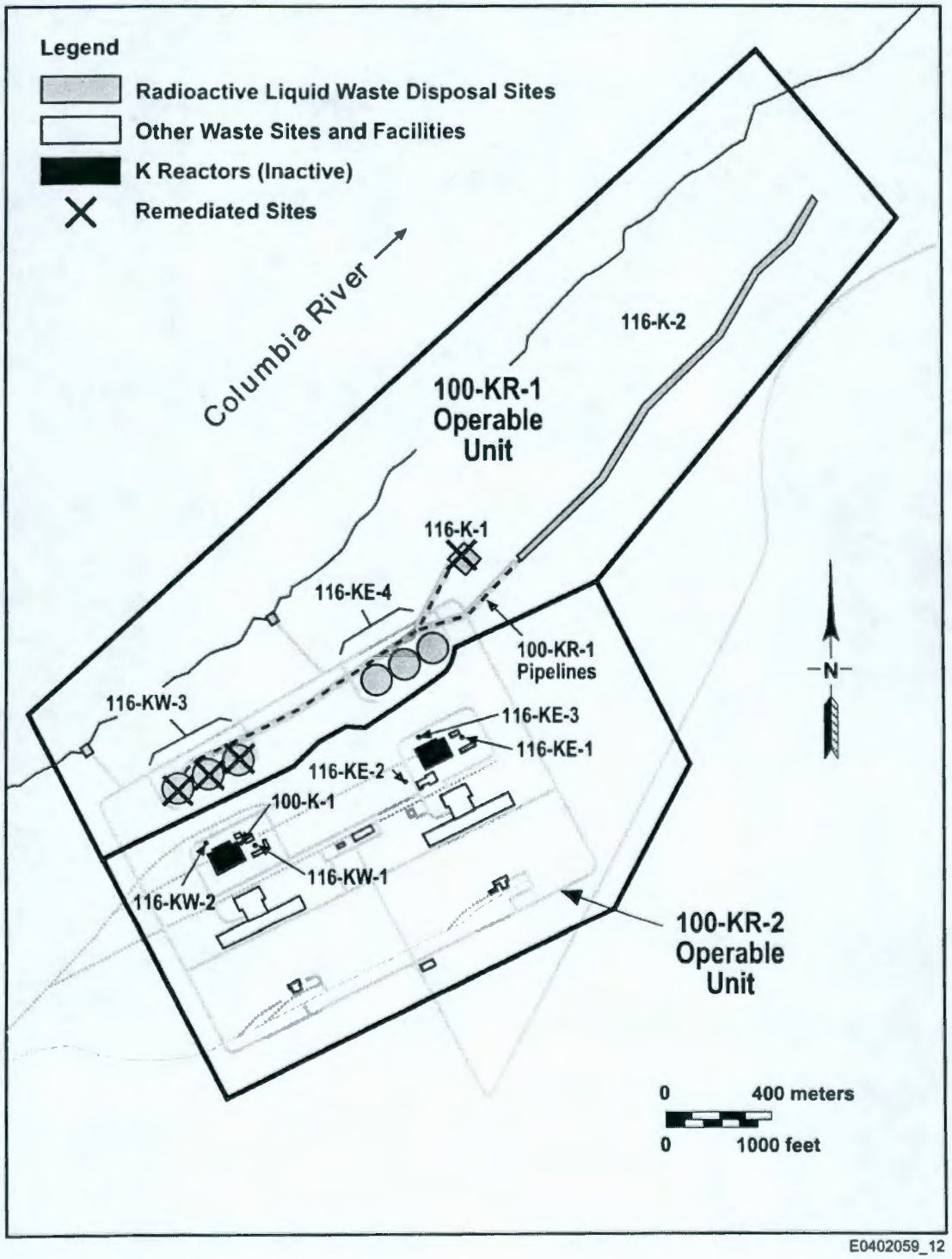


Figure 1-6. Burial Grounds at the 100-B/C Area.

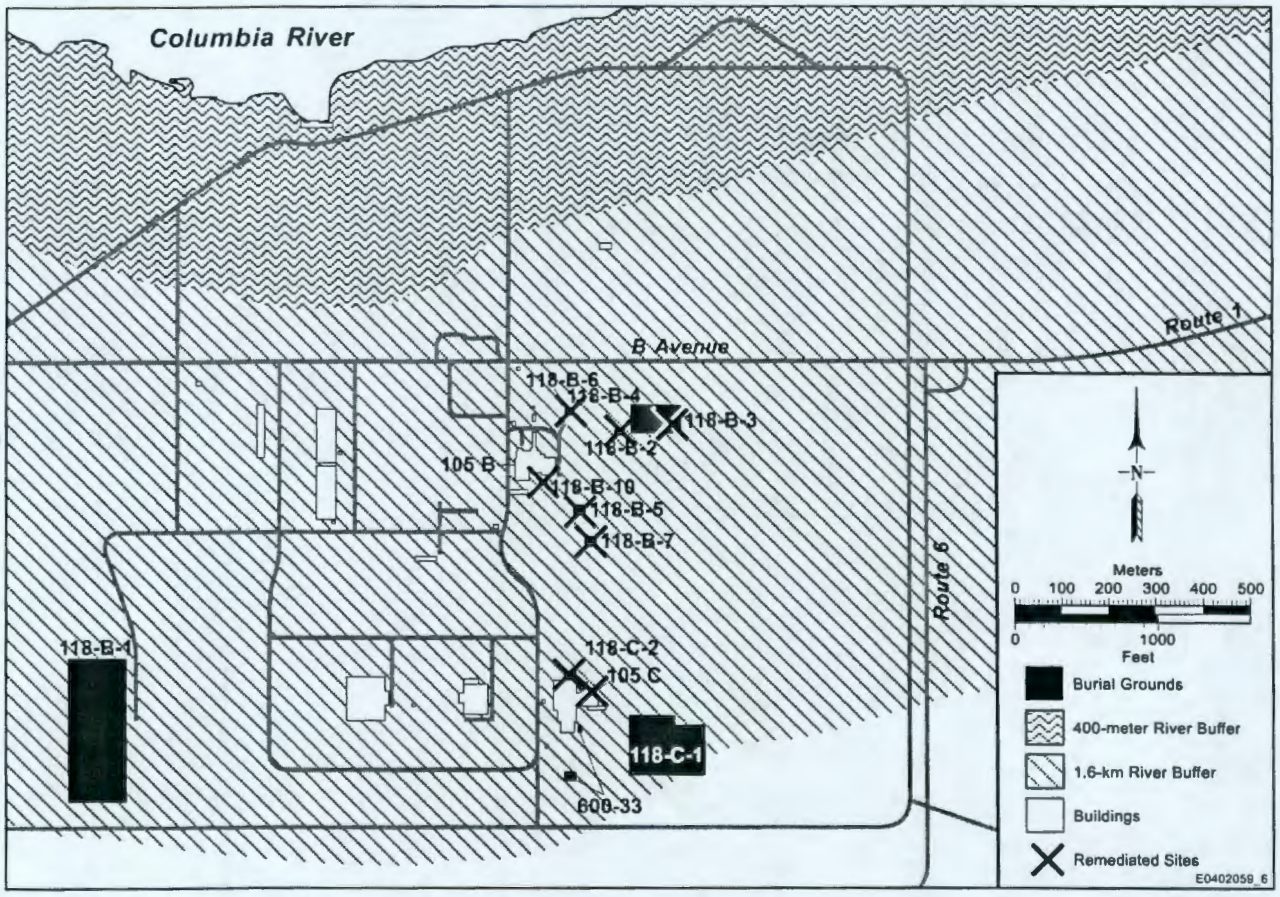


Figure 1-7. Burial Grounds at the 100-K Area.

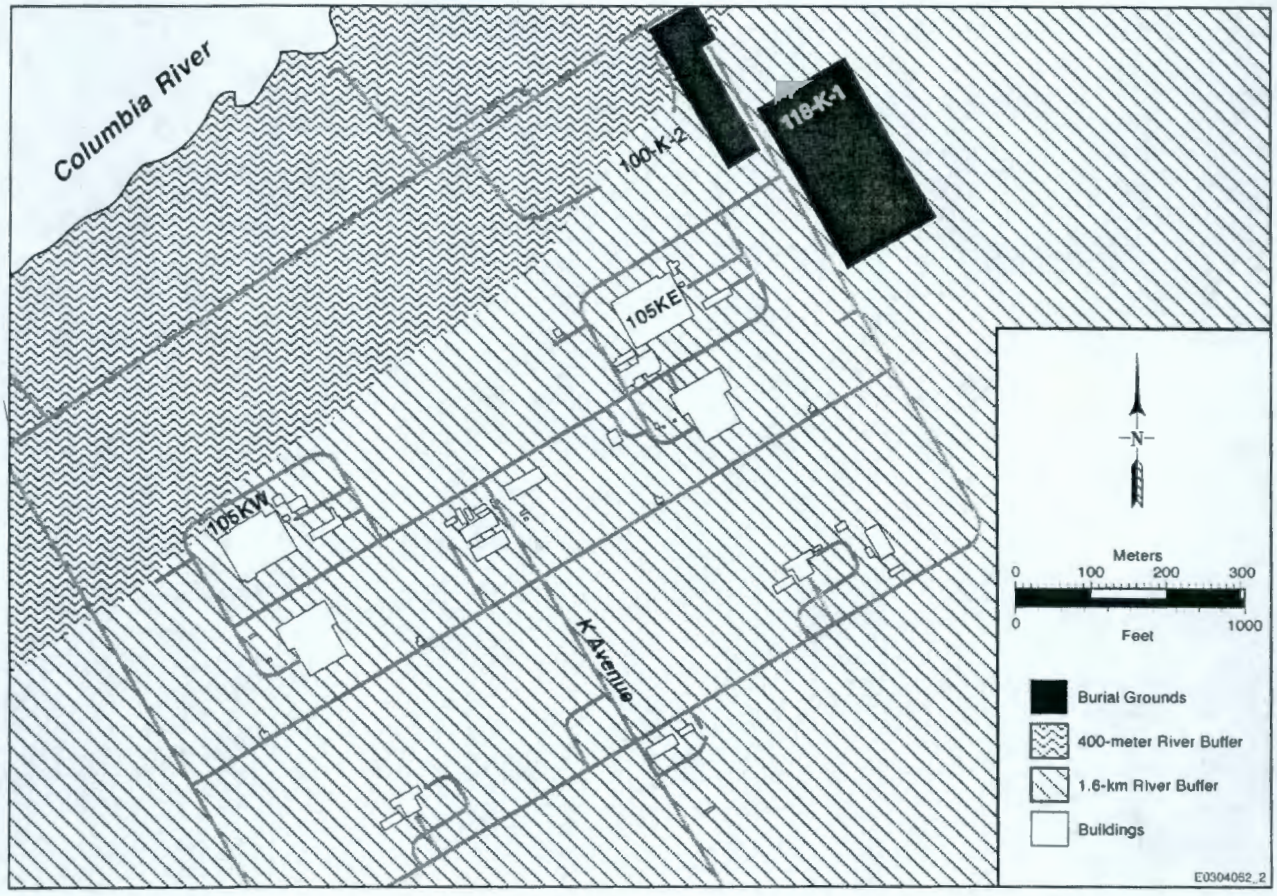


Figure 1-8. Burial Grounds at the 100-D Area.

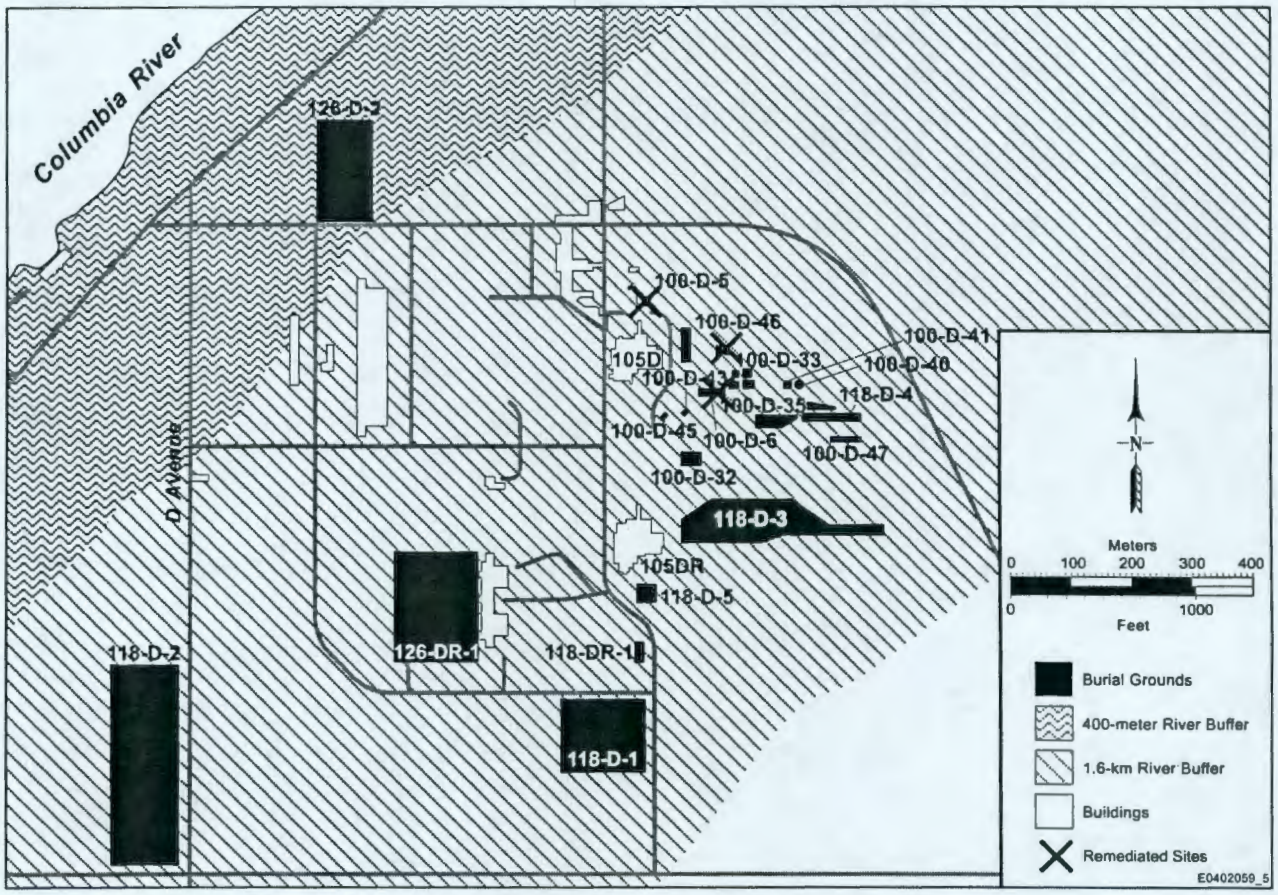


Figure 1-9. Burial Grounds at the 100-H Area.

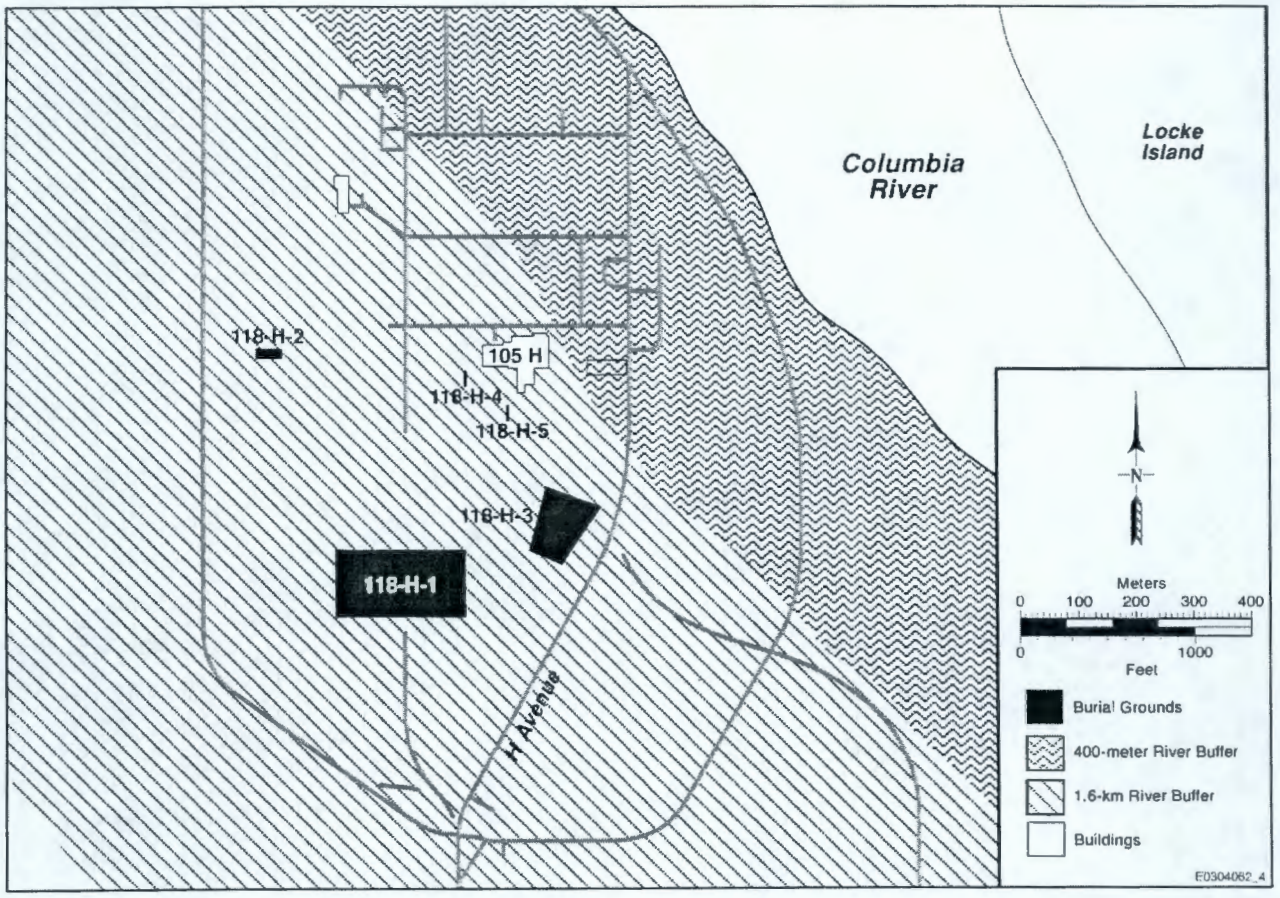
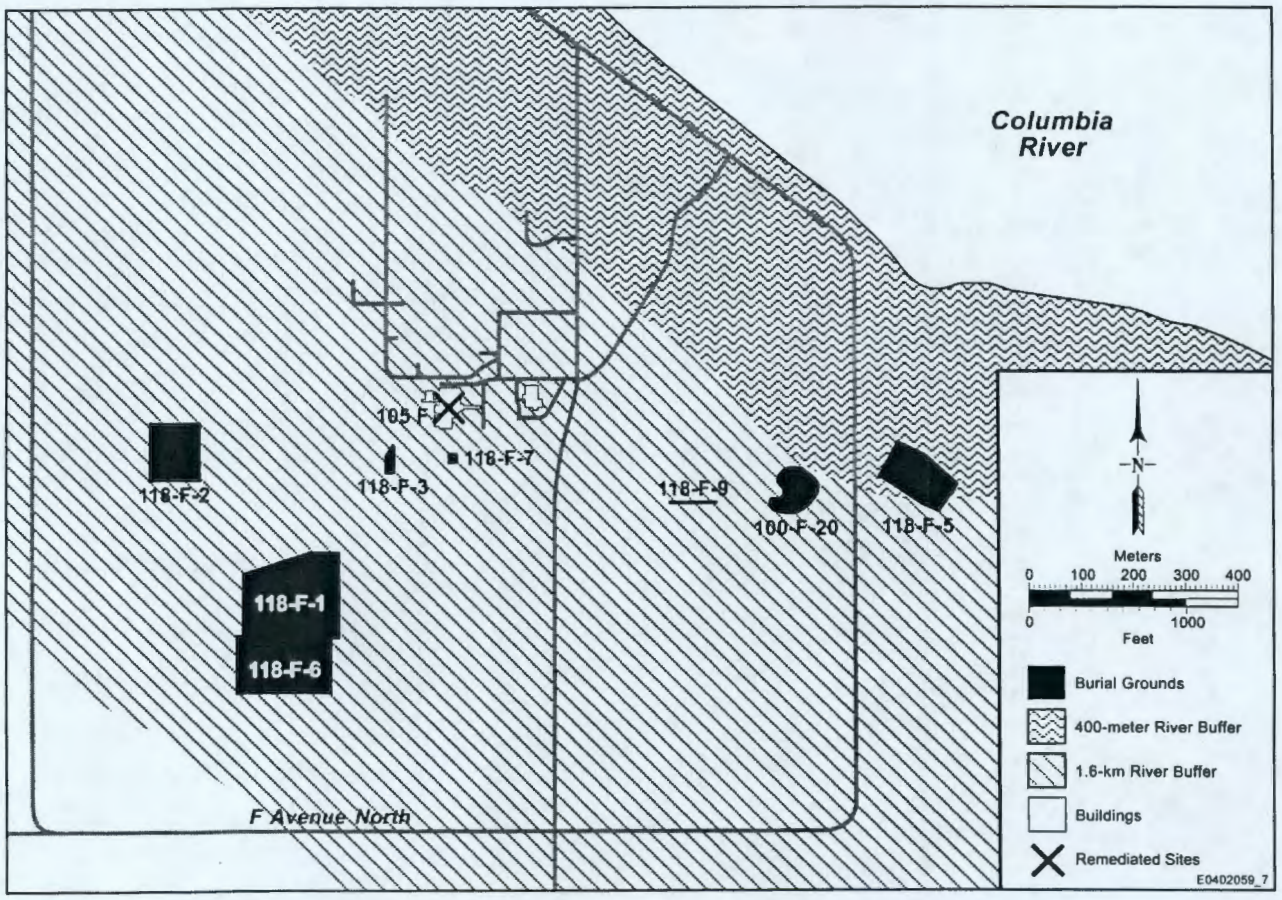


Figure 1-10. Burial Grounds at the 100-F Area.



2.0 BASIS FOR REMEDIAL ACTION

2.1 RECORD OF DECISION SUMMARY AND DECISION DEFINITION

2.1.1 Remedial Action Objectives

The RAOs set forth in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) are narrative statements that define the extent to which the waste sites require cleanup to protect human health and the environment. The RAOs identified in the RODs apply to contaminants in soils, structures, and debris. The Interim Action ROD specifically defines three RAOs. The Remaining Sites ROD specifically defines two RAOs, which are the same as the first two RAOs in the Interim Action ROD. The 100 Area Burial Grounds ROD also specifically defines two RAOs, which are the same as the first two RAOs in the Interim Action ROD. The RAOs cited below are taken directly from the RODs (in italics). Following each citation is a brief description of the intent of each RAO and a discussion of the point of compliance.

1. "*Protect human and ecological receptors from exposure to contaminants in soils, structures, and debris by dermal exposure, inhalation, or ingestion of radionuclides, inorganics or organics*" (EPA 1995, page 25; EPA 1999, page 26; and EPA 2000b, page 19).

   The Interim Action ROD elaborates, saying "(T)his RAO will be achieved through excavation to the State of Washington Model Toxics Control Act (MTCA) (WAC 173-340, 1996) levels for organic and inorganic chemical constituents in soil to support unrestricted (residential) use, and the draft [U.S. Environmental Protection Agency] (EPA) (40 CFR 196) and the draft Nuclear Regulatory Commission (10 CFR 20) proposed protection of human health standards of 15 mrem/yr in soils above background for radionuclides" (EPA 1995, page 25). The draft U.S. Nuclear Regulatory Commission regulation (10 *Code of Federal Regulations* [CFR] 20) was withdrawn and is no longer applicable.

   Subsequent to the Interim Action ROD being issued, the proposed EPA regulation (40 CFR 196) was withdrawn. However, the 100 Area Burial Grounds ROD states "(P)rotection will be achieved by reducing concentrations of contaminants in the upper 4.6 meters (15 ft) of soil exposure scenario. The levels of reduction will be such that for radionuclides the EPA CERCLA risk range of 10^{-4} to 10^{-6} increased cancer risk will be achieved. To address this objective, the total dose for radionuclides shall not exceed 15 mrem/yr above Hanford site background for 1,000 years following remediation also, State of Washington MTCA method B limits for inorganics and organics (See Table 2)" (EPA 2000b, page 19). Cleanup values are shown in Table 2 on pages 20 and 21 of EPA (2000b). If a waste site is an engineered structure, protection will be achieved by reducing concentrations of contaminants within the shallow zone (i.e., surface to 4.6 m [15ft] deep) to shallow zone cleanup standards (direct exposure, groundwater protection, and river protection remedial action goals (RAGs) are applicable to soils within 4.6 m [15 ft] of the ground surface) and by reducing concentrations of contaminants within the deep zone (i.e., greater than 4.6 m [15ft] below the ground surface) to deep zone cleanup standards (groundwater protection and river protection RAGs are applicable to soils greater than 4.6 m [15ft] below the ground surface).

Washington Administrative Code (WAC) 173-340 (1996) defines the point of compliance for soil cleanup levels as follows:

"For soil cleanup levels based on human exposure via direct contact, the point of compliance shall be established in the soils throughout the site from the ground surface to 15 ft below the ground surface. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities" (WAC 173-340-740[6][c]) (1996).

2. "*Control the sources of groundwater contamination to minimize the impacts to groundwater resources, protect the Columbia River from further adverse impacts, and reduce the degree of groundwater cleanup that may be required under future actions.*" (EPA 1995, page 25; EPA 1999, page 26; and EPA 2000b, page 22).

   The Interim Action ROD states "(T)his RAO will be achieved by protection of groundwater that has not been impacted such that contaminants remaining in the soil after remediation do not result in an adverse impact to groundwater that could exceed maximum contaminant levels (MCL) and nonzero [maximum contamination level goals] MCLGs under the Safe Drinking Water Act (SDWA). Another consideration for achievement of this RAO is protection of the Columbia River such that contaminants remaining in the soil after remediation do not result in an impact to groundwater, and therefore the Columbia River, that could exceed the Ambient Water Quality Criteria (AWQC) under the Clean Water Act for protection of fish. Since there are no AWQC for radionuclides, MCLs will be used" (EPA 1995, pages 25 and 26).

   The Interim Action ROD defines the point of compliance for soil cleanup levels protective of groundwater as a designated point of compliance beneath or adjacent to the waste site in groundwater. Measurement of compliance for protection of the river will be at a near-shore well, in the downgradient plume. The location and measurement of the point of compliance is to be defined by EPA and the Washington State Department of Ecology (Ecology). Monitoring for compliance will be performed at the defined point (EPA 1995, page 25).

   The 100 Area Burial Grounds ROD states "(P)rotection will be such that contaminants remaining in the soil after remediation do not result in an adverse impact to groundwater underneath the site that could exceed Maximum Contaminant Levels (MCLs) under the Safe Drinking Water Act (SDWA)" (EPA 2000b, page 22).

   Further, "(P)rotection of the Columbia River from adverse impacts such that contaminants remaining in the soil after remediation do not result in an impact to groundwater and, therefore, the Columbia River that could exceed the Ambient Water Quality Criteria (AWQC) under the Clean Water Act for protection of fish. Since there are no AWQC for radionuclides, MCLs will be used. The protection of receptors (aquatic species, with emphasis on salmon) in surface waters will be achieved by reducing or eliminating further contaminant loadings to groundwater such that receptors at the groundwater discharge in the Columbia River are not subject to additional adverse risks. Each of the reactor areas has an extensive well network and monitoring plans that have been approved by the lead regulatory agency for each reactor Area. Data from the networks is reviewed periodically to assure

adequate information is collected. Any changes to the monitoring plans will require approval of the lead regulatory agency" (EPA 2000b, page 22).

3. *"To the extent practicable, return soil concentrations to levels that allow for unlimited future use and exposure. Where it is not practicable to remediate to levels that will allow for unrestricted use in all areas, institutional controls and long-term monitoring will be required"* (EPA 1995, page 26).

   This RAO would be achieved by (1) meeting the first two objectives as defined above; (2) removing waste sites to the bottom of the engineered structure; and (3) providing institutional controls, as required (see Section 2.1.2).

   The Interim Action ROD also indicates that for establishing numerical RAGs protective of human health, the RAOs will be met by using the residential exposure scenario. Removal of soil and debris exceeding human health based goals and replacement (i.e., backfilling) with clean material also will meet the objective of protection of ecological receptors. Note that the top 4.6 m (15 ft) of soil is defined from the ground surface at the time of disposal.

4. *"Provide conditions suitable for future land use of the 100 Areas"* (EPA 2000b, page 22).

   According to the 100 Area Burial Grounds ROD, "(T)his RAO would be achieved by meeting the first two objectives as defined above" (EPA 2000b, page 22).

Once RAOs have been identified, it is necessary to develop numerical RAGs for use in remedial design and to verify that remedial action has achieved the RAOs. The RAO framework involves the following:

- Calculating contaminant-specific concentrations in soil that correspond to the RAGs for use in remedial design (see Section 2.1.4)

- Developing a verification methodology for use in remedial action to determine if residual concentrations in soil achieve the RAGs (see Section 3.6).

2.1.2 Remedial Action Goals

RAGs are the contaminant-specific numerical cleanup criteria developed to ensure that the remedial actions to be implemented will meet the RAOs set forth in Section 2.1.1 and the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b). The RAGs are based on applicable or relevant and appropriate requirements (ARARs), to-be-considered (TBC) information, points of compliance, and assumed land use for the remedial action identified in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b).

The first RAO will be achieved by meeting the following requirements:

- WAC 173-340-740 (1996) is currently the basis of the RAGs for nonradioactive constituents since the interim action RODs predate WAC-173-340-740, 2001 (Section 2.1.2.1)

- The EPA proposed standards for radionuclides (Section 2.1.2.2).

The second RAO will be achieved by meeting the following requirement:

- Protection of groundwater and the Columbia River (Sections 2.1.2.3, 2.1.2.4, and 2.1.2.5).

The third RAO will be achieved by:

- Meeting the requirements to achieve the first two RAOs
- Removing waste to the bottom of the engineered structure when the engineered structure exceeds the first RAO
- Providing institutional controls, as required, while RL controls the site and in the future in the event that RL relinquishes control of the site (see Section 2.1.5).

The fourth RAO will be achieved by:

- Meeting the requirements to achieve the first two RAOs.

2.1.2.1 Remedial Action Goals for Nonradioactive Contaminants in Soil. Cleanup standards for nonradioactive (i.e., inorganic and organic) contaminants in near-surface soil (to a depth of 4.6 m [15 ft] from the ground surface defined as the grade at the time of disposal) are specified under the 1996 version of the WAC 173-340 (1996) cleanup regulations that were in effect at the time the September 1995 Interim Remedial Action Record of Decision (EPA 1995) was approved. Method B (WAC 173-340-705) (1996) specifies cleanup levels for groundwater, surface water, soil, and air, assuming a residential exposure scenario.[1] Cleanup levels for individual hazardous substances are established using applicable state and federal laws and the risk equations specified in the 1996 WAC 173-340-720 through 750 (1996). Cleanup levels for individual carcinogens are based on the upper bound of the estimated excess lifetime cancer risk of one in one million (1×10^{-6}). Cleanup levels for individual noncarcinogenic substances are set at concentrations that are anticipated to result in no acute or chronic toxic effects on human health and the environment; this level corresponds to a hazard quotient of less than one. Cleanup levels are calculated using carcinogenic potency factors and noncarcinogenic reference doses available through the EPA "integrated risk information system" (IRIS) database or other EPA sources as described in WAC 173-340-708 (1996). As EPA updates the carcinogenic potency factors and noncarcinogenic reference doses in the IRIS database or other EPA sources, the RAGs and updated cleanup standards will be included in the applicable verification packages.

The Hanford Site background for arsenic is approximately 6.5 mg/kg, and was determined to be the cleanup level for the 100 Areas at the start of remediation. Additionally, the statewide

1 Method B is based on a residential land use scenario, including the potential for a 3.7-m (12-ft) –deep residential basement. It is assumed that deed restrictions or other institutional controls would be applied at waste sites as necessary to preclude direct exposure to residual contaminants in deep soils that might remain onsite.

arsenic background is approximately 7.0 mg/kg (Ecology, 1994). However, due to the elevated concentrations of arsenic in the 100 Area surface soil because of pre-Hanford farming uses of lead arsenate pesticides (Yodel and Delistraty, 2003), the Tri-Parties agreed in May 2000 to revise the cleanup level in the 100 Areas from 6.5 mg/kg to 20 mg/kg. The 20 mg/kg cleanup level is the WAC 173-340 (1996) Method A value used for sites in the State of Washington that contain a small number of hazardous substances, and should not otherwise be used for Hanford sites.

If a waste site involves multiple contaminants and/or multiple pathways of exposure, WAC 173-340-705 (1996) Method B cleanup levels for individual substances must be modified in accordance with the human health risk assessment procedures outlined in WAC 173-340-708 (1996). This modification of cleanup levels, if necessary, would take place during the verification of site cleanup following remediation. Under this method, the total excess lifetime cancer risk for a site shall not exceed one in one hundred thousand (1×10^{-5}), and the hazard index for substances with similar noncarcinogenic toxic effects shall not exceed one (WAC 173-340-705[4]) (1996).

Cleanup levels for some contaminants may be less than area background values or required detection limits (RDLs). Where WAC 173-340 (1996) Method B cleanup levels are less than area background concentrations, cleanup levels may be set at concentrations that are equal to the agreed upon site or area background concentrations (WAC 173-340-706[1][a][I]) (1996). Area background for nonradioactive contaminants in soil was characterized for the Hanford Site in *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes* (DOE-RL 2001b). Similarly, where WAC 173-340 (1996) Method B cleanup levels are less than RDLs for nonradioactive contaminants, cleanup levels will default to the RDLs (WAC 173-340-707[2]) (1996). Therefore, the cleanup level for an individual inorganic or organic contaminant in soil reflects the greatest value among the WAC 173-340 (1996) Method B cleanup level, the area background concentration, and the RDLs; but in no case shall cleanup levels be greater than concentrations specified under WAC 173-340 (1996) Method C (WAC 173-340-706 [1][a]) (1996). The WAC 173-340 (1996) cleanup levels, Hanford Site-specific background concentrations, RDLs, and RAGs for nonradioactive contaminants in near-surface soil are presented in Table 2-1. Future revisions will review the RDLs to determine if they should be lowered as a result of improved analytical technology.

In addition to the cleanup levels for a rural-residential land-use scenario set forth by WAC 173-340-740(3) (1996), alternative human exposure scenarios, including Native American and avid recreationalist exposure scenarios, are being developed as part of the 100-B/C Pilot Project. The 100-B/C Pilot Project is intended to evaluate the protectiveness of human and ecological receptors as a result of remedial actions taken in the 100-B/C Area. The Tri-Parties (EPA, Ecology, and RL) anticipate that the risk assessment approach and recommendations resulting from the 100-B/C Area Pilot Project will be used, or revised as necessary, to evaluate protectiveness of human and ecological receptors in support of a final ROD.

2.1.2.2 Remedial Action Goals for Radionuclide Contaminants in Soil. The RAGs for radionuclide contaminants in soil are based on the EPA draft proposed radionuclide soil cleanup standards. These proposed standards, as described in the "Notice of Proposed Rulemaking for

Radiation Site Cleanup Regulations" (40 CFR 196), would limit radiation doses from contaminated sites to 15 mrem/yr above site background levels for 1,000 years following the completion of a remedial action. The 1,000-year requirement ensures that the proposed standard accounts for the decay of radionuclides to daughter products that are more radioactive. The development of cleanup standards for the 100 Area will not be affected because the principal radionuclides of concern in the 100 Area (e.g., cobalt-60, cesium-137, europium-152, and europium-154) do not decay to daughter products that are more radioactive.

The 15-mrem/yr proposed standard corresponds to a lifetime increased cancer risk of 3×10^{-4}, based on the following assumptions:

- The future land use will be residential (includes irrigation)
- Future residents are potentially exposed for 30 years
- Potential exposure pathways are considered in assessing exposure to future residents. (The exposure pathways considered are external exposure, inhalation, crop ingestion, meat ingestion, fish ingestion, drinking water ingestion, and soil ingestion.)

The 15 mrem/yr standard falls within the range of other radiation protection standards promulgated by the EPA; for example, standards employed under the *Uranium Mill Tailings Radiation Control Act of 1978* and the "National Emissions Standards for Hazardous Air Pollutants" (NESHAP) (40 CFR 61).

Limiting exposure levels to 15 mrem/yr above background acknowledges that background varies from site to site. Radionuclide measurement techniques must distinguish site contamination from naturally occurring radionuclides. The radionuclides of concern in the 100 Area (e.g., cobalt-60, cesium-137, europium-152, and europium-154) are present at very low concentrations in background soils. Background concentrations of radionuclides in soils at the Hanford Site were published in *Hanford Site Background: Part 2, Soil Background for Radioactive Analytes* (DOE-RL 1996b).

To determine when remedial action has achieved the 15 mrem/yr cleanup level, radionuclide concentrations (pCi/g) in soil must be converted to a dose rate (mrem/yr) using a dose assessment model. The RESidual RADioactivity (RESRAD) model was selected as the dose assessment model for generating RAGs for radionuclide contaminants in soil and for verifying that concentrations remaining after remedial action achieve the 15 mrem/yr cleanup level. The RESRAD model was developed by Argonne National Laboratory (ANL 2002) to implement DOE guidelines for residual radioactive material in soil. The RESRAD model has been accepted by EPA and Ecology for performing dose assessments to support the 15 mrem/yr standard. The most current version of RESRAD will be used for conducting dose assessments.

The use of a dose assessment model requires specification of pathways of exposure to a hypothetical receptor of radionuclides present in the soil, and development of assumptions and input parameters for estimating exposures and doses to the receptor from radionuclides in the

soil. Specific RESRAD input parameters used to calculate the RAGs for radionuclide contaminants in soil are listed in Table B-1 in Appendix B.

The RESRAD model was used to calculate concentrations of individual radionuclides in soil that correspond to a dose rate of 15 mrem/yr. Single radionuclide soil concentrations corresponding to a 15 mrem/yr dose, Hanford Site-specific background concentrations, RDLs, and RAGs for radionuclides in near-surface soil are presented in Table 2-2. As was the case for nonradioactive contaminants in soil, the cleanup level for an individual radionuclide contaminant in soil reflects the greatest value among the single radionuclide soil concentration corresponding to a 15 mrem/yr dose, the area background concentration, and the RDLs.

The values in Table 2-2 assume that a single radionuclide contributes the entire dose and were calculated using generic site model input parameters; therefore, these values are intended for use in estimating contamination volumes, screening field sampling and analytical data, and guiding remediation. They are not intended to represent final cleanup concentrations to be achieved by remedial action at a particular site. The expectation is that most sites will have multiple radionuclides driving the cleanup; therefore, a cumulative dose of 15 mrem/yr would potentially result in individual radionuclide concentrations that are lower than the values presented in Table 2-2. During the verification process, site-specific input parameters will be used in the RESRAD model to verify that residual radionuclide concentrations achieve the cleanup standard. Section 3.6 describes the goals attainment process in detail.

2.1.2.3 Remedial Action Goals for Nonradioactive Contaminants in Water – Protection of Groundwater/Columbia River. Remedial action goals for nonradioactive contaminants in water, protective of groundwater, are based on MCLs and WAC 173-340-720(3)(1996) levels. For each nonradioactive contaminant, protection of groundwater is achieved by identifying the most restrictive contaminant-specific value from these standards as the cleanup level.

RAGs for nonradioactive contaminants in water that are protective of the Columbia River are based on MCLs, WAC 173-340-730(3) (1996) levels, AWQC, and "Water Quality Standards for Surface Waters of the State of Washington" (WAC 173-201A). For each nonradioactive contaminant, protection of the Columbia River is achieved by identifying the most restrictive contaminant-specific value from these standards as the cleanup level. Future revisions will optimize the RDLs for specific contaminants based on data quality assessment results and improved analytical technology.

2.1.2.4 Remedial Action Goals for Radionuclide Contaminants in Water – Protection of Groundwater/Columbia River. As amended in 1986, the SDWA seeks to protect public water supply systems through the protection of groundwater. Any radioactive substances that may be found in water are regulated under the SDWA. The "National Primary Drinking Water Regulations" (40 CFR 141) specify MCLs for radionuclide contaminants in drinking water. In addition, DOE Order 5400.5 establishes derived concentration guidelines (DCGs) for alpha emitters. RAGs for radionuclide contaminants in water, protective of both surface water and groundwater, are based on achieving the MCLs. Although some of the following information is not applicable to the current contaminants of concern (COCs), a complete discussion of the MCLs for radionuclides in water is presented.

Current MCLs for radionuclides are set at 4 mrem/yr for the sum of the doses from beta particles and photon emitters, 15 pCi/L for gross alpha particle activity (including radium-226, but excluding uranium and radon), and 5 pCi/L for combined radium-226 and radium-228 (40 CFR 141.66). The MCLs for strontium-90 and tritium are 8 pCi/L and 20,000 pCi/L, respectively (40 CFR 141.66). The MCL for total uranium is 30 μg/L (40 CFR 141.66). The current MCLs for beta emitters specify that the MCLs are to be calculated based on an annual dose equivalent of 4 mrem to the total body or any internal organ. It is further specified (40 CFR 141.66) that the calculation is to be performed on the basis of a 2-L/day (0.5 gal/day) drinking water intake using the 168 hours data listed in *Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air or Water for Occupational Exposure* (NBS 1963). For the following radionuclides 1/25th of the DOE DCG published in the Interim Action ROD (EPA 1995) is the most stringent applicable standard for drinking water: americium-241, plutonium-238, and plutonium-239/240. In these cases, 1/25th of the DCG is adopted as the RAG in water rather than the MCLs promulgated in 40 CFR 141.66.

RAGs for groundwater and those protective of the Columbia River are presented in Tables 2-3 and 2-4, respectively.

2.1.2.5 Remedial Action Goals for Residual Contaminants in Soil – Protection of Groundwater/Columbia River. Residual contaminants remaining in soil after remediation must be at levels such that concentrations of contaminants reaching the unconfined aquifer and, eventually, the Columbia River, by migration through the soil column do not exceed RAGs considered protective of groundwater and the Columbia River (Sections 2.1.2.3 and 2.1.2.4; Tables 2-3 and 2-4).

Groundwater Protection – Nonradioactive Contaminants. For nonradioactive contaminants, WAC 173-340-740(3)(a)(ii)(A), January 1996, specifies that concentrations of residual contaminants are considered protective of groundwater at levels equal to or less than 100 times the groundwater cleanup levels established in accordance with WAC 173-340-720 (1996) (i.e., the RAGs presented in Table 2-3), unless it can be demonstrated that a higher soil concentration is protective of groundwater at the site. This approach is applied to nonradioactive contaminants as the first step in calculating residual soil concentrations that are protective of groundwater. If residual concentrations exceed cleanup levels calculated using this approach, site-specific modeling will be performed to provide a refinement on contaminants found to simulate actual conditions at the waste site. Future revisions will review the RDLs to determine if they should be lowered as a result of improved analytical technology.

Groundwater Protection – Radionuclide Contaminants. WAC 173-340-740(3)(a)(ii)(A) (1996) does not apply to residual radionuclide contaminants. For radionuclides, groundwater protection is demonstrated through technical evaluation using RESRAD. The RESRAD model is used to demonstrate whether specific radionuclides will reach the groundwater within 1,000 years (the time period specified in the EPA proposed rule for radionuclide cleanup) and, if so, what groundwater concentrations would occur. The RESRAD input parameters used in the modeling are presented in Table B-1, Appendix B. A description of the modeling methodology is presented in Appendix C. The RESRAD model is used in conjunction with a contaminant-at-

depth profile to calculate values protective of groundwater. Table 2-5 lists contaminant-specific concentrations in soil that achieve protection of groundwater (i.e., that achieve groundwater RAGs) for those residual soil contaminants that the RESRAD model predicted will reach groundwater. The values in Table 2-5 are based on the generic site model illustrated in Figure C-1 of Appendix C. Site-specific RAGs that achieve protection of groundwater will be calculated using site-specific information.

Columbia River Protection – Nonradioactive and Radionuclide Contaminants. To achieve protection of the Columbia River, the calculation of RAGs for residual soil contamination must consider two additional contaminant transport steps beyond the migration of contaminants through the soil column and their subsequent leaching into groundwater. The additional contaminant transport steps are (1) the transportation, from beneath the waste site to near-river wells (the point of compliance), of contaminants that have leached to groundwater; and (2) the mixing of groundwater contaminant concentrations with river water within the substrate at the groundwater/river interface. The model that addresses these two steps is the dilution/attenuation factor (DAF) model, summarized in Appendix D. This model accounts for the time required for a contaminant to travel through the groundwater underlying a site to the river, radionuclide decay during that travel time period, and a 1:1 dilution factor applied to contaminant concentrations measured in near-river wells (to account for the difference in concentration between the near-river well and the substrate at the groundwater/river interface). In evaluating contaminant transport time, the model uses a 1,000-year period (starting from site closeout) and considers the effect of retardation as contaminants move from under the waste site to the river. As appropriate, dilution factors other than 1:1 will be evaluated on a constituent-specific basis using Hanford Site data. Future revisions will review the RDLs and MDAs to determine if they should be lowered as a result of improved analytical technology.

To be consistent, the same methodology applied to residual soil contamination to ensure protection of the groundwater was applied to ensure protection of the Columbia River. For residual nonradioactive contaminants, protection of the river is achieved by reducing concentrations remaining in soil after remediation to concentrations less than or equal to 100 times the RAG after the DAF has been applied. If residual contaminant concentrations exceed river protection cleanup levels calculated using this approach, site-specific modeling will be performed to provide a refinement on contaminants found to simulate actual conditions at the waste site.

For residual radionuclide contaminants that reach groundwater within 1,000 years, as demonstrated by RESRAD modeling, protection of the river is achieved by reducing concentrations remaining in soil after remediation to concentrations less than or equal to the value calculated by RESRAD to achieve the RAG after the DAF has been applied. Table 2-6 lists the RAGs after the DAF has been applied and the contaminant-specific concentrations in soil that achieve protection of the Columbia River for those residual soil contaminants that the RESRAD model predicted will reach groundwater. The values in Table 2-6 are based on the generic site model illustrated in Figure C-1 of Appendix C. Site-specific RAGs that achieve protection of groundwater will be calculated using a site-specific contaminant-at-depth profile.

2.1.3 Application of Remedial Action Goals

The decision process for determining the extent of remediation of the waste sites will incorporate site-specific factors. The waste sites are represented by the following three general categories. The application of RAGs to meet RAOs for each site category is discussed below.

- **Shallow sites:** For shallow sites, where the entire engineered structure, soil, or debris contamination is present within the top 4.6 m (15 ft), RAOs will be achieved when (1) contaminant concentrations are demonstrated to be at or below RAGs based on WAC 173-340-740(3) (1996) and the 15 mrem/yr standard assuming no land-use restrictions (i.e., residential scenario), and (2) contaminant concentrations meet RAGs that provide protection of groundwater and the Columbia River.

- **Intermediate sites:** For sites where the engineered structure and/or contaminated soil and debris begin above 4.6 m (15 ft) and extend to below 4.6 m (15 ft), the engineered structure, at a minimum, will be remediated to achieve RAOs. RAOs will be achieved when (1) contaminant concentrations are demonstrated to be at or below RAGs based on WAC 173-340-740(3) (1996) and the 15 mrem/yr standard assuming no land-use restrictions (i.e., residential scenario), and (2) contaminant concentrations meet RAGs that provide protection of groundwater and the Columbia River. Any residual contamination present below the engineered structure shall be subject to the same evaluation as that used for deep sites.

- **Deep sites:** For deep sites, where contamination begins at 4.6 m (15 ft) below the surface, RAGs protective of groundwater and the Columbia River must be met. The extent of remediation will be determined by evaluating several factors. These factors include the reduction of risk by decay of short-lived (half-life of less than 30.2 years) radionuclides, protection of human health and the environment, remediation costs, sizing of the Environmental Restoration Disposal Facility (ERDF), worker safety, presence of ecological and cultural resources, the use of institutional controls, and long-term monitoring costs. These "balancing factors" are discussed further in Section 2.1.5. The contaminant levels remaining at these sites must be protective of groundwater and the Columbia River.

2.1.4 Contaminant-Specific Concentrations in Soil

As discussed in Section 2.1.1, representative contaminant-specific concentrations in soil have been calculated that correspond to the RAGs described in Section 2.1.2. These contaminant-specific concentrations are used as follows:

- To identify target volumes in soil that require remediation for purposes of remedial design

- To identify minimum quantitation limits for contaminants in soil that must be achieved by analytical systems used during remedial action

- To provide "lookup" values for use in the field to rapidly evaluate analytical data collected during remedial action.

These contaminant-specific concentrations correspond to the RAGs, but are not intended for use in verifying that remedial action is complete at a site. The concentrations represent values that individually equate to WAC 173-340 (1996) values or 15 mrem/yr dose rate. For radionuclides, the expectation is that most sites will have multiple radionuclides driving the cleanup; therefore, a cumulative dose of 15 mrem/yr would potentially result in individual radionuclide concentrations that are lower than these "lookup" values. The process for developing and using these contaminant-specific concentrations is presented in Figure 2-1. The verification process is further defined in Section 3.6. A summary of all representative lookup values can be found in Table 2-7.

2.1.5 Balancing Factors

Based on existing knowledge, it is possible that residual wastes may remain in place at sites where (1) contamination begins at depths below 4.6 m (15 ft), (2) residual soil contamination is present below 4.6 m (15 ft) or the engineered structure, or (3) marginally-contaminated material is present. The Interim Action ROD (EPA 1995) provides a decision framework to evaluate leaving some contamination in place:

> "The decision to leave wastes in place at such sites will be a site-specific determination made during remedial design and remedial action activities that will balance the extent of remediation with protection of human health and the environment, disturbance of ecological and cultural resources, worker health and safety, remediation costs, operation and maintenance costs, and radioactive decay of short-lived (half life less than 30.2 years [e.g., ^{137}Cs] radionuclides). The application of the criteria for the balancing factors, the process for determining the extent of remediation at deep sites, and the public involvement process during such determinations shall be specified further in the Remedial Design Report."

In addition to the seven balancing factors identified above, the section of the Interim Action ROD entitled "Scope and Role of Response Action Within Site Strategy" identifies three additional factors: sizing of the ERDF, the use of institutional controls, and long-term monitoring costs.

The balancing factors can be divided into two categories: (1) factors affecting the size of the excavation and (2) factors associated with cost. Three of the balancing factors – minimizing disturbance of cultural or ecological resources, minimizing the size of ERDF (minimize waste volume), and protecting worker health and safety – weigh in favor of minimizing excavation size. The other balancing factors suggest that the extent of remediation and associated costs be weighed against the reliability and cost of institutional controls. The two categories, when weighed with protection of human health and the environment, lead to the following conclusions:

- Contaminant concentrations below 4.6 m (15 ft) or below the engineered structure will be required to meet the criteria for protection of the groundwater and the Columbia River, as stated in RAO # 2 in Section 2.1. For residual contamination below 4.6 m (15 ft) or below the engineered structure shown to impact groundwater or the Columbia River, the balancing factors may be invoked.

- Radioactive contaminants present below the 4.6-m (15-ft) level will be required to be equal to or below concentrations so that the external radiation to a potential receptor in a basement 3.7 m (12 ft) below ground (in combination with radiation exposure from other contaminant pathways) is below 15 mrem/yr.

- In the event that RL relinquishes full control of the site, deed restrictions will be applied, as necessary, to prohibit excavation and drilling below the 4.6-m (15-ft) level in those cases where contaminants meet the required groundwater/river protection cleanup goals but exceed concentrations that are protective for direct exposure.

- For areas where lateral movement of contaminants, low radionuclide levels, or small quantities of disposed waste would generate marginally-contaminated material to be disposed of at ERDF, or where it can be demonstrated that radionuclide concentrations will result in achieving an acceptable risk range within a reasonable period of time, the balancing factors may be invoked.

In the event that the consideration of balancing factors results in a recommendation to leave contaminated soils or debris in place at a waste site at levels that exceed the RAOs, the Interim Action ROD (EPA 1995) states that the Tri-Parties will initiate public involvement prior to making a decision to leave contamination in place. The process will be as described for an ESD in the *Community Relations Plan for the Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1997).

Deed/lease restrictions or other institutional controls and long-term monitoring may be required to prevent human exposure to groundwater and/or contaminated soils or interference with the integrity of the cleanup action for any site. Potential deed restrictions could prohibit the drilling of any well to groundwater or any activity that would result in soil disturbance greater than 3.7 m (12 ft) below the surface. The requirement for deed/lease restrictions will be documented in the site closeout verification package (see Section 3.7, CERCLA Cleanup Documentation") and executed in accordance with DOE land release policy (see Section 3.8, "Site Release"). Public comment would not be sought for deed/lease restrictions deemed necessary to prevent interference with the integrity of the cleanup action.

2.1.6 Applicable or Relevant and Appropriate Requirements

The "National Oil and Hazardous Substances Contingency Plan" (NCP) (40 CFR 300) and the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) require that the remedial actions described in this document comply with the ARARs established in the RODs. The purpose of this section is to discuss how each of the ARARs identified in the RODs will be met during remedial action. The discussions of ARAR compliance in this section apply to all waste sites in the RODs because

these waste sites are currently the only sites for which detailed remedial action plans and specifications have been prepared. As detailed plans and specifications are prepared for subsequent groups of sites, compliance with ARARs will be evaluated, and this section may be revised, as necessary, to incorporate any new activities that are subject to the ARARs.

All activities associated with the remedial action for the source area sites covered under the RODs will occur onsite, as that term is defined under the NCP. As a result, the remedial actions described in this document need only meet the substantive requirements of the ARARs established in the RODs.

If any requirement that would be applicable or relevant and appropriate for the selected remedial action is promulgated subsequent to the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) being signed, EPA will review the requirement and determine whether the selected remedy is still protective in light of the new requirement. This determination will be documented in the Administrative Record.

2.1.6.1 Chemical-Specific ARARs. Chemical-specific ARARs are typically health- or risk-based numerical regulatory values or methodologies that are applied to site-specific media and used to establish remedial action cleanup criteria. As discussed in Section 2.1.1, the chemical-specific ARARs identified in the RODs are as follows:

- WAC 173-340 (WAC 173-340-360 and WAC 173-340-700 through 760) (1996)
- Nonzero MCL goals and MCLs promulgated under the SDWA (40 CFR 141) and/or by the state of Washington (WAC 246-290) (the Interim Action ROD does not include the state of Washington's drinking water regulations as an ARAR; however, since the authority to implement the SDWA has been delegated to the state by the EPA, the state's regulations are considered to be an ARAR for the purpose of this RDR/RAWP)
- The AWQC developed under the *Clean Water Act* (Section 304) and/or promulgated by the state of Washington (WAC 173-200 and 201)
- The *Toxic Substances Control Act* (implemented via 40 CFR 761).

The application of these ARARs for establishing the contaminant-specific RAGs for the source area sites covered under the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) is described in Section 2.1.1.

The RODs identify two chemical-specific ARARs in addition to those listed above:

- "National Primary and Secondary Ambient Air Quality Standards" (40 CFR 50)
- "National Emissions Standards for Hazardous Air Pollutants" (40 CFR 61).

"National Emissions Standards for Hazardous Air Pollutants" (40 CFR 61) and "Radiation Protection – Air Emissions" (WAC 246-247). The NESHAPs documentation specifies that airborne emissions from all combined operations at the Hanford Site may not exceed 10 mrem/yr effective dose equivalent to the hypothetical offsite maximally exposed individual. The radionuclide emission standards apply to any fugitive, diffuse, and point-source air emissions of radionuclides generated during excavation or treatment of contaminated soil. WAC 246-247 requires monitoring when there is any nonzero potential to emit airborne radionuclides. WAC 246-247 also requires the application of best available radionuclide control technology if the potential exists for any nonzero radioactive emissions. Standard construction techniques such as using water spray to control fugitive emissions of contaminated dust and particulates will be used.

"National Primary and Secondary Ambient Air Quality Standards" (40 CFR 50). Authority to implement the national air quality standards has been delegated to the state of Washington and is implemented in WAC 173-400. It establishes standards and control requirements for air contaminants including particulates, lead, and dust. WAC 173-400 requires that as long as emissions do not impact any nonattainment areas, control consists only of reasonable precautions to prevent the release of air contaminants. The standard construction techniques that will be employed during excavation and treatment are reasonable precautions.

2.1.6.2 Action-Specific ARARs. Action-specific ARARs typically are technology- or activity-based regulatory requirements or limitations that are triggered by a particular action such as excavation, transport, and/or disposal of hazardous waste. The action-specific ARARs established in the RODs are identified below, along with a discussion explaining how the ARARs will be met during remedial action implementation.

WAC 173-340 (1996) Cleanup Regulations. Although WAC 173-340 (1996) is primarily a chemical-specific ARAR because it establishes numerical concentration values and methodologies used for deriving cleanup goals, the regulation does include requirements that cleanup of, and residual contamination remaining in, one site medium (e.g., soils and groundwater) do not impact other media either onsite or offsite (WAC 173-340-700[4][b] and [7][h] [1996]). These requirements will be met by establishing soil cleanup levels that are protective of groundwater and the Columbia River (see Section 2.1.1) by monitoring air emissions during remediation, and by implementing dust-control measures, as necessary, based on air emissions monitoring.

State of Washington "Dangerous Waste Regulations" (WAC 173-303). The EPA has delegated the authority to implement the *Resource Conservation and Recovery Act of 1976* (RCRA) to the state of Washington. As a result, the regulations promulgated by the state to implement RCRA (the "Dangerous Waste Regulations") are the primary ARARs for hazardous and dangerous waste generated during the remedial action. Activities performed to comply with the state regulations will also comply with the federal RCRA regulations specified in the RODs.

- **"Designation of Dangerous Waste" (WAC 173-303-070).** This section of Washington State's waste regulations specifies that the procedures will be used to determine if wastes

generated during the remedial action classify as dangerous or extremely hazardous wastes. The designation procedures cover both RCRA hazardous wastes (i.e., ignitability, corrosivity, reactivity, toxicity characteristic wastes, and listed wastes) and state-only dangerous wastes (i.e., wastes that meet the criteria for toxic or persistent dangerous wastes). Based on a reasonable search of historical documents and an evaluation of analytical data, it has been concluded that the waste sites contain no listed hazardous wastes or state-only dangerous wastes. However, certain sites may contain effluent sludges and debris with metal concentrations high enough that they would "fail" the toxicity characteristic leachate procedure (TCLP) test and would be classified as toxicity characteristic wastes. In addition, based on experience at some waste sites, solid metals such as lead bricks might be encountered that would fail the TCLP test and would be designated as dangerous waste.

- **"Land Disposal Restrictions" (WAC 173-303-140).** Washington State's land disposal restriction (LDR) regulations incorporate the federal RCRA LDR requirements set forth in 40 CFR 268, and also establishes LDRs for certain state-only dangerous wastes such as wastes that are classified as extremely hazardous and carbonaceous/organic wastes. As discussed above, it currently is anticipated that the only wastes generated during the remedial actions that would be subject to LDRs would be toxicity characteristic wastes. When LDR wastes are encountered, the requirements of 40 CFR 268 will be applied. A contingency plan addressing how LDR wastes will be handled during the remedial action has been prepared (BHI 1995). The contingencies shall be addressed at the time the LDR is encountered.

- **"Use and Management of Containers" (WAC 173-303-63).** The LDR regulations contained in 40 CFR 268.50 require that wastes that have been taken out of the area of contamination (AOC) and are subject to LDRs be stored only in containers, tanks, or buildings. Of these three storage options, container storage would be the only practical method for storing toxicity characteristic soil and debris. The LDR contingency plan describes how the storage requirements will be met (BHI 1995).

- **"Tank Systems" (WAC 173-303-640) and "RCRA Standards for Tank Systems Units" (40 CFR 264, Subpart J).** The remedial actions described in this report will not require the use of tanks to store or treat hazardous wastes.

- **"Miscellaneous Units" (WAC 173-303-680) and "RCRA Standards for Miscellaneous Treatment Units" (40 CFR 264, Subpart X).** As explained in Section 2.1.7, treatment for volume reduction is not anticipated at this time. As a consequence, the remedial actions described in this report are not envisioned to require the use of miscellaneous units to store or treat hazardous wastes.

***Hazardous Materials Transportation Act* and "Requirements for the Transportation of Hazardous Materials" (49 CFR Parts 100 to 179).** The RODs establish the U.S. Department of Transportation (DOT) requirements for the transportation of hazardous materials as an ARAR for offsite shipments of hazardous wastes. Currently, all hazardous waste shipments are anticipated to be onsite (from the source area sites to ERDF).

"Minimum Standards for Construction and Maintenance of Wells" (WAC 173-160) and "Regulation and Licensing of Well Contractors and Operators" (WAC 173-162). Washington State's "Minimum Standards for Construction and Maintenance of Wells" specifies standards for the construction, operation, and abandonment of resource protection (i.e., monitoring) wells. Groundwater monitoring and remediation are addressed under a separate OU from the 37 potential source area sites covered under the RODs. Because of this, the remedial actions described in this report currently do not include source area, site-specific monitoring well installation. However, if hazardous substances are left in place through application of the balancing factors, and groundwater monitoring at the specific site is required as a consequence, a well installation and monitoring plan will be prepared, as required, to meet the ARAR.

2.1.6.3 Location-Specific ARARs. Location-specific ARARs are restrictions placed on hazardous substance concentrations or remedial actions based on the specific location of the substance or action. The location-specific ARARs established in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) and ESD (EPA 2004) are discussed below.

Archaeological and Historical Preservation Act. The *Archaeological and Historical Preservation Act* requires that remedial actions at the source area sites do not cause the loss of any archaeological or historic data and that any archaeological or historic data must be preserved. There are no known archaeological or historic artifacts within the proposed "footprints" for the waste site excavations. If any are encountered during excavation, the appropriate authorities will be notified and the artifacts will be preserved. Consideration of archaeological and historic data is included in the balancing factors that will be evaluated if excavations need to be extended beyond those currently planned.

***National Historic Preservation Act* and "Protection of Historic Properties" (36 CFR 800).** The *National Historic Preservation Act* requires that agencies undertaking projects must evaluate impacts to properties that are listed in, or are eligible for inclusion in, the *National Register of Historic Places* (NPS 1988). There are no known historically significant properties within the proposed footprints of the waste site excavations. Consideration of such properties is included in the balancing factors that will be evaluated if excavations need to be extended beyond those currently planned.

***Historic Migratory Bird Treaty Act* and "Wildlife and Fisheries" (50 CFR Parts 10-24).** These requirements are applicable to the protection of migratory bird species associated with the 100 Area. The remedial action will comply with these requirements by following guidance prescribed in the *Mitigation Action Plan for the 100 and 600 Areas of the Hanford Site* (DOE-RL 2001c) and through the performance of site-specific ecological resource reviews prior to remedial action as prescribed in this RDR/RAWP.

"Compliance With Floodplain and Wetland Environmental Review Requirements" (10 CFR 1022) and "Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act" (40 CFR 6, Appendix A). These requirements address floodplain protection and are applicable to 100 Area sites located within the Columbia River floodplain. Actions taken within a floodplain must be conducted in a manner that avoids adverse impacts, minimizes potential harm, and restores and preserves

natural and beneficial values. Actions required by the RODs (backfilling, revegetation, resource protection, and mitigation) are expected to satisfy these requirements.

***Endangered Species Act of 1973* and "Interagency Cooperation -- Endangered Species Act of 1973" (50 CFR 402).** The *Endangered Species Act* requires that federal agencies consult with the Department of Interior to ensure that actions they authorize, fund, or implement do not jeopardize the continued existence of endangered or threatened species or adversely affect their critical habitat. Because several listed and candidate endangered or threatened species have been identified in and around the Hanford Site, the remedial actions described in this document will be managed so that these species existence will not be jeopardized, or will their habitat be adversely affected.
Native American Graves Protection and Repatriation Act is applicable to any sites should Native American remains be found.

2.1.6.4 Other Criteria, Advisories, or Guidance to Be Considered. TBC information generally consists of federal, state, and local criteria, advisories, and proposed standards that are not legally binding (i.e., are not promulgated regulations), but that may be useful in establishing cleanup goals or remedial alternatives that are protective of human health and the environment. The TBCs identified in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) are discussed below.

Ecology recently promulgated (February 12, 2001) terrestrial ecological evaluation procedures as part of its revision to the WAC 173-340 (1996) cleanup regulation (WAC 173-340-7490 [1996]). These procedures, along with the DOE Technical Standard *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE 2002) and the *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (EPA 1997b), will be considered as part of a multi-year risk assessment pilot study that is currently in progress.

Tri-Party Agreement renegotiations (Klein 2002) established a commitment to conduct a pilot risk assessment in the 100-B/C Area. This pilot assessment is currently under way and will be a multi-year effort targeted for completion in 2005 (see Table 3-1 and Figure 3-2). The pilot project, which is evaluating the effectiveness of remedial actions for the protection of human and ecological receptors in the 100-B/C Area, will result in methodology and recommendations that will feed into the post-cleanup risk assessment for the 100 Area. Coordination with EPA, Ecology, RL, and the Natural Resource Trustee Council will ensure a consensus approach to the management of post-remediation risks that address ecological as well as human health protection.

In addition, the Tri-Parties have agreed that the outcome of the 100-B/C risk assessment will be used to establish and refine the framework for the final remedial investigation/feasibility study and RODs for the soil sites. The assessment also addresses issues related to groundwater exposure scenarios along the Columbia River near-shore and riparian zones. This information will be available for use in the 100-BC-5 OU remedial investigation/feasibility study.

"Notice of Proposed Rulemaking for Radiation Site Cleanup Regulations" (40 CFR 196). The soil cleanup standard of 15 mrem/yr above natural background proposed by the EPA has

been specified in the Interim Action ROD (EPA 1995) as the RAG for soil cleanup that is protective of human health from exposure to radionuclides. Subsequent to this ROD being issued, the draft regulation was withdrawn. See Section 2.1.1 for further discussion.

ERDF Waste Acceptance Criteria. Waste acceptance criteria (e.g., concentration limits and waste form limitations) have been developed for ERDF and are provided in *Environmental Restoration Disposal Facility Waste Acceptance Criteria* (BHI 2002). This document provides the primary requirements that must be met in order for waste to be accepted at ERDF. It also cites specific regulations to direct the user to the level of detail necessary for criteria implementation.

"EPA Radiation Protection Guidance for Exposure to the General Public" (59 *Federal Register* [FR] 66414). The EPA has issued guidance recommending that nonmedical radiation doses to the general public from all sources and pathways not exceed 100 mrem/yr above background. The guidance also recommends that radiation doses from individual sources or pathways be lower. Cleanup to the 15 mrem/yr RAG will meet these recommendations.

***The Future for Hanford: Uses and Cleanup, the Final Report of the Hanford Future Site Uses Working Group* (Drummond 1992).** The RAO of cleanup to an "unrestricted status" is based on the recommendations in this document.

"Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)" (64 FR 61615). The final selected land uses for the 100 Areas are recreation, conservation, and preservation. The 100 Area cleanup scenario is consistent with the land-use plan.

2.1.7 Alternative Description

The selected remedy specified in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) is remove and dispose at ERDF, with treatment, as appropriate or required.

Appropriate treatment, as described in the Interim Action ROD(EPA 1995), is soil washing or thermal desorption to "minimize the amount of material to be transported to the ERDF for disposal." However, as described in the following paragraphs, evaluations of existing historical and analytical data and technology demonstrations have resulted in the conclusions that soil treatment for volume reduction will not be appropriate at this time.

Required treatment is any treatment required to comply with legal requirements. Of primary concern are LDR-related treatment requirements.

- **Thermal desorption:** The Interim Action ROD requires that, as appropriate, wastes contaminated with organic chemicals be treated using thermal desorption to reduce volumes requiring disposal at ERDF. The ERDF ROD Amendment (EPA 2002) allows for treatment at ERDF. Also, if concentrations of organic chemicals exceed ERDF waste acceptance criteria (BHI 2002) or LDR criteria, then thermal desorption would be required. However, evaluation of existing historical and analytical data indicates that organic chemicals are not

expected at the 100 Area waste sites nor are concentrations likely to be in excess of ERDF waste acceptance criteria. Therefore, thermal desorption will not be included in the detailed design for remedial action.

- **Soil washing:** The Interim Action ROD requires that, as appropriate, contaminated soils be treated using soil washing to reduce volumes requiring disposal at ERDF. A soil washing pilot plant was constructed in the 100-DR-1 OU, and a treatability test was performed to investigate the feasibility of soil washing (DOE-RL 1995b). Using data from the test, RL performed a comprehensive economic analysis to compare the relative costs of soil removal and direct disposal in ERDF with soil removal, soil washing, and disposal of the contaminated fraction in ERDF. The report documenting the analysis (BHI 1995) concluded that removal and disposal is less expensive than removal, soil washing, and disposal, although the difference between the two alternatives is small and within the estimated margin of error of the estimate. Fundamentally, the projected reduction in volumes requiring disposal at ERDF (and associated cost savings) do not offset the extra costs of constructing and operating the soil washing facility. The report recommended that soil washing not be included in remedial action plans at this time, and that actual remedial action costs be monitored and incorporated into a future update of the economic model. The ROD Amendment (EPA 1997a) also recognizes the results of the soil volume reduction treatability studies that indicate soil washing for volume reduction is not cost effective. Therefore, this treatment step will no longer be retained as an option for the 100 Area radioactive liquid effluent disposal sites.

- **Required treatment:** Treatment will be required for LDR material unless a treatability variance or ARAR waiver is requested by RL and approved by the regulatory agencies. The expected condition is that toxicity characteristic suspect waste may exist. If LDR wastes are encountered, the requirements of 40 CFR 268 will be applied. A contingency plan addressing how LDR wastes will be handled has been prepared (WAC 173-303). Should LDR material be encountered, it will be temporarily stored within the AOC and disposed of in accordance with applicable regulations (Section 2.1.6.2). The contingency plan will be implemented if and when LDR wastes are detected. If treatment is required to address LDR wastes, RL will obtain regulatory agency approval.

The Interim Action ROD presented the selected interim remedial actions for 37 high-priority waste sites that received liquid radioactive effluent discharges in the 100-BC-1, 100-DR-1, and 100-HR-1 OUs. This document introduced the "observational approach" and "plug-in approach" as innovative means to remediation of the individual waste sites and an enhancement to the selected remedy. The observational approach allowed for remediation of waste sites with limited information, using a "test as you go" approach to determine the nature and extent of contamination until cleanup goals have been met. The plug-in approach allowed the analogous site approach to be used for selection of the same remedy at multiple sites having similar circumstances without expenditure of resources to initially characterize individual sites.

The ROD Amendment (EPA 1997a) increased the scope of the selected remedy in the Interim Action ROD (EPA 1995) to include an additional 34 sites within the 100-BC-2, 100-DR-1, 100 DR-2, 100-FR-1, 100-HR-1, 100 KR-1, and 100-KR-2 OUs. This amendment also

recognized the results of the soil volume reduction treatability studies that indicate soil washing for volume reduction is not cost effective and removed it as a treatment option for the 100 Area radioactive liquid effluent disposal sites. Clarification regarding backfill and revegetation of remediated waste sites is included as guidance provided in the current mitigation action plan (DOE-RL 2001c).

The Remaining Sites ROD (EPA 1999) was issued to address the selected remedy of RTD for 46 additional waste sites in the 100 Area and waste sites in the 200-CW-3 OU located in the 200 West Area. An additional 161 sites were identified for use of the plug-in approach for remedy selection. These sites were identified as candidate sites needing further evaluation to support a no-action or remedial action decision. Because they are similar to the 46 sites proposed for RTD, they will "plug-in" to this same remedy if a remedial action is warranted. In addition to these sites, the Remaining Sites ROD also presents the mechanism to include any newly discovered sites that are similar to the 100 Area remaining sites as candidate sites to be "plugged-in" to the RTD remedy. Periodic publication of ESDs will serve as Tri-Party notification to the public of these additions.

The Remaining Sites ESD (EPA 2000a) provided notice of the decision to address two waste sites (600-23 and JA Jones No. 1) that were formerly included in the 300 Area remedial process to the 100 Area remedial action, and to remediate the sites following the RTD approach. Another ESD issued in January 2004 (EPA 2004) added 28 newly discovered sites to the list of candidate sites.

The 100 Area Burial Grounds ROD (EPA 2000b) was issued to address the selected remedy of RTD for 45 burial grounds located in the 100 Areas. This document carried forward the selected remedy used in previous documents of RTD and backfill followed by revegetation. The specific waste sites are located in the 100-B/C, 100-DR, 100-H, 100-F, and 100-K Areas, and are anticipated to rely heavily on the observational approach for remediation combined with a "characterize and remediate in one step" methodology.

2.2 REMEDIAL DESIGN

A phased approach is used for the remedial design tasks. The phased approach is to generally group waste sites by geographic locations. Each design group is initiated so remedial actions can be maintained. The leading remedial design task prepares documentation and defines concepts so they will be readily transferable to the sequential remedial design tasks. This concept streamlines the design process.

2.2.1 Group 1 Remedial Design

The Group 1 remedial design task includes sites within the 100-BC-1, 100-DR-1, and 100-HR-1 OUs. The waste sites are defined as the 116-C-1 Process Effluent Trench, 116-B-1 Process Effluent Trench, 116-B-11 Retention Basin, 116-C-5 Retention Basin, 116-B-13 Sludge Trench, 116-B-14 Sludge Trench, 100-B/C pipelines north of B Avenue, 116-H-1 Process Effluent Trench, and 116-D-1A/1B Fuel Storage Basin Trenches.

Remediation of these sites requires soil removal, segregation, storage, transportation, disposal, and backfilling. The remedial action subcontractor is provided with waste site-specific information on the expected contaminated area and depth, reactor area-specific information, and technical performance specifications. The detailed design for facility layout and excavation is completed by the remedial action subcontractor.

The technical performance specifications have been prepared for the types of waste sites found in Group 1. Each technical specification has been prepared so that it will be appropriate for use at all similar waste sites. The earthwork technical specification will require slight modifications for subsequent groups because it contains waste site-specific information. Each technical specification establishes quality and workmanship requirements and defines how quality is measured. Generally, each specification includes a list of Hanford Site-specific references; a list of codes, standards, laws, and regulations; definitions of applicable terms; and a discussion of materials, equipment, and associated testing. The list of technical specifications follows:

- Earthwork and excavated material handling
- Survey and decontamination station
- Waste profile station
- Basic electrical materials and methods
- Lighting.

During excavation, the waste site excavation is guided by field radioactivity measurements and in-process sampling and analysis. Procedures will provide a detailed discussion on the flow of data. The *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2004) and the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (100 Area Burial Grounds SAP) (DOE-RL 2001a) will address data management.

2.2.2 Group 2 Remedial Design

The Group 2 remedial design task includes sites within the 100-DR-1 OU. The waste sites are defined as the 116-D-7 Retention Basin, 116-DR-9 Retention Basin, 116-DR-1 Process Effluent Trench, 116-DR-2 Process Effluent Trench, five 107-D/DR sludge trenches, 100-D/DR Process Effluent Pipelines north of the road, and the 1607-D2 Septic System. The septic system is included because of its proximity to the Interim Action ROD (EPA 1995) waste sites, and is considered a "no action" site pending additional sampling. The design effort consists of gathering the additional engineering data. Any additional activities for the septic system is based on these data.

Remediation of these sites requires soil removal, segregation, storage, transportation, disposal, and backfilling. The remedial action subcontractor is provided with waste site-specific information on the expected contaminated area and depth, reactor area-specific information, and technical performance specifications. The detailed design for facility layout and excavation is completed by the remedial action subcontractor.

The design effort for this group includes any modifications to the earthwork technical specification and a compilation of the appropriate reactor area and waste site-specific information. This information is provided to the remedial action subcontractor as a basis for the detailed design.

2.2.3 Group 3 Remedial Design

The Group 3 remedial design task includes sites within the 100-B/C Area and 100-D Area. The waste sites are defined as the 116-B-9 French Drain, 116-B-10 Dry Well, 116-B-3 Pluto Crib, 116-B-2 Fuel Storage Basin Trench, 116-B-6A and B Cribs, 116-B-12 Seal Pit Crib, 100-B South Process Effluent Pipelines, 116-C-2A Pluto Crib Sand Filter, 116-C-2B Pluto Crib Pumping Station, 116-C-2C Pluto Crib, 100-C South Process Effluent Pipelines, 116-D-4 Crib, 116-D-1A and B Fuel Storage Basin Trenches, 116-D-6 French Drain, 116-D-2 Crib, 116-DR-3 Storage Basin Trench, 116-DR-4 Pluto Crib, 116-DR-6 Liquid Disposal Trench, 116-DR-7 Inkwell Crib, 100-DR South Process Effluent Pipelines, 116-D-3 French Drain, 116-D-9 Crib, and 100-D South Process Effluent Pipelines.

Remediation of these sites requires soil removal, segregation, storage, transportation, disposal, and backfilling. The remedial action subcontractor is provided with waste site-specific information on the expected contaminated area and depth, reactor area-specific information, and technical performance specifications. The detailed design for facility layout and excavation is completed by the remedial action subcontractor.

The design effort for this group includes any modifications to the earthwork technical specification and a compilation of the appropriate reactor area and waste site-specific information. This information is provided to the remedial action subcontractor as a basis for the detailed design.

2.2.4 Group 4 Remedial Design

The Group 4 remedial design task includes sites within the 100-F, 100-H, and 100-K Areas. The waste sites are defined as the 100-F-15 (108-F) French Drain, 100-F-19 Process Effluent Piping, 116-F-1 Lewis Canal Trench, 116-F-2 Trench, 116-F-3 Fuel Storage Basin Trench, 116-F-4 Pluto Crib, 116-F-5 Ball Washer Crib, 116-F-6 Liquid Waste Disposal Trench, 116-F-9 Trench, 116-F-10 French Drain, 116-F-11 French Drain, 116-F-14 Retention Basin, 126-F-1 Ash Pit, UPR-100-F-2 Basin Leak Ditch, 100-H-5 Sludge Burial Trench, 100-H-17 (116-H-2, 100-H-2) Trench, 100-H-21 Process Effluent Pipelines, 116-H-1 Process Effluent Trench, 116-H-3 Dummy Decontamination French Drain, 116-H-4 Pluto Crib, 116-H-7 Retention Basin, 100-K Process Effluent Piping, 116-K-1 Crib, 116-K-2 Effluent Trench, 116-KE-4 Retention Basins, and 116-KW-3 Retention Basins.

Remediation of these sites requires soil removal, segregation, storage, transportation, disposal, and backfilling. The remedial action subcontractor is provided with waste site-specific information on the expected contaminated area and depth, reactor area-specific information, and technical performance specifications. The detailed design for facility layout and excavation is completed by the remedial action subcontractor.

The design effort for this group includes any modifications to the earthwork technical specification and a compilation of the appropriate reactor area and waste site-specific information. This information is provided to the remedial action subcontractor as a basis for the detailed design.

2.2.5 Remaining Sites Remedial Design

The remaining sites remedial design includes additional sites in the 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-2, 100-IU-6, and 200-CW-3 OUs not already covered by existing remedial design efforts. These sites were determined to require remediation after on-site specific evaluation.

If remediation is needed, these sites require soil, debris, and waste removal, segregation, storage, transportation, disposal, and backfilling when contaminant concentrations exceed RAGs. The remedial action subcontractor is provided with waste site-specific information on the expected contaminated area and depth, reactor area-specific information, and technical performance specification. The detailed design for facility layout and excavation is completed by the remedial action subcontractor.

The design effort for this group includes any modifications to the earthwork technical specification and a compilation of the appropriate reactor area and waste site-specific information. This information is provided to the remedial action subcontractor as a basis for a change order.

2.2.6 100 Area Burial Grounds

The 100 Area burial grounds remedial design includes burial ground sites in the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 OUs.

Remediation of these sites requires soil and debris removal, segregation, storage, transportation, disposal, and backfilling. The remedial action subcontractor is provided with waste site-specific information on the expected contaminated area and depth, reactor area-specific information, and technical performance specification. The detailed design for facility layout and excavation is completed by the remedial action subcontractor.

The design effort for this group includes any modifications to the earthwork technical specification and a compilation of the appropriate reactor area and waste site-specific information. This information is provided to the remedial action subcontractor as a basis for a change order.

2.2.7 Future Remedial Design Groups

Preliminary planning and engineering for the remediation of the 118-K-1 Burial Ground was completed by the end of fiscal year 2003 (Puthoff 2002). Other future remedial design tasks will be defined based on the schedule for interim remedial actions (see Section 3.2.2).

Figure 2-1. Calculation of Contaminant-Specific Cleanup Levels.

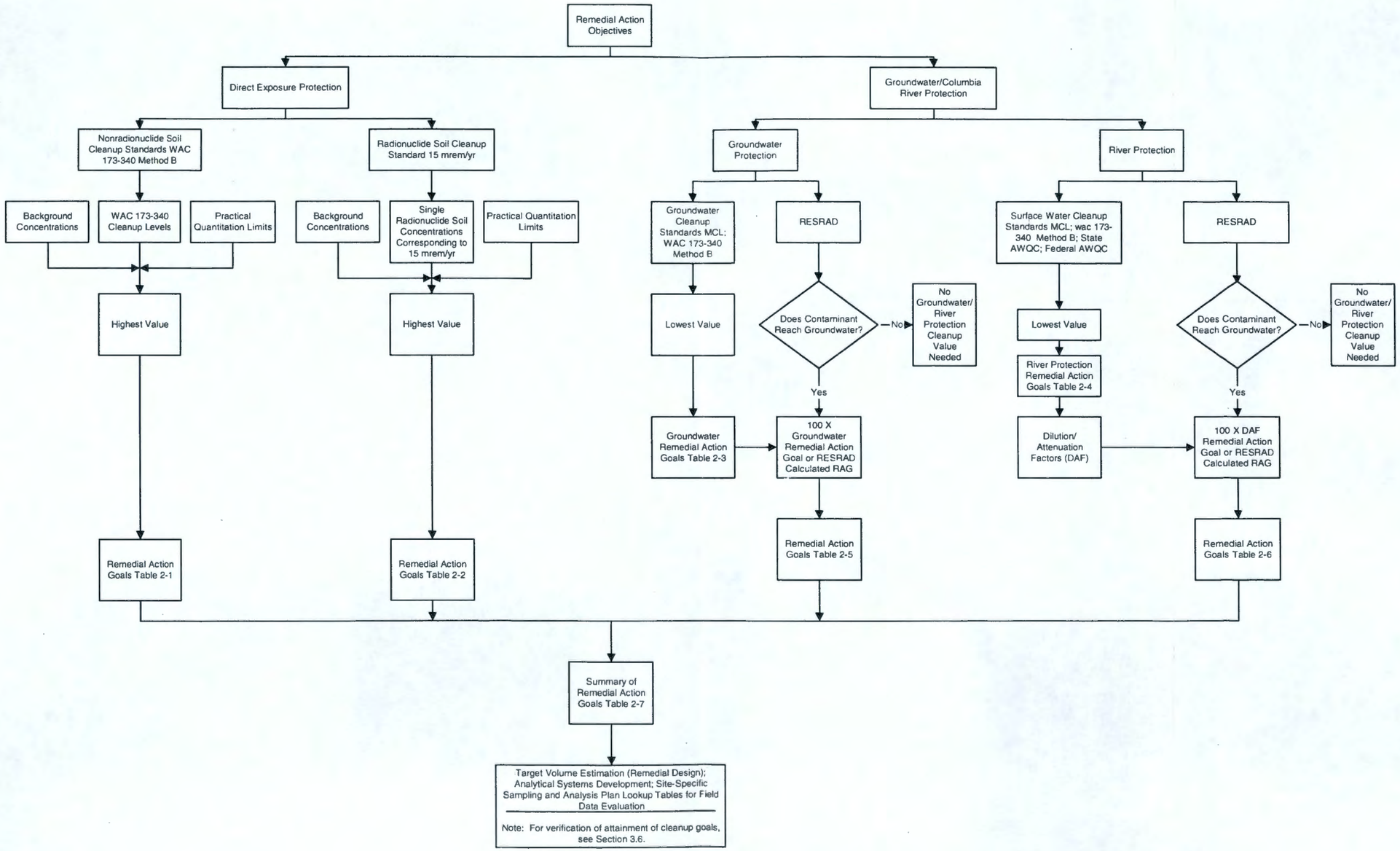


Table 2-1. WAC 173-340-740(3) (1996) Cleanup Levels for Direct Soil Exposure, Hanford Site-Specific Background Concentrations, Required Detection Limits, and Remedial Action Goals for Nonradioactive Contaminants in Soil. (2 Pages)

Contaminant	WAC 173-340-740(3) (1996) Cleanup Level (mg/kg)[a]	Hanford Site-Specific Background Concentration (mg/kg)[b]	Required Detection Limit (mg/kg)[c]	Value Selected for Remedial Action Goal (mg/kg)
Antimony	32	5[d]	6	32
Arsenic	1.67	6.5	10	20[e]
Barium	5,600	132	2	5,600
Cadmium	13.9[f]	0.81[d]	0.5	13.9[f]
Chromium (III)	80,000	18.5[g]	1	80,000
Chromium (VI)	2.1[h]	NA[i]	0.5	2.1
Lead	353[j]	10.2	5	353
Manganese	11,200	512	5	11,200
Mercury	24	0.33	0.2	24
Selenium	400	0.78[d]	10	400
Silver	400	0.73	1	400
Zinc	24,000	67.8	1	24,000
Benzo(a)anthracene	0.137	NA[i]	0.015[k]	0.137
Benzo(b)fluoranthrene	0.137	NA[i]	0.015[k]	0.137
Benzo(k)fluoranthrene	0.137	NA[i]	0.015[k]	0.137
Benzo(a)pyrene	0.137	NA[i]	0.015[k]	0.137
Bis(2-ethylhexyl)phthalate	71.4	NA[i]	0.33	71.4
Chlordane	0.769	NA[i]	0.02	0.769
Chrysene	0.137	NA[i]	0.1[k]	0.137
Ethylene glycol	160,000	NA[i]	5.0	160,000
Pentachlorophenol	8.33	NA[i]	0.33	8.33
Pesticides	Compound specific	NA[i]	Compound specific	Compound specific
Petroleum hydrocarbons	Compound specific	NA[i]	Compound specific	Compound specific
Phthalates	Compound specific	NA[i]	Compound specific	Compound specific
Polychlorinated biphenyls	0.5[l]	NA[i]	0.02	0.5

Table 2-1. WAC 173-340-740(3) (1996) Cleanup Levels for Direct Soil Exposure, Hanford Site-Specific Background Concentrations, Required Detection Limits, and Remedial Action Goals for Nonradioactive Contaminants in Soil. (2 Pages)

Contaminant	WAC 173-340-740(3) (1996) Cleanup Level (mg/kg)[a]	Hanford Site-Specific Background Concentration (mg/kg)[b]	Required Detection Limit (mg/kg)[c]	Value Selected for Remedial Action Goal (mg/kg)
Semivolatile organic analytes	Compound specific	NA[i]	Compound specific	Compound specific
Volatile organic analytes[i]	Compound specific	NA[i]	Compound specific	Compound specific

[a] Values are applicable for direct exposure to contaminants detected within the top 4.6 m (15 ft) of soil (WAC 173-340-740[6][c] [1996]). Source: *Model Toxics Control Act Cleanup Levels and Risk Calculations (CLARC II) Update* (Ecology 1996).
[b] Background concentrations are 90th percentile values of the log normal distribution of site-wide soil background data. Source: *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes* (DOE-RL 2001b).
[c] The RDLs are based on contractual required quantitation limits and contractual RDLs for offsite laboratories.
[d] Hanford Site–specific background not available; not evaluated during background study. Value is from *National Background Soil Metals Concentration in Washington State* (Ecology 1994).
[e] The cleanup level of 20 mg/kg has been agreed to by the Tri-Parties project managers. The basis for the 20 mg/kg is provided in Section 2.1.2.1.
[f] WAC 173-340-750(3) (1996) carcinogenic cleanup limit based on the inhalation exposure pathway. Calculation is presented in the *Calculation of RAGs for 100 Area RDR/RAWP Rev. 3: Calculate Effect of Water Hardness on Applicable River RAGS; Calculate PCB Groundwater Cleanup Levels; Calculate Cadmium Air Protection Carcinogenic Cleanup Level* (BHI 2001a).
[g] Measured as total chromium.
[h] WAC 173-340-750(3) (1996) carcinogenic cleanup limit based on the inhalation exposure pathway. Calculation is presented in the *Calculation of Hexavalent Chromium Carcinogenic Risk* (BHI 2000).
[i] NA = Not available; contaminant not evaluated during the background study.
[j] A WAC 173-340-740(3) (1996) value for lead is not available. This value is based on the *Guidance Manual for the Integrated Exposure Update Biokinetic Model for Lead in Children* (EPA 1994)
[k] The RAG is below the required detection limit as specified in Hanford Site-wide analytical services contracts. The value presented is the required detection limit. With prior notification, in most circumstances the laboratory will be able to provide detection limits less than or equal to the RAG values. Inability to meet the RAG values or the necessity for nonroutine analyses will be documented and agreed to by the project and the laboratory before samples are submitted. If an inability to meet RAG values occurs, the laboratory will report to the best available (or specifically negotiated) detection limits for the analysis.
[l] The soil cleanup value for PCBs is based on the formula for calculation of WAC 173-340 (1996) Method B soil cleanup levels presented in WAC 173-340-740(3)(a)(iii)(B) (1996) and the revised cancer potency factor for ingestion of PCBs of 2.0 kg-day/mg (EPA 1996a).
PCB = polychlorinated biphenyl

Table 2-2. Single Radionuclide Soil Concentrations Corresponding to a 15 mrem/yr Dose, Hanford Site-Specific Background Concentrations, Required Detection Limits, and Remedial Action Goals for Radionuclides in Near-Surface Soil.

Radionuclides	Soil Concentration Corresponding to 15 mrem/yr (pCi/g)[a]	Hanford Site-Specific Background Concentration (pCi/g)[b]	Required Detection Limit (pCi/g)[c]	Value Selected for Remedial Action Goal (pCi/g)
Americium-241	31.1	NA[d]	1	31.1
Carbon-14	5.16	NA[d]	1[e]	5.16
Cesium-137	6.2	1.1	0.1	6.2
Cobalt-60	1.4	0.008	0.05	1.4
Europium-152	3.3	NA[d]	0.1	3.3
Europium-154	3	0.033	0.1	3
Europium-155	125	0.054	0.1	125
Nickel-63	4,026	NA[d]	30[e]	4,026
Plutonium-238	37.4	0.004	1	37.4
Plutonium-239/240	33.9	0.025	1	33.9
Strontium-90	4.5	0.18	1[e]	4.5
Technetium-99	8.5	NA[d]	15[f]	15[f]
Thorium-232	1	1.3	1[e]	1.3[g]
Tritium (H-3)	510	NA[d]	30[e]	510
Uranium-233/234	0.78	1.1	1[e]	1.1[g]
Uranium-235	0.84	0.11	0.5	0.84
Uranium-238	0.84	1.1	1[e]	1.1[g]

[a] The RESRAD methodology used to calculate the single radionuclide soil concentrations is presented in Appendix B. Values in the table are lookup values based on the generic site model. Site-specific RAGs will be calculated for site closeout verification using site-specific information.

[b] Background concentrations are the results of rounding the 90th percentile values of the log normal distribution of site-wide soil background data. Source: *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE-RL 1996b).

[c] The RDLs are based on contract-required quantitation limits/contract-required detection limits for offsite laboratories.

[d] NA = Not available; contaminant not evaluated during the background study.

[e] This RDL is not available via rapid turnaround; it is only available via a protocol method requiring a longer turnaround time.

[f] Where cleanup levels are less than practical quantitation limits (PQLs) of the best available analytical methodology, cleanup levels default to the PQLs (WAC 173-340-745[6][c] [1996]). Laboratory contractual RDLs are equivalent to PQLs for these analytes. Periodic review will be performed to determine if alternate or improved methodology has been developed yielding lower analytical detection limits.

[g] Contractual RDLs are set at a nominal 1 pCi/g for these isotopes. Actual sample detection limits are expected to be below this value for routine soil analyses. It is expected that the presence of analytes greater than the lookup values will be detected and reported for most samples.

Table 2-3. Remedial Action Goals for Groundwater. (2 Pages)

Contaminant	Remedial Action Goal for Groundwater	Units	Source
Americium-241	1.2	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Carbon-14	2,000	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Cesium-137	60	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Cobalt-60	100	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Europium-152	200	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Europium-154	60	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Europium-155	600	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Nickel-63	50	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Plutonium-238	1.6	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Plutonium-239/240	1.2	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Strontium-90	8	pCi/L	40 CFR 141.66
Technetium-99	900	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Thorium-232	2	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Tritium (H-3)	20,000	pCi/L	MCL (40 CFR 141)
Uranium-233/234	30	µg/L[a]	40 CFR 141.66
Uranium-235	30	µg/L[a]	40 CFR 141.66
Uranium-238	30	µg/L[a]	40 CFR 141.66
Antimony	6	µg/L	MCL (40 CFR 141)
Arsenic	0.058	µg/L	WAC 173-340-720(3) (1996)
Barium	1,120	µg/L	WAC 173-340-720(3) (1996)
Cadmium	5	µg/L	MCL (40 CFR 141)
Total chromium	100	µg/L	MCL (40 CFR 141)
Chromium (VI)	80	µg/L	WAC 173-340-720(3) (1996)
Lead	15	µg/L	40 CFR 141.80
Manganese	50	µg/L	SMCL (40 CFR 143)
Mercury	2	µg/L	MCL (40 CFR 141)
Selenium	50	µg/L	MCL (40 CFR 141)
Silver	80	µg/L	WAC 173-340-720(3) (1996)
Sulfate	250,000	µg/L	SMCL (40 CFR 143)
Zinc	4,800	µg/L	WAC 173-340-720(3) (1996)

Table 2-3. Remedial Action Goals for Groundwater. (2 Pages)

Contaminant	Remedial Action Goal for Groundwater	Units	Source
Benzo(a)anthracene	0.012	µg/L	WAC 173-340-720(3) (1996)
Benzo(a)pyrene	0.012	µg/L	WAC 173-340-720(3) (1996)
Benzo(b)fluoranthrene	0.012	µg/L	WAC 173-340-720(3) (1996)
Benzo(k)fluoranthrene	0.012	µg/L	WAC 173-340-720(3) (1996)
Bis(2-ethylhexyl)phthalate	6.25	µg/L	WAC 173-340-720(3) (1996)
Chlordane	0.0673	µg/L	WAC 173-340-720(3) (1996)
Chrysene	0.012	µg/L	WAC 173-340-720(3) (1996)
Ethylene glycol	32,000	µg/L	WAC 173-340-720(3) (1996)
Pentachlorophenol	0.729	µg/L	WAC 173-340-720(3) (1996)
Pesticides	Compound specific	µg/L	WAC 173-340-720(3) (1996)
Petroleum hydrocarbons	Compound specific	µg/L	WAC 173-340-720(2) (1996)
Phthalates	Compound specific	µg/L	WAC 173-340-720(3) (1996)
Polychlorinated biphenyls	0.2	µg/L	WAC 173-340-720(3) (1996)
Semivolatile organic analytes	Compound specific	µg/L	WAC 173-340-720(3) (1996)
Volatile organic analytes	Compound specific	µg/L	WAC 173-340-720(3) (1996)

[a] The EPA has promulgated a drinking water MCL of 30 µg/L for total uranium (40 CFR 141.66). Based on the isotopic distribution of uranium on the Hanford Site, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in the *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* calculation brief (BHI 2001b).

DCG = derived concentration guide from DOE Order 5400.5
MCL = maximum contaminant level (40 CFR 141)
MPC = maximum permissible concentration
NBS = National Bureau of Standards (Handbook 69 [NBS 1963])
SMCL = secondary maximum contaminant level (40 CFR 143)

Table 2-4. Remedial Action Goals Protective of the Columbia River. (2 Pages)

Contaminant	Remedial Action Goal Protective of the Columbia River	Units	Source
Americium-241	1.2	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Carbon-14	2,000	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Cesium-137	60	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Cobalt-60	100	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Europium-152	200	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Europium-154	60	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Europium-155	600	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Nickel-63	50	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Plutonium-238	1.6	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Plutonium-239/240	1.2	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Strontium-90	8	pCi/L	40 CFR 141.66
Technetium-99	900	pCi/L	MCL calculated from NBS MPC (EPA 2000c)
Thorium-232	2	pCi/L	1/25th of the DCG (DOE Order 5400.5)
Tritium (H-3)	20,000	pCi/L	40 CFR 141.15
Uranium-233/234	30	µg/L[a]	40 CFR 141.66
Uranium-235	30	µg/L[a]	40 CFR 141.66
Uranium-238	30	µg/L[a]	40 CFR 141.66
Antimony	14	µg/L	Federal AWQC (40 CFR 131.36)
Arsenic	0.018	µg/L	Federal AWQC (40 CFR 131.36)
Barium	1,120	µg/L	WAC 173-340-730(3) (1996)
Cadmium	0.91	µg/L	Calculated using hardness =85 ppm $CaCO_3$ (WAC 173-201A-040)
Total chromium	65	µg/L	Calculated using hardness = 85 ppm $CaCO_3$ Federal AWQC (freshwater-chronic) (63 FR 68345)
Chromium (VI)	10	µg/L	State SWQS (freshwater-chronic) (WAC 173-201A)
Lead	2.1	µg/L	Calculated using hardness = 85 ppm $CaCO_3$ (WAC 173-201A-040)
Manganese	50	µg/L	SMCL (40 CFR 143)
Mercury	0.012	µg/L	State AWQC (WAC 173-201)
Selenium	5	µg/L	State AWQC (freshwater-chronic) (WAC 173-201)

Table 2-4. Remedial Action Goals Protective of the Columbia River. (2 Pages)

Contaminant	Remedial Action Goal Protective of the Columbia River	Units	Source
Silver	2.6	µg/L	Calculated using hardness = 85 ppm $CaCO_3$ (173-201A-040)
Sulfate	250,000	µg/L	SMCL (40 CFR 143)
Zinc	91	µg/L	Calculated using hardness = 85 ppm $CaCO_3$ (WAC 173-201A-040)
Benzo(a)anthracene	0.0028	µg/L	Federal AWQC (40 CFR 131.36)
Benzo(a)pyrene	0.0028	µg/L	Federal AWQC (40 CFR 131.36)
Benzo(b)fluoranthrene	0.0028	µg/L	Federal AWQC (40 CFR 131.36)
Benzo(k)fluoranthrene	0.0028	µg/L	Federal AWQC (40 CFR 131.36)
Bis(2-ethylhexyl)phthalate	1.8	µg/L	Federal AWQC (40 CFR 131.36)
Chlordane	0.00057	µg/L	Federal AWQC (40 CFR 131.36)
Chrysene	0.0028	µg/L	Federal AWQC (40 CFR 131.36)
Ethylene glycol	32,000	µg/L	WAC 173-340-730(3) (1996)
Pentachlorophenol	0.28	µg/L	Federal AWQC (40 CFR 131.36)
Pesticides	Compound specific	µg/L	Federal AWQC (40 CFR 131.36)
Petroleum hydrocarbons	Compound specific	µg/L	WAC 173-340-730(3) (1996)
Phthalates	Compound specific	µg/L	Federal AWQC (40 CFR 131.36)
Polychlorinated biphenyls	0.00017	µg/L	Federal AWQC (40 CFR 131.36)
Semivolatile organic analytes	Compound specific	µg/L	WAC 173-340-730(3) (1996)
Volatile organic analytes	Compound specific	µg/L	WAC 173-340-730(3) (1996)

[a] The EPA has promulgated a drinking water MCL of 30 µg/L for total uranium (40 CFR 141.66). Based on the isotopic distribution of uranium on the Hanford Site, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in the *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* calculation brief (BHI 2001b).

AWQC = ambient water quality criteria
DCG = derived concentration guide from DOE Order 5400.5
MCL = maximum contaminant level (40 CFR 141)
MPC = maximum permissible concentration
NBS = National Bureau of Standards (Handbook 69 [NBS 1963])
SMCL = secondary maximum contaminant level (40 CFR 143)
SWQS = surface water quality standards

Table 2-5. Lookup Values (Contaminant-Specific Concentrations in Soil) that Approximate Protection of Groundwater.[a] (3 Pages)

Contaminant	K_d [b] (mL/g)	Groundwater Remedial Action Goal (pCi/L or µg/L)	Contaminant-Specific Concentration in Soil Based on Achieving the Groundwater Remedial Action Goal (RESRAD)[c] (pCi/g or mg/kg)	Single Radionuclide Soil Concentration Corresponding to a 4 mrem/yr Dose (RESRAD) (pCi/g)	100 X Groundwater Remedial Action Goal[d] (pCi/g or mg/kg)	Lookup Value for Protection of Groundwater (pCi/g or mg/kg)
Americium-241	200	1.2	[e]	[e]	NA	[e]
Carbon-14	200	2,000	0.92	2.4	NA	1[f]
Cesium-137	50	60	[e]	[e]	NA	[e]
Cobalt-60	50	100	[e]	[e]	NA	[e]
Europium-152	200	200	[e]	[e]	NA	[e]
Europium-154	200	60	[e]	[e]	NA	[e]
Europium-155	200	600	[e]	[e]	NA	[e]
Nickel-63	30	50	[e]	[e]	NA	[e]
Plutonium-238	200	1.6	[e]	[e]	NA	[e]
Plutonium-239/240	200	1.2	[e]	[e]	NA	[e]
Strontium-90	25	8	[e]	[e]	NA	[e]
Technetium-99	0	900	0.58	3.2[g]	NA	15[f]
Thorium-232	200	2	[e]	[e]	NA	[e]
Tritium (H-3)	0	20,000	15.8	217	NA	15.8
Uranium-233/234	2	30	0.27	0.31	NA	1.1[h]
Uranium-235	2	30	0.27	0.31	NA	0.27
Uranium-238	2	30	0.27	0.31	NA	1.1[h]
Antimony	1.4	6	0.03	NA	0.6	0.6[g]
Arsenic	3	0.058	0.0008	NA	0.0058[j]	20[j]

Table 2-5. Lookup Values (Contaminant-Specific Concentrations in Soil) that Approximate Protection of Groundwater.[a] (3 Pages)

Contaminant	K_d [b] (mL/g)	Groundwater Remedial Action Goal (pCi/L or µg/L)	Contaminant-Specific Concentration in Soil Based on Achieving the Groundwater Remedial Action Goal (RESRAD)[c] (pCi/g or mg/kg)	Single Radionuclide Soil Concentration Corresponding to a 4 mrem/yr Dose (RESRAD) (pCi/g)	100 X Groundwater Remedial Action Goal[d] (pCi/g or mg/kg)	Lookup Value for Protection of Groundwater (pCi/g or mg/kg)
Barium	25	1,120	[e]	NA	112	132[i]
Cadmium	30	5	[e]	NA	0.5	0.5
Total chromium	200	100	[e]	NA	10	18.5[i]
Chromium (VI)	0	80	NA	NA	8	8
Lead	30	15	[e]	NA	1.5	10.2[i]
Manganese	50	50	[e]	NA	5[i]	512[i]
Mercury	30	2	[e]	NA	0.2	0.33[i]
Selenium	150	50	[e]	NA	5	5
Silver	90	80	[e]	NA	8	8
Sulfate	2	250,000	2,260	NA	25,000	25,000
Zinc	30	4,800	480	NA	480	480
Benzo(a)anthracene	360	0.012	[e]	NA	0.0012	0.015[g]
Benzo(a)pyrene	5,500	0.012	[e]	NA	0.0012	0.015[g]
Benzo(b)fluoranthrene	880	0.012	[e]	NA	0.0012	0.015[g]
Benzo(k)fluoranthrene	2,020	0.012	[e]	NA	0.0012	0.015[g]
Bis(2-ethylhexyl)phthalate	110	6.25	[e]	NA	0.625	0.625
Chlordane	51	0.0673	[e]	NA	0.00673	0.02[g]
Chrysene	200	0.012	[e]	NA	0.0012	0.1[g]
Ethylene glycol	0	32,000	[e]	NA	3,200	3,200

Table 2-5. Lookup Values (Contaminant-Specific Concentrations in Soil) that Approximate Protection of Groundwater.[a] (3 Pages)

Contaminant	K_d [b] (mL/g)	Groundwater Remedial Action Goal (pCi/L or µg/L)	Contaminant-Specific Concentration in Soil Based on Achieving the Groundwater Remedial Action Goal (RESRAD)[c] (pCi/g or mg/kg)	Single Radionuclide Soil Concentration Corresponding to a 4 mrem/yr Dose (RESRAD) (pCi/g)	100 X Groundwater Remedial Action Goal[d] (pCi/g or mg/kg)	Lookup Value for Protection of Groundwater (pCi/g or mg/kg)
Pentachlorophenol	53	0.729	[e]	NA	0.0729	0.33[g]
Pesticides	80-700	Compound specific	[e]	NA	Compound specific	Compound specific
Petroleum hydrocarbons	50	Compound specific	[e]	NA	Compound specific	Compound specific
Phthalates	100-1,000	Compound specific	[e]	NA	Compound specific	Compound specific
Polychlorinated biphenyls [k]	530	0.2	[e]	NA	0.02	0.02[g]
Semivolatile organic analytes	3	Compound specific	[e]	NA	Compound specific	Compound specific
Volatile organic analytes	0.2	Compound specific	NA	NA	Compound specific	Compound specific

[a] Reference Appendix C for methodology used to develop values in this table.
[b] Reference Appendix E for methodology used to develop values in this column.
[c] Reference Appendix B for methodology used to develop values in this column.
[d] For nonradioactive contaminants that reach groundwater, per WAC 173-340-740(3)(a)(ii)(A) (1996), contaminant concentrations in soil equal to or less than 100 times the groundwater cleanup level are protective of groundwater. The following example calculation assumes unit density for soil:
Y µg/L x 100 x 1 L/1,000 mL x 1 mL/1g x 1,000 g/1 kg x 1 mg/1,000 µg = 0.Y mg/kg.
[e] The generic RESRAD model predicts the contaminant will not reach groundwater within a 1,000-year time frame. Site-specific RESRAD modeling will be performed based on conditions encountered at the time of remediation.
[f] Contractual RDLs are set at a nominal 1 pCi/g for these isotopes. Actual sample detection limits are expected to be below this value for routine soil analyses. It is expected that the presence of analytes greater than the lookup values will be detected and reported for most samples.
[g] Where cleanup levels are less than practical quantitation limits (PQLs) of the best available analytical methodology, cleanup levels default to the PQLs (WAC 173-340-745[6][c]) (1996). Laboratory contractual RDLs are equivalent to PQLs for these analytes. Periodic review will be performed to determine if alternate or improved methodology has been developed yielding lower analytical detection limits.
[h] Soil activity predicted by RESRAD to achieve the RAG protective of the groundwater is less than the Hanford Site background. Therefore, the soil background concentration is used as the soil lookup value for protection of groundwater.
[i] 100 times the groundwater RAG is less than the Hanford Site soil background. Therefore, the soil background concentration is used as the lookup value for protection of groundwater.
[j] The cleanup value of 20 mg/kg has been agreed to by Tri-Party project managers. The basis for 20 mg/kg is provided in Section 2.1.2.1.
[k] Compliance is based on the sum of all aroclors detected. Values in the table are lookup values based on the generic site model. Site-specific RAGs will be calculated for site closeout verification using site-specific information.
K_d = distribution coefficient
NA = not applicable

Table 2-6. Lookup Values (Contaminant-Specific Concentrations in Soil) that Approximate Protection of the Columbia River.[a] (3 Pages)

Contaminant	K_d (mL/g)	River Protection Remedial Action Goal (pCi/L or µg/L)	Remedial Action Goal (DAF Applied) (pCi/L or µg/L)[b]	Contaminant-Specific Concentration in Soil Based on Achieving the Remedial Action Goal (DAF Applied) – (RESRAD)[c] (pCi/g or mg/kg)	Single Radionuclide Soil Concentration Corresponding to a 4 mrem/yr Dose (RESRAD) (pCi/g)	100 X Remedial Action Goal[d] (DAF Applied) (pCi/g or mg/kg)	Lookup Value for Protection of the Columbia River (pCi/g or mg/kg)
Americium-241	200	1.2	[e]	[f]	[e]	NA	[e]
Carbon-14	200[g]	2,000	4,000	0.95	2.4	NA	1[h]
Cesium-137	50	60	[e]	[e]	[e]	NA	[e]
Cobalt-60	50	100	[e]	[e]	[e]	NA	[e]
Europium-152	200	200	[e]	[e]	[e]	NA	[e]
Europium-154	200	60	[e]	[e]	[e]	NA	[e]
Europium-155	200	600	[e]	[e]	[e]	NA	[e]
Nickel-63	30	50	[e]	[e]	[e]	NA	[e]
Plutonium-238	200	1.6	[e]	[e]	[e]	NA	[e]
Plutonium-239/240	200	1.2	[e]	[e]	[e]	NA	[e]
Strontium-90	25	8	[e]	[e]	[e]	NA	[e]
Technetium-99	0	900	1,800	1.04	3.2	NA	15[h]
Thorium-232	200	2	4[e]	[e]	[e]	NA	[e]
Tritium (H-3)	0	20,000	40,000	106.7	217	NA	106.1
Uranium-233/234	2	30[i]	60	0.54[j]	0.31	NA	1.1[k]
Uranium-235	2	30[i]	60	0.54[j]	0.31	NA	0.31
Uranium-238	2	30[i]	60	0.54[j]	0.31	NA	1.1[k]
Antimony	1.4	14	28	NA	NA	2.8	2.8
Arsenic	3	0.018	0.036	NA	NA	0.0036	20[l]
Barium	25	1,120	2,240	[e,f]	NA	224	224

Table 2-6. Lookup Values (Contaminant-Specific Concentrations in Soil) that Approximate Protection of the Columbia River.[a] (3 Pages)

Contaminant	K_d (mL/g)	River Protection Remedial Action Goal (pCi/L or µg/L)	Remedial Action Goal (DAF Applied) (pCi/L or µg/L)[b]	Contaminant-Specific Concentration in Soil Based on Achieving the Remedial Action Goal (DAF Applied) – (RESRAD)[c] (pCi/g or mg/kg)	Single Radionuclide Soil Concentration Corresponding to a 4 mrem/yr Dose (RESRAD) (pCi/g)	100 X Remedial Action Goal[d] (DAF Applied) (pCi/g or mg/kg)	Lookup Value for Protection of the Columbia River (pCi/g or mg/kg)
Cadmium	30	0.91	1.82	[e,f]	NA	0.182	0.2
Total chromium	200	65	130	[e]	NA	13	18.5
Chromium (VI)	0	10	20	NA	NA	2	2
Lead	30	2.1	4.2	[e]	NA	0.42	10.2[j]
Manganese	50	50	100	[e]	NA	10	512[j]
Mercury	30	0.012	0.024	[e]	NA	0.0024	0.33[j]
Selenium	150	5	10	[e]	NA	1	1[f]
Silver	90	2.6	5.2	[e]	NA	0.52	1[f]
Sulfate	2	250,000	500,000	4,520	NA	50,000	25,000[m]
Zinc	30	91	182	[e]	NA	18.2	67.8[j]
Benzo(a)anthracene	360	0.0028	0.0056	[e]	NA	0.00056	0.015[f]
Benzo(a)pyrene	5,500	0.0028	0.0056	[e]	NA	0.00056	0.015[f]
Benzo(b)fluoranthrene	880	0.0028	0.0056	[e]	NA	0.00056	0.015[f]
Benzo(k)fluoranthrene	2,020	0.0028	0.0056	[e]	NA	0.00056	0.015[f]
Bis(2-ethylhexyl) Phthalate	110	1.8	3.6	[e]	NA	0.36	0.36
Chlordane	51	0.00057	0.00114	[e]	NA	0.000114	0.02[f]
Chrysene	200	0.0028	0.0056	[e]	NA	0.00056	0.1[f]
Ethylene glycol	100	32,000	64,000	[e]	NA	6,400	6,400
Pentachlorophenol	53	0.28	0.56	[e]	NA	0.056	0.33[f]
Pesticides	80-700	Compound specific	Compound specific	[e]	NA	Compound specific	Compound specific

Table 2-6. Lookup Values (Contaminant-Specific Concentrations in Soil) that Approximate Protection of the Columbia River.[a] (3 Pages)

Contaminant	K_d (mL/g)	River Protection Remedial Action Goal (pCi/L or µg/L)	Remedial Action Goal (DAF Applied) (pCi/L or µg/L)[b]	Contaminant-Specific Concentration in Soil Based on Achieving the Remedial Action Goal (DAF Applied) – (RESRAD)[c] (pCi/g or mg/kg)	Single Radionuclide Soil Concentration Corresponding to a 4 mrem/yr Dose (RESRAD) (pCi/g)	100 X Remedial Action Goal[d] (DAF Applied) (pCi/g or mg/kg)	Lookup Value for Protection of the Columbia River (pCi/g or mg/kg)
Total petroleum hydrocarbons	50	Compound specific	Compound specific	[e]	NA	Compound specific	Compound specific
Phthalates	100-1,000	Compound specific	Compound specific	[e]	NA	Compound specific	Compound specific
Polychlorinated biphenyls[j]	530	0.00017	0.00034	[e]	NA	0.000034	0.02[f]
Semivolatile organic analytes	3	Compound specific	Compound specific	[e]	NA	Compound specific	Compound specific
Volatile organic analytes	0.2	Compound specific	Compound specific	N/A	NA	Compound specific	Compound specific

[a] Reference Appendix C for methodology used to develop values in this table. Values in the table are lookup values based on the generic site model. Site-specific RAGs will be calculated for site closeout verification using site-specific information.
[b] Reference Appendix D for methodology used to develop DAF RAGs.
[c] Reference Appendix C for methodology used to develop values in this column.
[d] Contractual RDLs are set at a nominal 1 pCi/g for these isotopes. Actual sample detection limits are expected to be below this value for routine soil analyses. It is expected that the presence of analytes greater than the lookup values will be detected and reported for most samples.
[e] The generic RESRAD model predicts the contaminant will not reach groundwater or the Columbia River within a 1,000-year time frame. Site-specific RESRAD modeling will be performed based on conditions encountered at the time of remediation.
[f] 100 times the DAF times the RAG protective of the Columbia River is less than the RDL. Therefore, the RDL is used as the soil lookup value for protection of the Columbia River.
[g] The Kd of 200 for C-14 will be applicable to the 100 Areas, except for the 100-K Area, where a site-specific value will be established prior to close out of waste sites.
[h] Where cleanup levels are less than practical quantitation limits (PQLs) of the best available analytical methodology, cleanup levels default to the PQLs (WAC 173-340-745[6][c]) (1996). Laboratory contractual RDLs are equivalent to PQLs for these analytes. Periodic review will be performed to determine if alternate or improved methodology has been developed yielding lower analytical detection limits.
[i] The units for uranium-233/234, uranium-235, and uranium-238 are µg/L.
[j] 100 times the DAF times the RAG protective of the Columbia River is less than the Hanford Site soil background. Therefore, the soil background is used as the soil lookup value for protection of the Columbia River.
[k] Soil activity predicted by RESRAD to achieve the RAG protective of the Columbia River is less than the Hanford Site background. Therefore, the soil background concentration is used as the soil lookup value for protection of the Columbia River.
[l] The cleanup value of 20 mg/kg has been agreed to by Tri-Party project managers. The basis for 20 mg/kg is provided in Section 2.1.2.1.
[m] Contaminant specific concentrations based on RESRAD value less than the RDL, therefore, the RDL is used for the soil lookup value for the protection of groundwater.
K_d = distribution coefficient
NA = not applicable

Table 2-7. Lookup Values Summary: Contaminant-Specific Cleanup Levels. (3 Pages)

Contaminant	First Remedial Action Objective – Protection from Direct Exposure		Second Remedial Action Objective – Protection of Groundwater/Columbia River		Lookup Values Summary	
	Remedial Action Goal for Nonradionuclides (mg/kg)	Remedial Action Goal for Radionuclides (pCi/g)	Contaminant-Specific Concentration in Soil Protective of Groundwater (pCi/g or mg/kg)	Contaminant-Specific Concentration in Soil Protective of the Columbia River (pCi/g or mg/kg)	Remedial Action Goal – Shallow Zone (<4.6 m [15 ft])[a]	Remedial Action Goal – Deep Zone (>4.6 m [15 ft])[b, c]
Americium-241	NA	31.1	[d]	[d]	31.1	[d]
Carbon-14	NA	5.16	[d]	[d]	5.16	[d]
Cesium-137	NA	6.2	[d]	[d]	6.2	NA[d]
Cobalt-60	NA	1.4	[d]	[d]	1.4	NA[d]
Europium-152	NA	3.3	[d]	[d]	3.3	NA[d]
Europium-154	NA	3	[d]	[d]	3	NA[d]
Europium-155	NA	125	[d]	[d]	125	NA[d]
Nickel-63	NA	4,026	[d]	[d]	4,026	NA[d]
Plutonium-238	NA	37.4	[d]	[d]	37.4	NA[d]
Plutonium-239/240	NA	33.9	[d]	[d]	33.9	NA[d]
Strontium-90	NA	4.5	[d]	[d]	4.5	NA[d]
Technetium-99	NA	15[e]	15[e]	15[e]	15[e]	15[e]
Thorium-232	NA	1.3	[d]	[d]	1.3	NA[d]
Tritium (H-3)	NA	510	15.8	106.8	15.8	15.8
Uranium-233/234	NA	1.1[f]	1.1[f]	1.1[f]	1.1[f]	1.1[f]
Uranium-235	NA	0.84	0.27	0.31	0.84	0.27
Uranium-238	NA	1.1[f]	1.1[f]	1.1[f]	1.1[f]	1.1[f]
Antimony	32	NA	0.6[e]	2.8	0.6[d]	0.6[e]

Table 2-7. Lookup Values Summary: Contaminant-Specific Cleanup Levels. (3 Pages)

Contaminant	First Remedial Action Objective – Protection from Direct Exposure		Second Remedial Action Objective – Protection of Groundwater/Columbia River		Lookup Values Summary	
	Remedial Action Goal for Nonradionuclides (mg/kg)	Remedial Action Goal for Radionuclides (pCi/g)	Contaminant-Specific Concentration in Soil Protective of Groundwater (pCi/g or mg/kg)	Contaminant-Specific Concentration in Soil Protective of the Columbia River (pCi/g or mg/kg)	Remedial Action Goal – Shallow Zone (<4.6 m [15 ft])[a]	Remedial Action Goal – Deep Zone (>4.6 m [15 ft])[b, c]
Arsenic	20[g]	NA	20[g]	20[g]	20[g]	20[g]
Barium	5,600	NA	132[f]	224[f]	132[f]	132[f]
Cadmium	13.9	NA	0.5	0.2[e]	0.2[e]	0.2[e]
Total chromium	80,000	NA	18.5[f]	18.5[f]	18.5[f]	18.5[f]
Chromium (VI)	2.1	NA	8	2	2	2
Lead	353	NA	10.2[f]	10.2[f]	10.2[f]	10.2[f]
Manganese	11,200	NA	512[f]	512[f]	512[f]	512[f]
Mercury	24	NA	0.33[f]	0.33[f]	0.33[f]	0.33[f]
Selenium	400	NA	5	1	1	1
Silver	400	NA	8	0.52	0.52	0.52
Sulfate	NA	NA	25,000	25,000	25,000	25,000
Zinc	24,000	NA	480	67.8[f]	67.8[f]	67.8[f]
Benzo(a)anthracene	0.137	NA	0.05[e]	0.05[e]	0.05[e]	0.05[e]
Benzo(a)pyrene	0.137	NA	0.015[e]	0.015[e]	0.015[e]	0.015[e]
Benzo(b)fluoranthrene	0.137	NA	0.015[e]	0.015[e]	0.015[e]	0.015[e]
Benzo(k)fluoranthrene	0.137	NA	0.015[e]	0.015[e]	0.015[e]	0.015[e]
Bis(2-ethylhexyl)phthalate	71.4	NA	0.625	0.36	0.36	0.36
Chlordane	0.769	NA	0.02[e]	0.02[e]	0.02[e]	0.02[e]
Chrysene	0.137	NA	0.1[e]	0.1[e]	0.1[e]	0.1[e]

Table 2-7. Lookup Values Summary: Contaminant-Specific Cleanup Levels. (3 Pages)

Contaminant	First Remedial Action Objective – Protection from Direct Exposure		Second Remedial Action Objective – Protection of Groundwater/Columbia River		Lookup Values Summary	
	Remedial Action Goal for Nonradionuclides (mg/kg)	Remedial Action Goal for Radionuclides (pCi/g)	Contaminant-Specific Concentration in Soil Protective of Groundwater (pCi/g or mg/kg)	Contaminant-Specific Concentration in Soil Protective of the Columbia River (pCi/g or mg/kg)	Remedial Action Goal – Shallow Zone (<4.6 m [15 ft])[a]	Remedial Action Goal – Deep Zone (>4.6 m [15 ft])[b, c]
Ethylene glycol	160,000	NA	3,200	6,400	3,200	3,200
Pentachlorophenol	8.33	NA	0.33[e]	0.33[e]	0.33[e]	0.33[e]
Pesticides	Compound specific	NA	Compound specific	Compound specific	Compound specific	Compound specific
Petroleum hydrocarbons	Compound specific	NA	Compound specific	Compound specific	Compound specific	Compound specific
Phthalates	Compound specific	NA	Compound specific	Compound specific	Compound specific	Compound specific
Polychlorinated biphenyls [h]	0.5	NA	0.02[e]	0.02[e]	0.02[e]	0.02[d, e]
Semivolatile organic analytes	Compound specific	NA	Compound specific	Compound specific	Compound specific	Compound Specific
Volatile organic analytes	Compound specific	NA	Compound specific	Compound specific	Compound specific	Compound specific

[a] In the shallow zone, cleanup must achieve the direct exposure RAO and the groundwater/Columbia River RAO; therefore, the lowest value among the "Protection from Direct Exposure," "Protective of Groundwater," and "Protective of the Columbia River" values is the applicable lookup value.
[b] In the deep zone, cleanup must achieve the groundwater/Columbia River RAO; therefore, the lowest value between the "Protective of Groundwater" and the "Protective of the Columbia River" values is the applicable lookup value.
[c] Deep zone RAGs are not applicable for protection from direct exposure to radionuclides because a potentially exposed individual in a basement is protected from gamma radiation by 0.9 m (3 ft) of soil and a concrete floor.
[d] The generic RESRAD model predicts the contaminant will not reach groundwater within a 1,000-year time frame. Site-specific RESRAD modeling will be performed based on conditions encountered at the time of remediation.
[e] The RAG is below the RDL. The value presented is the RDL (see Tables 2-1, 2-5, and 2-6).
[f] Contractual RDLs are set at a nominal 1 pCi/g for these isotopes. Actual sample detection limits are expected to be below this value for routine soil analyses. It is expected that the presence of analytes greater than the lookup values will be detected and reported for most samples.
[g] The cleanup value of 20 mg/kg has been agreed to by Tri-Party project managers. The basis for 20 mg/kg is provided in Section 2.1.2.1.
[h] Where cleanup levels are less than practical quantitation limits (PQLs) of the best available analytical methodology, cleanup levels default to the PQLs (WAC 173-340-745[6][c]) (1996). Laboratory contractual RDLs are equivalent to PQLs for these analytes. Periodic review will be performed to determine if alternate or improved methodology has been developed yielding lower analytical detection limits.
NA = not applicable

3.0 REMEDIAL ACTION APPROACH AND MANAGEMENT

Initiation of full-scale remedial action to accomplish the goals set forth in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) requires completion of numerous interdependent tasks. Key tasks are illustrated in the flowchart presented in Figure 3-1. Activities or documents requiring regulatory agency approval are appropriately designated.

3.1 REMEDIAL ACTION OPERATING SYSTEM

Remediation, in accordance with the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b), requires soil excavation, treatment as appropriate or required, disposal, and backfilling. Clean overburden can be segregated and stockpiled onsite for backfill purposes. For the purpose of this discussion, the system design is divided into five subsystems: pre-excavation, excavation, material handling and transportation, soil characterization and analysis, and decontamination. These subsystems merge to become the operating remediation system.

3.1.1 Pre-Excavation

Site setup involves stripping the existing organic materials and debris; establishing site utility services, as required; and constructing roads, field support facilities, and survey and decontamination stations (where loaded containers are surveyed for radioactive contamination and decontaminated, if necessary). Stripping removes surface and near-surface materials (including roots, organic materials, vegetation, cobbles, and boulders) that will be stockpiled and used later as a top dressing and planting medium for revegetation. After backfill of cleanup sites, revegetation will be conducted as discussed in Appendix H. Hanford Site roadways are constructed of existing site materials, except the surface course, which is imported. Field support facilities provide a changing area, lunchroom, and offices at individual sites. The changing area includes lockers, benches, and storage for both clean and contaminated personal protection equipment.

3.1.2 Excavation

Excavation begins when the in situ analytical system has obtained sufficient data to characterize the site's initial conditions (initial conditions are used for database purposes) and the excavation subcontractor receives notification to begin work. Excavation of the designated work site involves removing clean and contaminated soils, debris, and anomalous waste present within the sites boundaries. The soils exposed during excavation are monitored for radiological and hazardous constituents as defined in the 100 Area SAP (DOE-RL 2004) and the 100 Area Burial Grounds SAP (DOE-RL 2001a). The in situ analytical system provides in situ characterization and analysis of radiologically-contaminated soil.

Materials are excavated using standard equipment and construction methods for both shallow lifts and deep excavations. Containers (described in Section 3.1.3) are relocated from the container staging area to the excavation site and are prepared with a plastic liner. Excavated

materials are placed in the lined containers and, depending on the material composition, are designated for transport to either ERDF, a clean material storage area, or a soil treatment storage area.

For all burial grounds and dump sites, materials will be excavated with standard construction equipment using one or more of the following techniques to sort and disposition waste:

- **Mechanical Grizzly or Power Screen.** Material will be excavated using heavy equipment and passed through a large sieve-type apparatus (grizzly) or power screen with 15-cm (6-in.) openings. Observation, sorting, and radiological surveys of the material may be performed at the dig face, on material retained by the grizzly or power screen, and on material passing through the grizzly or power screen.

- **0.3-m (1-ft)-Horizontal Lifts.** The exposed surface of each lift will be visually observed, radiologically screened, sorted (as necessary) to remove anomalous material and large debris, and then excavated using heavy equipment and stockpiled. Material will also be observed as it is being stockpiled for any additional sorting that is appropriate.

- **0.3-m (1-ft)-Diagonal (Sloping) Lifts.** The exposed surface of each lift will be visually observed as it is raked down the face of an excavation slope using heavy equipment. Material will be radiologically surveyed at the bottom of the slope, sorted as necessary, and stockpiled. Material will also be observed as it is being stockpiled for any additional sorting that is appropriate.

- **Bulk Excavate and Spread.** Material will be bulk excavated using heavy equipment, and then spread onto the ground in approximately 0.3-m (1-ft) layers. The shallow layer of material will then be radiologically screened and sorted.

- **0.2-m (0.5-ft)-Loader Lifts.** The surface of each lift will be visually observed, radiologically screened, sorted as necessary, and then excavated using the front-end loader. This technique is best suited for areas with little visible debris.

In excavation areas where there are large quantities of observed lead containing materials (e.g., lead bricks, lead slag) intermixed with the soil, a variation of these excavation/sorting methods may be used. Observation, sorting, and radiological surveys for removal of the large materials and nonlead anomalous materials will be performed using one or more of the methods described above. The remaining materials may then be identified as meeting the RCRA definition of "soil" per 40 CFR 268.2, and considered hazardous/dangerous due to lead contamination. In such cases, the soil will be sampled in accordance with the 100 Area SAP (DOE-RL 2004) and transported to ERDF or other approved facility for treatment (stabilization) and subsequent disposal.

Sluicing (use of water) is not an acceptable excavation method. Excavation operations in areas where there is known drummed waste will be performed using horizontal lifts (as described above). In all other cases, selection of the excavation/sorting method will be made by the remedial action subcontractor, and the method may be changed to another approved method

based on the type of material being excavated. Alternate excavation/sorting methods (e.g., vacuum systems, metal detectors) may be proposed by the project on a case-by-case basis and implemented with concurrence from the RL and EPA project representatives. During the excavation process, care will be taken to prevent the breakage or puncture of unopened or sealed cans, jars, and containers.

Material that has been excavated using one of the approved sorting techniques will be directed in one of the following ways:

- Material that is above cleanup levels and within ERDF waste acceptance criteria (BHI 2002) will be loaded into plastic-lined, roll-off containers on project haul trucks at the excavation site. Asbestos-containing material will be double bagged or put into roll-off containers that are double lined. The loaded containers will be covered (i.e., by folding and securing the liner over the load) and surveyed prior to being transported to a container transfer facility (CTF) using the project haul trucks. If contamination is found on a container exterior, the container will be decontaminated using standard equipment and techniques. In the unlikely event that a container cannot be decontaminated using standard methods, advanced techniques will be implemented, as necessary. Released containers will be off-loaded and staged in the CTF until applicable shipping papers are completed. When the shipping papers have been completed, ERDF transport vehicles will enter the CTF, pick up the full containers, and haul them to ERDF.

- Anomalous waste (e.g., drums, intact containers, elemental lead, unknown materials) and/or above cleanup level material that is not within ERDF waste acceptance criteria (BHI 2002) will be set aside within the AOC or within designated staging piles for further characterization and final disposition (see Section 4.0). As needed, appropriate inerting materials may be added to drums that contain waste with pyrophoric properties. Waste that is subsequently identified for ERDF disposal or staging will be directed as described previously, with the exception that drummed waste will be transported on flatbed trailers. Excavated material that must be sent to facilities other than ERDF for treatment and/or disposal will be stockpiled or drummed and staged within the AOC until loaded for offsite shipment. Identification of an appropriate treatment and/or disposal facility, and arrangements for loading and transporting excavated material to facilities other than ERDF will be made on a case-by-case basis by the project in coordination with Environmental Restoration Contractor (ERC) waste management representatives. Prior to shipment, an offsite determination must be obtained from the EPA for receipt, storage, treatment, and disposal of CERCLA waste at the identified treatment/disposal facility.

- Material that is free of anomalous waste and below cleanup levels may be stockpiled onsite for use as backfill material.

Containers destined for ERDF are surveyed (if required) and decontaminated (if required) prior to entering the clean work area. Survey stations provide sheltered work areas where loaded containers are covered (i.e., by folding and securing the liner over the load) and surveyed for radioactive contamination. If contamination is found on a container's exterior, contamination is removed at the survey and decontamination stations. In the unlikely event that a container

cannot be decontaminated with the normal equipment and techniques available at the survey and decontamination station, an evaluation will be made of the advanced and appropriate techniques, and these will be implemented.

After containers are released, they are relocated to a clean container transfer area. When the shipping papers have been completed and a transport vehicle is available, the containers are placed onto clean trailers for hauling to ERDF. The trucks and trailers used for hauling within the excavation site remain in the contaminated area and do not require decontamination. Empty containers being returned from ERDF are loaded onto excavation site trailers for refilling.

Activities are guided during excavation from data obtained by the in situ analytical system or in-process sampling using quick-turnaround laboratory analyses working concurrently with excavation. These data are used to continually update the site characteristics database. Additional information on characterization during excavation is presented in the 100 Area SAP (DOE-RL 2004).

Dust control is maintained on the haul roads, at the excavation site, and at the clean soil storage area, as well as at the contingency storage area for soils potentially requiring treatment. Use of water for dust control at the excavation site will be minimized. All material being transported from the excavation site is covered, contained, or has moisture content adequate for inhibiting dust without being covered or contained during transport and disposal. The moisture content of bulk contaminated material destined for ERDF disposal is in accordance with ERDF waste acceptance criteria (BHI 2002). Dust fixative is applied to open excavation sites when potential concerns arise about health issues or the spread of contamination.

Exposed dig faces and excavated material will be surveyed and characterized for appropriate disposition. When RAOs have been met and verified, site backfill will be authorized. Clean backfill material is obtained from clean material storage areas, approved/clean rubble, and local borrow sites. Excavations are backfilled so the sites conform to the local topography.

3.1.3 Material Handling and Transportation

All contaminated materials, including excavated soils, debris, disposable protective clothing, air filters, and trash, whether stored or transported to ERDF, require proper packaging, handling, and transporting. The design of the packaging, handling, and transportation systems involves an efficient method of transporting bulk contaminated materials from each contaminated area to a clean work area.

The proposed containers for hauling excavated materials are open-top, roll-off boxes with inside dimensions of approximately 6.10 m (20 ft) long, 2.13 m (84 in.) wide, 1.32 m (52 in.) tall, with a maximum payload of 18.1 metric tons (20 tons),. The steel containers have 0.6-cm (0.25-in.)--thick floors, 0.5-cm (0.18-in.)-thick walls, and hinged locking rear gates. Other features include steel construction, a single top-hinged or side-hinged end gate, 20.3-cm (8-in.)-diameter wheels at gate end, painted identification number, a heavy duty top-edge side rail, and fork pockets to accommodate lifting by forklift. A sufficient number of containers are available to ensure uninterrupted excavation operations. The open-top construction allows for top loading, and the top-hinged end gate allows the contents to be emptied by dump-bed trailers.

Haul trailers are used to transport the containers from the excavation area to the CTF, as well as to ERDF. The containers are transported on roll-on/roll-off trailers towed by conventional tractor units. The trailers and tractors are suitable for operating on sloped excavation access ramps and other off-road ramps, and also meet applicable DOT requirements. The wheel wells of the tractors tires are constructed to prevent soils from being thrown onto the trailer and its containers.

Dump-bed haul trailers are used to transport containers and to deposit excavated materials at the clean material storage area and, if required, at the LDR material storage area. The dump-bed haul trailers have hydraulic dumping capabilities that make them suitable for handling the containers, as all of the dumping and operational controls for the trailers are located inside the motive tractor cab. Handling of both loaded and empty containers will be roll-on and roll-off; however, the containers are also equipped with bottom-lift forklift pockets.

Containers are transported over existing Hanford Site roadways to ERDF. Empty containers returning from ERDF are removed from the clean tractor trailers at the container transfer area and placed onto tractor trailers for refilling. A queue, maintained near the end of the container transfer area, provides temporary storage for full and/or empty containers if a backlog of containers develops or is required. The queue helps to maintain a continuous flow of materials through the transportation system by allowing excavation to continue for a limited time if the trucks running to ERDF are not operating, or it allows ERDF trucks to continue to run for a limited time if the excavators are not operating.

3.1.4 Soil and Debris Characterization and Analysis

Soil and debris characterization and analysis is based on the observational approach. This approach relies on recorded information from historical process operations, including effluent discharges and waste disposal records, and information from limited field investigations on the nature and extent of existing contamination combined with a "characterize-and-remediate-in-one-step" methodology. The latter methodology consists of site excavation, field screening, and in-process sampling for contaminants at sites where remedial action and cleanup goals have been selected. Remediation proceeds until it can be demonstrated through a combination of field screening, in-process sampling, and confirmatory sampling that cleanup goals have been achieved.

During excavation, soils are monitored for both radiological and chemical constituents. For the radioactive liquid effluent sites, gamma-emitting radiological constituents are used as the primary "indicator" contaminants to guide excavation for the following reasons:

- Data indicate, in general, that when gamma-emitting radionuclide concentrations are less than cleanup criteria, concentrations of nonradiological constituents are also less than cleanup criteria.

- Gamma-emitting radionuclide contaminants are readily detected with field instruments at levels specified for cleanup, whereas alpha- and beta-emitting radionuclides and chemical constituents are not readily detected.

At other sites, monitoring methods depend on the anticipated contaminants. If field screening methodologies are not available for the primary or indicator contaminants, in-process samples may be collected for quick-turnaround laboratory analysis to guide excavation.

On initial completion of excavation at each waste site, cleanup verification sampling and analysis will be performed to confirm attainment of cleanup criteria for all COCs. If analytical results indicate that cleanup criteria have not been achieved, then excavation will resume with appropriate analyses as guidance.

Each shipment of soil/debris transported to ERDF is referenced to a waste profile that is representative of the material found at the site. The waste profile is "in effect" until the characteristics of the excavation site have changed significantly. A large increase in radioactivity levels for any of the expected constituents, or the detection of previously unknown contaminants, would trigger the issuance of an updated waste profile. If the waste profile, as indicated by field screening, approaches ERDF waste acceptance criteria (BHI 2002), a sampling event will be initiated.

3.1.5 Decontamination

Decontamination to support excavation activities is provided primarily by the following two methods: (1) wet methods using pressure washers and steam cleaners, and (2) dry methods using wiping and high-efficiency particulate air-filtered vacuum cleaners.

The following are best management practices (BMPs) for the wet cleaning and/or decontamination of heavy equipment and vehicles working directly in contaminated areas, when cleaning and/or decontamination water is not collected.

General BMP. This applies to all equipment cleaning/decontamination activities within a waste site.

- Decontamination should be conducted within the waste site to prevent the spread of contaminants.
- The amount of water used to clean equipment should be minimized.
- Raw or potable water should only be used.
- Soaps, detergents, or other cleaning agents should not be added to wash water.
- Pressure washing will normally use cold water (hot water may be used to avoid icing).
- Steam cleaning may be used only after other decontamination methods prove to be ineffective.
- Decontamination practices will be documented in the daily log.
- Personnel responsible for equipment decontamination will be trained to this BMP.

Ongoing Remediation Site BMP. This applies to equipment being washed and/or decontaminated within sites that have ongoing remediation.

- Equipment washing/decontamination will be located in areas with ongoing waste removal.
- Spent wash water and associated contamination will be kept within the AOC.
- Pre- and post-washing/decontamination contaminant surveys are not required.
- The project may opt to collect wash water for reuse in the excavation or to be sent for treatment.

Completed Remediation Site BMP. This applies to equipment being washed and/or decontaminated within sites that have achieved preliminary remediation goals.

- At the "completion" of excavation activities at a site, the project may opt to transport the equipment to a nearby site that is being remediated (by excavation) to perform equipment washing/decontamination (as described above).
- Equipment washing/decontamination to be performed at the site will be physically located within the remediated site.
- A pre- and post-survey will be performed on the washing/decontamination area to assess and remediate (if required) areas affected by the activity.
- When the washing/decontamination is set up in an area of a site that has apparently attained the preliminary remediation goals, sampling of the area will be performed per the 100 Area SAP (DOE-RL 2004).
- The project may opt to perform other methods of equipment washing and/or decontamination for a completed site (e.g., wrap the equipment for transfer to a decontamination pad, provide for a temporary facility at the site to collect wash water, fix the contamination to the equipment).

3.2 PROJECT SCHEDULE AND COST

Project schedules are developed in accordance with Bechtel Hanford, Inc. (BHI) procedure manual ERC-PC-01, *Baseline and Funds Management System,* at several different levels consistent with the project work breakdown structure (WBS). The WBS-based schedules promote complete and consistent compliance with DOE Order 4700.1, *Project Management System,* and cost and schedule control systems criteria. Large-scale (multi-year) projects encompassing multiple smaller projects (e.g., each waste site remediation can be considered a single project, while the entire project is to remediate all waste sites) are generally planned and scheduled using a phased approach. Near-term (less than 1 year) work is usually planned and

scheduled at a detail activity level using logic ties to establish and maintain a true critical-path schedule. Logic-driven, critical-path schedules, commonly referred to as the critical-path method, are used to manage and control the daily progress of the work and provide early warning of problem areas. Forecast planning and scheduling (1 to 2 years) can be performed at the task-package level, and long-range planning and scheduling (greater than 2 years) is performed at the work package or cost account levels.

3.2.1 Remediation Scheduling

Post-ROD planning and scheduling for remediation projects follows a distinct pattern consistent with the work package level of the WBS. Planning elements at this level include, but are not limited to or bound by, remedial design, procurement, remedial actions, and site closures.

3.2.1.1 Remedial Design. Remedial design includes all design work, project plans, project procedures, remediation cost estimating, drawings, and specifications required to procure a remediation subcontractor to perform the remediation. Project plans will define the data-gathering requirements to ensure worker health and safety and to eventually prove the waste sites meet remediation goals and standards. Project procedures will define the "how to" of obtaining data and controlling the site activities. Planning documentation is discussed further in Section 3.4. Scope of work, design drawings, and specifications will provide the necessary tools to procure a subcontractor.

3.2.1.2 Procurement. Procurement includes soliciting qualified subcontractors, preparing requests for proposals (RFPs), awarding the subcontract, coordinating submittal, negotiating change orders, and receiving and controlling subcontractor request for payments. The RFP documents are prepared as part of the remedial design. Procurement must assemble the RFP and contract documents.

3.2.1.3 Remedial Actions. Remedial action includes implementing the remedial design and project plans. The implementation will include, but will not be limited to, subcontractor oversight, excavation, material handling, analytical system operations, worker health and safety, radiological controls, data gathering, and overall daily conduct of operations. Subcontractor oversight occurs through administration of subcontract documents. Project specifications and procedures define the "how to" of excavation, material handling, analytical system operation, data gathering, and overall daily conduct of operations. Worker health and safety and radiological control requirements are included in site health and safety plans and permits.

3.2.1.4 Site Verification and Closeout. Site verification and closeout includes, but is not limited to, data evaluation, data interpretation, preparation of documentation, and updating the Hanford Site Waste Information Data System (WIDS).

3.2.2 100 Area Interim Remedial Action Schedule

With the signing of the Interim Action ROD (EPA 1995) in September 1995, RL committed to perform remedial actions over the next several years on 37 waste sites within the 100 Area. In a 1997 ROD Amendment (EPA 1997a), RL committed to perform remedial actions at an

additional 34 waste sites. In the July 1999 Remaining Sites ROD (EPA 1999), RL committed to perform remedial actions at 46 remaining waste sites and use the plug-in approach at 161 other remaining sites. In the September 2000 100 Area Burial Grounds ROD (EPA 2000b), RL committed to perform remedial actions at 45 burial grounds. Three of these sites (i.e., 100-D-5, 100-D-6, and 100-D-46) were remediated during remediation of liquid waste disposal sites with which they were associated. A schedule for all Interim Action ROD, ROD Amendment, Remaining Sites ROD, and 100 Area Burial Grounds ROD waste sites is provided in Figure 3-2. The schedule is based on factors defined by the Tri-Parties with public involvement (Appendix F). These factors include the following:

- Remedial actions shall occur concurrently in two reactor areas within 15 months of issuance of the Interim Action ROD. The initial two reactor areas are 100-B/C and 100-D/DR.

- Remedial actions will be initiated in the 100-H Area on completion of remedial actions in either the 100-B/C or the 100-D/DR Area (see the *Richland Environmental Restoration Project Fiscal Year 2001-2003 Detailed Work Plan* [DWP] [DOE-RL 2000]).

- The methodology for prioritizing waste sites is summarized as initiating at the waste sites closest to the Columbia River and moving south toward the reactor buildings. This methodology incorporates the four factors defined by the Tri-Parties: (1) waste site impacts or impacts to groundwater, primarily due to chromium; (2) waste site proximity to the Columbia River; (3) waste site is a large contributor to surface radiation exposure; and (4) waste site follows logical construction management practices.

- If waste sites are added, upon regulatory agency review and approval, the schedule will be updated and the additional waste sites will be integrated into the remedial action.

- In accordance with an ESD to the ERDF ROD (EPA 1996b) to authorize disposal of Environmental Restoration Program investigation-derived waste (IDW) in ERDF, RL developed an integrated schedule for disposal of these wastes. The schedule presented in the DWP (DOE-RL 2000) identifies this activity (i.e., for those wastes associated with the 100 Area RODs).

The remedial action schedules for cleanup of the 100 Area are driven by a set of milestones that have been established as part of the Tri-Party Agreement (Ecology et al. 1998), a number of which have recently been renegotiated. Schedule commitments associated with all Interim Action ROD, ROD Amendment, Remaining Sites ROD, and 100 Area Burial Grounds waste sites are summarized in Table 3-1 and are shown in Figure 3-2.

3.2.3 Project Cost

Cost estimates for remediation of waste sites listed in this document were prepared as part of their respective feasibility studies and subsequently carried forward into their proposed plans and RODs. Cost estimates were prepared with an accuracy of -30% and +50% to support evaluation

and remedial alternative and selection of a remedy. Cost estimates are updated based on design work.

3.3 PROJECT TEAM

The term project team, in the strictest sense, means all individuals working to accomplish a particular project. According to this definition, there are numerous members of the project team. For the purpose of this discussion, the project team will be limited to the ERC or River Corridor Contractor, RL, EPA, and Ecology.

3.3.1 Regulatory Agencies

The regulatory agencies for the CERCLA remediation activities in the 100 Area of the Hanford Site are EPA and Ecology. The lead regulatory agency will depend on the OU area where the remediation activities are taking place (e.g., the EPA is currently the lead regulatory agency for 100-B/C, 100-F, and 100-KE/KW, and Ecology is the lead regulatory agency for 100-D/DR, 100-H, and 100-N). The lead regulatory agency may request support from the nonlead agency, if necessary. The lead regulatory agency is responsible for overseeing the activities to ensure that all applicable regulatory requirements are met.

3.3.2 U.S. Department of Energy, Richland Operations Office

RL is the government agency responsible for the remedial actions throughout the 100 Area and the remaining Hanford Site. RL has assigned project managers to each major area and task involved with remediation activities.

RL project managers are responsible for the management of their assigned activities, including scope, budget, schedule, quality, personnel, communication, risk/safety, contracts, and regulatory interface.

3.3.3 Environmental Restoration Contractor

BHI, along with its pre-selected subcontractors CH2M HILL Hanford, Inc. and Eberline Services Hanford, Inc., make up the ERC Project Team. Under the direction of the manager of remedial action projects, project managers are assigned consistent with the project management assignments of RL to promote a single point-of-contact management philosophy. Each ERC project manager must develop, maintain, and oversee individual project teams. The project team will include all required disciplines to accomplish the remedial actions in a safe, efficient, and compliant manner.

3.4 PLANNING DOCUMENTATION

Planning documentation to implement remedial actions includes the preparation of a set of field documents required to guide the work being performed. Examples include analytical system

work instructions, site support systems work instructions, and radiation work permits. Some documentation requires the review and concurrence of RL and the regulatory agencies. In accordance with the 100 Area RODs, SAPs are already identified as primary documents. Other tiered documents (e.g., remedial designs, air monitoring plans [AMPs]) may require approval by the lead regulatory agency, if requested, and will follow the processes identified below.

3.4.1 Field Procedures

Field procedures provide guidance to the site workers during field work execution. The procedures define the scope, operations, progression of field work, personnel control requirements, radiological posting requirements, and analytical system guidance. The procedures also provide contingency plans should unexpected conditions arise. The site superintendent must execute the field operations in compliance with the field procedure.

3.4.2 Sampling and Analysis Plans

The 100 Area SAP (DOE-RL 2004) and the 100 Area Burial Grounds SAP (DOE-RL 2001a) provide guidance to field samplers during the field work specific to a remediation site or group of sites. The relationship between this RDR/RAWP and the SAPs is illustrated in Figure 3-3. Sampling is performed to meet five objectives: excavation guidance, waste profile verification, worker health and safety, site cleanup verification, and overburden soil and backfill material verification.

The 100 Area SAP also defines the decision-making process for the remaining sites. The remaining sites encompass a variety of miscellaneous liquid and non-liquid disposal sites, dump sites, burn pits, debris piles, french drains and unplanned releases. The decision-making process for the remaining sites is performed on a site-specific basis. Because of the diversity of characteristics among the remaining sites, an agreement was made with the regulators to provide the details of the sample design for each site in a site-specific work instruction.

The 100 Area SAP and the 100 Area Burial Grounds SAP include quality assurance project plans. The quality assurance project plans define the chain of custody and analysis strategy to control the quality and reliability of the analytical data. The field analytical team must perform all sampling and analysis efforts in strict compliance with the SAPs. The SAPs are primary documents and are provided to RL and regulatory agencies for review and approval.

Protocols for managing analytical data developed to support remedial action are specified in Section II.3.10 of the 100 Area SAP (DOE-RL 2004). The data management process starts with using the project's past-practice data as input to the data quality objective process and tracks the remedial action project sample data flow through collection, analysis, verification/validation, and storage in site data management databases. Both the past-practice and remedial action project data are managed under documented configuration control procedures. Procedures are in place for the integrated sample data management processes.

3.4.3 Health and Safety Plan

Health and safety (H&S) plans are prepared in conjunction with the activity hazards classification. These plans provide guidance to the site superintendent and all personnel on the site for health and safety concerns specific to the remediation site and action. The ERC site-specific H&S plan is prepared by the project H&S officer and is reviewed by all project staff and ERC functional organizations. The site superintendent must comply with the H&S plan at all times. All project field staff must understand the H&S plan. All unescorted site visitors are required to read and sign the H&S plan before entering the construction area. Escorted visitors are briefed on the H&S concern and must be escorted by the site superintendent or designee at all times when in the construction area. The H&S plan is prepared and revised in accordance with the BHI H&S procedures manual (BHI-SH-02). The excavation subcontractor may prepare a separate H&S plan.

3.4.4 Mitigation Action Plan

The *Mitigation Action Plan for the 100 and 600 Areas of the Hanford Site* (DOE-RL 2001c) provides guidance to the design and field staff to ensure that natural and cultural resources are protected during field activities. The plan also includes avoidance and minimization steps for mitigation.

3.4.5 Remedial Action Design

RL shall provide the lead regulatory agency remedial designs for review and approval, if requested. Summary briefings and discussions may be held at Unit Manager's Meetings (UMM) or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules for issuing RFPs.

The following process will be followed to implement the requirement above, and may be modified and documented at the 100 Area UMM:

Remedial Design Reviews:

- RL shall provide the draft remedial design package and design schedule to the lead regulatory agency at the UMM, or deliver to the local field office.
- Lead regulatory agency shall provide notice to RL within a timely manner, if approval is warranted.
- Lead regulatory agency review period is generally two weeks. If additional review time is necessary, the review period can be increased up to 45 calendar days. To minimize impacts to the schedule, additional review time should be communicated early in the process.
- Review comments and issues shall be identified and resolved in a timely manner. Review comments and issues, including responses or resolutions, shall be documented in the UMM,

letters, or other forums, as agreed.

- RL shall provide a copy of the final remedial design package, which has comments incorporated, to the lead regulatory agency at the UMM, deliver to the local field office, or transmit.

Remedial Design Approval:

- An approval letter should be provided by the lead regulatory agency to RL within a reasonable timeframe. The approval letter should reference the specific design, and reference that approval by the lead regulatory agency was warranted.

3.4.6 Air Monitoring Plans

The substantive requirements applicable to radioactive air emissions resulting from remediation activities are to quantify potential emissions, monitor the emissions, and identify and employ best available radionuclide control technology. Exemption from these requirements may be requested if the potential-to-emit for the activity or emission unit would result in a total effective dose equivalent of less than 0.1 mrem/year. Implementation of these elements fulfills the ARARs identified in the 100 Area RODS. The use of best available radionuclide control technology includes, but is not limited to, dust suppression (e.g., water, water sprays, fixatives) and the use of other standard engineering controls (e.g., high-efficiency particulate air filter vacuum cleaners). An AMP for the remedial action activity will be developed to incorporate the above requirements and will be provided to the lead regulatory agency for review and approval, if requested. Summary briefings and discussions may be held at UMMs or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules.

The following process will be followed to implement the requirement above, and may be modified at the 100 Area UMM.

Air Monitoring Plan Reviews:

- RL shall provide the draft AMP and schedule to the lead regulatory agency at the UMM, deliver to the local field office, or other forums (as agreed).

- Lead regulatory agency shall provide documented notice to RL within a timely manner, if approval is warranted.

- Lead regulatory agency review period is generally two weeks. If additional review time is necessary, the review period can be increased up to 45 calendar days. To minimize impacts to the schedule, additional review time should be communicated early in the process.

- Review comments and issues shall be identified and resolved in a timely manner. Review comments and issues, including responses or resolutions, shall be documented in the UMM, letters, or other forums (as agreed).

- RL shall provide a copy of the final AMP, which has comments incorporated, to the lead regulatory agency at the UMM, deliver to the local field office, or transmit.

Air Monitoring Plan Approval:

- RL shall transmit the final AMP to the lead regulatory agency for approval.

- The lead regulatory agency should provide an approval letter to RL within a reasonable timeframe. The approval letter should reference the specific AMP, and reference that approval by the lead regulatory agency was warranted.

3.5 REMEDIAL ACTION CHANGE MANAGEMENT

Three types of changes in the 100 Area remedial actions are possible that affect compliance with the requirements in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b): (1) a nonsignificant or minor change, (2) a significant change to a component of the remedy, and (3) fundamental changes to the overall remedy.

A nonsignificant or minor change falls within the normal scope of changes occurring during the remedial design and remedial action processes. These minor changes should be documented in the appropriate post-decision project file. Nonsignificant changes shall not impact the requirements of the RODs or will they impact the functional requirements. Examples of nonsignificant changes include, but are not limited to, the following:

- The addition of waste sites that are adjacent to and within the area required for remediation of sites addressed in the RODs

- Modifications to the remedial action schedule that do not impact agreed-upon milestones

- The addition of IDW associated with the sites listed in this document for remediation in a manner that is consistent with the scope and role of action as described in the RODs. The minor change to manage IDW associated with the waste sites addressed by the RODs is being planned at this time as shown on the project schedule, which is included in the DWP (DOE-RL 2000)

- The granting of a treatability variance if it is technically impractical to meet the LDR treatment standard.

It may be determined that a significant change to the selected remedy as described in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) is necessary after the RODs have been signed. Significant changes are defined as changes that significantly modify the scope, performance, or

component cost for the remedy as presented in the RODs. All significant changes will be addressed in an ESD. An example outline for an ESD can be found in the Interim Action ROD, Exhibit 8-3 (EPA 1995). Examples of significant changes will include, but are not limited to, the following:

- A 50% increase in the total cost of site remediation addressed in the RODs
- A delay in the point in time when the remedial action or objectives are met
- The addition of 100 Area IDW not associated with the sites in this document
- The addition of waste sites for remediation in a manner that is consistent with the scope and role of action as described in the RODs.

A fundamental change is a change that does not meet the requirements set forth in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) or that incorporates remedial activities not defined in the scope of the RODs. In few cases are there fundamental changes to a ROD. Should the situation arise, the RODs must be amended. Examples of significant changes that fundamentally alter the remedy are as follows:

- Waste remains in place above cleanup objectives due to cultural resources
- A final land use is defined that is not compatible with the RODs
- Stabilization of waste remaining in place in the 100 Area rather than excavating and disposing the soil at ERDF.

The project manager is responsible for tracking all changes and obtaining appropriate reviews by ERC staff. The project manager will discuss the change with RL, and RL will then discuss the type of change that is necessary with the EPA and Ecology. The lead regulatory agency's responsibility is to determine the significance of the change. Appropriate documentation will follow based on the type of change.

3.6 ATTAINMENT OF REMEDIAL ACTION OBJECTIVES

This section describes the approach for verifying attainment of cleanup of soils in accordance with the RAOs identified in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) and presents the supporting calculations. Because candidate sites are subject to compliance with RAOs prior to rejection as waste sites, they too are subject to verification with the RAGs in accordance with the approach below.

The analytical results used to verify attainment of RAOs will be derived from one of three types of sampling designs, focused sampling, random, or statistical sampling or a combination of both. In focused sampling, process knowledge and professional judgment are used to limit the number of samples from a site and focus sample collection on locations that are expected to have the

highest contamination levels. The subsequent evaluation is based on maximum values. Statistical sampling uses composite values and summary statistics for decision making. Based on experience to date, focused sampling is often appropriate for confirmatory sampling at remaining candidate sites, whereas statistical sampling is most often used at radioactive liquid effluent sites and remaining sites that require remedial action. The site-specific work instructions (WIs) (sampling designs) are reviewed and approved by the lead regulatory agency. Based on the lead regulatory agency review, these WIs may be modified, as appropriate, prior to approval.

The general approach for verifying attainment of RAOs is presented in Figure 3-4 and involves the following steps.

- Identify the unit(s) within a site for cleanup verification.
- Calculate the summary statistics for the identified unit(s) (statistical sampling design) or maximum values (focused sampling).
- Identify the appropriate RAGs to be applied to the unit(s).
- Evaluate the summary statistics or maximum values, as appropriate, for the identified unit(s) against the decision rules for achieving the appropriate RAGs.
- Verify that radionuclide soil concentrations are less than the 15 mrem/yr radionuclide soil cleanup standard for direct exposure.
- Verify the attainment of the nonradionuclide soil concentrations corresponding to WAC 173-340-740(3) (1996) soil cleanup standards for direct contact.
- Verify that radionuclide soil concentrations are less than the radionuclide groundwater protection standard.
- Verify the attainment of the nonradionuclide contaminant concentrations in soil less than or equal to 100 times the groundwater RAGs for protection of groundwater.
- Verify that radionuclide soil concentrations are less than the radionuclide Columbia River protection standard after the DAF has been applied.
- Verify the attainment of the nonradionuclide contaminant concentrations in soil less than or equal to 100 times the RAGs for protection of the Columbia River after the DAF has been applied.

Details regarding verification sampling and analysis may be found in the 100 Area SAP (DOE-RL 2004) and the 100 Area Burial Grounds SAP (DOE-RL 2001a).

3.6.1 Identify the Unit(s) Within a Site for Cleanup Verification

In this step, the site is divided into units for purposes of collecting verification samples. Summary statistics (e.g., arithmetic mean and 95% upper confidence limit [UCL]) or maximum values are calculated for verification samples from a particular unit. Verification sampling and analysis data will be evaluated against the decision rules (see Section 3.6.4) on a unit-by-unit basis. Generally, a site will be divided into the following units: (1) stockpiled "clean" soil that will be returned to the excavation, (2) soil from the bottom of the excavation when excavation is from 0 to 4.6 m (0 to 15 ft) below ground surface, and (3) soil from the bottom of the excavation when excavation is greater than 4.6 m (15 ft) below ground surface. Additional units may be defined, as needed, for large sites or other specific needs. Overburden (stockpiled) "clean" soil from multiple waste sites may be combined into a single common overburden pile or multiple common overburden piles. These units will be identified in instructions prepared for confirmation sampling. Details regarding verification sampling and analysis can be found in the 100 Area SAP (DOE-RL 2004) and the 100 Area Burial Grounds SAP (DOE-RL 2001a).

For candidate sites, confirmatory sampling may be performed to determine whether or not a site exceeds applicable RAGs. Factors such as site construction and purpose, contaminants of potential concern, process history, waste form, and contaminant dispersion mechanisms are considered so that the applicable sampling design may be chosen. The confirmatory sampling data will be evaluated against the decision rules (Section 3.6.5) on a unit-by-unit basis. Generally, a confirmatory sampling effort site will consist of just one unit, soil/material from the engineered structure from 0 to 4.6 m (15 ft) below grade level. Additional units may be defined, as needed, for large sites or other specific needs. These units will be identified in site-specific work instructions prepared for confirmation sampling, which are submitted to the lead regulatory agency for review and approval. Details regarding verification sampling and analysis can be found in the 100 Area SAP (DOE-RL 2004) and site-specific work instructions for verification sampling.

3.6.2 Calculate the Summary Statistics for the Identified Unit(s) (Statistical Sampling Design)

The summary statistics needed for each unit (Section 3.6.1) are arithmetic mean, standard deviation, single-sided 95% UCL, and the total number of samples collected from the unit. The number of samples with concentrations exceeding the WAC 173-340 (1996) cleanup level and two times the WAC 173-340 (1996) cleanup level must also be determined from the sampling and analytical data.

The 95% UCL for the mean will be calculated for each COC, with adjustments for censored data in accordance with *Statistical Guidance for Ecology Site Managers* (Ecology 1992) and *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-Detection Limit or Below-PQL Values (Censored Data Sets)* (Ecology 1993). For the nonradionuclides, the 95% UCL will be compared to the WAC 173-340 (1996) Method B limit in addition to the comparison of the raw data to twice the WAC 173-340 (1996) Method B limit and the proportion of raw data exceeding that WAC 173-340 (1996) Method B limit.

The 95% UCL for each of the COCs will be used as the basis for RESRAD modeling, as necessary.

Examination of the distribution of large nonradionuclide data sets (10 or more data points per component) will be done per guidelines presented in the Ecology guidance documents (Ecology 1992, 1993), and will typically be performed using the WAC 173-340 (1996) Stat Microsoft® Excel module. Small data sets (less than 10 data points per component) will be evaluated in accordance with Section 5.2.1.4 of Ecology (1992) (refer to Figure 3-5).

3.6.3 Determine the Maximum Values for the Identified Unit(s) (Focused Sampling Design)

The maximum values for each unit (Section 3.6.1) must be determined from the data set. The number of samples with concentrations exceeding the WAC 173-340 (1996) cleanup level and two times the WAC 173-340 (1996) cleanup level must also be determined from the sampling and analytical data.

3.6.4 Identify the Appropriate Remedial Action Goals to be Applied to the Unit(s)

The RAG or RAGs that apply to a site must be identified to verify that remedial action has attained the RAOs. A review of Section 2.1.2 provides the necessary information to identify the appropriate RAGs. One or more of these goals may apply to any particular unit. Compound-specific RAGs (e.g., hydrocarbons, pesticides, volatile organic analytes, and semivolatile organic compounds) will be calculated, as needed, for site verification.

3.6.5 Evaluate the Data Against the Decision Rules for Achieving the Appropriate Remedial Action Goals

For the RAGs identified in the previous step, decision rules are defined that will be used to test verification sampling and analysis data. For statistical sampling designs, these decision rules are as follows:

- WAC 173-340-740(7)(e) (1996) standards are achieved under the following conditions:
  - The 95% UCL on the arithmetic mean from verification samples collected is less than the cleanup standard for each COC
  - No single sample concentration is greater than two times the cleanup standard
  - Less than 10% of the sample concentrations exceed the cleanup standard.
- Radionuclide soil cleanup standards are achieved under the following conditions: The dose calculated from the 95% UCL on the arithmetic mean for the sum of all radioactive COCs

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from verification samples collected from the sides of the excavation and from soil 0 to 4.6 m (0 to 15 ft) below grade is less than 15 mrem/yr above background. The dose is calculated assuming exposure during a portion of the individual's lifetime through inhalation, soil ingestion, crop ingestion, meat and milk ingestion, aquatic foods ingestion, drinking water ingestion, and external gamma exposure pathways using residential exposure assumptions (specific assumptions for dose calculations are presented in Appendix B). Figure 3-5 illustrates this scenario.

- For nonradioactive contaminants, cleanup of soils for groundwater protection will have been achieved when the 95% UCL on the arithmetic mean concentration in soil of each COC is less than 100 times the groundwater RAG as presented in Table 2-5 or when site-specific modeling or other appropriate methods indicate that the residual contaminant concentrations will not impact groundwater at levels above the groundwater RAG for 1,000 years.

- For radionuclide contaminants, cleanup of soils for groundwater protection will have been achieved when the 95% UCL on the arithmetic mean concentration in soil of each COC is less than the value, as calculated by RESRAD, that meets the groundwater RAG as presented in Table 2-5.

- For nonradioactive contaminants, cleanup of soils for protection of the Columbia River will have been achieved when the 95% UCL on the arithmetic mean concentration in soil of each COC is less than 100 times the RAG after the DAF has been applied as presented in Table 2-6, or when site-specific modeling or other appropriate methods indicate that the residual contaminant concentrations will not impact the river at levels above the surface water RAG after the DAF has been applied for 1,000 years (EPA 2000b).

- For radionuclide contaminants, cleanup of soils for protection of the Columbia River will have been achieved when the 95% UCL on the arithmetic mean concentration in soil of each COC is less than the value, as calculated by RESRAD, that meets the RAG after the DAF has been applied as presented in Table 2-6.

For focused sampling designs, the decision rules are the same except that maximum values are used in lieu of the 95% UCL on the arithmetic mean concentration.

3.6.6 Verify the Attainment of the Radionuclide Soil Cleanup Standard

Determining when a remedial action has achieved the cleanup level (15 mrem/yr above background) involves converting radionuclide concentrations (in pCi/g) in soil into dose rates (in mrem/yr) using a dose assessment model. Use of a model requires an exposure scenario that specifies (1) a hypothetical receptor, (2) pathways of exposure from radionuclides in soil to the receptor, and (3) assumptions and parameters for estimating exposures and doses to the receptor from radionuclides in soil.

Unrestricted future use in the 100 Area is represented by an individual resident in a rural-residential setting. This resident is assumed to consume crops raised in a backyard garden, meat and milk from locally raised livestock, and meat from game animals and fish, and to live in

a residence with a basement 3.7 m (12 ft) below grade. The following exposure pathways are considered when estimating doses from radionuclides in soil: inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure. External gamma exposure is assumed to be the only exposure pathway from contaminants at the bottom of the excavation and is assumed to occur only when an individual is in the basement. (Wastes left in place at depths greater than 4.6 m [15 ft] and that are protective of groundwater and the Columbia River will have institutional controls applied [e.g., deed restrictions for well drilling and deep excavation].) This individual is conservatively assumed to spend 25% of his/her lifetime in the basement. Therefore, doses are calculated separately in fill soil from 0 to 4.6 m (0 to 15 ft) below grade and for residual contaminants at the bottom of the excavation. These doses are then summed to obtain the total dose associated with radionuclides in soil. A list of the assumptions and model parameters used in RESRAD is presented in Appendix B.

3.6.7 Verify the Attainment of the WAC 173-340-740(3) (1996) Cleanup Standards

Verifying the attainment of WAC 173-340-740(3) (1996) cleanup standards involves comparing the appropriate summary statistics or maximum values with the RAGs presented in Table 2-1, or conducting a site-specific assessment using models or other appropriate methods to demonstrate that residual site contamination does not pose an unacceptable risk. The decision rules for WAC 173-340 (1996) standards presented in Section 3.6.4 are also used for this verification.

3.6.8 Verify the Attainment of the Contaminant Concentrations in Soil for Protection of the Groundwater

Verifying the attainment of groundwater protection RAGS for radionuclides involves using the RESRAD model with site-specific and 100 Area-specific parameters to assess the groundwater impact from residual site contamination. The RESRAD estimated groundwater concentrations (as effected by post-remediation residual contamination) are used to calculate a dose based on groundwater used as drinking water or are directly compared to radionuclide drinking water maximum contaminant levels. For nonradionuclides, the summary statistical values are compared to the groundwater protection soil RAGs developed in Table 2-5. The groundwater protection RAG is attained if the statistical values are less than the Table 2-5 RAGs and each sample data set meets the requirements of the WAC 173-340-740(7)(e) (1996) three-part test. If this is not the case, a more detailed assessment using RESRAD or other appropriate methods (e.g., leach tests) is used to assess the potential of residual site contaminants to impact groundwater. If this assessment indicates that the residual contamination at the site will not impact groundwater at concentrations above the groundwater RAGs, then the groundwater protection RAG has been attained.

3.6.9 Verify the Attainment of the Contaminant Concentrations in Soil for Protection of the Columbia River

The Columbia River radionuclide protection RAGs are identical to the groundwater protection RAGs; therefore, showing groundwater protection as discussed above also shows protection of the Columbia River. For nonradionuclides, the summary statistical values are compared to the Columbia River protection soil RAGs developed in Table 2-6. The river protection RAG is

attained if the statistical values are less than the Table 2-6 RAGs and each sample data set meets the requirements of the WAC 173-340-740(7)(e) (1996) three-part test. If this is not the case, a more detailed assessment using RESRAD or other appropriate methods (e.g., leach tests) is used to assess the potential of residual site contaminants to impact groundwater and the river. If this assessment indicates that the residual contamination at the site will not impact groundwater (and therefore the river) at concentrations above the river RAGs, then the Columbia River protection RAG has been attained.

3.7 CERCLA CLEANUP DOCUMENTATION

Subsequent to remedial action, cleanup verification reports will be prepared. The reports will provide the needed documentation for verification of interim remedial action at a site and to support the eventual deletion of the OU from the NPL. Cleanup verification reports will be prepared for groups of sites or individual sites, as needed. Guidance found in Appendix G is one method to satisfy this requirement. Less complex sites require less complex verification reports. At a minimum, the following is required for each waste site:

- Description of current waste site condition
- Basis for reclassification
- Analytic data or data references (if applicable).

Candidate sites confirmed not to exceed the RAGs for any constituents will be reclassified as no action per the waste site reclassification guideline TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)" (DOE-RL 1998b). Regulator approval will be documented on a Waste Site Reclassification Form, which is accompanied by a regulator reviewed site-specific informal report. Supporting documentation (e.g., calculations, memorandum to file explaining field investigation effort) will be held in records retention for retrieval, if ever required. The WIDS database will serve as formal notification to the public that the site is no longer a candidate for remedial action and does not exceed RAOs established in the Remaining Sites ROD (EPA 1999).

3.8 SITE RELEASE

RL will continue to manage the land in the 100 Area of the Hanford Site as long as necessary to support remedial actions and other missions. The release of land areas for other uses will depend on the following: (1) release of the individual waste sites, and (2) the completion of other work in the OU such as decontamination and decommissioning of facilities as well as final cleanup verification under CERCLA.

It is unknown at this time when a final ROD will be recorded for the 100 Area NPL site, but the final ROD will contain operation and maintenance requirements. The RL will provide institutional controls (e.g., site monitoring and access restrictions) to meet all project missions until such time that they are deemed unnecessary.

Institutional controls are designed to prevent exposure to contamination by limiting land or resource uses. Continuing existing institutional controls during the interim action include access controls, water-use and land-use restrictions, and signs. Restrictions on certain land uses (e.g., restricting drilling or excavation) are administered through the onsite excavation permit process. Access control is ensured through Hanford Site badging requirements and the use of signs posted along the Columbia River shoreline for restricted uses. RL is responsible for establishing and maintaining land-use and access restrictions until the RAOs are achieved. RL will notify EPA and Ecology upon discovering any trespassing incident and will report the incident to the Benton County Sheriff's Office.

Where deed restrictions or other institutional controls are used in accordance with this RDR/RAWP and the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b), RL will not allow any activities that would interfere with the remedial action prior to EPA and Ecology approval. Additionally, RL will take necessary measures, such as filing the deed restrictions in appropriate county offices, to ensure the continuation of these restrictions prior to any transfer or lease of the property. A copy of a notification of any restrictions will be given to any prospective purchaser/transferee before any transfer or lease by RL. RL will provide EPA and Ecology with written verification that these restrictions have been put in place.

A plan for implementing current and post-remedial action institutional controls as specified in the RODs is presented in the *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE-RL 2002). The institutional controls defined in this plan will be enforced during and after cleanup, as appropriate. The plan describes the types of institutional controls used and how each type of control is, or will be, implemented. The institutional controls are grouped into five main types: warning notices, entry restrictions, land-use management, groundwater-use management, and waste site information management.
In addition, the plan includes the following:

- A tracking mechanism defining restricted land areas and changes to these areas
- Notification requirements for activities that are inconsistent with the institutional control objectives for the site
- A point of contact for institutional control compliance on the Hanford Site
- Evaluation of the implementation and effectiveness of institutional controls on an annual basis with a report issued each year to EPA and Ecology by September 30.

The following institutional controls will be implemented:

- Warning notices:
  - Appropriate signage are posted at various locations around the perimeter of the Hanford Site. Additionally: One sign is located along the Columbia River at each reactor area (100-B/C, 100-K, 100-N, 100-D/DR, 100-H, and 100-F). The signs will consist of one each in Spanish and English. The signs will be located so that the distance for viewing

from the Columbia River will be approximately 150 m (500 ft). No signs will be placed between reactor areas. Another sign will be placed at the major road entrance to the areas (100-B/C, 100-K, 100-N, 100-D/DR, 100-H, and 100-F). Location of the signs have been coordinated with the regulators. The English sign along the river reads as follows:

WARNING: HAZARDOUS AREA
DO NOT ENTER
Area May Contain Hazardous Soil and Water Seeps
For Information Call: 509-376-7501

The Spanish sign reads as follows:

ADVERTENCIA: AREA DE PELIGRO
NO ENTRES
Esta area puede contener tierra y fuentes de agua que son peligrosas.
Para Informacion Usted Puede Llamar a (509) 376-7501

- Along access roads, one large sign is located at the entrance to the active remediation area. The sign reads as follows:

WARNING: HAZARDOUS AREA
Area May Contain Hazardous Soil
Only Authorized Personnel Allowed
For Information Call: 509-376-7501

- Entry restrictions: Site access is restricted and security badges must be worn by employees, contractors, and visitors. Before receiving a badge, all must receive the level of training required to access the site or perform work.

- Land-use management: Excavation permits are required for excavations in the areas to prevent unplanned disturbances, spread of contamination, or infiltration.

- Groundwater-use management: Groundwater use is restricted, except for the purpose of monitoring and treatment, as approved by EPA or Ecology or as authorized in EPA-approved documents. Groundwater use is also controlled through excavation permits.

- Waste site-specific institutional controls: The site-specific institutional control requirements and information on the location and nature of any remaining contamination documented in the cleanup verification package (in Section 8.0, "Statement of Protectiveness") is maintained in WIDS.

Figure 3-1. Remedial Action Process Overview.

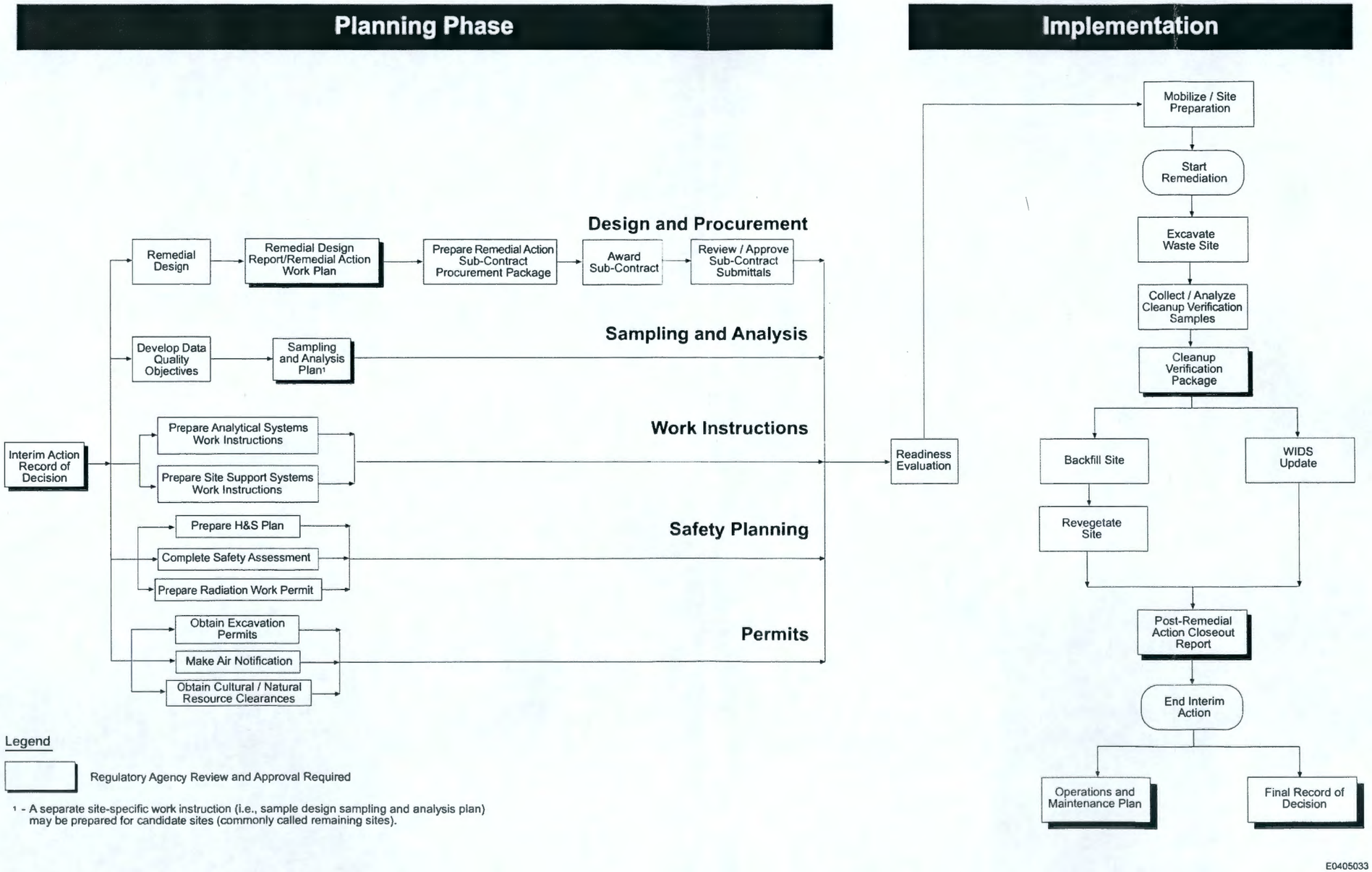


Figure 3-2. Tri-Party Agreement Milestones for 100 Area CERCLA Cleanup.

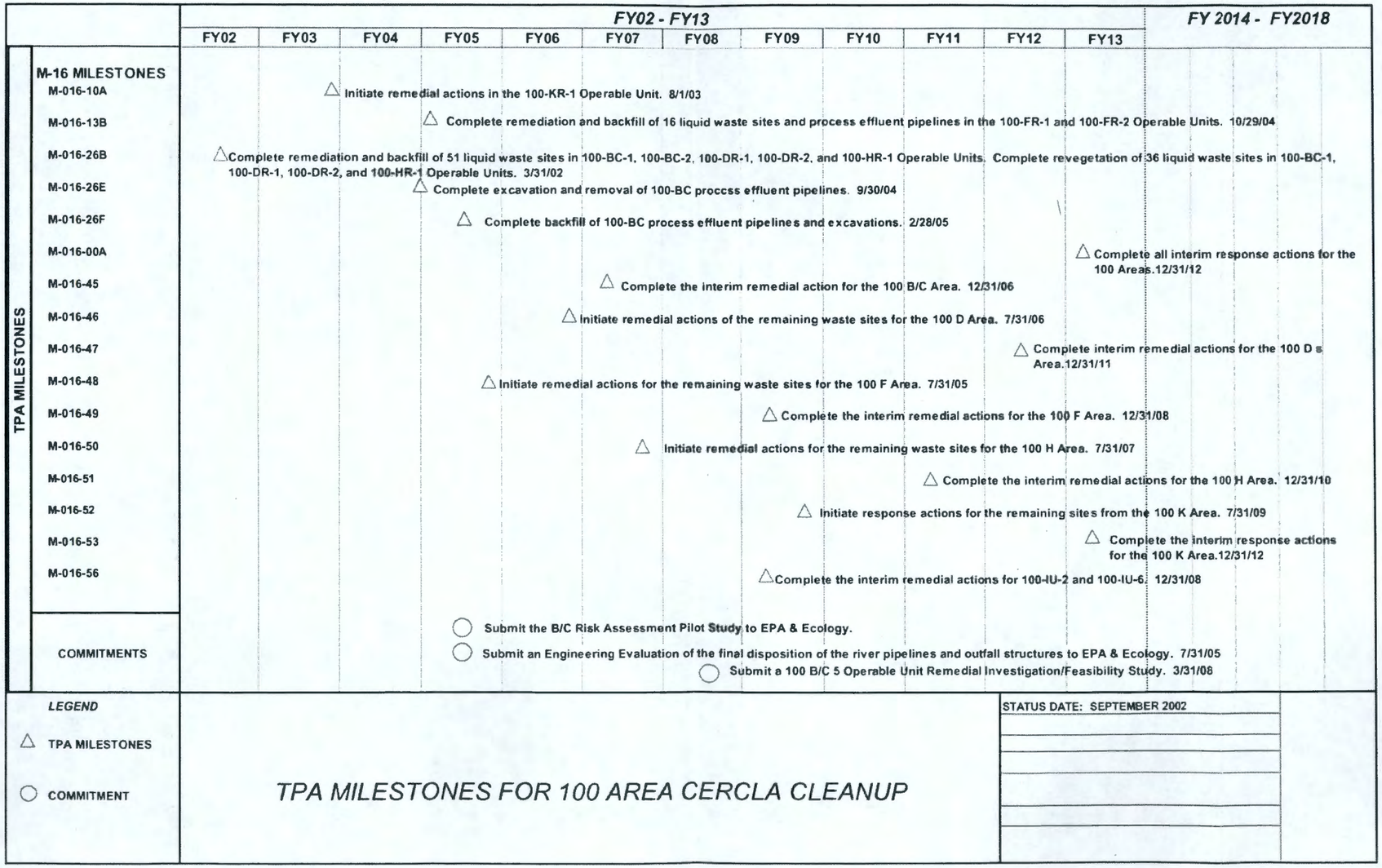
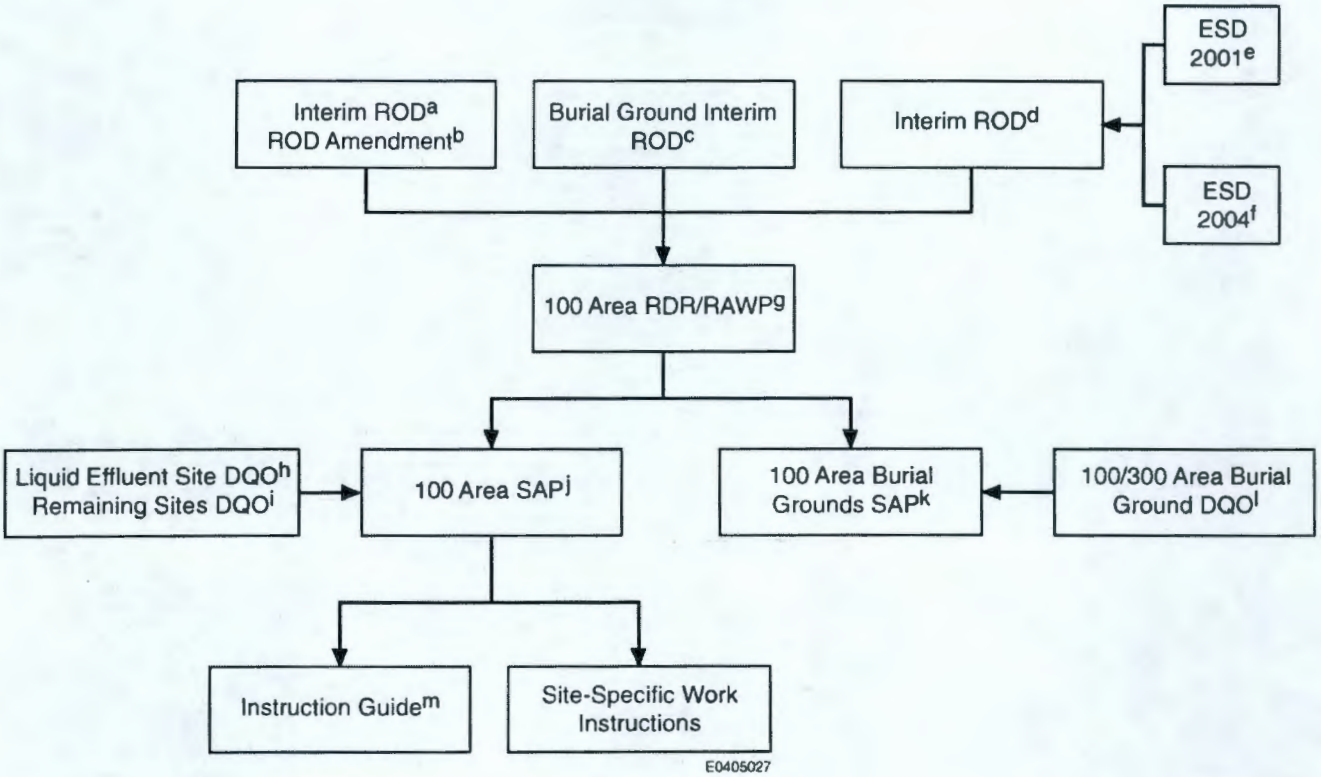


Figure 3-3. 100 Area Record of Decisions and Implementing Documents



NOTE: The 100-N Area is not included in these documents.

[a] *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington* (EPA 1995).

[b] *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (EPA 1997).

[c] *Interim Action Record of Decision for the 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-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (EPA 1999b).

[d] *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units (100 Area Burial Grounds), Hanford Site, Benton County, Washington* (EPA 2000b).

[e] *Explanation of Significant Difference for the 100 Area Remaining Sites ROD* (EPA 2000a).

[f] *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action ROD* (EPA 2004).

[g] *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (this document).

[h] *Data Quality Objectives Summary Report for the 100-FR-1, 100-FR-2, 100-HR-1, 100-KR-1, and 100-KR-2 Group 4 Waste Sites* (DOE-RL 1997b); *Data Quality Objectives Summary Report for the 100-BC-1, 100-BC-2, 100-DR-1, and 100-DR-2 Group 3 Waste Sites* (DOE-RL 1997a); *Data Quality Objectives for the 100-D Group 2 Waste Sites* (DOE-RL 1996b).

[i] *Data Quality Objectives Summary Report for the 100 Area Remaining Confirmatory Sampling Effort Sites* (BHI 2003a).

[j] *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2004).

[k] *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (DOE-RL 2001).

[l] *Data Quality Objective Summary Report for the 100 Area Burial Grounds and 300-FF-2 Operable Unit Waste Sites* (BHI 2001).

[m] *Instruction Guide for Remediation of the 100 Areas Waste Sites* (BHI 2003b).

Figure 3-4. Verification of Soil Cleanup.

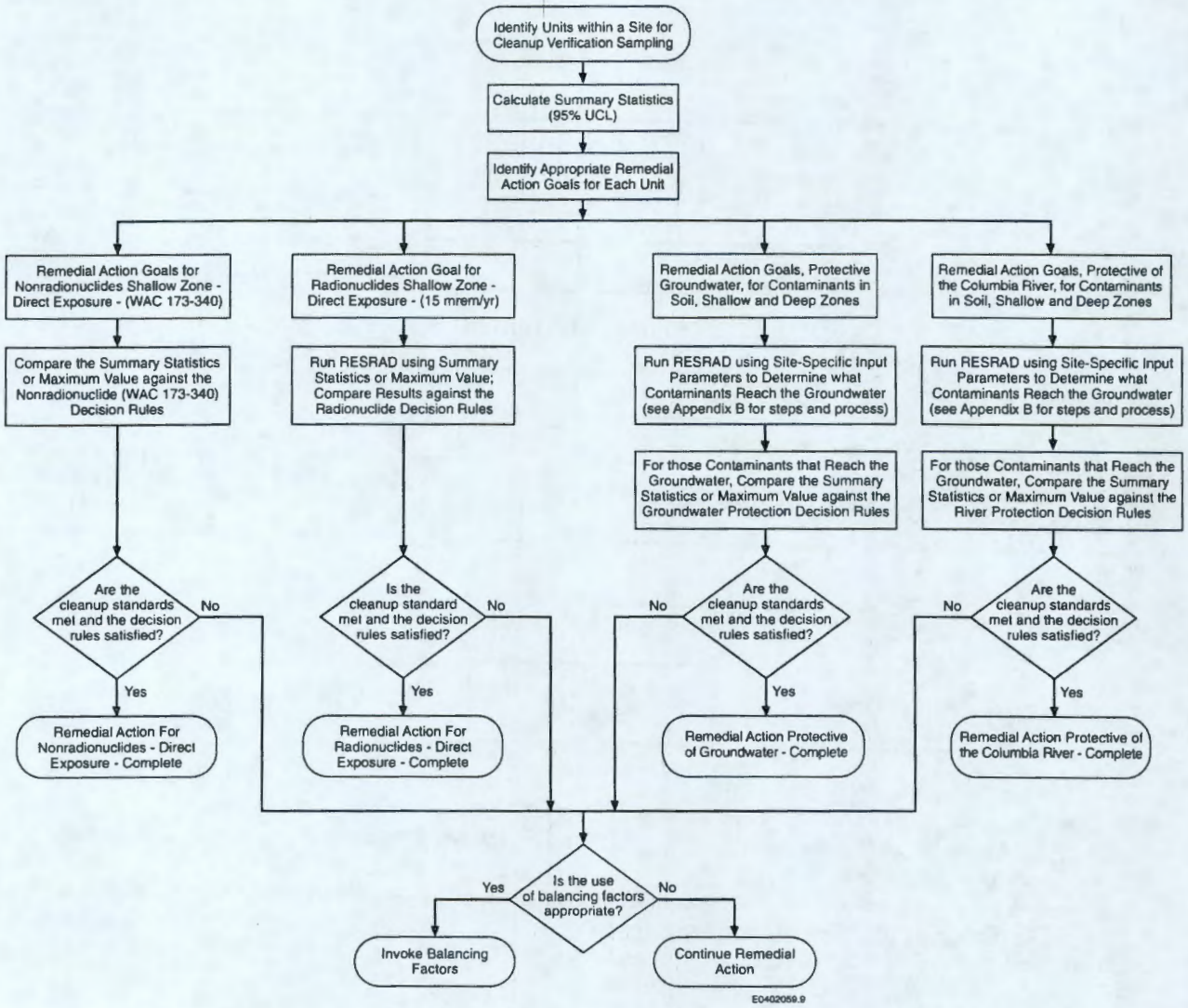


Figure 3-5. Human Exposure Scenario.

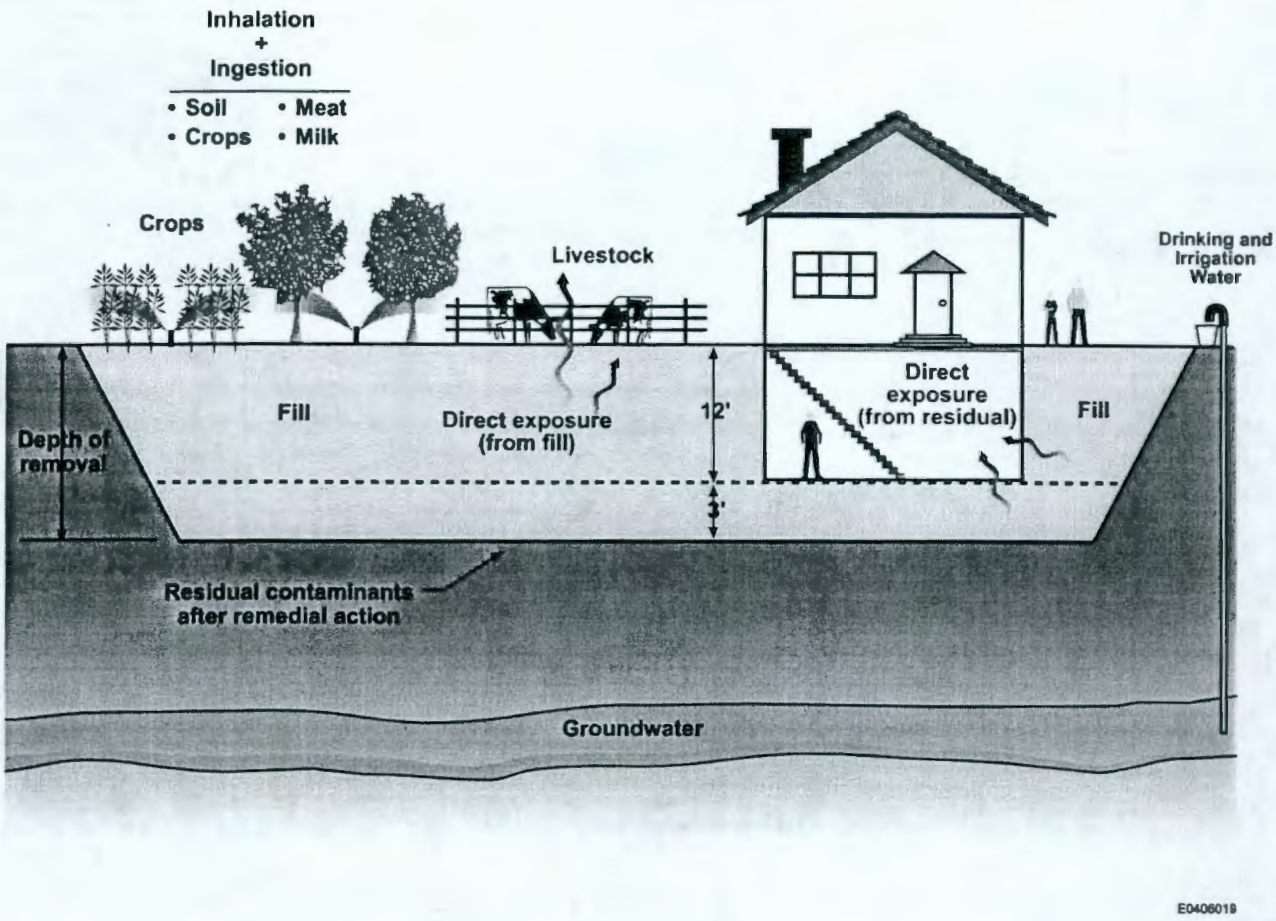


Table 3-1. Summary of Relevant Tri-Party Agreement Milestones.

Milestone	Description	Due Date
	General 100 Area Milestones	
M-016-10A	Initiate remedial actions in the 100-KR-1 OU.	August 01, 2003 Complete
M-016-13B	Complete remediation and backfill of 16 liquid waste sites and process effluent pipelines in the 100-FR-1 and 100-FR-2 OUs.	October 29, 2004
M-016-26B	Complete remediation and backfill of 51 liquid waste sites in the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, and 100-HR-1 OUs. Complete revegetation of 36 liquid waste sites in the 100-BC-1, 100-DR-1, 100-DR-2, and 100-HR-1 OUs.	March 31, 2002 Complete
M-016-26E	Complete excavation and removal of 100–B/C process effluent pipelines.	September 30, 2004
M-016-26F[a]	Complete backfill of 100–B/C process effluent pipelines and excavations.	February 28, 2005
M-016-00A	Complete all interim response actions for the 100 Area. Completion of interim response actions is defined as the completion of the Interim ROD or Action Memorandum requirements in accordance with an approved RDR/RAWP or Removal Action Work Plan and obtain EPA and/or Ecology approval of the appropriate project closeout documents.	December 31, 2012
M-016-45	Complete the interim remedial action for the 100-B/C Area.	December 31, 2006
M-016-46	Initiate remedial actions of the remaining waste sites for the 100-D Area.	July 31, 2006
M-016-47	Complete the interim remedial actions for the 100-D Area.	December 31, 2011
M-016-48	Initiate remedial actions for the remaining waste sites for the 100-F Area.	July 31, 2005
M-016-49	Complete the interim remedial actions for the 100-F Area.	December 31, 2008
M-016-50	Initiate remedial actions for the remaining waste sites for the 100-H Area.	July 31, 2007
M-016-51	Complete the interim remedial actions for the 100-H Area.	December 31, 2010
M-016-52	Initiate response actions for the remaining waste sites from the 100-K Area.	July 31, 2009
M-016-53	Complete the interim response actions for the 100-K Area.	December 31, 2012
M-016-56	Complete the interim remedial actions for the 100-IU-2 and 100-IU-6 OUs.	December 31, 2008
	Additional Commitments	
	Submit the 100-B/C risk assessment pilot study to EPA and Ecology.	July 31, 2005
	Submit an engineering evaluation of the final disposition of the river pipelines and outfall structures to EPA and Ecology.	July 31, 2005

[a] Tri-Party Agreement Milestone M-016-26F has an associated commitment to submit the 100-B/C risk assessment pilot study to EPA and Ecology. This pilot study will feed into the post-cleanup risk assessment for the 100 Area.

Definitions for Tri-Party Agreement Milestones M-016-45 through M-016-56:

Initiate Remedial Actions: This is the initiation of excavation of waste sites.

Remaining Waste Sites: This includes all waste sites that have been designated for response actions including liquid disposal sites, solid waste burial grounds, unplanned releases, miscellaneous pipelines, and other miscellaneous waste sites.

Complete Interim Remedial Actions: This includes the completion of the excavation, backfill, and revegetation of the waste sites. It also includes the completion of the decontamination and decommissioning of ancillary facilities. EPA/Ecology approval of the waste site reclassification form for cleanup verification packages must also be done.

4.0 WASTE MANAGEMENT

This waste management plan establishes the requirements and describes the activities for the management and disposal of waste associated with the remedial actions as stipulated in the Interim Action ROD (EPA 1995), the ROD Amendment (EPA 1997a), the Remaining Sites ROD (EPA 1999), and the 100 Area Burial Grounds ROD (EPA 2000b).

Waste management activities will be performed in accordance with waste management ARARs identified in Section 2.1.6 of each ROD. The requirements specified by the ARARs and other applicable guidance will be addressed in Site-Specific Waste Management Instructions (SSWMI). The SSWMI will address waste storage, transportation, packaging, handling, and labeling as they specifically apply to waste streams from each waste site.

4.1 PROJECTED WASTE STREAMS

In conducting the remedial action, various waste steams will be encountered. Each waste stream will require specific processing and disposal. Similar types of OU-specific waste will be managed uniformly. Assignment of waste to the appropriate waste stream depends on knowing the designation of the waste and appropriate disposal facility. Projected waste streams include, but are not limited to, the following:

- Nonhazardous, nondangerous miscellaneous solid waste
  - Filter paper, wipes, personal protective equipment, cloth, plastic, equipment, tools, pumps, wire, metal and plastic piping, and materials from cleanup of unplanned releases
  - "Demolition waste," which means solid waste, largely inert waste, resulting from the demolition or razing of buildings, roads, or other man-made structures
- Low-level radioactive waste, including soil and associated miscellaneous solid waste. Decommissioning debris includes such materials as concrete, wood, rebar, metal/plastic pipe and screens, wire, liners, equipment, pumps, and tanks
- Mixed waste (i.e., waste that is both low-level radioactive waste and hazardous waste)
- Liquids including, but not limited to, the following:
  - Water from unplanned releases (i.e., spills)
  - Decontamination/cleaning fluids
- Used oil/hydraulic fluids
- Returned sample waste associated with these waste sites.

4.1.1 Waste Characterization, Designation, and Disposal

Miscellaneous solid waste and demolition debris that has contacted contaminated media, and/or is designated as contaminated by process knowledge or other information, may be disposed of at ERDF as described above. Waste will be characterized and designated in accordance with requirements of the receiving facility and in accordance with the approved 100 Area SAP (DOE-RL 2004) and the 100 Area Burial Grounds SAP (DOE-RL 2001a). The sorting process is observational and is performed to identify the nonconforming waste forms. Waste will be designated using process knowledge, historical analytical data, engineering calculations, and/or analyses of samples identified in the referenced documents or SAPs, as appropriate. Anomalous wastes are defined as waste materials that must be sorted out of the burial ground dig face or by a mechanical sorting process because they require special handling and/or treatment prior to disposal. This anomalous material may or may not require additional characterization prior to disposal. Every effort will be made to minimize waste volume for disposal at ERDF through recycling and reuse, as appropriate.

ERDF is the preferred disposal location, provided that the waste acceptance criteria(BHI 2002) are met. As necessary, waste will be stored within the AOC, in staging piles, or at ERDF as described in the following subsections.

Miscellaneous solid waste and demolition debris that has contacted contaminated media may be disposed of at ERDF as described above. Miscellaneous solid waste or demolition debris that is nondangerous and has been radiologically released may be disposed of at an offsite permitted disposal facility or a limited purpose inert landfill, or recycled, as appropriate. On a case-by-case basis, and as allowed by the lead regulatory agency, such waste forms may be used as waste site backfill provided that general size and/or placement requirements are met. These case-by-case agreements will be documented in UMMs or other forums agreed to by the lead regulatory agency. Uncontaminated soils will be placed on the ground near the point of origin. Waste handling and disposal options are further described in Section 4.3.

Small volumes of liquid that have been solidified may also be disposed of at ERDF if the waste meets ERDF waste acceptance criteria. Liquid waste that does not meet the acceptance criteria will be shipped to an appropriate offsite facility. Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440. Used nonradioactive oil will be sent offsite for recycling or disposal. Spent or unusable chemicals/reagents may also be generated during field sampling and analysis, and would require disposal based on the designation.

Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440. The exception is used oil and solid waste that has not contacted contaminated media that is sent for recycling or disposal at an offsite facility. An offsite determination is also required prior to shipment of waste to an approved offsite facility.

Three categories of waste exist from a designation standpoint: (1) wastes that do not require additional characterization or special handling, (2) wastes that do not require additional characterization but do require special handling, and (3) wastes that require additional characterization.

4.1.1.1 Wastes That Do Not Require Additional Characterization or Special Handling. Wastes that do not require additional characterization or special handling include untreated wastes that conform to the conceptual waste form models (CWFMs) (and/or process soil) that may be designated without characterization, and do not require special handling for human exposure or waste acceptance.

4.1.1.2 Wastes That Do Not Require Additional Characterization, But Do Require Special Handling. Wastes that do not require additional characterization but do require special handling are untreated wastes that conform to the CWFMs (and/or process soil) that may be designated without characterization, but do require special handling for human exposure or waste acceptance. Waste types in this category include, but are not limited to, the following:

- Lead bricks
- Cadmium shielding
- Friable asbestos-containing materials
- High-dose, highly-contaminated components that do not contain dangerous/hazardous materials.

4.1.1.3 Wastes That Require Additional Characterization. Wastes that require additional characterization include untreated and/or treated wastes that cannot be designated without characterization, and may also require special handling for human exposure protection or waste acceptance. Unknown anomalous materials are included in this category.

4.1.2 Waste Designation Methods

The burial ground wastes will be designated for waste disposition based on one of several methods, including historical data, process knowledge, engineering calculations, and sampling and analysis. This is presented for information purposes only and the generator is responsible for proper waste designation. Each of these methods and their applications is described as follows:

- Historical data may be used to designate waste forms that have previously been characterized (e.g., 100 Area Reactor Interim Safe Storage Project, general housekeeping activities, the *100 Area Excavation Treatability Study Report* [DOE-RL 1996a]). In addition, previous and current 300 Area burial ground remediation projects have designated significant quantities of buried solid waste. The waste forms in this category are readily identified and are known for their hazardous material content.

- Process knowledge will be used to designate wastes for which process knowledge provides sufficient information. Waste forms such as asbestos-containing floor tiles and pipe lagging do not require sampling and analysis because these will be designated as asbestos-containing materials based on visual observation.

- Engineering calculations may be performed to determine the weight or volume of a hazardous waste in a certain matrix (e.g., calculating lead-based paint content on pump housings).

- Field screening and sampling and analysis will be used for designation of wastes when the other methods are not appropriate. Sampling and analysis is required for liquids and most of the anomalous waste forms.

Visual observations combined with historical data, process knowledge, and engineering calculations can result in a cost-effective and expeditious waste designation. The observational designation process is based on the assumption that the buried waste did not change after disposal; however, it is recognized that containers of liquids may have leaked, causing dangerous/hazardous materials to come into contact with buried solid wastes, or contaminated soils may have been disposed in the burial grounds. It is, therefore, necessary to screen the co-mingled soil during excavation.

Specific types of anomalous wastes that are repeatedly discovered during remediation should become new CWFMs. This would be a field decision based on concurrence by the BHI Waste Management representative, safety engineer, project environmental lead, and analytical lead (or task lead, as appropriate), and is documented in the project files.

After the anomalous waste forms are removed, the co-mingled soil will be referred to as "process soil," consistent with current 300 Area burial ground remediation terminology. Process soil will be field screened on a frequency basis in addition to field observations.

In addition to the frequency-based field screening, visual observations made in the dig face or process soil piles will be used to trigger field screening. This is based on visual observations of color changes, odors, the presence of leaking containers, significant radiological detector readings, large accumulations of dangerous/hazardous solid materials (e.g., lead bricks), or other anomalous conditions.

Depending on the volume of anomalous soil and the detected values, additional sampling may be initiated for laboratory analysis, or the project may assign the appropriate waste code and ship the anomalous soil for treatment and disposal. If the project elects to sample for laboratory analysis, one sample should be collected from the location with the highest field screening readings. The results of the laboratory analysis will be used to determine if the soil is designated as dangerous/hazardous waste. Figure 4-1 provides a logic flow diagram for disposition of anomalous waste forms. Figure 4-2 provides a logic flow diagram for disposition of soil.

4.2 INITIAL WASTE DESIGNATIONS

Waste designation for the 100 Area burial grounds will initially be based on analytical data obtained from the 118-B-1 Burial Ground as described in the *118-B-1 Burial Ground Excavation Treatability Test Report* (DOE-RL 1995a), *Estimates of Solid Waste Buried in 100 Area Burial Grounds* (Miller and Wahlen 1987), and *Radiological Characterization of the Retired 100 Areas*

(Dorian and Richards 1978). These initial waste designations will be applied to analogous 100 Area burial ground sites and their waste forms. These data will also be used to develop initial waste profiles. This enables remediation to start without hindering production to satisfy initial waste designation requirements. However, undesignated anomalous media must be characterized as they are discovered.

4.3 WASTE STREAM-SPECIFIC MANAGEMENT

The following sections describe how the various waste streams will be managed.

4.3.1 Miscellaneous Solid Wastes

This is nonhazardous, nonradioactive waste that is expected to consist of paper, debris, and other solid waste that will be collected during the remediation activities. Miscellaneous solid waste that has contacted potentially contaminated materials will be segregated from other materials. Miscellaneous solid waste will be placed in containers that are appropriate for the material and the disposal facility. Miscellaneous solid waste that has not contacted contaminated media, and contact miscellaneous solid waste that is nondangerous and has been radiologically released, may be disposed offsite at a permitted disposal facility, disposed in an onsite limited purpose or inert landfill, or recycled, as appropriate.

4.3.2 Low-Level Radioactive Waste

Low-level radioactive waste including soil, concrete, debris, and structures will be removed during excavation. Low-level radioactive debris (e.g., concrete, wood, rebar, metal/plastic pipe and screens, wire, liners, bentonite/sand/gravel, equipment, pumps, tanks) will be generated during the decommissioning of wells. Plastic, paper, and other compactible waste will also be generated as part of the remediation activities. Debris that has contacted contaminated media may be disposed of at ERDF after meeting ERDF waste acceptance criteria (BHI 2002). If the waste acceptance criteria cannot be met, the waste will be shipped to an appropriate offsite facility, depending on the waste designation. Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440. Material that can be radiologically released may be disposed offsite at a permitted disposal facility, disposed in an onsite limited purpose or inert landfill, or recycled, as appropriate.

4.3.3 Hazardous and/or Mixed Waste (Both Radioactive and Hazardous)

Hazardous and/or mixed waste that meets the LDR treatment standards and the most current ERDF waste acceptance criteria may be disposed of at ERDF. Wastes that do not meet the acceptance criteria may be temporarily stored until they can be treated to meet the criteria and will be handled on a case-by-case basis. Depending on the waste designation, the waste may be shipped to an appropriate offsite facility. Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440.

4.3.4 Liquid

4.3.4.1 Liquids from Unplanned Releases. If a release occurs, the notification of ERC Spill Release Support is required. The reporting requirements will be met as required by DOE O 232.1A. The ERC spill reporting point of contact will determine the actions required to address the spill. The lead regulatory agency will be notified of significant spills.

4.3.4.2 Decontamination Fluids. Decontamination fluids (i.e., water and/or nonhazardous cleaning solutions) from cleaning equipment and tools used in the OUs will be discharged to the ground (if appropriate) in accordance with the *Best Management Practice for Wet Cleaning and/or Decontamination of Equipment Working in Contaminated Areas* (BHI 1999). If decontamination fluids are collected and they are above the purgewater collection criteria, they will be designated and transported to the Purgewater Storage and Treatment Facility (also known as ModuTanks™), the Effluent Treatment Facility (ETF) (if the waste acceptance criteria can be met), or other facility as authorized by the lead regulatory agency. Small volumes of decontamination fluids may be stabilized to eliminate free liquids and then disposed of at ERDF after meeting the waste acceptance criteria (BHI 2002).

4.3.5 Used Oil and Hydraulic Fluids

Used oil and hydraulic fluids are generated during the operation of the machinery at the waste sites and will be sent offsite for recycling or disposal, as appropriate.

4.3.6 Returned Sample Waste

Screening and analysis of both solids and liquids may be conducted at the waste sites, offsite or onsite laboratories, and/or the Radiological Counting Facility. Samples from the Radiological Counting Facility and 222-S Laboratory are authorized for return to the OU. Unused samples and associated laboratory waste from offsite analyses will be dispositioned in accordance with the laboratory contract and agreements for return of the waste to the Hanford Site. Waste from field screening and onsite laboratories will be managed depending on whether it has been altered. Altered samples will be contained and disposed of at ETF, ERDF, or other appropriate facility as authorized by the lead regulatory agency, depending on waste designation. Unaltered liquid waste generated during sample screening and analysis may be discharged to the ground near the point of generation (if it is below the collection criteria limits) or disposed of at ETF, ERDF, or other appropriate facility if it meets the collection criteria. Some liquids may be neutralized and/or stabilized to meet the disposal facility's waste acceptance criteria. Pursuant to 40 CFR 300.440, remedial project manager approval will be obtained before returning unused samples or waste from offsite laboratories. Approval of this RDR/RAWP constitutes remedial project manager approval for shipment of offsite and onsite laboratory sample waste back to the waste site of origin.

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4.4 WASTE HANDLING, PACKAGING, AND LABELING

Materials requiring collection will be placed in containers appropriate for the material and the receiving facility. ERDF containers will be used for most wastes.

Waste moved outside the AOC must meet all substantive requirements of WAC 173-303 and DOT requirements, as applicable. Waste will be packaged, marked, and labeled in accordance with SSWMIs.

4.5 STORAGE

The amount of waste stored at the site will be kept to a minimum. Full containers will be prepared for disposal as quickly as economically feasible. Radioactive waste will be managed separately from nonradioactive waste. In general, disposal of waste recovered in support of this RDR/RAWP will either be disposed of at ERDF or at an inert or limited purpose landfill. As necessary, waste will be stored within the AOC, in staging piles, or at ERDF as described in the following subsections.

4.5.1 Area of Contamination

Waste from the 100 Area sites and their connecting pipelines that are excavated and held for further analysis, treatment, or any other reason (not immediately transported to ERDF) will be temporarily stored in the AOC. Waste managed within the AOC is not subject to substantive provisions of 40 CFR 264.554. The AOC approach was discussed in the NCP (55 FR 8666) with regards to remedial actions under CERCLA. The guidance states that the AOC can be equated to an RCRA landfill where movement within the area would not be considered land disposal and would not trigger the requirements of Subtitle C, such as 90-day storage or LDRs. Any movement of soil outside of the AOC will trigger compliance with all ARARs, such as RCRA provisions for management of hazardous waste. The AOC for each waste site will be delineated in the project drawings. These drawings will be provided to the lead regulatory agency for review and approval, if requested.

4.5.2 Staging Piles

As an alternative to storage within the AOC, waste that is not immediately transported to ERDF or other EPA-approved disposal facility may be stored in staging piles. Staging piles must be designed so as to prevent or minimize releases of hazardous wastes and hazardous constituents into the environment, and minimize or adequately control cross-media transfer. Staging piles must be closed by removing or decontaminating all remediation waste; contaminated containment system components, structures, and equipment contaminated with waste; and leachate. A map outlining the AOC and staging piles will be developed for each excavation area. The map will be posted at the construction office and will be updated in the field, as needed, if plumes or other areas of contamination are discovered that change the AOC or staging pile areas.

The staging piles must be operated in accordance with the substantive standards and design criteria prescribed in 40 CFR 264.554, paragraphs (d) through (k). General requirements for the staging piles include the following.

- Staging piles are used only during remedial operations for temporary storage at a facility, and must be located within the contiguous property where the wastes to be managed in the staging piles originated.

- Staging piles cannot be used for flowing (i.e., liquid) waste storage.

- The staging pile must be designed so as to prevent or minimize releases of hazardous wastes and hazardous constituents into the environment, and minimize or adequately control cross-media transfer. To protect human health and the environment, this can include installation of berms, dust control practices, or using liners/covers, as appropriate.

- The staging pile must not operate for more than 2 years (measured from the first time remediation waste is placed into the pile), except when the EPA grants an operating term extension. A record of the date when remediation waste was first placed in the staging pile must be maintained until final closeout of the site is achieved.

- Ignitable or reactive waste must not be placed in a staging pile unless it has been treated or mixed before being placed in the pile so that the waste no longer meets the definition of ignitable or reactive waste, or the waste is managed to protect it from exposure to any material or condition that may cause it to ignite or react.

- Incompatible wastes may not be placed in the same staging pile unless the requirements in 40 CFR 264.17(b) have been met. The incompatible materials must be separated or they must be protected from each other with a dike, berm, wall, or other device. Remediation waste may not be piled on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 CFR 264.17(b).

- Within 180 days after the operating term of the staging pile located in a previously uncontaminated area expires, the staging pile must be closed in accordance with substantive provisions of 40 CFR 264.258(a) and 40 CFR 264.111, or 40 CFR 265.258(a) and 40 CFR 265.111. This includes removing all remediation waste, contaminated containment system components, contaminated structures and equipment, and leachate.

Approval of this RDR/RAWP by the regulators constitutes general authorization to operate staging piles during remediation of the 100 Area. Specific staging pile locations will be identified on project drawings and approved by the lead regulatory agency in UMMs or other forums agreed to by the lead regulatory agency. Field operation of staging piles within the referenced regulatory provisions will be accomplished through the following controls:

- The staging pile area will be surrounded with a minimum of a 15-cm (6-in.) berm to control run-on/run-off control prior to use.

- Dust control practices will be deployed consistent with soil piles managed in the AOC, including the use of crusting agents, as necessary, to minimize migration/leaching or contaminants into underlying soil. Application of water for dust control will prevent contamination spread beyond the boundaries of the AOC.

- Surveys of the staging pile area will be performed prior to placement to ensure that no cross-media transfer or staging of waste on previous contaminated areas.

- Gross sorting of waste will be performed within the AOC to identify and remove anomalous waste, including drums or other containers from the bulk soil, prior to moving the soil to the staging piles. Additional sorting may be required on bulk soil in the staging pile area. Any dangerous waste identified will be packaged and managed appropriately (drums) within the staging pile area and within close proximity to the specific staging pile. Drums will be properly labeled, managed, and inspected, and must be inspected weekly or as described in BHI-EE-10, *Waste Management Plan.*

Once characterization and designation of the material in the staging piles is completed, the waste will be loaded into containers for transport to ERDF or shipped offsite for treatment and/or disposal, as appropriate. To close out the staging piles areas after the waste has been removed, samples of the residual soil will be collected in accordance with the 100 Area Burial Grounds SAP (DOE-RL 2001a). The sample results will be evaluated with the soil cleanup levels in Tables 2-1, 2-2, 2-3, and 2-4 to demonstrate attainment of the RAOs.

4.5.3 Environmental Restoration Disposal Facility Drummed Waste Staging Area

On a case-by-case basis, a staging area is available at ERDF for containerized wastes (e.g., drums) from the 100 Area remedial action sites that require special handling and/or treatment, such as thermal treatment of a mixed radioactive/dangerous waste. Containerized waste will be characterized at the site prior to transport to the ERDF staging area. All containerized waste sent to the ERDF staging area will be stored in accordance with requirements prescribed by the ERDF ROD Amendment (EPA 2002) and implementing documents.

4.6 WASTE TRANSPORTATION

Packaging, marking, and labeling for transportation will be in accordance with DOT 49 CFR requirements and the SSWMI, as appropriate. With appropriate documentation (e.g., safety analysis report for packaging or risk-based exemption), packaging exceptions to DOT requirements that provide an equivalent degree of safety during transportation may be used for waste shipments. Coordination and preparation of these documents will be approved by RL with the assistance of the Waste Management and Transportation group. ERDF roll-off-type containers will be used for most bulk wastes. Tractor-trailer flatbed units will be used for transportation of containerized waste. Containers will be sealed and shipped to the identified disposal facility as quickly as economically feasible. Waste will be transported in accordance with WAC 173-303 and DOT regulations, as appropriate.

4.7 WASTE TREATMENT

The selected remedy specified in the RODs (EPA 1995, 1997a, 1999, 2000a, 2000b) is remove and dispose to an authorized facility such as ERDF. Treatment, as appropriate or required, may be conducted at ERDF or the OU. Required treatment is any treatment required to comply with legal requirements. However, as described in Section 2.0 of this RDR/RAWP, evaluations of existing historical and analytical data and technology demonstrations have resulted in the conclusions that soil treatment for volume reduction will not be appropriate at this time.

Treatment will be required for LDR material unless a treatability variance or ARAR waiver is requested by RL and approved by the regulatory agencies. If LDR wastes are encountered, the requirements of 40 CFR 268 will be applied. Should LDR material be encountered, it will be temporarily stored within the AOC or staging piles, and disposed of in accordance with applicable regulations. If treatment is required to address LDR wastes, RL will obtain regulatory agency approval.

Figure 4-1. Logic Flow Diagram for Disposition of Buried Waste and Co-Mingled Soil.

Figure 4-2. Logic Flow Diagram for Disposition of Anomalous Waste Forms.

5.0 REFERENCES

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10 CFR 1022, "Compliance with Floodplain/Wetlands Environmental Review Requirements," *Code of Federal Regulations*, as amended.

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40 CFR 6, "Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act," *Code of Federal Regulations*, as amended.

40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards," *Code of Federal Regulations*, as amended.

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

40 CFR 131, "Water Quality Standards," *Code of Federal Regulations*, as amended.

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

40 CFR 142, "National Secondary Drinking Water Regulations," *Code of Federal Regulations*, as amended.

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40 CFR 196, "Notice of Proposed Rulemaking for Radiation Site Cleanup Regulations," *Code of Federal Regulations*, as amended.

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

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APPENDIX A

WASTE SITE INFORMATION

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WASTE SITE INFORMATION

This appendix provides a list of all the waste sites identified in the following Records of Decision:

- *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington* (hereinafter referred to as the Record of Decision [ROD]) (EPA 1995) – Page G-1

- Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units (hereinafter referred to as the amended Record of Decision [ROD Amendment]) (EPA 1997) – Page G-4

- *Interim Action Record of Decision for the 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-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (hereinafter referred to as the Remaining Sites ROD) (EPA 1999) – Page G-16

- *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units Hanford Site (100 Area Burial Grounds), Hanford Site, Benton County, Washington* (hereinafter referred to as the 100 Area Burial Grounds ROD) (EPA 2000) – Page G-10

Also provided is a status of which sites have been remediated and interim closed or reclassified as a no-action site. For the waste sites that have not yet been reclassified or remediated, additional information such as estimated waste volumes, approximate dimensions of the site, and potential contaminants of concern is provided, if available.

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
Waste Sites Identified in the Interim Record of Decision for the 100-BC, 100-H, and 100-D Areas						
100-BC-1 Operable Unit						
100-B-8 and 100-C-6, 100-B/C Process Effluent Pipelines	Site has been remediated and interim closed. See CVP-2003-00019 and CVP-2003-00022 for site-specific information.					
116-B-1, Process Effluent Trench	Site has been remediated and interim closed. See CVP-99-00012 for site-specific information.					
116-B-2, Fuel Storage Basin Trench	Site has been remediated and interim closed. See CVP-99-00015 for site-specific information.					
116-B-3, Pluto Crib	Site has been remediated and interim closed. See CVP-99-00013 for site-specific information.					
116-B-4, French Drain	Site has been remediated and interim closed. See CVP-99-00014 for site-specific information.					
116-B-5, Crib	Site has been excavated and closed out. See Waste Site Reclassification Form Control Number 1998-064.					
116-B-6A, Crib	Site has been remediated and interim closed. See CVP-99-00011 for site-specific information.					
116-B-6B, Crib	Site has been remediated and interim closed. See CVP-99-00017 for site-specific information.					
116-B-9, French Drain	Site has been remediated and interim closed. See CVP-99-00009 for site-specific information.					
116-B-10, Dry Well/Quench Tank	Site has been remediated and interim closed. See CVP-99-00010 for site-specific information.					
116-B-11, Retention Basin	Site has been remediated and interim closed. See CVP-99-00001 for site-specific information.					
116-B-12, Crib	Site has been remediated and interim closed. See CVP-99-00008 for site-specific information.					
116-B-13, Sludge Trench	Site has been remediated and interim closed. See CVP-99-00002 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-B-14, Sludge Trench	Site has been remediated and interim closed. See CVP-99-00003 for site-specific information.					
116-C-1, Process Effluent Trench	Site has been remediated and interim closed. See CVP-98-00006 for site-specific information.					
116-C-5, Retention Basin	Site has been remediated and interim closed. See CVP-99-00004 for site-specific information.					
100-DR-1 Operable Unit						
100-D-4, 107-D Sludge Trench # 5	Site has been remediated and interim closed. See CVP-98-00004 for site-specific information.					
100-D-18, 107-D Sludge Trench # 4	Site has been remediated and interim closed. See CVP-2000-00001 for site-specific information.					
100-D-20, 107-D Sludge Trench # 3	Site has been remediated and interim closed. See CVP-98-00003 for site-specific information.					
100-D-21, 107-D Sludge Trench # 2	Site has been remediated and interim closed. See CVP-98-00002 for site-specific information.					
100-D-22, 107-D Sludge Trench # 1	Site has been remediated and interim closed. See CVP-98-00001 for site-specific information.					
100-D-49, 100-D/DR, Process Effluent Pipelines	Site has been remediated and interim closed. See CVP-2000-00003, CVP-2000-00005, CVP-2000-00034, and CVP-2003-00016 for site-specific information.					
116-D-1A, Fuel Storage Trench	Site has been remediated and interim closed. See CVP-2000-00010 for site-specific information.					
116-D-1B, Fuel Storage Basin Trench	Site has been remediated and interim closed. See CVP-2000-00010 for site-specific information.					
116-D-2 (116-D-2A), Crib: unlined earthen structure	Site has been remediated and interim closed. See CVP-2000-00013 for site-specific information.					
116-D-4, Crib	Site has been remediated and interim closed. See CVP-2000-00008 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-D-6, French Drain	Site has been remediated and interim closed. See CVP-2000-00009 for site-specific information.					
116-D-7, Retention Basin	Site has been remediated and interim closed. See CVP-99-00007 for site-specific information.					
116-D-9, Crib	Site has been remediated and interim closed. See CVP-2000-00012 for site-specific information.					
116-DR-1 and DR-2, Process Effluent Trench	Site has been remediated and interim closed. See CVP-2000-00002 for site-specific information.					
116-DR-9, Retention Basin	Site has been remediated and interim closed. See CVP-99-00006 for site-specific information.					
100-HR-1 Operable Unit						
100-H Process Effluent Piping (100-H-1 and 100-H-21)	Site has been remediated and interim closed. See CVP-2000-00029 for site-specific information.					
116-H-1, Process Effluent Trench	Site has been remediated and interim closed. See CVP-2000-00026 for site-specific information.					
116-H-2, Effluent Disposal Trench	Site has been remediated and interim closed. See CVP-2000-00031 for site-specific information.					
116-H-4, Pluto Crib	The 116-H-4 Pluto Crib site is an inactive, mixed liquid waste site that operated from 1950 to 1952 to receive about 1,000 L (254.2 gal) of contaminated cooling water from reactor process tubes containing ruptured fuel elements. After its use was discontinued in 1952, this pluto crib was covered with about 3.1 m (10 ft) of soil and marked with permanent concrete monuments. The pluto crib was uncovered and exhumed in 1960, during construction of the 105-H confinement system, so that the 117-H Filter Building could be constructed at the same location. Wastes from the site were moved to the 105-H Thimble Pit (118-H-5), where they are now buried. Because little information could be located to characterize the pluto crib's exhumation and reburial, it is unclear how much contaminated soil was removed.					
116-H-7, Retention Basin	Site has been remediated and interim closed. See CVP-2000-00027 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
Waste Sites Identified in the Amended Record of Decision for the 100-BC, 100-H, 100-D, 100-F, and 100-K Areas						
100-BC-2 Operable Unit						
116-C-2A, Pluto Crib	Site has been remediated and interim closed. See CVP-99-00019 for site-specific information.					
116-C-2B, Pluto Crib Pump Station	Site has been remediated and interim closed. See CVP-99-00019 for site-specific information.					
116-C-2C, Pluto Crib Sand Filter	Site has been remediated and interim closed. See CVP-99-00019 for site-specific information.					
100-DR-1 Operable Unit						
116-D-3, Crib	3.1 m (10 ft) x 3.1 m (10 ft) x 3.1 m (10 ft)	Soil: 33 LCM (43 LCY)	Site Rejected			
116-DR-3, Storage Basin Trench	Received contaminated sludge and water from the 105-DR fuel storage basin.		Shallow site: Top, based on 0:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure between 1.8 m to 3.1 m (6 ft to 10 ft) below grade. Assumed slope, 1.5:1 for personnel access. Bottom, based on nominal bottom footprint of 3.1 m x 3.1 m (10 x 10 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria (re: ROD). Soil, based on 3.1 m (10 ft) depth, 1.8 m (6 ft) overburden, and bottom area.	Assumes 1.5:1 layback for access	^{60}Co, ^{137}Cs, ^{152}Eu, ^{154}Eu, $^{239/240}Pu$, ^{90}Sr, ^{99}Tc, $^{233/234}U$, ^{238}U
	3.1 m (10 ft) x 3.1 m (10 ft) x 3.1 m (10 ft)	Soil: 33 LCM (43 LCY)				
116-DR-4, Pluto Crib	Site has been remediated and interim closed. See CVP-2000-00015 for site-specific information.					
116-DR-6, Liquid Disposal Trench	Site has been remediated and interim closed. See CVP-2000-00014 for site-specific information.					
100-FR-1 Operable Unit						
UPR-100-F-2 Basin Leak Ditch	Site has been remediated and interim closed. See CVP-2001-00011 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-F-15 (108-F), French Drain	Site has been remediated and interim closed. See CVP-2002-00001 for site-specific information.					
100-F-19, 100-F Process Effluent Piping	Site has been remediated and interim closed. See CVP-2001-00002 and CVP-2001–00003 for site-specific information.					
116-F-1, Trench (Lewis Canal)	Site has been remediated and interim closed. See CVP-2002-00009 for site-specific information.					
116-F-2, Trench	Site has been remediated and interim closed. See CVP-2001-00005 for site-specific information.					
116-F-3, (105-F) Storage Basin Trench	Site has been remediated and interim closed. See CVP-2002-00008 for site-specific information.					
116-F-4, Crib (Pluto Crib)	Site has been remediated and interim closed. See CVP-2001-00006 for site-specific information.					
116-F-5, Ball Washer Crib	Site has been remediated and interim closed. See CVP-2001-00007 for site-specific information.					
116-F-6, Liquid Waste Disposal Trench (Cooling Water Trench)	Site has been remediated and interim closed. See CVP-2002-00010 for site-specific information.					
116-F-9, Trench (Animal Waste Leach Trench)	Site has been remediated and interim closed. See CVP-2001-00008 for site-specific information.					
116-F-10, French Drain (105-F Dummy Decon French Drain)	Site has been remediated and interim closed. See CVP-2003-00003 for site-specific information.					
116-F-11, French Drain (Cushion Corridor French Drain)	Site has been remediated and interim closed. See CVP-2001-00003 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-F-14, Retention Basin	Site has been remediated and interim closed. See CVP-2001-00009 for site-specific information.					
100-FR-2 Operable Unit						
126-F-1, Powerhouse Ash Pit	Site is pending remediated and interim closed. See CVP-2002-00004 is on hold per EPA.					
100-HR-1 Operable Unit						
100-H-5 Sludge Burial Trench AKA, 116-H-7 Sludge Burial Trench	Site has been remediated and interim closed. See CVP-2000-00028 for site-specific information.					
100-H-17, Trench (co-located w/ 116-H-2 and 100-H-2)	Site has been remediated and interim closed. See CVP-2000-00031 for site-specific information.					
116-H-3, (105-H Dummy Decontamination French Drains)	Site has been remediated and interim closed. See CVP-2000-00032 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-KR-1 Operable Unit						
116-K-1, (100-K Crib)	Site has been remediated and interim closed. See CVP-2003-00024 for site-specific information.					
116-K-2, (100-K Mile-Long Trench)	Runs in an east-west direction parallel to the Columbia River, northeast of the north corner of the 100-K exclusion area fence. It was excavated as a replacement for the 116-K-1 Crib to percolate contaminated cooling water effluent into the soil column. Contamination includes mixed fission products and metals.		Deep site: Top, based on 1:1 slope from 5.33 m (17 ft) bottom depth. Depth, assumed engineered structure at 5.33 m (17 ft) depth. Assumed slope: 1:1 natural repose. Bottom area, based on nominal bottom footprint of 1,249.68 m x 1.2 m (4099 ft x 4 ft).	Depth, assumed all contaminated soils below 4.57 m (15 ft) meet human health, and groundwater protection criteria (re: ROD). Soil, based on excavation with 1:1 side slope.	N/A	^{241}Am, ^{14}C, ^{134}Cs, ^{137}Cs, ^{60}Co, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{63}Ni, ^{238}Pu, $^{239/240}$Pu, ^{40}K, ^{226}Ra, ^{90}Sr, ^{228}Th, ^{232}Th, ^{3}H, $^{233/234}$U, ^{238}U Al, As, Ba, Be, Ca, Cr, Cr^{+6}, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Ag, Na, V, Zn
	1,249.68 m (4099 ft) x 1.2 m (4 ft) x 5.33 m (17 ft) deep	Soil: 69,559 LCM (91,122 LCY)				
116-KE-4, (107-KE Retention Basins)	Consisted of three tanks located northeast of the KE Reactor. Contaminated cooling water from the reactor was diverted to any one of the tanks.		Shallow site: Top, based on 1:1 slope from 3.9 m (13 ft) bottom depth. Depth, assumed engineered structure at 3.9 m (13 ft) depth. Assumed slope: 1:1 natural repose. Bottom area, based on nominal bottom footprint of 240.79 x 76.2 m (790 x 250 ft)	Depth, assumed all contaminated soils below 4.57 m (15 ft) meet human health, and groundwater protection criteria (re: ROD).	N/A	^{241}Am, ^{134}Cs, ^{137}Cs, ^{60}Co, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{63}Ni, ^{238}Pu, $^{239/240}$Pu, ^{40}K, ^{226}Ra, ^{90}Sr, ^{228}Th, ^{232}Th, ^{3}H, $^{233/234}$U, ^{238}U Al, Sb, As, Ba, Be, Ca, Cr, Cr^{+6}, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Ag, Na, V, Zn
	240.79 m (790 ft) x 76.2 m (250 ft) x 3.9 m (13 ft) deep	Soil: 88,927 LCM (116,494 LCY)				
116-KW-3, Retention Basin	Site has been remediated and interim closed. See CVP-2004-00001 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-KR-2 Operable Unit						
100-K-1, French Drain[1]	Located to the east of the 105-KW Reactor building, north of the 116-KW Stack, and south of the 119-KW Exhaust Air Sampling Building. It received radioactive effluent from the 119-KW Sample Building. Site is a gravel-filled concrete pipe extending to an unknown depth.		N/A	N/A	N/A	^{60}Co, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{238}Pu, $^{239/240}Pu$
	0.3 m (1.0 ft) diameter	3 LCM (2 LCY)				
116-KE-1, Condensate Crib[1]	Cobble-filled crib located north of 115-KE and east of 118-KE-1. It received condensate from the KE Reactor gas purification system.		N/A	N/A	N/A	^{3}H, ^{14}C
	12.2 m (40.0 ft) x 12.2 m (40.0 ft) x 7.9 m (25.9 ft)	179 LCM (137 LCY)				
116-KE-2, Waste Crib[1]	Wooden crib structure located west of the 1706-KER Building. It received liquid waste from KE Reactor effluent test loop. Discharge into the crib continued until the early 1980s when DOE mandated the end of ground disposal of radioactive waste in the 100-K Area.		N/A	N/A	N/A	^{3}H, ^{14}C
	4.9 m (16.1 ft) x 4.9 m (16.1 ft) x 9.8 m (32.2 ft)	502 LCM (384 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-KE-3, French Drain[1]	Located north of the 105-KE Reactor building. It is part of a sub-basin drainage disposal system for the 105-KE fuel storage basin (100-K-42). The site operated from 1955 to 1971 as an overflow crib.		N/A	N/A	N/A	^{60}Co, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{155}Eu, $^{239/240}Pu$
	6.1 m (20.0 ft) diameter x 23.8 m (78.1 ft)	44 LCM (34 LCY)				
116-KW-1, Condensate Crib[1]	Located north of 115-KW and east of 118-KW-1. It received condensate from the KW Reactor gas purification system.		N/A	N/A	N/A	^{3}H, ^{14}C, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{154}Eu, ^{155}Eu, ^{238}Pu, ^{238}U
	12.2 m (40.0 ft) x 12.2 m (40.0 ft) x 7.9 m (25.9 ft)	179 LCM (137 LCY)				
116-KW-2, French Drain[1]	Located north of the 105-KW Reactor building. It operated from 1955 to 1970 as an overflow crib for sub-basin drainage from the 105-KW fuel storage basin.		N/A	N/A	N/A	^{60}Co, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{155}Eu, $^{239/240}Pu$
	6.1 m (20.0 ft) diameter x 23.8 m (78.1 ft)	44 LCM (34 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
Waste Sites Identified as Selected Proximity Sites for the 100-BC, 100-D, 100-H, 100-F, and 100-K Areas (identified as selected proximity sites for these areas per the 1995 ROD or ROD amendment)						
100-D-52, Downcomer Insulation Space Drain Dry Well	Site has been remediated and interim closed. See CVP-2000-00018 for site-specific information.					
116-B-16, 111-B Fuel Examination Tanks	Site has been remediated and interim closed. See CVP-99-00011 for site-specific information.					
1607-D2:4, Septic Tank	Site has been remediated and interim closed. See CVP-98-00005, CVP-99-00005, and CVP-2000-00004 for site-specific information.					
Additional 100 Area Sites Added for Remedial Action						
100-B-12, Filter Box Storage	Site has been remediated and interim closed. See CCN 089130 for site-specific information.					
100-F-35, Soil Contamination Area Inside the 105-F Exclusion Area	Site has been remediated and interim closed. See CVP-2002-00007 for site-specific information.					
Waste Sites Identified in the 100 Area Burial Grounds Record of Decision						
100-BC-1 Operable Unit						
118-B-5 Ball 3X Burial Ground	Site has been remediated and interim closed. See CVP-2004-00003.					
118-B-7 Solid Waste Burial Site[2, 3]	2.4 m (8 ft) x 2.4 m (8 ft) x 2.4 m (8 ft)	Soil: 73 LCM (95 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-B-10 Ball 3X Storage Vault	Site has been remediated and interim closed. See CVP-2004-00004.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-BC-2 Operable Unit						
118-B-1 B Burial Ground[2, 3, 4]	305 m (1,000 ft) x 98 m (321 ft) x 6 m (20 ft)	Soil: 81,507 LCM (106,601 LCY) 87,630 LCM (114,632 LCY)	Waste site dimensions were found in various references or assumed. Assumed the waste site was in the shape of an inverted frustrum of a right pyramid, with slopes of 1.5:1. The waste site was broken into zones according to the geophysical investigation figures, the volume for each zone was calculated, and then added together.	A percent debris/percent soil was assumed for this site based on percentages estimated in DOE/RL-95-34, Rev. 0. Assumed the waste volume was 33% debris and 67% potentially contaminated soil. This did not include layback soil.	The layback soil was assumed to be uncontaminated. Assumed slope of 1.5:1.	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{108m}Ag, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg
118-B-2 Minor Construction Burial Ground No. 1[2, 3]	18.3 m (60 ft) x 9.1 m (30 ft) x 77 m (13.8 ft)	Soil: 920 LCM (1,204 LCY)	N/A	N/A	N/A	^{60}Co, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu Cr, Pb, Hg
118-B-3 Minor Construction Burial Ground No. 2[2, 3, 4]	106.7 m (350 ft) x 84 m (275 ft) x 6.1 m (20 ft)	Soil: 55,539 LCM (72,638 LCY) 22,966 LCM (30,027 LCY)	Waste site dimensions were found in various references or assumed. Assumed the waste site was in the shape of an inverted frustrum of a right pyramid, with slopes of 1.5:1.	A percent debris/percent soil was assumed for this site based on percentages estimated in DOE/RL-95-34, Rev. 0. Assumed the waste volume was 33% debris and 67% potentially contaminated soil. This did not include layback soil.	The layback soil was assumed to be uncontaminated. Assumed slope of 1.5:1.	^{60}Co, ^{63}Ni, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{238}Pu, $^{239/240}Pu$ Cr, Pb, Hg
118-B-4 105-B Spacer Burial Ground	Site has been remediated and interim closed. See CVP-2004-00002.					
118-B-6 108-B Solid Waste Burial Ground[2, 3, 4]	4.6 m (15 ft) x 3 m (10 ft)	Soil: 770 LCM (1,007 LCY) 966 LCM (1,265 LCY)	Waste site dimensions were found in various references or assumed. Assumed the waste site was in the shape of an inverted frustrum of a right pyramid, with slopes of 1.5:1.	A percent debris/percent soil was assumed for this site based on percentages estimated in DOE/RL-95-34, Rev. 0. Assumed the waste volume was 33% debris and 67% potentially contaminated soil. This did not include layback soil.	The layback soil was assumed to be uncontaminated. Assumed slope of 1.5:1.	^{3}H Pb, Hg

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
118-C-1 105-C Solid Waste Burial Ground[2, 3, 4]	156 m (510 ft) x 122 m (400 ft) x 6.1 m (20 ft)	Soil: 30,677 LCM (40,122 LCY) 46,345 LCM (60,617 LCY)	Waste site dimensions were found in various references or assumed. Assumed the waste site was in the shape of an inverted frustrum of a right pyramid, with slopes of 1.5:1. The waste site was broken into zones according to the geophysical investigation figures, the volume for each zone was calculated, and then added together.	A percent debris/percent soil was assumed for this site based on percentages estimated in DOE/RL-95-34, Rev. 0. Assumed the waste volume was 33% debris and 67% potentially contaminated soil. This did not include layback soil.	The layback soil was assumed to be uncontaminated. Assumed slope of 1.5:1.	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{108m}Ag, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg
118-C-2 105-C Ball Storage Tank[2, 3, 4]	Site has been remediated and interim closed. See CVP-2004-00005 for site-specific information.					
600-33 105-C Reactor Test Loop Burial Site[2, 3, 4]	6.1 m (20 ft) x 6.1 m (20 ft) x 3 m (10 ft)	Soil: 304 LCM (398 LCY) 966 LCM (1,265 LCY)	Waste site dimensions were found in various references or assumed. Assumed the waste site was in the shape of an inverted frustrum of a right pyramid, with slopes of 1.5:1.	A percent debris/percent soil was assumed for this site based on percentages estimated in DOE/RL-95-34, Rev. 0. Assumed the waste volume was 33% debris and 67% potentially contaminated soil. This did not include layback soil.	The layback soil was assumed to be uncontaminated. Assumed slope of 1.5:1.	^{60}Co, ^{63}Ni
100-DR-1 Operable Unit						
100-D-32 Minor Construction Burial Ground No. 6[2, 3]	15.2 m (50 ft) x 15.2 m (50 ft) x 7.6 m (25 ft)	Soil: 3,279 LCM (4,288 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{238}U, ^{238}Pu, $^{239/240}Pu$ Cr, Pb, Hg
100-D-33 Minor Construction Burial Ground No. 4[2, 3]	30.5 m (100 ft) x 15.2 m (50 ft) x 7.6 m (25 ft)	Soil: 5,544 LCM (7,251 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
100-D-35 Minor Construction Burial Ground No. 1[2, 3]	30.5 m (100 ft) x 15.2 m (50 ft) x 7.6 m (25 ft)	Soil: 5,544 LCM (7,251 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-D-41 (118-D-18) Construction Burial Ground[2, 3]	12.2 m (40 ft) x 12.2 m (40 ft) x 7.6 m (25 ft)	Soil: 1,074 LCM (1,405 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
100-D-45 (118-D-4B) Buried VSR Thimble Site[2, 3]	24.7 m (81 ft) x 7.3 m (24 ft) x 5.2 m (17 ft)	Soil: 2,254 LCM (2,948 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-D-1 100-D Burial Ground No. 1[2, 3]	137.3 m (450 ft) x 114.4 m (375 ft) x 6.1 m (20 ft)	Soil: 45,332 LCM (59,289 LCY)	N/A	N/A	N/A	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{108m}Ag, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg
118-D-4 Construction Burial Ground[2, 3]	183 m (600 ft) x 61 m (200 ft) x 7.6 m (25 ft)	Soil: 88,876 LCM (116,239 LCY)	N/A	N/A	N/A	^{14}C, ^{60}Co, ^{63}Ni Cd, Pb
126-D-2 184-D Coal Pit[2, 3]	122 m (400 ft) x 68.6 m (225 ft) x 6.1 m (20 ft)	Soil: 67,095 LCM (87,752 LCY)	N/A	N/A	N/A	Chromate, Pb, undetermined inorganic chemicals
100-DR-2 Operable Unit						
100-D-40 Minor Construction Burial Ground #5 Hole[2, 3]	12.2 m (40 ft) diameter x 6.1 m (20 ft) depth	Soil: 2,431 LCM (3,180 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
100-D-43 (118-D-4C) Buried VSR Thimble Site 4C[2, 3]	21.4 m (70 ft) x 7.6 m (25 ft) x 4.6 m (15 ft)	Soil: 876 LCM (1,146 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
100-D-47 Construction Burial Ground 4E (118-D-4E)[2, 3]	69.5 m (228 ft) x 57 m (187 ft) x 7.6 m (25 ft)	Soil: 3,982 LCM (5,208 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-D-2 100-D Burial Ground No. 2[2, 3]	305 m (1,000 ft) x 109 m (357 ft) x 7.6 m (25 ft)	Soil: 32,859 LCM (42,976 LCY)	N/A	N/A	N/A	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{108m}Ag, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
118-D-3 100-D Burial Ground No. 3[2, 3]	61 m (200 ft) x 6.1 m (20 ft) x 7.6 m (25 ft)	Soil: 179,373 LCM (234,597 LCY)	N/A	N/A	N/A	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{108m}Ag, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg
118-D-5 Ball 3X Burial Ground[2, 3]	12.2 m (40 ft) x 6.1 m (20 ft) x 4.6 m (15 ft)	Soil: 882 LCM (1,154 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-DR-1 105-DR Gas Loop Burial Ground[2, 3]	38.1 m (125 ft) x 22.9 m (75 ft) x 8.8 m (29 ft)	Soil: 6,188 LCM (8,093 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
126-DR-1 190-DR Clearwell Tank Pit[2, 3]	160 m (525 ft) x 12.8 m (42 ft) x 6.1 m (20 ft)	Soil: 21,785 LCM (28,492 LCY)	N/A	N/A	N/A	N/A Chromate, Pb, undetermined inorganic chemicals
100-FR-2 Operable Unit						
100-F-20, PNL Parallel Pits[2, 3]	80 m (262 ft) x 55 m (180 ft) x 6.1 m (20 ft)	Soil: 7,905 LCM (10,339 LCY)	N/A	N/A	N/A	^{60}Co, ^{90}Sr, $^{239/240}Pu$
118-F-1, Burial Ground No. 1[2, 3]	183 m (600 ft) x 152.5 m (500 ft) x 6.1 m (20 ft)	Soil: 187,717 LCM (245,510 LCY)	N/A	N/A	N/A	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{108m}Ag, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg
118-F-2, Burial Ground No. 2[2, 3]	112.2 m (368 ft) x 99.4 m (326 ft) x 6.1 m (20 ft)	Soil: 87,525 LCM (114,472 LCY)		N/A	N/A	^{60}Co, ^{63}Ni, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{238}U, ^{238}Pu, $^{239/240}Pu$ Cr, Pb, Hg
118-F-3, Burial Ground No. 3[2, 3]	53.4 m (175 ft) x 15.3 m (50 ft) x 4.6 m (15 ft)	Soil: 2,531 LCM (3,310 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-F-5, PNL Sawdust Pit[2, 3]	152.5 m (500 ft) x 45.8 m (150 ft) x 4.6 m (15 ft)	Soil: 29,475 LCM (38,550 LCY)	N/A	N/A	N/A	^{60}Co ^{90}Sr, $^{239/240}Pu$
118-F-6 PNL Solid Waste Burial Ground[2, 3]	122 m (400 ft) x 61 m (200 ft) x 6.1 m (20 ft)	Soil: 85,761 LCM (112,165 LCY)	N/A	N/A	N/A	^{60}Co, ^{90}Sr, $^{239/240}Pu$

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
118-F-7 Burial Ground/ Hardware Storage Vault[2, 3]	4.9 m (16 ft) x 2.4 m (8 ft) x 2.4 m (8 ft)	Soil: 105 LCM (137 LCY)	N/A	N/A	N/A	^{60}Co, ^{108m}Ag Cd, Pb
118-F-9 PNL Rad Site[2, 3]	30.5 m (100 ft) x 4.6 m (15 ft) x 4.6 m (15 ft)	Soil: 892 LCM (1,166 LCY)	N/A	N/A	N/A	^{60}Co, ^{90}Sr, $^{239/240}$Pu
100-HR-2 Operable Unit						
118-H-1 100-H Burial Ground No. 1[2, 3]	213.5 m (700 ft) x 106.8 m (350 ft) x 7.6 m (25 ft)	Soil: 67,738 LCM (88,593 LCY)	N/A	N/A	N/A	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg
118-H-2 100-H Burial Ground No. 2[2, 3]	42.7 m (140 ft) x 30.5 m (100 ft) x 4.6 m (15 ft)	Soil: 359 LCM (469 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-H-3 Construction Burial Ground[2, 3]	91.5 m (300 ft) x 61 m (200 ft) x 61 m (25 ft)	Soil: 11,870 LCM (15,525 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-H-4 Ball 3X Burial Ground[2, 3]	45.8 m (150 ft) x 9.2 m (30 ft) 4.6 m (15 ft)	Soil: 2,083 LCM (2,724 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni
118-H-5 Thimble Pit[2, 3]	9.2 m (30 ft) x 0.6 m (2 ft) x 3 m (10 ft)	Soil: 96 LCM (126 LCY)	N/A	N/A	N/A	^{60}Co, ^{63}Ni, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{238}U, ^{238}Pu, $^{239/240}$Pu Cr, Pb, Hg
100-KR-2 Operable Unit						
118-K-1 100-K Burial Ground[2, 3]	366 m (1,200 ft) x 183 m (600 ft) x 6.1 m (20 ft)	Soil: 245,923 LCM (321,636 LCY)	N/A	N/A	N/A	^{3}H, ^{14}C, ^{60}Co, ^{63}Ni, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu Cd, Pb, Hg
118-K-2 (100-K-2) Sludge Burial Ground[2, 3]	53.4 m (175 ft) x 18.3 m (60 ft) x 4.6 m (15 ft)	Soil: 4,738 LCM (6,197 LCY)	N/A	N/A	N/A	^{60}Co, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, ^{228}Th, ^{232}Th, $^{233/234}$U, ^{238}U, $^{239/240}$Pu Cr, Pb, Hg
100 Area Remaining Sites for Remove, Treat, and Dispose (per Remaining Sites ROD Table A-1)						

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-B-5, Effluent Vent Disposal Trench, 116-B-9, 105-B Effluent Vent Trench	Site has been remediated and interim closed. See CVP-2003-00014 for site-specific information.					
116-B-7 (1904B-1 Outfall Structure)	Site has been remediated and interim closed. See CVP-2002-00003 for site-specific information.					
128-B-3 (Coal Ash and Demolition Waste Site)	Formerly used for burning nonradioactive, combustible wastes and disposal of solid building demolition waste. Chemical-stained soil and stressed vegetation visible along the riverbanks. This site includes former waste site 600-57.		Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 137.2 m x 18.3 m (450 x 60 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Undetermined
	137.2 (450 ft) x 18.3 m (60 ft) x 4.6 m (15 ft)	Soil: 13192 LCM (17250 LCY)				
132-B-6 (1904-B-2 Outfall Structure)	Site has been remediated and interim closed. See CVP-2002-00003 for site-specific information.					
1607-B7 Septic Tank System (1607-B7 Sanitary Sewer System, 124-C-1)	Site has been remediated and interim closed. See CVP-2003-0004 for site-specific information.					
1607-B8 Septic Tank System (124-C-2, 1607-B8 Sanitary Sewer System Septic Tank and Disposal Field for 190-C Pumphouse	Site has been remediated and interim closed. See CVP-2003-00005 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
1607-B9 Septic Tank System (1607-B9 Sanitary Sewer System, 124-C-3)	Site has been remediated and interim closed. See CVP-2003-00006 for site-specific information.					
1607-B10 Septic Tank System, Sewage Disposal Field	Site has been remediated and interim closed. See CVP-2003-00007 for site-specific information.					
1607-B11 Septic Tank System	Site has been remediated and interim closed. See CVP-2003-00009 for site-specific information.					
100-C-3 (119-C Sample Building French Drain, 119-C French Drain)	Site has been remediated and interim closed. See CVP-2003-00008 for site-specific information.					
132-C-2, 1904-C Outfall, 116-C-4	Site has been remediated and interim closed. See CVP-2002-00003 for site-specific information.					
100-D-1, contaminated Drain, contaminated Storm Drain	Received radioactive and hazardous liquid waste leakage from 116-D-7 (107-D) Retention Basin. Site is a concrete storm drain system attached to underground piping running from the south side of the patrol road to the 1904-D outfall.		Intermediate site: Top, based on 1.5:1 slope from 5.2 m (17 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.2 m (17 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 1.0 m x 1.0 m (3.3 x 3.3 ft).	Depth, assumed all contaminated soils below 5.2 m (17 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	SVOA, TPH, VOA, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
	*1.0 m (3.3 ft) x 1.0 m (3.3 ft) x 5.2 m (17 ft)	Soil: 57 LCM (75 LCY)				
100-D-2, Solid Waste Site, Lead Sheeting	Lead sheeting was not removed from the concrete pad when it was buried during demolition of 190-D Building in 1995. Located near the 190-D Annex.		Shallow site: Top, based on 1.5:1 slope from 0.3 m (1.0 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.3 m (1.0 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 1.2 m x 1.2 m (4 x 4 ft).	Depth, assumed all contaminated soils below 0.3 m (1.0 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Pb
	*1.2 m (4.0 ft) x 1.2 m (4.0 ft) x 0.3 m (1.0 ft)	Soil: 0.3 LCM (1.0 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-D-3, Solid Waste Burial Ground, Silica Gel	Received silica gel from the 115-D/DR drying towers. Potentially contaminated with radioactive and hazardous materials. Site is in a vegetation-free graveled lot.		Intermediate site: Top, based on 1.5:1 slope from 5.2 m (17.0 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.2 m (17.0 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 12.2 m x 7.0 m (40 x 20 ft).	Depth, assumed all contaminated soils below 5.2 m (17.0 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	^{14}C Undetermined
	12.2 m (40.0 ft) x 7.0 m (20.0 ft) x 5.2 m (17.0 ft)	Soil: 365 LCM (477 LCY)				
100-D-12 (Sodium Dichromate and Acid Unloading Station	Site has been remediated and interim closed. See CVP-2000-00016 for site-specific information.					
100-D-19 (Sludge Trench near 116-D-7)	Site has been remediated and interim closed. See CVP-2000-00003 for site-specific information.					
100-D-31, 100-D Water Treatment Facilities Underground Pipelines, 100-D Process Sewer System	Carried water treatment waste and rainwater runoff to outfall 116-D-5 until 1977. The process sewer drainage was diverted solely to the 120-D-1 Ponds from 1977 to 1994. Site does not include process sewer for reactor facilities or reactor process effluent.		Shallow site: Top, based on 1.5:1 slope from 3.7 m (12 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.7 m (12 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 1098.0 m x 2.0 m (6,500 ft x 6.5 ft).	Depth, assumed all contaminated soils below 3.7 m (12 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Undetermined Cr, Hg
	1098.0 m (6500 ft) x 2.0 m (6.5 ft) x 3.7 m (12 ft)	Soil: 4242 LCM (5547 LCY)				
116-D-5 (1904-D Outfall Structure)	Received reactor process effluent from the 116-D-7 Retention Basin from 1944 to 1975. Also received process waste water from 183-D, 184-D, 190-D, 185/189-D, and other miscellaneous facilities. Located 122 m (400 ft) west of the 116-D-7 Retention Basin on the bank of the Columbia River.		Intermediate site: Top, based on 1.5:1 slope from 6.7 m (22 ft) bottom depth. Depth, assumed engineered structure from the surface to 6.7 m (22 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 18.3 m x 7.3 m (60 ft x 24 ft).	Depth, assumed all contaminated soils below 6.7 (22 ft) m meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	^{14}C, ^{137}Cs, ^{90}Sr, $^{235,238}U$, $^{239/240}Pu$ Undetermined

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
	18.3 m (60 ft) x 7.3 m (24 ft) x 6.7 m (22 ft)	Soil: 1249 LCM (1633 LCY)				
116-D-8 100-D Cask Storage Pad	Concrete pad and two associated french drains contaminated by radionuclides, potassium borate, and other inorganic chemicals.		N/A	N/A	Assumes 1.5:1 layback for access	^{137}Cs, ^{152}Eu, ^{228}Th, ^{238}U
	Unknown	Soil: 4,556 LCM (5,957 LCY)				
120-D-2, 186-D Waste Acid Reservoir	Designated as a waste site because lead flashing was not removed when the facility was demolished in place in 1979. Located at the northeast corner of the 186-D Building, pit constructed of acid-proof brick, waterproof membrane, vitrified pipe, #8 lead flashing, and gunnite. Facility never used (no records found to document use).		Shallow site: Top, based on 1.5:1 slope from 4.0 m (14 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.0 m (14 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 28.0 m x 28.0 m (92 x 92 ft).	Depth, assumed all contaminated soils below 4.0 m (14 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Pb
	28.0 m (92 ft) x 28.0 m (92 ft) x 4.0 m (14 ft)	Soil: 5,370 LCM (7,022 LCY)				
116-DR-5 (1904-DR Outfall Structure)	Received reactor process effluent from the 116-DR-9 Retention Basin. Located 91 m (300 ft) north of the northwest corner of the 107-D Retention Basin.		Intermediate site: Top, based on 1.5:1 slope from 6.7 m (22 ft) bottom depth. Depth, assumed engineered structure from the surface to 6.7 m (22 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 18.3 m x 7.3 m (27 ft x 14 ft).	Depth, assumed all contaminated soils below 6.7 (22 ft) m meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	^{14}C, ^{137}Cs, ^{90}Sr, $^{235,238}U$, $^{239/240}Pu$ Undetermined
	8.2 m (27 ft) x 4.3 m (14 ft) x 6.7 m (22 ft)	Soil: 338 LCM (442 LCY)				
116-DR-7 (Inkwell Crib)	Site has been remediated and interim closed. See CVP-2000-00019 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
UPR-100-F-1, 141 Building Sewer Line Spill, UN-100-F-1, 141-C to 141-M Sewer Line Leak	Site has been remediated and interim closed. See CVP-2001-00003 for site-specific information.					
100-F-2 (Strontium Gardens)	Site has been remediated and interim closed. See CVP-2001-00001 for site-specific information.					
100-F-23 (141-C Drywell)	Site has been remediated and interim closed. See CVP-2003-00011 for site-specific information.					
100-F-24 (145-F Drywell)	Site has been remediated and interim closed. See CVP-2003-00012 for site-specific information.					
100-F-25 (146-FR Drywells and UPR-100-F-3 Mercury Spill)	Site has been remediated and interim closed. See CVP-2003-00010 for site-specific information.					
100-F-29, 100-F Experimental Animal Farm Process Sewer Pipelines	Site has been remediated and interim closed. See CVP-2001-00003 for site-specific information.					
116-F-8 (1904-F Outfall Structure)	Received reactor process effluent from the 116-F-14 Retention Basin. Demolished concrete structure marked with underground radioactive contamination warning signs. Lower part of spillway is exposed and intact.		Intermediate site: Top, based on 1.5:1 slope from 7.9 m (26 ft) bottom depth. Depth, assumed engineered structure from the surface to 7.9 m (26 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 8.2 m x 4.3 m (27 x 14 ft).	Depth, assumed all contaminated soils below 7.9 m (26 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	^{60}Co, ^{152}Eu, ^{154}Eu, ^{155}Eu, Cr^{+6}
	8.2 m (27 ft) x 4.3 m (14 ft) x 7.9 m (26 ft)	Soil: 307 LCM (402 LCY)				
116-F-15 (108-F Radiation Crib)	Concrete sump in the ground floor of the 108-F Radiobiology Laboratory. Received drainage from laboratory floor and hood drains.		Shallow site: Top, based on 1.5:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 0.9 m x 0.9 m (3 ft x 3 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	$^{230/240}Pu$, ^{90}Sr, ^{238}U, Pb, Cr^{+6}
	0.9 m (3 ft) x 0.9 m (3 ft) x 1.5 m (5 ft)	Soil: 1.5 LCM (2 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-F-16 (PNL Outfall)	Concrete spillway connected to the 116-F-8 outfall, which received wastewater from the 100-F-29 Experimental Animal Facility sewers. Most of the spillway has been backfilled, but a portion near the river shoreline is visible.		Intermediate site: Top, based on 1.5:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.2 m (17 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 30.1 m x 4.6 m (100 ft x 15 ft).	Depth, assumed all contaminated soils below 5.2 m (17 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	$^{239/240}Pu$, ^{90}Sr, ^{137}Cs, Pb, Cr^{+6}
	30.1 m (100 ft) x 4.6 m (15 ft) x 5.2 m (17 ft)	Soil: 684 LCM (894 LCY)				
120-F-1, Glass Dump	Site is an open trench containing approximately 0.6 m (2 ft) of fluorescent tubes, light bulbs, vacuum tubes, small batteries, and empty chemical bottles.		Shallow site: Top, based on 1.5:1 slope from 1.2 m (4 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.2 m (4 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 10.7 m x 2.4 m (35 ft x 8 ft).	Depth, assumed all contaminated soils below 1.2 m (4 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Undetermined
	10.7 m (35 ft) x 2.4 m (8 ft) x 1.2 m (4 ft)	Soil: 37 LCM (48 LCY)				
1607-F2 (septic tank and drain field)	Site has been remediated and interim closed. See CVP-2002-00005 for site-specific information.					
1607-F6 (septic tank and drain field)	Site has been remediated and interim closed. See CVP-2001-00010 for site-specific information.					
100-H-11, Expansion Box French Drain E	The site is a french drain inside a concrete expansion box next to the south wing of the H Reactor. A 1.5-m (5-ft)-diameter effluent line makes a 40-degree turn in the box, and the drain was designed to drain any leaks from the pipe.		Shallow site: Top, based on 1.5:1 slope from 4.3 m (14 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.3 m (14 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 3.1 m x 3.1 m (10 ft x 10 ft).	Depth, assumed all contaminated soils below 4.3 m (14 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Undetermined
	3.1 m (10 ft) x 3.1 m (10 ft) x 4.3 m (14 ft)	Soil: 55 LCM (72 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-H-12, Expansion Box French Drain F and Shielding Lead	The site is a french drain inside a concrete expansion box next to the H Reactor. A 1.5-m (5-ft)-diameter effluent line makes a 90-degree turn in the box, and the drain was designed to drain any leaks from the pipe. The manhole access to the box is blocked with lead bricks to shield from a high dose.		Intermediate site: Top, based on 1.5:1 slope from 5.2 m (17 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.2 m (17 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 3.1 m x 3.1 m (10 ft x 10 ft).	Depth, assumed all contaminated soils below 5.2 m (17 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Undetermined Pb
	3.1 m (10 ft) x 3.1 m (10 ft) x 5.2 m (17 ft)	Soil: 55 LCM (72 LCY)				
100-H-13, French Drain G	The site is a 1.2-m (4-ft)-diameter vitrified clay pipe with a 6.3-cm (2.5-in.) steel pipe entering from the H Reactor. The purpose of the drain and pipe are not known.		N/A	N/A	Assumes 1.5:1 layback for access	Undetermined
	Unknown	Soil: 55 LCM (72 LCY)				
100-H-14, Surface Contamination Zone H	Surface contamination zone of unknown origin next to the south wall of the reactor building fuel storage basin. Contamination was stabilized with 46 to 61 cm (18 to 24 in.) of soil and marked as subsurface contamination. The source of the contamination is unknown.		Intermediate site: Top, based on 1.5:1 slope from 5.2 m (17 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.2 m (17 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 12.2 m x 12.2 m (40 ft x 40 ft).	Depth, assumed all contaminated soils below 5.2 m (17 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Undetermined
	12.2 m (40 ft) x 12.2 m (40 ft) x 5.2 m (17 ft)	Soil: 782 LCM (1,022 LCY)				
100-H-22, Soil contaminated by Effluent Line Leakage	Site has been remediated and interim closed. See CVP-2000-00029 for site-specific information.					
100-H-24 (151-H Sub-station Laydown Yard)	Site has been remediated and interim closed. See CVP-2000-00030 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-H-31, Polychlorinated Biphenyl in Soil On North Side of 105-H Reactor Building	Sampling of stained oil in 1991 at this former location of an electrical substation found 1,200 µg/kg of Aroclor-1260 in one soil sample.		Intermediate site: Top, based on 1.5:1 slope from 5.2 m (17 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.2 m (17 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 3.1 m x 3.1 m (10 ft x 10 ft).	Depth, assumed all contaminated soils below 5.2 m (17 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	PCBs
	3.1 m (10 ft) x 3.1 m (10 ft) x 5.2 m (17 ft)	Soil: 55 LCM (72 LCY)				
116-H-5 (1904-H Outfall Structure)	Received H Reactor process effluent for discharge to pipelines to the Columbia River. This site is a former concrete structure that was demolished in place. Site is covered with approximately 0.61 m (2 ft) of soil.		Intermediate site: Top, based on 1.5:1 slope from 6.7 m (22 ft) bottom depth. Depth, assumed engineered structure from the surface to 6.7 m (22 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 8.2 m x 4.3 m (27 ft x 14 ft).	Depth, assumed all contaminated soils below 6.7m (22 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, Tc-99, U-234, U-235, U-238, Cr (total), Cr^{+6}, Hg, Pb
	8.2 m (27 ft) x 4.3 m (14 ft) x 6.7 m (22 ft)	Soil: 148 LCM (193 LCY)				
116-H-9, 117-H Crib, 117-H Seal Pit Crib	Gravel-filled crib that received drainage from the 117-H Filter Building seal pits. Drainage entered through a cement-asbestos pipe. Crib received short-lived radionuclides that have decayed. Site was released from radiation controls in 1967; however, the crib remains listed as a Class V underground injection well.		Shallow site: Top, based on 1.5:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 ft x 20 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	^{137}Cs, ^{152}Eu, ^{226}Ra, $^{228,232}Th$, ^{238}U
	6.1 m (20 ft) x 6.1 m (20 ft) x 4.6 m (15 ft)	Soil: 63 LCM (83 LCY)				
1607-H2 (Septic Tank and Drain Field)	Site has been remediated and interim closed. See CVP-2000-00024 for site-specific information.					
1607-H4 (Septic Tank and Drain Field)	Site has been remediated and interim closed. See CVP-2000-00025 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-14, 183-KE Acid Neutralization Pit and Overflow French Drain	Received sulfuric acid overflow from the 183-KE day-use acid tank. The excavation for the drain was filled with aggregate and covered with a limestone layer. The steel cover of the pit is west of the alum storage tanks, south of the southwest corner of the 183-KE Water Treatment Plant chlorine storage building.		Intermediate site: Top, based on 1.5:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 1.5 m x 4.6 m (5 ft x 15 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
	1.5 m (5 ft) x 4.6 m (15 ft) x 4.6 m (15 ft)	Soil: 60 LCM (78 LCY)				
100-K-18 (183-KW Caustic Neutralization Pit)	The site is a lined pit used to neutralize caustic solutions before disposal to the process sewer system. The pit is a brick-lined concrete box located southwest of the sulfuric acid tank at the 183-KW Water Treatment Plant.		Shallow site: Top, based on 1.5:1 slope from 0.9 m (3 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.9 m (3 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 2.50 m x 2.0 m (8.3 ft x 6.3 ft).	Depth, assumed all contaminated soils below 0.9 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	As, Ba, Cd, Cr, Pb, Hg, Ag, Se
	2.5 m (8.3 ft) x 2.0 m (6.3 ft) x 0.9 m (3 ft)	Soil: 11.5 LCM (15 LCY)				
100-K-34, 183-KW Acid Neutralization Pit	Received sulfuric acid tank transfer and overflow waste for neutralization before draining to the process sewer. The pit is a brick-lined concrete box located adjacent to the west outside wall of the 183-KW Water Treatment Plant Building and just north of the chlorine storage building.		Shallow site: Top, based on 1.5:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 2.5 m x 2.0 m (8.5 ft x 6.3 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	As, Ba, Cd, Cr, Pb, Hg, Ag, Se, Sulfate
	2.5 m (8.5 ft) x 2.0 m (6.3 ft) x 1.5 m (5 ft)	Soil: 17 LCM (22 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-42, 100 Area KE Basin, 105-KE Fuel Storage Basin, K East Basin, Irradiated Fissile Material Storage, Metal Storage Basin, 100-K-40	The site is the fuel storage basin for the KE Reactor. Although the basins originally served the K Reactors, N Reactor spent nuclear fuel was accumulated in the K Basins from 1979 through 1987. A portion of the fuel elements in the 105-KE Fuel Storage Basin and the concrete of the basin walls have degraded, leaving sludge, fuel particles, and debris that must be removed before remediation of this site can occur. This site is part of the Spent Nuclear Fuels Program (EM-60).		N/A	N/A	Assumes 1.5:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, $^{239/240}Pu$
	Unknown	Soil: 5,129 LCM (6,719 LCY)				
100-K-43, KW Basin, 105-KW Fuel Storage Basin, K West Basin, Irradiated Fissile Material Storage	The site is the fuel storage basin for the 105-KW Reactor. Although the basins originally served the K Reactors, N Reactor spent nuclear fuel was accumulated in the K Basins from 1979 through 1987. The fuel elements in the 105-KE Fuel Storage Basin and the concrete of the basin walls have degraded, leaving sludge, fuel particles, and debris that must be removed before remediation of this site can occur. This site is part of the Spent Nuclear Fuels Program (EM-60).		N/A	N/A	Assumes 1.5:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{152}Eu, ^{154}Eu, $^{239/240}Pu$
	Unknown	Soil : 1,534 LCM (2,009 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-53, 100-KE Glycol Heat Recovery Underground Pipelines	Underground steel supply and return pipelines that transported ethylene glycol solutions between the 150-KE heat recovery station (116-KE-5) and the 165-KE Powerhouse.		Shallow site: Top, based on 1.5:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 295.9 m x 3.1 m (970 ft x 10 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Ethylene glycol
	295.9 m (970 ft) x 3.1 m (10 ft) x 1.5 m (5 ft)	Soil: 146 LCM (191 LCY)				
100-K-54, 100-KW Glycol Heat Recovery Underground Pipelines	Underground steel supply and return pipelines that transported ethylene glycol solutions between the 150-KW heat recovery station (116-KW-4) and the 165-KW Powerhouse. The pipelines originate at 116-KW-4 and end at 165-KW Building north wall.		Shallow site: Top, based on 1.5:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 295.9 m x 3.1 m (970 ft x 10 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Ethylene glycol
	295.9 m (970 ft) x 3.1 m (10 ft) x 1.5 m (5 ft)	Soil: 146 LCM (191 LCY)				
116-K-3 (1904-K Outfall Structure)	Formerly received KE and KW Reactor process effluent for discharge to pipelines to the Columbia River. Currently regulated by an EPA NPDES outfall permit to discharge clean process cooling water and water treatment effluent to the Columbia River. The outfall structure is a reinforced concrete water box with attached spillway.		Intermediate site: Top, based on 1.5:1 slope from 7.0 m (23 ft) bottom depth. Depth, assumed engineered structure from the surface to 7.0 m (23 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 10.0 m x 10.7 m (33 ft x 35 ft).	Depth, assumed all contaminated soils below 7.0 m (23 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	^{60}Co, ^{137}Cs, $^{152,154}Eu$, $^{239/240}Pu$, ^{90}Sr
	10.0 m (33 ft) x 10.7 m (35 ft) x 7.0 m (23 ft)	Soil: 1,604 LCM (2,098 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
120-KE-1, 183-KE Filter Waste Facility Dry Well, 100-KE-1, 183-KE Filter Water Facility, 183-KE Acid Neutralization Pit, 100-K-26	Received sulfuric acid and sulfuric acid sludge for neutralization before draining to the process sewer system. The site is a brick-lined concrete box that contained crushed limestone. During the time this facility operated, sulfuric acid and sludge were contaminated with mercury. Identical to 120-KW-1.		Shallow site: Top, based on 1.5:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 2.5 m x 2.0 m (8.5 ft x 6.3 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	As, Ba, Cd, Cr, Pb, Hg, Ag, Se, Sulfate
	2.5 m (8.5 ft) x 2.0 m (6.3 ft) x 1.5 m (5 ft)	Soil: 17 LCM (22 LCY)				
120-KE-2, 183-KE Filter Waste Facility French Drain, 100-KE-2, 183 KE Filter Water Facility	French drain used from 1955 to 1971 for disposal of sulfuric acid sludge removed from sulfuric acid tanks. A vitrified clay pipe was placed vertically in an excavation. The bottom of the pipe and bottom of the excavation were filled with coarse rock. Identical to 120-KW-2.		Shallow site: Top, based on 1.5:1 slope from 3.4 m (11 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.4 m (11 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 2.5 m x 2.0 m (8.5 ft x 6.3 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	As, Ba, Cd, Cr, Pb, Hg, Ag, Se, Sulfate
	4.0 m (13 ft) x 1.0 m (3 ft) x 3.4 m (11 ft)	Soil: 94 LCM (123 LCY)				
120-KW-1, 183-KW Filter Water Facility Dry Well, 100-KW-1, 183-KW Acid Neutralization Pit, 100-K-17	Received sulfuric acid and sulfuric acid sludge for neutralization before draining to the process sewer system. The site is a brick-lined concrete box that contained crushed limestone. During the time this facility operated, sulfuric acid and sludge were contaminated with mercury. Identical to 120-KE-1.		Shallow site: Top, based on 1.5:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 2.5 m x 2.0 m (8 ft x 6 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	As, Ba, Cd, Cr, Pb, Hg, Ag, Se, Sulfate
	2.5 m (8 ft) x 2.0 m (6 ft) x 1.5 m (5 ft)	Soil: 11 LCM (15 LCY)				

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
120-KW-2, 183-KW Filter Water Facility French Drain, 100-KW-2	French drain used from 1955 to 1971 for disposal of sulfuric acid sludge removed from sulfuric acid tanks. A vitrified clay pipe was placed vertically in an excavation. The bottom of the pipe and bottom of the excavation were filled with coarse rock. Identical to 120-KE-2.		Shallow site: Top, based on 1.5:1 slope from 3.4 m (11 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.4 m (11 ft) depth. Assumed slope: 1.5:1. Bottom area, based on nominal bottom footprint of 4.0 m x 1.0 m (13 ft x 3 ft).	Depth, assumed all contaminated soils below 1 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	As, Ba, Cd, Cr, Pb, Hg, Ag, Se, Sulfate
	4.0 m (13 ft) x 1.0 m (3 ft) x 3.4 m (11 ft)	Soil: 94 LCM (123 LCY)				
600-23	Site has been remediated and interim closed. See CVP-2001-00020 for site-specific information.					
600-149, Small Arms Range, Rifle and Pistol Range, 661 Complex, 600-54	The site was used from the 1940s through the 1950s as a practice range for handguns, rifles, shotguns, machine guns, hand grenades, smoke bombs, and other small arms and incendiary devices. Rubble, wire, lead bullets, and transit piping remnants are scattered about the site.		Shallow site: Bottom, based on 1.5:1 slope from 1 m (3 ft) depth. Depth, assumed engineered structure from the surface to 1 m (3 ft) depth. Assumed slope: 1.5:1. Top area, based on nominal top footprint of 554.7 m x 381.0 m (1,820 ft x 1250 ft).	Depth, assumed all contaminated soils below 1.0 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1.5:1 layback for access	Pb
	554.7 m (1,820 ft) x 381.0 m (1,250 ft) x 1.0 m (3 ft)	Soil: 210,717 LCM (161,126 LCY)				
JA Jones 1	Site has been remediated and interim closed. See CVP-2001-00019 for site-specific information.					
Candidate 100 Area Remaining Sites for Plug-in of Remove, Treat, and Dispose (See Remaining Sites ROD Table A-2)						
100-B-1, Surface Chemical and Solid Waste Dumping Area, Laydown Yard	45.7 m (150 ft) x 3.0 m (10 ft) x 1.5 m (5.0 ft)	Soil: 378.0 LCM (495.0 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5.0 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5.0 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 45.7 m x 3.0 m (150 x 10 ft).	Depth, assumed all contaminated soils below 1.5 m (5.0 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-B-3, Former Hot Thimble Burial Ground	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-008 for site-specific information.					
100-B-10, 107-B Basin Leak and Warm Springs	Site has been remediated and interim closed. See CVP-2004-00004.					
100-B-11 (115-B/C Caisson Site, 115-BC Sump, 115-BC Drywell, 115-B Tank, 115-B/C Caisson Valve Pit)	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2004-003 for site-specific information.					
100-B-14 (100-B Area Process and Sanitary Sewer Underground Pipelines)	Consists of abandoned underground process sewers associated with 100-B Area operations, mostly north and west of B Reactor and joining to empty into the 116-B-7 Outfall. Also, the pipelines feeding the 1607-B7 septic systems, the sodium dichromate pipelines from the 108-B Building to the 190-B Building, and the treated water pipelines from the 190-B Building to B Reactor. Pipelines carried nonradioactive waste fluids, sodium dichromate, pre-reactor treated cooling water, and septage.		The 100-B-14 site was divided into 9 subsites. The 100-B-14:3 (West Process Sewer Pipelines) was reclassified as no action. See Waste Site Reclassification Form Control Number 2004-007. The 100-B-14:5 (Na Dichromate and Na Silicate Pipelines) was reclassified as no action. See Waste Site Reclassification Form Control Number 2004-009. The 100-B-14:6 (184-B Powerhouse Piping) was reclassified as no action. See Waste Site Reclassification Form Control Number 2004-010. The 100-B-14:7 (185-B/190-B Sump/Pipeline) was reclassified as no action. See Waste Site Reclassification Form Control Number 2004-011. The following subsites were turned over to Remedial Action for remove, treat, dispose: 100-B-14:1 (Main Process Collection Pipes), 100-B-14:2 (115-B Gas Recir Septic), The 100-B-14:4 (Cooling Water Pipe Tunnels), 100-B-14:8 (190-B Pipelines), and 100-B-14:9 (1607-B7 Septic).			
	Approximately 14,600 LF	N/A	N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, metals, Pb

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-B-16 (Utility Poles and Fixtures Debris Pile)	Two piles of debris from teardown of utility poles, including treated wood; lead-tipped bolts; dry transformers; and miscellaneous metal, wood, and wiring. Main pile located northwest of B Reactor. Second pile (poles only) located south of main pile. No sign of leakage at site.		N/A	N/A	N/A	Creosote, PCBs, Pb
	30 ft by 70 ft by 4 ft and 30 ft by 50 ft by 6 ft	Soil, debris: 36,000 BCF				
116-B-15, 105-B Fuel Storage Basin Cleanout Percolation Pit, 105-B Fuel Storage Discharge Pond, 105-B Pond	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-052 for site-specific information.					
118-B-9 (104-B-1 Tritium Vault, 104-B-2 Tritium Laboratory)	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2004-004 for site-specific information.					
120-B-1, 105-B Battery Acid Sump	1.5 m (5 ft) x 1.5 m (5 ft) x 3.0 m (10 ft) (see note 2)	Soil: 88 LCM (115 LCY) (see note 2)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 1.5 m x 1.5 m (5 x 5 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
126-B-3, 184-B Coal Pit, Coal Ash and Demolition Waste Site, Dump and Burning Pit Site	121.9 m (400 ft) x 68.6 m (225 ft) x 3.0 m (10 ft)	Soil: 31,399 LCM (41,055 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 121.9 m x 68.6 m (400 x 225 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
128-B-2, 100-B Burn Pit #2	137.2 m (450 ft) x 15.2 m (50 ft) x 9.1 m (30 ft)	Soil: 37,177 LCM (48,611 LCY)	Intermediate site: Top, based on 1:1 slope from 9.1 m (30 ft) bottom depth. Depth, assumed engineered structure from the surface to 9.1 m (30 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 137.2 m x 15.2 m (450 x 50 ft).	Depth, assumed all contaminated soils below 9.1 m (30 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
132-B-1, 108-B Tritium Separation Facility	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-044 for site-specific information.					
132-B-3, 108-B Ventilation Exhaust Stack Site	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-011 for site-specific information.					
132-B-4, 117-B Filter Building	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-010 for site-specific information.					
132-B-5, 115-B/C Gas Recirculation Facility	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-027 for site-specific information.					
1607-B2, 1607-B2 Septic Tank System, 124-B-2, 1607-B2 Sanitary Sewer System	91.4 m (300 ft) x 22.9 (75 ft) x 3.0 m (10 ft)	Soil: 8,584 LCM (11,224 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 91.4 m x 22.9 m (300 x 75 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Pb, pesticides, SVOA

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-232 (100B Electrical Laydown Area)	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2004-066 for site-specific information.					
100-C-7, 183-C Filter Building / Pumproom Facility Foundation and Demolition Waste	93.0 m (305 ft) x 88.4 m (290 ft) x 3.0 m (10 ft)	Soil: 30,792 LCM (40,261 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 93.0 m x 88.4 m (305 x 290 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Sr-90, U-234, U-235, U-238, Cr^{+6}, Hg, Pb, SVOA, VOA
100-C-9 (100-C Area Process and Sanitary Sewer Underground Pipelines)	Consists of abandoned underground process sewers associated with C Reactor operations, which join to form the 2,143-m (7.0-ft)-long, 46-cm (18-in.)-diameter cast iron process sewer that empties into the 1-C-2 Outfall. Also, the pipelines feeding the 1607-B8, 1607-B9, 1607-B-10, and 1607-B11 septic systems and the treated water pipelines from the 190-B Building to B Reactor. Pipelines carried nonradioactive waste fluids, pre-reactor treated cooling water, and septage.		The 100-C-9 site was divided into four subsites. The 100-C-9:3 (Clearwells) Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2004-014 for site-specific information. The 100-C-9:4 (B Rx Valve Pit) Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2004-015 for site-specific information. The 100-C-9:1 (Box Sewer) and 100-C-9:2 (2607-B9 Septic) subsites were turned over to Remedial Action for remove, treat, dispose.			
	Approximately 10,600 LF	Soil, Pipe volume N/A	N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, metals, Pb.
116-C-3, 105-C Chemical Waste Tanks	3.7 m (12 ft) x 3.7 m (12 ft) x 3.7 m (12 ft)	Soil: 246 LCM (322 LCY)	Shallow site: Top, based on 1:1 slope from 3.7 m (12 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.7 m (12 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 3.7 m x 3.7 m (12 x 12 ft).	Depth, assumed all contaminated soils below 3.7 m (12 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden and bottom area.	Assumes 1:1 layback for access	C-14, gamma spec, Sr-90, H-3, Am-241, Pu-238, Pu-239/240, Ni-63, U-234/235, U-238, Hg, As, Ba, Cd, Cr (total), Pb, Se, Ag

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-C-6, 105-C Fuel Storage Basin Cleanout Percolation Pit, 105-C Pond	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-034 for site-specific information.					
128-C-1, 100-C Burning Pit	*65.6 m (225 ft) x 38.1 m (125 ft) x 1.5 m (5 ft)	Soil: 4,873 LCM (6,371 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 65.6 m x 38.1 m (225 x 125 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
132-C-1, 116-C Reactor Exhaust Stack Site, 105-C Reactor Stack Site,	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-026 for site-specific information.					
132-C-3, 117-C Filter Building Site,	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-024 for site-specific information.					
141-C, 141-C Animal Barn, Large Animal Barn & Biology Laboratory, Hog Barn	*20.7 m (68 ft) x 20.7 m (68 ft) x 1.0 m (3 ft)	Soil: 493 LCM (644 LCY)	Shallow site: Top, based on 1:1 slope from 1.0 m (3 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.0 m (3 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 20.7 m x 20.7 m (68 ft x 68 ft).	Depth, assumed all contaminated soils below 1.0 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, U-234, U-235, Cr^{+6}, Hg, Pb, PAH

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
UPR-100-D-1, Oil Soaked Soil	0.6 m (2 ft) x 0.6 m (2 ft) x 4.6 m (15 ft)	Soil: 176 LCM (230 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.6 m x 0.6 m (2 ft x 2 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
100-D-7, Undocumented Solid Waste Site Dump Area	122.0 m (400 ft) x 40.0 m (131 ft) x 0.6 m (2 ft)	Soil: 3,483 LCM (4,554 LCY)	Shallow site: Top, based on 1:1 slope from 0.6 m (2 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.6 m (2 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 122.0 m x 40.0 m (400 x 131 ft).	Depth, assumed all contaminated soils below 0.6 m (2 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
100-D-8 (105-DR Process Sewer Outfall)	**8.2 m (27 ft) x 4.3 m (14 ft) x 4.6 m (15 ft)	Soil: 624 LCM (817 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 8.2 m x 4.3 m (27 x 14 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, Tc-99, U-234, U-235, U-238, Cr (total), Cr^{+6}, Hg, Pb
100-D-13, Unnumbered Septic System A, Septic Tank D-13, 100 DR Area Sewage Disposal Unit, 124-DR-3, 1607-DR3	26.5 m (87 ft) x 18.4 m (60 ft) x 3.0 m (10 ft)	Soil: 2,225 LCM (2,910 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 26.5 m x 18.4 m (87 ft x 60 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-239/240, Sr-90, Cd, Cr (total), Cr^{+6}, Hg, Pb, pesticides, SVOA

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-D-15, Debris North of 100-D Area Perimeter Road and Debris South of 100-D Perimeter Road – within 100-D-55 (Gravel Pit #21)	15.2 m (50 ft) x 15.2 m (50 ft) x 0.30 m (1 ft)	Soil: 88 LCM (115 LCY)	Shallow site: Top, based on 1:1 slope from 0.3 m (1 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.3 m (1 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 15.2 m (50 ft x 50 ft).	Depth, assumed all contaminated soils below 0.3 m (1 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
100-D-23, 119-DR Sample Building Drywell	Site has been remediated and interim closed. See CVP-2003-00018 for site-specific information.					
100-D-24, 119D Sample Building Drywell	0.6 m (2 ft) x 0.6 m (2 ft) x 3.1 m (10 ft)	Soil: 62 LCM (81 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.6 m x 0.6 m (2 x 2 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Sr-90, U-234, U-235, U-238, Cr^{+6}, Hg, Pb, SVOA, VOA
100-D-27, 151-D Substation UPR, A-2 Substation Transformer #A401C Leak	9.1 m (30 ft) x 9.1 m (30 ft) x 4.6 m (15 ft)	Soil: 1,029 LCM (1,346 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 9.1 m x 9.1 m (30 ft x 30 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
100-D-28, 190-DR Building Septic System	14.0 m (46 ft) x 11.0 m (36 ft) 3.0 m (10 ft)	Soil: 853 LCM (1,116 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 14.0 m x 11.0 m (46 ft x 36 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-239/240, Sr-90, Cd, Cr (total), Cr^{+6}, Hg, Pb, pesticides, SVOA

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-D-30, 190-D Sodium Dichromate Soil Contamination, 185-D, 189-D Decon-tamination and Demolition Project, 185-D Sodium Dichromate Trench & Sump	93.0 m (304 ft) x 1.0 m (3.3 ft) x 4.6 m (15 ft)	Soil: 2,515 LCM (3,289 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 93.0 m x 1.0 m (304 x 3.3 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Undetermined
100-D-42 (Buried VSR Thimble Site)	Consists of a solid waste burial ground that contains vertical safety rod (VSR) thimbles. Located east of the two reactor effluent pipelines in the 100-D Area.		N/A	N/A	N/A	Mn-54, Co-60, Al, potassium borate
100-D-50 (100-DR Water Treatment Facilities Underground Pipelines)	Consists of abandoned underground pipelines that carried treated and untreated wastewater from the 183-DR Building, the 183-DR Clearwells, and 105-DR Reactor to the 100-D-8 Outfall. Reinforced concrete piping 0.3 m (12 in.) to 1.8 m (72 in.) in diameter. Located south of the above-listed buildings, generally running in an east-west direction. Pipelines carried nonradioactive waste fluids, pre-reactor treated cooling water, and septage.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, metals, Pb
	15 ft x 70 ft x 30 ft	Soil debris 40,500 BCF				

Table 1. 100 Area Waste Site Status and Information.

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	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-D-54 (Drywell Near Fire Facility Gravel Scrubber)	Consists of a 56-cm (28-in.) drywell constructed of concrete pipe with a steel cover. Approximately 1.5 m (4.9 ft) deep with a 5-cm (2-in.) pipe entering near the bottom. Located approximately 5.5 m (18 ft) southwest of the southwest corner of the 119-DR Sample Building. Use undetermined.		N/A	N/A		Co-60, Cs-137, Eu-152/154, Sr-90, C-14, H-3, Th, U, Hg, ICP metals including Pb, Semi-VOAs and VOAS.
100-D-56 (100-D Area Sodium Dichromate Underground Supply Lines)	Consists of two abandoned 7.6-cm (3-in.) underground supply lines that carried concentrated sodium dichromate between the 108-D, 185-D, 189-D, 190-D, and 183-DR Buildings and the 100-D Sodium Dichromate Transfer Station.		N/A	N/A		Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, metals, Pb
100-D-61 (Utility Pole and Fixture Debris Piles)	Site of debris pile from the teardown of utility poles. Pile includes treated wood, lead-tipped bolts, and other debris. Located northeast of the 183-D Filter Building.		N/A	N/A		Pb, creosote, As, PCBs
116-D-10, 105-D Fuel Storage Basin Cleanout Percolation Pit, 105-D Fuel Storage Discharge Ponds, 105-D Ponds	25.9 m (85 ft) x 14.0 m (46 ft) x 1.1 m (3.5 ft)	Soil: 501 LCM (656 LCY)	Shallow site: Top, based on 1:1 slope from 1.1 m (3.5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.1 m (3.5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 25.9 m x 14.0 m (85 x 46 ft).	Depth, assumed all contaminated soils below 1.1 m (3.5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, U-234, U-235, U-238, Hg, Pb, PCB
128-D-1, 100 D/DR Burning Pit	The Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-009 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
128-D-2 Burn Pit	*73.2 m (240 ft) x 73.2 m (240 ft) x 0.3 m (1 ft)	Soil: 1,891 LCM (2,476 LCY)	Shallow site: Top, based on 1:1 slope from 0.3 m (1 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.3 m (1 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 73.2 m x 73.2 m (240 x 240 ft).	Depth, assumed all contaminated soils below 0.3 m (1 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
130-D-1, 1716-D Gasoline Storage Tank, 1706-D Gasoline Storage Tank	6.1 m (20 ft) x 6.1 m (20 ft) x 4.6 m (15 ft)	Soil: 633 LCM (828 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 x 20 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, As, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
132-D-1, 115-D/DR Gas Recirculating Facility	51.2 m (168 ft) x 29.9 m (98 ft) x 3.4 m (11 ft)	Soil: 6,998 LCM (9,154 LCY)	Intermediate site: Top, based on 1:1 slope from 3.4 m (11 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.4 m (11 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 51.2 m x 29.9 m (168 x 98 ft).	Depth, assumed all contaminated soils below 3.4 m (11 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-234, U-235, U-238
132-D-2, 117-D Filter Building	18.0 m (59 ft) x 12.0 m (39 ft) x 8.2 m (27 ft)	Soil: 5,198 LCM (6,797 LCY)	Intermediate site: Top, based on 1:1 slope from 8.2 m (27 ft) bottom depth. Depth, assumed engineered structure from the surface to 8.2 m (27 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 18.0 m x 12.0 m (59 x 39 ft).	Depth, assumed all contaminated soils below 8.2 m (27 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
132-D-3, 1608-D Waste Water Pumping Station, 1608-D Effluent Pumping Station	6.1 m (20 ft) x 6.1 m (20 ft) x 9.8 m (32 ft)	Soil: 3,175 LCM (4,152 LCY)	Intermediate site: Top, based on 1:1 slope from 9.8 m (32 ft) bottom depth. Depth, assumed engineered structure from the surface to 9.8 m (32 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 x 20 ft).	Depth, assumed all contaminated soils below 9.8 m (32 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB
1607-D4, 1607-D4 Septic Tank and Associated Drain Field, 124-D-4, 1607-D4 Sanitary Sewer System, 1607-D4 Septic Tank	6.0 m (19.6 ft) x 6.0 m (19.6 ft) x 3.0 m (10 ft)	Soil: 299 LCM (391 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.0 m x 6.0 m (19.6 x 19.6 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Pb, pesticides, SVOA
1607-D5, 1607-D5 Septic Tank and Associated Drain Field, 124-D-5, 1607-D5 Sanitary Sewer System, 1607-D5 Septic Tank	6.0 m (19.6 ft) x 6.0 m (19.6 ft) x 3.0 m (10 ft)	Soil: 299 LCM (391 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.0 m x 6.0 m (19.6 ft x 19.6 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Pb, pesticides, SVOA
116-DR-8, 117-DR Crib, 117-DR Seal Pit Crib	3.1 m (10 ft) x 3.1 m (10 ft) x 5.2 m (17 ft)	Soil: 457 LCM (598 LCY)	Intermediate site: Top, based on 1:1 slope from 5.2 m (17 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.2 m (17 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 3.1 m x 3.1 m (10 ft x 10 ft).	Depth, assumed all contaminated soils below 5.2 m (17 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Sr-90, U-234, U-235, U-238, Cr^{+6}, Hg, Pb, SVOA, VOA

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-DR-10, 105-DR Fuel Storage Basin Cleanout Percolation, 105-DR Fuel Storage Discharge Pond, 105-DR Pond	*24.4 m (80 ft) x 15.2 m (50 ft) x 4.6 m (15 ft)	Soil: 3,052 LCM (3,991 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 24.2 m x 15.2 m (80 ft x 50 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, U-234, U-235, U-238, Hg, Pb, PCB
132-DR-1, 1608-DR Waste Water Pumping Station, 1608-DR Effluent Pumping Station	11.0 m (36 ft) x 10.4 m (34 ft) 8.5 m (28 ft)	Soil: 3,861 LCM (5,049 LCY)	Intermediate site: Top, based on 1:1 slope from 8.5 m (28 ft) bottom depth. Depth, assumed engineered structure from the surface to 8.5 m (28 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 11.0 m x 10.4 m (36 ft x 34 ft).	Depth, assumed all contaminated soils below 8.5 m (28 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB

Table 1. 100 Area Waste Site Status and Information.

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	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-F-26 (100-F Water Treatment Facility Underground Pipelines)	Consists of the upstream (pre-reactor) process sewers associated with 100-F Area operations, including all underground water lines used to transport reactor cooling water between water treatment facilities and the 105-F Reactor building. Includes all underground lines running between buildings and those that run to drainage facilities and to the emergency cooling high tanks (water towers). Lines downstream from the reactor building (i.e., those lines that carried cooling water from the reactor to the retention basin, trench, and/or the river) are excluded. Also excluded are those underground lines associated with the Experimental Animal Farm. Pipelines carried nonradioactive waste fluids, sodium dichromate, and pre-reactor treated cooling water.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, metals, Pb
100-F-36 (108-F Chemical Pump House, 108-F Biological Laboratory)	Site of a former chemical makeup facility, since demolished, that originally supported F Reactor operations and later served as a biological laboratory. Remaining structural elements include pieces of foundation at the southeast and southwest corners and the cast iron pipe associated with the 116-F-15 french drain.		N/A	N/A	N/A	Asbestos, Pb, Pu-238, Sr-90, Co-60, Cs-137
100-F-37 (French Drain Discovered Near Hydrant F-2)	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2004-095 for site-specific information.					

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	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-F-38 (Yellow-Stained Soil Near Hydrant F-2)	Consists of yellow-stained soil found during utility work, source unknown. Located near site 100-F-37. No radiological contamination found, but sample of stained soil showed lead and chromium.		N/A	N/A	N/A	Pb, Cr
100-H-28 (100-H Water Treatment Facilities Underground Pipelines)	Consists of the upstream (pre-reactor) process sewers associated with H Reactor, including all underground water lines used to transport reactor cooling water between water treatment facilities and the 105-H Reactor building. Includes all contaminated underground lines running between buildings and those that run to drainage facilities. Lines downstream from the reactor building (i.e., those lines that carried cooling water from the reactor to the retention basin, trench, and/or the river) are excluded. Pipelines carried nonradioactive sodium dichromate process wastes and pre-reactor treated cooling water.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, metals, Pb

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WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-H-33 (183-H Solar Evaporation Basins Radionuclide Components)	Site of four former concrete basins with an area of about 2,452 m^2 (26,400 ft^2) that were demolished as part of a *Resource Conservation and Recovery Act of 1976* (RCRA) closure. Built originally as part of the 100-H water treatment system and later used to solar evaporate mixed waste shipped from the 300 Area fuel fabrication facilities. Located north of H Reactor and just north of the east 183-H Clearwell. Under RCRA closure, all detectable nonradiological contamination was removed, packaged, and disposed. RCRA closure did not address any radionuclides that were associated with the site. The contaminated concrete surface was scabbled and disposed. The remaining concrete was surveyed and the rubble placed in the adjacent 183-H Clearwells. Clean closure of the site was not achieved due to levels of fluoride and nitrate remaining in the soil below the excavated 6.1 m (20 ft) that are above *Model Toxics Control Act* (MTCA) Method B cleanup levels. Remedial measures included placing a vapor barrier at the bottom of the excavation; replacing the excavated soils with clean, compacted backfill; and groundwater monitoring.		N/A	N/A	N/A	Gross alpha, gross beta, U-234, U-235, Tc-99

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-57 (107-KE Drainage Ditch)	Consists of a dry, shallow ditch that extends from the 116-K-3 (1904-K) Outfall Structure and the 116-K-1 Crib. A second ditch extends from the culvert to the Columbia River. The culvert conveyed process effluent leakage from the area surrounding the 107-KE Basins to the ditch. The two ditches intersect below the bank located just north of the basins. The ditch at the bottom of the bank is approximately 300 m (980 ft) long and 2 m (6.6 ft) wide; the ditch leading from the culvert to the river is approximately 270 m (890 ft) long, and the width is generally 2 m (6.6 ft) wide but widens significantly in the middle section.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}
100-K-60 (1904-K Process Sewer [165-KW])	Consists of the 1.68-m (66-in.) concrete process sewer that begins at 165-KW and runs up to the point of intersection with the pipelines coming from the 105-KW Reactor building. Does not include the radioactive process sewer pipelines, water supply lines, or glycol heat pipelines or site 100-K-47. Used to dispose of treated and untreated wastewater generated by the water treatment facilities and powerhouse.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, metals, Pb

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-63 (100-KW Contamination Area)	Site is along the Columbia River north of the 100-K West Reactor Area and 107-KW Retention Basins. It is posted as an Underground Radioactive Material Area, with two sections posted as Soil Contamination Areas due to surface and subsurface contamination as a result of leaks from the basins.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}
100-K-64 (100-KE Contamination Area)	Site is along Columbia River north of the 100-K East Reactor Area and 107-KE Retention Basins. It is posted as a Radiological Contamination Area, a Soil Contamination Area and an Underground Radioactive material Area, due to surface and subsurface contamination as a result of leaks from the basins.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}
100-K-77 (Underground Railroad Ties Southeast of 1706-KE)	Site of railroad ties discovered at the bottom of an excavation about 7 m (23 ft) east-southeast of the 1706-KE Building. Excavation measured approximately 2.9 by 3.1 by 2.1 m deep (9.5 by 10 by 6.9 ft deep). The site was backfilled and the railroad ties at the bottom of the excavation were left in place, but the sidewall braces were probably removed prior to backfilling. Use unknown. Sampling for radionuclides and organics was conducted and no contamination was found.		N/A	N/A	N/A	Creosote
100-K-78 (Fenced Contamination Area)	Site of an apparent unplanned release that resulted in soil contamination. Dimensions are 19.4 by 16.4 m (63.7 by 53.8 ft). Located northeast of the 116-K-1 Crib.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-79 (Sodium Dichromate and Sulfuric Acid Product Pipelines at 100-K)	Consists of the following: sodium dichromate product pipelines from the railroad offloading area to the dichromate storage tanks and then to the 183-KE and 183-KW Buildings; the sulfuric acid product pipelines from the acid storage tanks to the 183 buildings; and the treated water pipelines from the 165 Power Control Buildings to the 105-KE and 105-KW Reactor buildings. Mostly encased in tunnels except for areas where offloaded from railroad cars. No recorded releases.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, Cr^{+6}, Cr, Hg, metals, Pb
116-KE-6A (1706-KE Condensate Collection Tank)	Site of a 363-L (96-gal) collection tank that received condensate from the 1706-KE evaporation unit, which was used to treat radioactive mixed wastes generated in the 1706-KE laboratories. This site is associated with the 1706-KE treatment, storage, and disposal (TSD) unit. The Tri-Parties agreed to conduct cleanup of this TSD unit using CERCLA, and the associated CERCLA documentation.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, inorganics and organics
116-KE-6B (1706-KE Evaporation Tank)	Site of a 114-L (30-gal) evaporation tank that was used to treat radioactive mixed wastes generated in the 1706-KE laboratories. This site is associated with the 1706-KE treatment, storage, and disposal (TSD) unit. The Tri-Parties agreed to conduct cleanup of this TSD unit using CERCLA, and the associated CERCLA documentation.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, inorganics and organics

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
116-KE-6C (1706-KE Waste Accumulation Tank)	Site of a 2,082-L (550-gal) tank that accumulated mixed wastes from the 1706-KE laboratories prior to ion exchange and treatment at the 1706-KE evaporation unit. This site is associated with the 1706-KE treatment, storage, and disposal (TSD) unit. The Tri-Parties agreed to conduct cleanup of this TSD unit using CERCLA, and the associated CERCLA documentation.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, inorganics and organics
116-KE-6D (1706-KE Ion Exchange Column)	Site of a 0.14-m^3 (5-ft^3) mixed bed resin ion-exchange column used to treat mixed wastes from the 1706-KE laboratories prior treatment at the 1706-KE evaporation unit. This site is associated with the 1706-KE treatment, storage, and disposal (TSD) unit. The Tri-Parties agreed to conduct cleanup of this TSD unit using CERCLA, and the associated CERCLA documentation.		N/A	N/A	N/A	Co-60, Cs-137, Eu-152/154, Sr-90, inorganics and organics
628-3 Burn Pit	76 m (250 ft) x 12.2 m (40 ft) x 0.3 m (1 ft)	Soil: 334 LCM (437 LCY)	Shallow site: Top, based on 1:1 slope from 0.3 m (1 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.3 m (1 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 76.0 m x 12.2 m (250 ft x 40 ft).	Depth, assumed all contaminated soils below 0.3 m (1 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-30, 100-DR Construction Laydown Area	213.4 m (700 ft) x 182.9 m (600 ft) x 1.5 m (5.0 ft)	Soil: 69,473 LCM (90,839 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 213.4 m x 182.9 m (700 ft x 600 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
UPR-100-F-3, Mercury Spill	3.1 m (10 ft) x 3.1 m (10 ft) 0.61 m (2.0 ft)	Soil: 9 LCM (12 LCY)	Shallow site: Top, based on 1:1 slope from 0.61 m (2 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.61 m (2 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 3.1 m x 3.1 m (10 ft x 10 ft).	Depth, assumed all contaminated soils below 0.61 m (2 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se
100-F-4, 108-F Building 12-inch French Drain	Site has been remediated and interim closed. See CVP-2002-00001 for site-specific information.					
100-F-7, Underground Fuel Tank – 1705-F Building	15.2 m (50 ft) x 15.2 m (50 ft) x 4.6 m (15 ft)	Soil: 2,102 LCM (2,749 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 15.2 m (50 ft x 50 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	N/A	SVOA, TPH, VOA, As, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
100-F-9, French Drain at East End of 105-F Storage Room (Northeast Corner)	0.9 m (3 ft) x 0.9 m (3 ft) x 1.8 m (6 ft)	Soil: 18 LCM (23 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.9 m x 0.9 m (3 ft x 3 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, Cr^{+6}, Pb

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-F-10, French Drain at East End of 105-F Storage Room (Southeast Corner)	Site has been remediated and interim closed. See CVP-2003-00017 for site-specific information.					
100-F-11, 108-F Building 18 inch French Drain	Site has been remediated and interim closed. See CVP-2002-00001 for site-specific information.					
100-F-12, 36 inch French Drain at 105-F Building	0.9 m (3 ft) x 0.9 m (3 ft) x 1.8 m (6 ft)	Soil: 18 LCM (23 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.9 m x 0.9 m (3 ft x 3 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, Cr^{+6}, Pb
100-F-14, 100-FR-2 Vent Pipe, 100-F Carpenter Shop Waste Site Vent	3.1 m (10 ft) x 3.1 m (10 ft) 4.6 m (15 ft)	Soil: 343 LCM (449 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 3.1 m x 3.1 m (10 ft x 10 ft).	Depth, assumed all contaminated soils below 0.4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, As, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
100-F-16, 108-F Building 30-inch French Drain, Undocumented	Site has been remediated and interim closed. See CVP-2002-00001 for site-specific information.					
100-F-18, 105-F Condensate Drain Field, Underground Tank at 105-F Building, Undocumented	0.9 m (3 ft) x 0.9 m (3 ft) x 3.0 m (10 ft)	Soil: 62 LCM (81 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.9 m x 0.9 m (3 ft x 3 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Sr-90, U-234, U-235, U-238, Cr^{+6}, Hg, Pb, SVOA, VOA

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-F-28, Septic Tank and Drainfield	Site has been rejected. See Waste Site Reclassification Form Control Number 2001-30 for site-specific information.					
100-F-31, 144-F Sanitary Sewer System	12.2 m (40 ft) x 12.2 m (40 ft) x 3.1 m (10 ft)	Soil: 827 LCM (1,081 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 12.2 m x 12.2 m (40 ft x 40 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, U-234, U-235, Cr^{+6}, Hg, Pb, PAH
100-F-33, 146-F Aquatic Biology Fish Ponds	35 m (115 ft) x 15.2 m (50 ft) x 1.5 m (5 ft)	Soil: 1,073 LCM (1,403 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 35.0 m x 15.2 m (115 ft x 50 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, U-234, U-235, Cr^{+6}, Hg, Pb, PAH
100-F-34, Biology Facility French Drain	Site has been remediated and interim closed. See CVP-2001-00002 for site-specific information.					
116-F-7, 117-F French Drain	6.1 m (20 ft) x 6.1 m (20 ft) x 3.0 m (10 ft)	Soil: 308 LCM (403 LCY)	Shallow site: Top, based on 1:1 slope from 3.0 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.0 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 ft x 20 ft).	Depth, assumed all contaminated soils below 3.0 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Sr-90, U-234, U-235, U-238, Cr^{+6}, Hg, Pb, SVOA, VOA
116-F-12, 148-F French Drain	Site has been remediated and interim closed. See CVP-2001-00002 for site-specific information.					

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	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
118-F-4, 115-F Pit, 115-F Crib	3.1 m (10 ft) x 3.1 m (10 ft) 4.6 m (15 ft)	Soil: 343 LCM (449 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 3.1 m x 3.1 m (10 ft x 10 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-154, H-3, Sr-90
126-F-2, 183-F Clearwells	229.0 m (751 ft) x 41.1 m (135 ft) 4.6 m (15 ft)	Soil: 56,122 LCM (73,382 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 229.0 m x 41.1 m (751 ft x 135 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB
128-F-1, 100-F Burning Pit, 100-F Burning Pit No. 1	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-035 for site-specific information.					
128-F-2, 100-F Burning Pit	45.7 m (150 ft) x 18.3 m (60 ft) 3.1 m (10 ft)	Soil: 3,659 LCM (4,784 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 45.7 m x 18.3 m (150 ft x 60 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
128-F-3, PNL Burn Pit	30.5 m (100 ft) x 30.5 m (100 ft) x 3.1 m (10 ft)	Soil: 3,949 LCM (5,164 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 30.5 m x 30.5 m (100 ft x 100 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se

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	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
132-F-1, 132-F-1 Chronic Feeding Barn, 141-F, 141-F Sheep Barn	21.3 m (70 ft) x 21.3 m (70 ft) x 0.1 m (3 ft)	Soil: 519 LCM (679 LCY)	Assumed shallow site: 455 m^2 (4900 ft^2) with unknown depth.	Depth unknown	N/A	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, U-234, U-235, Cr^{+6}, Hg, Pb, PAH
132-F-3, 115-F Gas Recirculating Facility	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-025 for site-specific information.					
132-F-4, 116-F Reactor Stack, 116-F Reactor Exhaust Stack, 132-F-4 Reactor Stack Demolition Site	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-023 for site-specific information.					
132-F-5, 117-Filter Building	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-029 for site-specific information.					
132-F-6, 1608-F Waste Water Pumping Station, 1608-F Effluent Pumping Station, 132-F-6 Lift Station	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-032 for site-specific information.					
182-F, 182-F Reservoir	170.7 m (560 ft) x 94.2 m (309 ft) x 4.6 m (15 ft)	Soil: 91,057.0 LCM (119,059.0 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 170.7 m x 94.2 m (560 ft x 309 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
1607-F1, 1607-F1 Septic Tank and Associated Drain Field, 124-F-1, 1607-F1 Sanitary Sewer System, 1607-F1 Septic Tank	13.7 m (45 ft) x 9.5 m (31 ft) x 3.1 m (10 ft)	Soil: 748 LCM (978 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 13.7 m x 9.5 m (45 ft x 31 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Pb, pesticides, SVOA
1607-F3, 1607-F3 Septic Tank, 124-F-3, 1607-F3 Sanitary Sewer System	18.3 m (60 ft) x 15.2 m (50 ft) x 3.1 m (10 ft)	Soil: 1,381 LCM (1,806 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 18.3 m x 15.2 m (60 ft x 50 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Pb, pesticides, SVOA
1607-F4, 1607-F4 Septic Tank, 124-F-4, 1607-F4 Sanitary Sewer System	7.3 m (24 ft) x 6.1 m (20 ft) x 3.1 m (10 ft)	Soil: 343 LCM (449 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 7.3 m x 6.1 m (24 ft x 20 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-239/240, Sr-90, Cd, Cr (total), Cr^{+6}, Hg, Pb, pesticides, SVOA
1607-F5, 1607-F5 Septic Tank, 124-F-5, 1607-F5 Sanitary Sewer System	7.3 m (24 ft) x 6.1 m (20 ft) x 3.1 m (10 ft)	Soil: 343 LCM (449 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 7.3 m x 6.1 m (24 ft x 20 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Pb, pesticides, SVOA

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
1607-F7, 141-M Building Septic Tank, 124-F-7	18.3 m (60 ft) x 13.1 m (43 ft) x 3.1 m (10 ft)	Soil: 1,223 LCM (1,599 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 18.3 m x 13.1 m (60 ft x 43 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-239/240, Sr-90, Cd, Cr (total), Cr^{+6}, Hg, Pb, pesticides, SVOA
100-H-3, 1716-H Garage Fuel Tank Site	15.2 m (50 ft) x 15.2 m (50 ft) x 4.6 m (15 ft)	Soil: 2,102 LCM (2,749 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 15.2 m (50 ft x 50 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, As, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
100-H-4, 1717-H Hot Shop, French Drain, and, contaminated Storage Unit	3.7 m (12 ft) x 3.7 m (12 ft) x 1.8 m (6 ft)	Soil: 62 LCM (81 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 3.7 m x 3.7 m (12 ft x 12 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Sr-90, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, SVOA
100-H-7, French Drain A	0.9 m (3 ft) x 0.9 m (3 ft) x 1.8 m (6.0 ft)	Soil: 18.0 LCM (23.0 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.9 m x 0.9 m (3 ft x 3 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, Cr^{+6}, Pb

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-H-8, French Drain B	0.9 m (3 ft) x 0.9 m (3 ft) x 1.8 m (6 ft)	Soil: 18 LCM (23 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.9 m x 0.9 m (3 ft x 3 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, Cr^{+6}, Pb
100-H-9, French Drain C	0.6 m (2 ft) x 0.6 m (2 ft) x 1.8 m (6 ft)	Soil: 18 LCM (23 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.6 m x 0.6 m (2 ft x 2 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, Cr^{+6}, Pb
100-H-10, French Drain D	1.2 m (4 ft) x 1.2 m (4 ft) x 1.8 m (6 ft)	Soil: 18 LCM (23 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 1.2 m x 1.2 m (4 ft x 4 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-238, Pu-239/240, Sr-90, Cr^{+6}, Pb
126-H-2, 183-H Clearwells/ Disposal Pit	229.0 m (751 ft) x 41.1 m (135 ft) x 5.5 m (18 ft)	Soil: 68,946 LCM (90,149 LCY)	Intermediate site: Top, based on 1:1 slope from 5.5 m (18 ft) bottom depth. Depth, assumed engineered structure from the surface to 5.5 m (18 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 229.0 m x 41.1 m (751 ft x 135 ft).	Depth, assumed all contaminated soils below 5.5 m (18 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
128-H-1, 100-H Burning Pit, 100-H Burning Pit No. 1	91.4 m (300 ft) x 91.4 m (300 ft) x 3.1 m (10 ft)	Soil: 31,311 LCM (40,940 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 91.4 m x 91.4 m (300 ft x 300 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
128-H-2, Burning Pit	52 m (170 ft) x 41.2 m (135 ft) x 1.5 m (5 ft)	Soil: 3,991 LCM (5,221 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 52 m x 41.2 m (170 ft x 135 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
128-H-3, 100-H Burning Ground #3	54.9 m (180 ft) x 21.3 m (70 ft) x 4.6 m (15 ft)	Soil: 8,118 LCM (10,615 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 54.9 m x 4.6 m (180 ft x 70 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
132-H-1, 116-H Reactor Exhaust Stack Burial Site	67.1 m (220 ft) x 7.6 m (25 ft) x 3.1 m (10 ft)	Soil: 2,603 LCM (3,404 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 67.1 m x 7.6 m (220 ft x 25 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
132-H-2, 117-H Filter Building Site	18.2 m (60 ft) x 12.2 m (40 ft) x 9.8 m (32 ft)	Soil: 7,247 LCM (9,476 LCY)	Intermediate site: Top, based on 1:1 slope from 9.8 m (32 ft) bottom depth. Depth, assumed engineered structure from the surface to 9.8 m (32 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 18.2 m x 12.2 m (60 ft x 40 ft).	Depth, assumed all contaminated soils below 9.8 m (32 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB
132-H-3, 1608-H Waste Water Pumping Station Site, 116-H-8, 1608-H Effluent Pumping Station Site	11.0 m (36 ft) x 10.4 m (34 ft) x 9.8 m (32 ft)	Soil: 5,031 LCM (6,578 LCY)	Intermediate site: Top, based on 1:1 slope from 9.8 m (32 ft) bottom depth. Depth, assumed engineered structure from the surface to 9.8 m (32 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 11.0 m x 10.4 m (36 ft x 34 ft).	Depth, assumed all contaminated soils below 9.8 m (32 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB
600-151, Dumping Areas 50 yd and 200 yd downstream of River Mile 14, military installation NW of 100-H Area	243.8 m (800 ft) x 182.9 m (600 ft) x 0.2 m (0.5 ft)	Soil: 7,828 LCM (10,235 LCY)	Shallow site: Top, based on 1:1 slope from 0.2 m (0.5 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.2 m (0.5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 243.8 m x 182.9 m (800 ft x 600 ft).	Depth, assumed all contaminated soils below 0.2 m (0.5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
1607-H1, 1607-H1 Septic Tank and Associated Drain Field, 124-H-1, 1607-H1 Sanitary Sewer System, 1607-H1 Septic Tank	21.3 m (70 ft) x 15.2 m (50 ft) x 3.1 m (10 ft)	Soil: 1,574 LCM (2,059 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 21.3 m x 15.2 m (70 ft x 50 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Pu-239/240, Sr-90, Cd, Cr (total), Cr^{+6}, Hg, Pb, pesticides, SVOA

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
UPR-100-K-1, 100-KE Fuel Storage Basin leak, UN-100-K-1	45.7 m (150 ft) x 30.5 m (100 ft) x 4.6 m (15 ft)	Soil: 9,305 LCM (12,167 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 45.7 m x 30.5 m (150 ft x 100 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, U-234, U-235, U-238, Hg, Pb, PCB
100-K-13 Liquid Waste French Drain	1.5 m (5 ft) x 1.5 m (5 ft) x 4.6 m (15 ft)	Soil: 229 LCM (299 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 1.5 m x1.5 m (5 ft x 5 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Pb, pesticides, SVOA
100-K-29, 183-KE Sandblasting Site	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2004-040 for site-specific information.					
100-K-30, 183-KE Sulfuric Acid Tank (West Tank)	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-036 for site-specific information.					
100-K-31, 183-KE Sulfuric Acid Tank (East tank)	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2004-038 for site-specific information.					
100-K-32, 183-KW Sulfuric Acid Tank (East tank)	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-039 for site-specific information.					
100-K-33, 183-KW Sulfuric Acid Tank (West tank)	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2004-041 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-35, 183-KE Acid Neutralization Pit	3.1 m (10 ft) x 1.8 m (6 ft) x 1.5 m (5 ft)	Soil: 26 LCM (35 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 3.1 m x 1.8 m (10 ft x 6 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
100-K-36, 1706-KE Chemical Storage Facility Dry Well	0.6 m (2 ft) x 0.6 m (2 ft) x 2.1 m (7 ft)	Soil: 26 LCM (35 LCY)	Shallow site: Top, based on 1:1 slope from 2.1 m (7 ft) bottom depth. Depth, assumed engineered structure from the surface to 2.1 m (7 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.6 m x 0.6 m (2 ft x 2 ft).	Depth, assumed all contaminated soils below 2.1 m (7 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
100-K-46, 119-KE French Drain, Drywell	0.6 m (2 ft) x 0.6 m (2 ft) x 3.1 m (10 ft)	Soil: 62 LCM (81 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 0.6 m x 0.6 m (2 ft x 2 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Sr-90, U-234, U-235, U-238, Cr^{+6}, Hg, Pb, SVOA, VOA
100-K-48, 100-KE Oil Contamination Areas	15.2 m(50 ft) x 6.1 m (20 ft) x 1.5 m (5 ft)	Soil: 229 LCM (299 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 6.1 m (50 ft x 20 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, Ba, Cd, Cr (total), Pb, Se, Ag, PCB

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
100-K-49, 100-KW Oil Contamination Area	15.2 m(50 ft) x 6.1 m (20 ft) x 1.5 m (5 ft)	Soil: 229 LCM (299 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 6.1 m (50 ft x 20 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
120-KE-3, 100-KE-3, 183-KE Filter Water Facility Trench	12.2 m (40 ft) x 0.9 m (3 ft) x 0.9 m (3 ft)	Soil: 26 LCM (35 LCY)	Shallow site: Top, based on 1:1 slope from 0.9 m (3 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.9 m (3 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 12.2 m x 0.9 m (40 ft x 3 ft).	Depth, assumed all contaminated soils below 0.9 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
120-KE-6, 183-KE Sodium Dichromate Tank	6.1 m (20 ft) x 6.1 m (20 ft) x 0.9 m (3 ft)	Soil: 53 LCM (69 LCY)	Shallow site: Top, based on 1:1 slope from 0.9 m (3 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.9 m (3 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 ft x 20 ft).	Depth, assumed all contaminated soils below 0.9 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Undetermined
120-KW-5, 183-KW Sodium Dichromate Storage Tank	6.1 m (20 ft) x 6.1 m (20 ft) x 0.9 m (3 ft)	Soil: 53 LCM (69 LCY)	Shallow site: Top, based on 1:1 slope from 0.9 m (3 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.9 m (3 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 ft x 20 ft).	Depth, assumed all contaminated soils below 0.9 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Undetermined
128-K-1, 100-K Burning Pit	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2004-042 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
128-K-2, 100-K Construction Dump	243.8 m (800 ft) x 85.3 m (280 ft) x 1.5 m (5 ft)	Soil: 37,371 LCM (48,864 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 243.8 m x 85.3 m (800 ft x 280 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
130-K-2, 1717-K Waste Oil Storage Tank	6.1 m (20 ft) x 3 m (10 ft) x 3.7 m (12 ft)	Soil: 290 LCM (380 LCY)	Shallow site: Top, based on 1:1 slope from 3.7 m (12 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.7 m (12 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 3.0 m (20 ft x 10 ft).	Depth, assumed all contaminated soils below 3.7 m (12 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
130-KE-1, 105-KE Emergency Diesel Oil Storage Tank, 105-KE Emergency Diesel Fuel Tank	6.1 m (20 ft) x 6.1 m (20 ft) x 6.7 m (22 ft)	Soil: 1,381 LCM (1,806 LCY)	Intermediate site: Top, based on 1:1 slope from 6.7 m (22 ft) bottom depth. Depth, assumed engineered structure from the surface to 6.7 m (22 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 ft x 20 ft).	Depth, assumed all contaminated soils below 6.7 m (22 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, Tc-99, U-234, U-235, U-238, Cr (total), Cr^{+6}, Hg, Pb
130-KW-1, 105-KW Emergency Diesel Oil Storage Tank, 105-KW Emergency Diesel Fuel Tank	6.1 m (20 ft) x 6.1 m (20 ft) x 6.7 m (22 ft)	Soil: 1,381 LCM (1,806 LCY)	Intermediate site: Top, based on 1:1 slope from 6.7 m (22 ft) bottom depth. Depth, assumed engineered structure from the surface to 6.7 m (22 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 6.1 m x 6.1 m (20 ft x 20 ft).	Depth, assumed all contaminated soils below 6.7 m (22 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, Tc-99, U-234, U-235, U-238, Cr (total), Cr^{+6}, Hg, Pb

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
216-N-1 Cooling Water Pond	152.4 m (500 ft) x 30.5 m (100 ft) x 1.8 m (6 ft)	Soil: 10,484 LCM (13,708 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 152.4 m x 30.5 m (500 ft x 100 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{155}Eu, ^{238}U, $^{239/240}Pu$ Undetermined
216-N-2 Cooling Water Trench	15.2 m (50 ft) x 3.0 m (10 ft) x 2.1 m (7 ft)	Soil: 220 LCM (288 LCY)	Shallow site: Top, based on 1:1 slope from 2.1 m (7 ft) bottom depth. Depth, assumed engineered structure from the surface to 2.1 m (7 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 3.0 m (50 ft x 10 ft).	Depth, assumed all contaminated soils below 2.1 m (7 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{155}Eu, ^{238}U, $^{239/240}Pu$ Undetermined
216-N-3 Cooling Water Trench	15.2 m (50 ft) x 6.1 m (20 ft) x 1.8 m (6 ft)	Soil: 290 LCM (380 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 6.1 m (50 ft x 20 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{155}Eu, ^{238}U, $^{239/240}Pu$
216-N-4 Cooling Water Pond	152.4 m (500 ft) x 61.0 m (200 ft) x 1.8 m (6 ft)	Soil: 20,379 LCM (26,646 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 152.4 m x 61 m (500 ft x 200 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{155}Eu, ^{238}U, $^{239/240}Pu$

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
216-N-5 Cooling Water Trench	24.4 m (80 ft) x 4.6 m (15 ft) x 1.8 m (6 ft)	Soil: 352 LCM (460 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 24.4 m x 4.6 m (80 ft x 15 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{155}Eu, ^{238}U, $^{239/240}Pu$ Undetermined
216-N-6 Cooling Water Pond	152.4 m (500 ft) x 45.7 m (150 ft) x 1.8 m (6 ft)	Soil: 15,427 LCM (20,171 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 152.4 m x 45.7 m (500 ft x 150 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{155}Eu, ^{238}U, $^{239/240}Pu$ Undetermined
216-N-7 Cooling Water Trench	24.3 m (80 ft) x 4.6 m (15 ft) x 1.8 m (6 ft)	Soil: 352 LCM (460 LCY)	Shallow site: Top, based on 1:1 slope from 1.8 m (6 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.8 m (6 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 24.3 m x 4.6 m (80 ft x 15 ft).	Depth, assumed all contaminated soils below 1.8 m (6 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	^{60}Co, ^{90}Sr, ^{137}Cs, ^{155}Eu, ^{238}U, $^{239/240}Pu$
600-3, Hanford Townsite Excess Material Storage Yard/Paint Pit	487.7 m (1600 ft) x 282.0 m (925 ft) x 0.9 m (3 ft)	Soil: 145,376 LCM (190,084 LCY)	Shallow site: Top, based on 1:1 slope from 0.9 m (3 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.9 m (3 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 487.7 m x 282.0 m (1,600 ft x 925 ft).	Depth, assumed all contaminated soils below 0.9 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate Undetermined

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-5, White Bluffs Waste Oil Dump, Asphalt Heliport	4.6 m (15 ft) x 4.6 m (15 ft) x 1.5 m (5 ft)	Soil: 70 LCM (92 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 4.6 m x 4.6 m (15 ft x 15 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
UPR-600-16, P-11 Fire and Contamination Spread, UN-600-16, UN-616-16	54.9 m (180 ft) x 30.5 m (100 ft) x 0.9 m (3 ft)	Soil: 1,838 LCM (2,404 LCY)	Shallow site: Top, based on 1:1 slope from 0.9 m (3 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.9 m (3 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 54.9 m x 30.5 m (180 ft x 100 ft).	Depth, assumed all contaminated soils below 0.9 m (3 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, Tc-99, U-234, U-235, U-238, Cr (total), Cr^{+6}, Hg, Pb
600-29, 100-K Construction Lay-down Area, 100-K-41	609.6 m (2000 ft) x 304.8 m (1000 ft) x 0.3 m (1 ft)	Soil: 65,252 LCM (85,319 LCY)	Shallow site: Top, based on 1:1 slope from 0.3 m (1 ft) bottom depth. Depth, assumed engineered structure from the surface to 0.3 m (1 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 609.6 m x 304.8 m (2000 ft x 1000 ft).	Depth, assumed all contaminated soils below 0.3 m (1 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
600-52, White Bluffs Surface Basin	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-028 for site-specific information.					
600-98, East White Bluffs City Landfills, East White Bluffs Dump and East White Bluffs Dump #2, East White Bluffs Landfill, EWBCL	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2004-098 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-99, J. A. Jones 2, J. A. Jones #2, J. A. Jones 2	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-037 for site-specific information.					
600-100, White Bluffs Landfill, White Bluffs City Landfill, WBL, White Bluffs City Dump, 600-119	38.1 m (125 ft) x 15.2 m (50 ft) x 3.1 m (10 ft)	Soil: 2,647 LCM (3,462 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 38.1 m x 15.2 m (125 ft x 50 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
600-107, 213-J & K Cribs, Gable Mountain Plutonium Storage Vault Cribs, 213-J & K Cribs	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-033 for site-specific information.					
600-108, 213-J & K Vaults, 213-J & K Storage Facility (SF), 213-J & K Magazine Waste Storage Cavern, 213-J & K Storage Facility	12.2 m (40 ft) x 3.7 m (12 ft) x 2.4 m (8 ft)	Soil: 255 LCM (334 LCY)	Shallow site: Top, based on 1:1 slope from 2.4 m (8 ft) bottom depth. Depth, assumed engineered structure from the surface to 2.4 m (8 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 12.2 m x 3.7 m (40 ft x 12 ft).	Depth, assumed all contaminated soils below 2.4 m (8 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	Am-241, C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Ni-63, Pu-238, Pu-239/240, Sr-90, U-234, U-235, U-238, Hg, Pb, PCB
600-109, HTCL, Hanford Trailer Camp Landfill	30.5 m (100 ft) x 30.5 m (100 ft) x 2.4 m (8 ft)	Soil: 3,043 LCM (3,979 LCY)	Shallow site: Top, based on 1:1 slope from 2.4 m (8 ft) bottom depth. Depth, assumed engineered structure from the surface to 2.4 m (8 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 30.5 m x 30.5 m (100 ft x 100 ft).	Depth, assumed all contaminated soils below 2.4 m (8 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se
600-110, HTL, Hanford Townsite Landfill	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2004-062 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-111, P-11 Critical Mass Laboratory Crib, 116-F-6	2.4 m (8 ft) x 2.4 m (8 ft) x 4.6 m (15 ft)	Soil: 299 LCM (391 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 2.4 m x 2.4 m (8 ft x 8 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	C-14, Co-60, Cs-137, Eu-152, Eu-154, Eu-155, H-3, Pu-238, Pu-239/240, Sr-90, U-238, Ag, Cd, Cr (total), Cr^{+6}, Hg, Pb, Se, PCB
600-120, White Bluffs Spare Parts Burn Pit, Spare Parts Burn Pit	15.2 m (50 ft) x 15.2 m (50 ft) x 3.1 m (10 ft)	Soil: 1,187 LCM (1,553 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 15.2 m (50 ft x 50 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
600-124, White Bluffs Burn Site and Paint Disposal Area, Burn Site and Paint Disposal Area	15.2 m (50 ft) x 15.2 m (50 ft) x 3.1 m (10 ft)	Soil: 1,187 LCM (1,553 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 15.2 m (50 ft x 50 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se sulfate
600-125, White Bluffs Waste Disposal Trench 1, Waste Disposal Trenches	30.5 m (100 ft) x 7.6 m (25 ft) x 3.1 m (10 ft)	Soil: 1,258 LCM (1,645 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 30.5 m x 7.6 m (100 ft x 25 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-127, White Bluffs Loading Docks and Fuel Storage Area, Fuel Storage Area	55.5 m (182 ft) x 35.4 m (116 ft) x 1.5 m (5 ft)	Soil: 3,685 LCM (4,819 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 55.5 m x 35.4 m (182 ft x 116 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	SVOA, TPH, VOA, Ba, Cd, Cr (total), Pb, Se, Ag, PCB
600-128, White Bluffs Oil and Oil Filter Dump Site, Oil and Oil Filter Dump Site	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-039 for site-specific information.					
600-129, White Bluffs Pre-MED Community Dump Site 1, Pre-MED White Bluffs Community Dump Site (Oil Can Site)	201.7 m (660 ft) x 152.4 m (500 ft) x 3.1 m (10 ft)	Soil: 111,321 LCM (145,556 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 201.7 m x 152.4 m (660 ft x 500 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
600-131, White Bluffs Water Station and Special Fabrication Shops and Warehouse, Special Fabrication Shop and Warehouse	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-045 for site-specific information.					
600-132, White Bluffs Construction Contractor Shop Landfill, Construction Contractor Shop Landfill	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-040 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-139, White Bluffs Automotive Repair Shop and Associated Waste Sites, Automotive Repair Shop	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-041 for site-specific information.					
600-176, White Bluffs Paint Disposal Area	15.2 m (50 ft) x 15.2 m (50 ft) x 3.1 m (10 ft)	Soil: 1,187 LCM (1,552 LCY)	Shallow site: Top, based on 1:1 slope from 3.1 m (10 ft) bottom depth. Depth, assumed engineered structure from the surface to 3.1 m (10 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 15.2 m x 15.2 m (50 ft x 50 ft).	Depth, assumed all contaminated soils below 3.1 m (10 ft) meet human health, and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
600-181, White Bluffs Oil Dump	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-048 for site-specific information.					
600-188, White Bluffs Waste Disposal Trench 2	91.4 m (300 ft) x 40.2 m (132 ft) x 4.6 m (15 ft)	Soil: 22,648 LCM (29,613 LCY)	Shallow site: Top, based on 1:1 slope from 4.6 m (15 ft) bottom depth. Depth, assumed engineered structure from the surface to 4.6 m (15 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 91.4 m x 40.2 m (300 ft x 132 ft).	Depth, assumed all contaminated soils below 4.6 m (15 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
600-190, White Bluffs Warehouse Tar/Paint Disposal Area	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-047 for site-specific information.					
600-201, White Bluffs Paint and Solid Waste Disposal Site	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-038 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	
600-202, Hanford Townsite Four Burn and Burial Pits	152.4 m (500 ft) x 76.2 m (250 ft) x 6.1 m (20 ft)	Soil: 91,540 LCM (119,692 LCY)	Intermediate site: Top, based on 1:1 slope from 6.1 m (20 ft) bottom depth. Depth, assumed engineered structure from the surface to 6.1 m (20 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 152.4 m x 76.2 m (500 ft x 250 ft).	Depth, assumed all contaminated soils below 6.1 m (20 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
600-204, Hanford Townsite Burn and Burial Trench	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2003-043 for site-specific information.					
600-205, Hanford Townsite Landfill 2	61.0 m (200 ft) x 30.5 m (100 ft) x 1.5 m (5 ft)	Soil: 3,509 LCM (4,589 LCY)	Shallow site: Top, based on 1:1 slope from 1.5 m (5 ft) bottom depth. Depth, assumed engineered structure from the surface to 1.5 m (5 ft) depth. Assumed slope: 1:1. Bottom area, based on nominal bottom footprint of 61.0 m x 30.5 m (200 ft x 100 ft).	Depth, assumed all contaminated soils below 1.5 m (5 ft) meet human health and groundwater protection criteria. Soil, based on depth, overburden, and bottom area.	Assumes 1:1 layback for access	PCB, pesticides, SVOA, TPH, VOA, asbestos, Ag, Cd, Ba, Cr (total), Cr^{+6}, Hg, Pb, Se, sulfate
600-208, Hanford Construction Camp Boiler House Ponds	Site has been remediated and is interim closed. See Waste Site Reclassification Form Control Number 2004-096 for site-specific information.					
628-1, White Bluffs Burn Pit	Site has been reclassified as no action. See Waste Site Reclassification Form Control Number 2003-046 for site-specific information.					

Table 1. 100 Area Waste Site Status and Information.

WIDS Designation	Waste and Other Information		Assumptions on Volumes			Contaminants of Potential Concern
	Dimensions	Volume/ Demolition Waste Volume	Excavation	Contaminated/Potentially Contaminated	Noncontaminated	

[1] Dimensions, volumes, and contaminants of concern are from EPA (1997).
[2] Dimensions and contaminants of concern are from EPA (2000).
[3] Volumes are from Appendix A of the *100 Area Burial Grounds Focused Feasibility Study*, DOE/RL-98-18.
[4] Dimensions and waste volumes for the 100-B/C burial grounds can be found in Calculation No. 0100B-CA-C0012.
* Depth assumed based on analogous site.
** Width, length, and depth assumed.
BCF = bank cubic foot
BCM = bank cubic meter
N/A = not available
NPDES = National Pollutant Discharge Elimination System
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analyte
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbon
VOA = volatile organic analyte
WIDS = Waste Information Data System

REFERENCES

0100B-CA-C0012, *100-B/C Area Burial Grounds Volume Estimates*, Rev. 1, Bechtel Hanford, Inc., Richland, Washington.

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CVP-98-00001, *Cleanup Verification Package for the 100-D-22 Sludge Pit*, Bechtel Hanford, Inc., Richland, Washington.

CVP-98-00002, *Cleanup Verification Package for the 100-D-21 Sludge Pit*, Bechtel Hanford, Inc., Richland, Washington.

CVP-98-00003, *Cleanup Verification Package for the 100-D-20 Sludge Pit*, Bechtel Hanford, Inc., Richland, Washington.

CVP-98-00004, *Cleanup Verification Package for the 100-D-4 Sludge Pit*, Bechtel Hanford, Inc., Richland, Washington.

CVP-98-00005, *Cleanup Verification Package for the 1607-D2:1 Abandoned Tile Field*, Bechtel Hanford, Inc., Richland, Washington.

CVP-98-00006, *Cleanup Verification Package for the 116-C-1 Process Effluent Trench*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00001, *Cleanup Verification Package for the 116-B-11 Retention Basin*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00002, *Cleanup Verification Package for the 116-B-13 South Sludge Trench*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00003, *Cleanup Verification Package for the 116-B-14 North Sludge Trench*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00004, *Cleanup Verification Package for the 116-C-5 Retention Basin*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00005, *Cleanup Verification Package for the 1607-D2:4 Septic Tank*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00006, *Cleanup Verification Package for the 116-DR-9 Retention Basin*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00007, *Cleanup Verification Package for the 116-D-7 Retention Basin*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00008, *Cleanup Verification Package for the 116-B-12 Seal Pit Crib*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00009, *Cleanup Verification Package for the 116-B-9 French Drain*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00010, *Cleanup Verification Package for the 116-B-10 Dry Well/Quench Tank*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00011, *Cleanup Verification Package for the 116-B-6A Crib and 116-B-16 Fuel Examination Tank*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00012, *Cleanup Verification Package for the 116-B-1 Process Effluent Trench*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00013, *Cleanup Verification Package for the 116-B-3 Pluto Crib*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00014, *Cleanup Verification Package for the 116-B-4 French Drain*, Bechtel Hanford, Inc., Richland, Washington.

CVP-99-00015, *Cleanup Verification Package for the 116-B-2 Fuel Storage Basin Trench*, Bechtel Hanford, Inc., Richland, Washington.

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APPENDIX B

SUMMARY OF RESRAD METHODOLOGY

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SUMMARY OF RESRAD METHODOLOGY

B.1 INTRODUCTION

Cleanup of radionuclides in soils at 100 Area liquid waste disposal sites is intended to achieve a cumulative 15 mrem/yr above background dose rate. Determining when remedial action has achieved this cleanup level involves converting radionuclide concentrations (pCi/g) in soil into dose rates (mrem/yr) using a dose assessment model. Use of a model requires an exposure scenario that specifies a hypothetical receptor (i.e., a resident, worker, or recreational user of a site), pathways of exposure from radionuclides in soil to the receptor, and assumptions and parameters to estimate exposures and doses to the receptor from radionuclides in soil. This appendix describes the model selected to perform dose assessments for the 100 Area remedial design/remedial action, describes the exposure scenario, and presents the parameters and assumptions used in the model. The version history for the RESidual RADioactivity (RESRAD) dose model is listed in Section B.7.

B.2 MODEL SELECTION

The RESRAD model was selected for the 100 Area remedial design/remedial action and demonstration project as the dose assessment model for generating remedial action goals for radionuclide contaminants in soil, and for verifying that concentrations remaining after remedial action achieve the 15 mrem/yr cleanup level. The RESRAD model was developed by Argonne National Laboratory (ANL) to implement U.S. Department of Energy (DOE) guidelines for residual radioactive material in soil (ANL 1993). The RESRAD model has been accepted by the U.S. Environmental Protection Agency (EPA) and U.S. Nuclear Regulatory Commission (NRC) for performing dose assessments to support radionuclide soil cleanup standards.

B.3 EXPOSURE SCENARIO

A primary goal of the *Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (EPA 1995b) signed in September 1995 by the Tri-Parties (the EPA, Washington State Department of Ecology, and DOE, Richland Operations Office) is to achieve cleanup levels that would not restrict future land use in the 100 Areas. This goal was identified by the Future Site Uses Working Group and was emphasized by many stakeholders during the development of the proposed plan and during the public comment period. This general goal must be specified in terms of an exposure scenario and exposure pathways to use RESRAD to convert radionuclide concentrations in soil into a dose.

For the purpose of using RESRAD, unrestricted future use in the 100 Areas is represented by an individual resident in a rural-residential setting. This resident is assumed to consume crops raised in a backyard garden; consume animal products, such as meat and milk from locally raised

livestock or meat from game animals (including fish); and live in a residence on the waste site. The exposure pathways considered in estimating dose from radionuclides in soil are inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure. This individual is conservatively assumed to spend 80% of his lifetime on site.

The selected exposure pathways are consistent with the recommendations provided by the RESRAD user's manual (ANL 1993), except for exclusion of the radon gas inhalation pathway. Protection of groundwater is intended to achieve maximum contaminant levels, which is consistent with the NRC- and EPA-proposed radionuclide soil cleanup standard (40 *Code of Federal Regulations* [CFR] 196). For fish ingestion at the 100 Area sites, there is little likelihood that surface runoff to the point of exposure (the Columbia River) would contribute significantly to total exposure. For most of the contaminants of potential concern in the 100 Areas, external exposure would be the dominant exposure pathway (ingestion and inhalation exposure pathways contribute little to total exposure). However, for strontium-90, ingestion pathways are the dominant exposure pathways and should be included to properly address cleanup of strontium-90 in soil.

B.4 EXPOSURE PATHWAYS

The following exposure pathways were used to convert radionuclide concentrations in soil to doses:

- External exposure
- Inhalation of suspended dust
- Crop ingestion
- Meat ingestion
- Milk ingestion
- Aquatic foods ingestion
- Soil ingestion
- Drinking water ingestion.

B.5 ASSUMPTIONS

The input parameters and assumptions used in RESRAD to generate the lookup values presented in this remedial design report/remedial action work plan are summarized in Table B-1. For the purpose of site closeout verification, the RESRAD input values (e.g., the thickness of the contaminated zone, the thickness of the uncontaminated zone, and the size of the waste site) will be determined on a site-specific basis. RESRAD calculates all radionuclides in the decay chain (daughters) in calculating ingrowth and decay. It has not been determined what daughters were present at the time of waste emplacement, but they would be insignificant dose contributors; therefore, estimated daughters are not calculated or input.

Values for some of these parameters (e.g., thickness of the contaminated zone, thickness of the uncontaminated zone, areal extent of the site, and leachability) depend on specific site characteristics. Waste sites near the river (such as outfalls) may require modified input parameters. For purposes of developing lookup values to guide field excavation, generic values have been assumed; however, to verify whether a specific site has met cleanup goals, input values will be determined on a site-specific basis.

B.6 NATURE AND EXTENT OF CONTAMINATION

The general process will be to first determine the nature and extent of residual contamination (concentrations and thickness of contaminated zone[s]). This information will then be input to the RESRAD model to evaluate migration potential. The specific process to determine the thickness of the contaminated zone(s) and the associated contaminant profile will follow a hierarchy as shown in the following steps:

1. Assume worst case: Concentrations of residual contamination are uniform from the bottom of the excavation to groundwater. If modeling using this assumption indicates that this is protective of groundwater and the river, no further evaluation will be performed.

2. Site-specific information: Use process knowledge, historic sampling data, remediation data, etc., to determine profile. If available site-specific information is sufficient, no further evaluation is required.

3. Analogous site information: Compare site to other sites for which profiles have been determined to see if appropriate analogies can be made. The factors considered could include site stratigraphy, depth to groundwater, volume of liquid disposed, and type of contaminants. If available analogous site information is sufficient, no further evaluation is required.

4. Subsurface sampling: The safest, most cost-effective method (e.g., trenching, boreholes) will be used to obtain site-specific data. The data obtained from subsurface sampling are not intended to meet statistical criteria for representative sampling, but will provide a qualitative measure of the extent of contamination below the site. Location will be determined on a site-by-site basis by DOE using data collected during excavation.

It is anticipated that, through data collection in two or three subsurface sampling events, information will be gained in order to determine if Option 4 is a viable option to verify the conceptual model to allow for site closeout. The Tri-Parties will evaluate the information to determine whether to continue this practice.

B.7 RESRAD VERSION HISTORY

The RESRAD version history available from the RESRAD Internet Web site (http://web.ead.anl.gov/resrad/home2/reshstry.cfm) is reproduced below with the most recent version and its issue date listed first. This history is supplemented with notes presented at *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1998) unit managers' meetings.

RESRAD 6.21 (9/5/02)[1]:

- Corrected transfer factors default distributions for several radionuclides to match those listed in NUREG/CR-6697 (NRC 2000).
- An enhanced probabilistic output graphing capability has been added.
- A problem with spontaneous fission in the water pathway has been corrected.
- Minor changes were made to the Dose Conversion Factor (DCF) Editor, including the resolution of problems with dose units and creation of risk factors.
- A Windows XP® compatibility issue has been resolved, making RESRAD completely Windows XP compatible.

RESRAD 6.2 (5/31/02)[2]:

- Fixed correlation bug that occurred when a large number of parameters is specified for uncertainty analysis.
- The interactive output now allows scatter plots of input parameter vs. input parameter.
- There is no longer a prompt to save the input file after a probabilistic run.
- A printer driver is no longer required to view output.
- Interactive output is now closed when "File, Run" is selected.
- Uncertainty database is compacted after a RESRAD run.
- The external DCF values for U-238+D and Ce-144+D changed from 1.37E-01 to 1.52E-01 and 3.20E-01 to 3.24E-01, respectively.

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[1] Comparison of radionuclide dose and excess cancer risk calculated from the 116-F-9 Animal Waste Leaching Trench cleanup verification data using RESRAD, Versions 6.2 and 6.21, showed no differences in predicted dose rates or predicted excess cancer risks.

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[2] Comparison of RESRAD outputs from Versions 6.1 and 6.2 for uranium-234, uranium-235, and uranium-238 data from the 316-1 South Process Pond shows that the predicted dose rates are slightly increased in Version 6.2 outputs, but there are no changes to excess lifetime cancer risks predicted by RESRAD. For 100 Area waste sites, uranium-238 activity was either below background (and therefore not modeled in RESRAD) or uranium-238 was not a contaminant of concern (COC) in all cleanup verification packages that have been completed. Therefore, uranium data from a 300 Area site were used to compare dose estimate results from RESRAD, Versions 6.1 to 6.2. Cerium is not identified as a COC for any of the waste sites for which RESRAD, Version 6.1, was used.

RESRAD 6.1 (7/27/01):

- Risk library now includes Health Effects Assessment Summary Tables (HEAST) (EPA 1995a, 2001); Federal Guidance Report (FGR) 13, "Morbidity" (EPA 1999); and FGR 13, "Mortality" (EPA 1999).
- User choice of radiological units: Ci, Bq, dps, dpm for activity and mrem or Sv for dose.
- The area factor (AF) for a zero wind speed is 1. The AF for wind speeds greater than 10 m/s is AF(10).
- Basic radiation dose limit changed from 30 to 25 mrem/yr.
- Provide more feedback to the user when the uncertainty output is being processed.
- Uncertainty database updated to Microsoft® Access 2000.
- Improved help.

RESRAD 6.00 (10/15/00):

The probabilistic version was updated and released including the following features:

- Default data distributions for important variables.
- Template files for nonradionuclide dependent variables.
- A help system to display the input distributions.
- Feedback on how long the calculation will take.
- A robust user input screen for setting distributions, input correlations, and sampling characteristics.
- An estimate of the variability of the end results given the sampling size and characteristics.
- A set of four output results including interactive tables and graphs, a full report, and a structured database with all the raw samplings and intermediate results.
- Input-output correlation analysis.
- Analysis with both the peak-of-the-means and means-of-the-peaks methods.
- Windows® user interface code upgraded from 16-bit Visual Basic® (VB)4 to 32-bit VB6.
- Quadruple precision used in Bateman calculations for decay/ingrowth source factors. This is important for decay chains of five or longer.
- Quadruple precision used in Romberg integrations. This shortened calculations times and completely eliminated convergence failure errors.
- Improved integrated risk convergence.

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- Introduced ratio between default DCF and DCF for inorganic C-14.
- Included occupancy considerations for the inhalation of gaseous C-14 and tritium. Removed consideration of tritium in particulate form.
- Consider evasion losses of C-14 and tritium for groundwater pathways.
- Improved robustness when chain retardation factor ratios widely vary in different zones.
- Add ability to perform nonintegrated risk (1 point).
- Improved radon progeny risk calculation.

RESRAD 5.95 (12/23/99):

- Easy to use DCF editor.
- All Fortran code upgraded from Fortran 77 (Lahey F77L3) to Fortran 95 (Lahey/Fujitsu LF95).

RESRAD 5.91 (9/23/99)[3]:

- Revamp DCF editor.
- Gracefully notifies user if a calculation error occurs.
- Uncertainty analysis improvements.
- Time integration of dose.
- Allow user to find pathway peaks.
- Improve treatment of 4th and 5th daughter radionuclide in groundwater calculation.
- Y2K compliance check.
- Provide Windows standard help.
- Add additional nuclides.
- Ability to run batch files.
- Allow sensitivity analysis on plant factors.
- Distribute with Uncertainty analysis (still under "For Test and Evaluation").
- Interface improvements.

RESRAD 5.82 (4/30/98):

- Allow plot data to be exported to tab-delimited text file.
- Corrected Installation problem on Windows 3.1.
- Corrected plotting problem for soil guidelines.

[3] Comparisons of RESRAD outputs for several 100-B/C Area waste sites showed that the maximum dose due to direct exposure predicted by RESRAD 5.91 is 1% to 4% lower than the dose predicted by RESRAD 5.82 while all other RESRAD outputs are virtually the same. The year of the peak dose predicted by RESRAD 5.91 is lower, but the predicted peak dose and peak groundwater radionuclide activities (concentrations) are virtually identical for RESRAD 5.91 or 5.82.

RESRAD 5.81 (4/9/98):

- Corrected plotting problem for soil guidelines.
- Corrected sensitivity plotting problems with branching radionuclides.
- Enhanced file saving checks before running.
- Does not allow negative time since waste placement.
- Corrected uncertainty plotting problems with branching radionuclides.

RESRAD 5.80 (3/13/98):

- Support for Windows NT®.
- Repaired "Export to EXCEL" for latest versions.
- Allow sensitivity on leaching and solubility.
- Various interface improvements.

RESRAD 5.782 (10/31/97):

- Fixed various interface problems.

RESRAD 5.781 (8/29/97):

- Change default Mass Loading Factor in occupancy factor to 0.0001 g/m3.
- Easier Cancel option.
- Reset Co-60 Plant Transfer Factor.

RESRAD 5.78 (8/20/97):

- Correctly initialize meat concentrations.
- Correct plotting problem with branching radionuclides.
- Use exponential notation on plots when appropriate.

RESRAD 5.77 (8/8/97):

- Do not print peak dose table when peak is a user selected time.
- Allow plotting of soil concentrations.
- Initialize meat concentration.

RESRAD 5.76 (7/25/97):

- Ensure convergence for distribution coefficient (K_d) calculation, given water concentrations.
- Disallow user selection of variables not supported for sensitivity analysis.
- Add sensitivity description to graphics title.
- Add single pathway name to graphics title.

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- Allow foe sensitivity analysis of single nuclide and single pathway.
- Minor interface cleanup.
- Installation cleanup.
- Add menu selection to allow user to save all reports.
- Plot data at time of maximum dose (peak).

RESRAD 5.75 (7/4/97):

- Incorporation of new area factor model for inhalation.
- Time integrated risk.
- User's ability to change radon DCF.
- User's ability to change Plant Factors.
- Compatibility with Uncertainty Analysis.
- DCF Library Save/New feature cleanup.
- Graphics look update.
- Graphics interface.
- Button prompts for navigator.
- C-14/tritium calculations off then pathways off.
- Groundwater reorganization.
- External DCF includes beta component .

RESRAD 5.70 for Windows (1/31/97):

- Release of Windows Version with DOS® "emulator."
- Runs on Windows 3.1® and Windows 95®.

RESRAD 5.62 (7/3/96):

- Updated default Slope Factors from latest HEAST tables.
- Added an error check to the Fortran module to avoid file collisions in Windows.

RESRAD 5.61 (8/28/95):

- Corrected an error in the calculation of water-independent radon doses for graphic points in cases where the contaminated area is less than 100 m.
- Corrected an error which caused short-lived radionuclides to have a zero K_d if the calculations are run after changing the half-life, but before going to screen R012.
- Corrected an error in the calculation of food storage time correction factors for small concentrations near the end of a decay chain.
- Half lives were changed to reflect ICRP-38 data.

® DOS (MS-DOS), Windows 3.1, and Windows 95 are registered trademarks of Microsoft Corporation in the United States and/or other countries.

RESRAD 5.60 (4/25/95):

- Corrected errors in graphing interface routine (RESPLOT).
- Corrected U-238 external dose conversion factor to FGR-12 value.
- Updated Slope factor tables.
- Modified internal dose conversion factors to match FGR-11.

RESRAD 5.50 (3/14/95):

- Replace the external gamma pathway model with a model based on the FGR-12 database.
- Significantly modified the graphing interface.
- Corrected an error in the concentration report for radionuclides with branch decay
- Changed the default value reported for the foundation depth in the radon pathway in SUMMARY.REP to the new default of -1.
- Added a warning and check to prevent attempting calculation of K_d's using water concentration in cases where there are no unsaturated zones.
- Corrected a problem with switching to a 6 month cut-off half-life with Sb-125 selected.

RESRAD 5.44 (2/16/95):

- Changed the radon pathway's default foundation depth to -1 m to assume (conservatively) that buildings are built on top of the contaminated zone.
- Added various checks to input, calculation, and output.
- Modified radon pathway to reduce execution time.

RESRAD 5.43 (1/11/95):

- Modification to correct a potential bug which may miscalculate daughter concentrations in the saturated zone in cases where there is no unsaturated zone.

RESRAD 5.42 (1/5/95):

- Corrected SOILD external calculations (Shape factor between -1 and 0).

RESRAD 5.41 (5.40) (11/28/94):

- Modification to the cover and depth factor for the tritium and C-14 ingestion and inhalation pathway models.
- Changed the effective surface density to correspond with the current default soil density.
- Changed tritium and C-14 deposition velocity from 0.0 to 0.001 m/sec.

- Begin distribution of RESRAD.QA input and report to verify RESRAD calculations on a user's computer.

RESRAD 5.191 (8/22/94):

- Modified soil ingestion rate for onsite occupancy.
- Fixed an occasionally incorrect Summary Report entry which showed the summed pathway dose total to be zero.

RESRAD 5.19:

- Support networked printers.
- Modify interface to correctly disable/enable parameters according to the current pathways.

RESRAD 5.18 (7/13/94):

- User interface modified to reflect comments from Haliburton (1994). These modifications include changes to the allowable ranges of several parameters and better checks on sensitivity ranges.
- User interface modified to always display "Hot Keys."

RESRAD 5.17:

- Modification to account for decay and ingrowth during food storage time (from harvest to consumption).

RESRAD 5.16:

- Minor correction to the Dose Factor Library Files.

RESRAD 5.05 (3/11/94):

- Corrected a potential problem in the calculation of daughter transfer function the ground water transport model.
- Added site-specific data files name to screen banner line.

RESRAD 5.04 (2/23/94):

- Allow user access to soil mixing depth when soil ingestion is the only active pathway.
- Correct a problem caused by certain cover depths and densities.

RESRAD 5.03 (12/16/93):

- Incorporation of ROMBERG integration method.

RESRAD 5.02 (12/15/93):

- Modified DEFAULT.DAT and PATHCHK.DAT to correct minor bugs.

RESRAD 5.01 (12/2/93):

- Corrected the concentration report for radionuclides with a spontaneous fission branch fraction.
- Modify interface checks and enable/disable features.
- Add Laser Jet 4 to the printer menu.

RESRAD 5.00 (9/24/93):

- See Manual ANL/EAD/LD-2 (ANL 1993) for status.

B.8 REFERENCES

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Table B-1. Input Parameter Values Used in RESRAD to Calculate Remedial Action Goals for Direct Exposure and Groundwater/River Protection. (6 Pages)

RESRAD Category	Parameter	Units	User Input, Direct Exposure[a]	User Input, Groundwater/ River Protection[b]	Rationale	Reference
Exposure Pathways		NA	External Gamma, Inhalation, Plant Ingestion, Meat Ingestion, Milk Ingestion, Aquatic Foods, Drinking Water, Soil Ingestion	Plant Ingestion, Meat Ingestion, Milk Ingestion, Aquatic Foods, Drinking Water		
R011 - CZ	Area of CZ	m^2	10,000	10,000	Generic site model[c]	
	Thickness of CZ[d]	m	4.6	6	Direct exposure - cleanup standards apply to upper 4.6 m (15 ft); GW/River - half the vadose zone in the generic site model is contaminated, half is uncontaminated	
	Length Parallel to Aquifer Flow	m	100	100	Square root of contaminated site area	
	Radiation Dose Limit	mrem/yr	15	4	Direct exposure - proposed federal standard for soil; GW/River - standard promulgated under SDWA	40 CFR 196 40 CFR 141
	Elapsed Time of Waste Placement	yr	0	0	RESRAD default	
R012 –Principal Radionuclides Concentrations	All radionuclide contaminants of concern	pCi/g	95% UCL statistical values	95% UCL statistical values		
R013 - Cover and CZ Hydrological Data	Cover Depth	m	0	4.6	Generic site model; GW/River - Assume clean fill is used to applicable depth of remediation	
	Density of Cover Material	g/cm^3	Not used	1.6		
	Cover Erosion Rate	m/yr	Not used	0.001		
	Density of CZ	g/cm^3	1.6 - Soil 2.31 - Concrete	1.6 - Soil 2.31 - Concrete	Hanford 100 Area-specific data Concrete-specific density	DOE/RL-90-07 (DOE-RL 1992) *Perry's Chemical Engineers' Handbook*, (Perry 1973)
	CZ Erosion Rate	m/yr	0.001	0.001	RESRAD default	

Table B-1. Input Parameter Values Used in RESRAD to Calculate Remedial Action Goals for Direct Exposure and Groundwater/River Protection. (6 Pages)

RESRAD Category	Parameter	Units	User Input, Direct Exposure[a]	User Input, Groundwater/ River Protection[b]	Rationale	Reference
R013 - Cover and CZ Hydrological Data (cont.)	CZ Total Porosity		0.4	0.4	WDOH guidance	WDOH/320-015 (WDOH 1997)
	CZ Field Capacity		0.15	0.15	Same as SZ Field Capacity	
	CZ Hydraulic Conductivity	m/yr	250	250	Hanford 100 Area-specific data	DOE/RL-96-11 (DOE-RL 1997) DOE/RL-93-37 (DOE-RL 1994b)
	CZ b Parameter		4.05	4.05	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Humidity in Air	g/cm^3	8	8	RESRAD default	
	Evapotranspiration Rate		0.91	0.91	EPA, Region X guidance	Letter from EPA
	Wind Speed	M/s	3.4	3.4	Hanford Site average	PNNL-12087 (Burke et al. 1999)
	Precipitation	m/yr	0.16	0.16	Based on 16 cm (6.3 in.) average annual rainfall	DOE/RL-90-07 (DOE-RL 1992)
	Irrigation Rate	m/yr	0.76	0.76	EPA, Region X guidance	Letter from EPA
	Irrigation Mode		Overhead	Overhead	RESRAD default	
	Runoff Coefficient		0.2	0.2	RESRAD default	
	Watershed Area for Nearby Stream or Pond	m^2	1,000,000	1,000,000	RESRAD default	
	Accuracy for Water/Soil Computations		0.001	0.001	RESRAD default	
R014 - SZ Hydrological Data	Density of SZ	g/cm^3	1.6	1.6	Hanford 100 Area-specific data	DOE/RL-90-07 (DOE-RL 1992)
	SZ Total Porosity		0.4	0.4	WDOH guidance	WDOH/320-015 (WDOH 1997)
	SZ Effective Porosity		0.25	0.25	Agreement among the Tri-Parties[e]	ANL 1993, Table 3.2
	SZ Field Capacity		0.15	0.15	Field Capacity = Total Porosity - Effective Porosity	ANL 1993, Equation 4.4
	SZ Hydraulic Conductivity	m/yr	5,530	5,530	Hanford 100 Area-specific data	DOE/RL-96-11 (DOE-RL 1997) DOE/RL-93-37 (DOE-RL 1994b)
	SZ Hydraulic Gradient		0.00125	0.00125	Based on GW velocity = 27.8 m/yr, porosity = 0.25, hydraulic conductivity = 5,530	DOE/RL-94-136 (DOE-RL 1994a)
	SZ b Parameter		4.05	4.05	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Water Table Drop Rate	m/yr	0.001	0.001	RESRAD default	

Table B-1. Input Parameter Values Used in RESRAD to Calculate Remedial Action Goals for Direct Exposure and Groundwater/River Protection. (6 Pages)

RESRAD Category	Parameter	Units	User Input, Direct Exposure[a]	User Input, Groundwater/ River Protection[b]	Rationale	Reference
R014 - SZ Hydrological Data (cont.)	Well Pump Intake Depth	m below water table	4.6	4.6	Typical RCRA well screen length	
	Nondispersion or Mass-Balance		ND	ND	RESRAD default	
	Well Pumping Rate	m^3/yr	250	250	RESRAD default	
R015 - Uncontaminated and Unsaturated Strata Hydrological Data	Number of Unsaturated Strata		1	1	Generic site model; one contaminated zone, one uncontaminated zone	DOE/RL-96-17 (this document)
	Thickness[d]	m	12	6	Generic site model	DOE/RL-96-17 (this document)
	Soil Density	g/cm^3	1.6 - Soil 2.31 - Concrete	1.6 - Soil 2.31 - Concrete	Hanford 100 Area-specific data Concrete specific density	DOE/RL-90-07 (DOE-RL 1992) *Perry's Chemical Engineers' Handbook* (Perry 1973)
	Total Porosity		0.4	0.4	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Effective Porosity		0.25	0.25	Agreement among the Tri-Parties[e]	ANL 1993, Table 3.2
	Field Capacity		0.15	0.15	Field Capacity = Total Porosity - Effective Porosity	ANL 1993, Equation 4.4
	Soil-specific b Parameter		4.05	4.05	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Hydraulic Conductivity	m/yr	250	250	Hanford 100-Area specific data	DOE/RL-96-11 (DOE-RL 1997) DOE/RL-93-37 (DOE-RL 1994b)
R016 - Distribution Coefficients and Leach Rates	CZ K_d	mL/g	Contaminant-specific	Contaminant-specific	Appendices D and E	DOE/RL-96-17 (this document)
	Uncontaminated Zone K_d		Contaminant-specific	Contaminant-specific	Appendices D and E	DOE/RL-96-17 (this document)
	Saturated Zone K_d		Contaminant-specific	Contaminant-specific	Appendices D and E	DOE/RL-96-17 (this document)
	Leach Rate	yr	Contaminant-specific	Contaminant-specific	RESRAD manual	
	Saturated Solubility		0	0	RESRAD default	
R017 - Inhalation and External Gamma	Inhalation Rate	m^3/yr	7,300	Not used	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Mass Loading for Inhalation	g/m^3	0.0001	Not used	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Exposure Duration	yr	30	30	RESRAD default	

Table B-1. Input Parameter Values Used in RESRAD to Calculate Remedial Action Goals for Direct Exposure and Groundwater/River Protection. (6 Pages)

RESRAD Category	Parameter	Units	User Input, Direct Exposure [a]	User Input, Groundwater/ River Protection [b]	Rationale	Reference
R017 - Inhalation and External Gamma (cont.)	Indoor Dust Filtration Factor		0.4	Not used	RESRAD default	
	External Gamma Shielding Factor		0.8	Not used	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Indoor Time Fraction		0.6	Not used	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Outdoor Time Fraction		0.2	Not used	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Shape Factor		Circular	Not used	RESRAD default	
R018 - Ingestion Pathway Data, Dietary Parameters	Fruits, Vegetables, and Grain Consumption	kg/yr	110	110	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Leafy Vegetable Consumption	kg/yr	2.7	2.7	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Milk Consumption	L/yr	100	100	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Meat and Poultry Consumption	kg/yr	36	36	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Fish Consumption	kg/yr	19.7[f]	19.7[f]	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Other Seafood Consumption	kg/yr	0.9	0.9	RESRAD default	
	Soil Ingestion	g/yr	73[f]	Not used	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Drinking Water Intake	L/yr	730	730	WDOH guidance	WDOH/320-015 (WDOH 1997)
	Drinking Water Contamination Fraction		1	1	RESRAD default	
	Household Water Contamination Fraction		1	1	RESRAD default	
	Livestock Water Contamination Fraction		1	1	RESRAD default	
	Irrigation Water Contamination Fraction		1	1	RESRAD default	
	Aquatic Food Contamination Fraction		0.5	0.5	RESRAD default	
	Plant Food Contamination Fraction		-1	-1	RESRAD default	

Table B-1. Input Parameter Values Used in RESRAD to Calculate Remedial Action Goals for Direct Exposure and Groundwater/River Protection. (6 Pages)

RESRAD Category	Parameter	Units	User Input, Direct Exposure[a]	User Input, Groundwater/ River Protection[b]	Rationale	Reference
R018 - Ingestion Pathway Data, Dietary Parameters (cont.)	Meat Contamination Fraction		-1	-1	RESRAD default	
	Milk Contamination Fraction		-1	-1	RESRAD default	
R019 - Ingestion Pathway Data, Nondietary	Livestock Fodder Intake for Meat	kg/d	68	68	RESRAD default	
	Livestock Fodder Intake for Milk	kg/d	55	55	RESRAD default	
	Livestock Water Intake for Meat	L/d	50	50	RESRAD default	
	Livestock Water Intake for Milk	L/d	160	160	RESRAD default	
	Livestock Intake of Soil	kg/d	0.5	0.5	RESRAD default	
	Mass Loading for Foliar Deposition	g/m^3	0.0001	0.0001	RESRAD default	
	Depth of Soil Mixing Layer	m	0.15	0.15	RESRAD default	
	Depth of Roots	m	0.9	0.9	RESRAD default	
R020 – Groundwater Usage	Groundwater Fractional Usage - Drinking Water		1	1	RESRAD default	
	Groundwater Fractional Usage - Household Usage		1	1	RESRAD default	
	Groundwater Fractional Usage - Livestock Water		1	1	RESRAD default	
	Groundwater Usage - Irrigation		1	1	RESRAD default	
R021 - Radon	Radon parameters are not used; Radon is not a Hanford Site COPC.				WDOH guidance	WDOH/320-015 (WDOH 1997)

Table B-1. Input Parameter Values Used in RESRAD to Calculate Remedial Action Goals for Direct Exposure and Groundwater/River Protection. (6 Pages)

RESRAD Category	Parameter	Units	User Input, Direct Exposure[a]	User Input, Groundwater/ River Protection[b]	Rationale	Reference

Note: Site-specific input parameters, such as the thickness of the contaminated zone and the thickness of the uncontaminated zone, will be determined on a site-specific basis for cleanup verification calculations.

[a] Input parameters used to calculate single radionuclide soil concentrations corresponding to a 15 mrem/yr dose.

[b] Input parameters used to determine if contaminants in soil will reach groundwater within a 1,000-year time frame.

[c] Generic site model parameters will be changed to site-specific values for cleanup verification.

[d] These values are for preliminary use only. The thickness of the contaminated zone and the thickness of the uncontaminated zone will be determined on a site-specific basis for cleanup verification calculations.

[e] Use of an effective porosity of 0.25 as a generic 100 Area input parameter is based upon agreement among the Tri-Parties. An effective porosity of 0.25 corresponds to values for sand and gravel reported in ANL 1993, Table 3.2.

[f] *Environmental Restoration Contractor Meeting Minutes - 100 Area Remedial Action and Waste Disposal Unit Managers' Meeting*, May 18, 2000, ERC CCN 079768, Approved by U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Richland Operations Office, Richland, Washington. The soil ingestion input parameter values are in accordance with WAC 173-340-740(3)(iii)(B), Ecology 1996.

ANL = Argonne National Laboratory
CZ = contaminated zone
EPA = U.S. Environmental Protection Agency
GW = groundwater
NA = not applicable
ND =
RCRA = *Resource Conservation and Recovery Act of 1976*
SDWA = *Safe Drinking Water Act*
SZ = saturated zone
UCL = upper confidence limit
WDOH = Washington State Department of Health

APPENDIX C

METHODOLOGY FOR DETERMINING IF CONTAMINANTS IN SOIL REACH GROUNDWATER, AND FOR DETERMINING CONTAMINANT-SPECIFIC CONCENTRATIONS IN SOIL THAT ACHIEVE PROTECTION OF GROUNDWATER AND THE COLUMBIA RIVER

APPENDIX C

METHODOLOGY FOR DETERMINING IF CONTAMINANTS IN SOIL REACH GROUNDWATER, AND FOR DETERMINING CONTAMINANT-SPECIFIC CONCENTRATIONS IN SOIL THAT ACHIEVE PROTECTION OF GROUNDWATER AND THE COLUMBIA RIVER

C.1 INTRODUCTION

Residual nonradioactive and radionuclide contaminants remaining in soil after remediation must be at levels such that concentrations of contaminants reaching groundwater and, eventually, the Columbia River, by migration through the soil column do not exceed remedial action goals (RAGs) considered protective of these resources. For nonradioactive contaminants, the 100 times rule is applied first to determine concentrations that can remain in place without impacting groundwater. If residual contaminant concentration exceeds concentrations calculated using the 100 times rule, the RESidual RADioactivity (RESRAD) model can be used on a site-specific basis to determine if residual concentrations are protective. For radionuclide contaminants, RESRAD is used first to determine which contaminants reach groundwater, then to calculate concentrations that can remain in place protective of groundwater and the river. Methodology for modeling to protect the Columbia River is the same as that for modeling protection of groundwater, with the concentration multiplied by a factor to account for dilution and attenuation as contaminants migrate through the groundwater to the river.

C.2 BACKGROUND

The RESRAD model incorporates a dynamic, one-dimensional, analytical model to evaluate contaminant migration from a source in the vadose zone to groundwater (ANL 1993). The RESRAD model provides the flexibility to incorporate site-specific information to develop a model of contamination that can contain three distinct layers: a cover layer above the remaining soil contamination, a contaminated layer, and an uncontaminated vadose layer between the contaminated layer and the groundwater. The contaminated and vadose layer can be divided into multiple zones dependent on the availability of site-specific information. Using heterogeneous information to create discrete zones greatly influences the determination of transport time of contaminant species.

The generic site model is illustrated in Figure C-1. Site geometry, location relative to the Columbia River, and depth to groundwater are generic 100 Area inputs; site-specific inputs will be used for closeout verification. It is assumed that there are two zones beneath the excavated waste site (1) a contaminated zone of uniform concentration, and (2) an uncontaminated zone. The contaminated zone is assumed to be half of the vadose zone below 4.6 m (15 ft).

C.3 CALCULATIONAL METHODOLOGY

To run the RESRAD model for protection of groundwater and the Columbia River, appropriate distribution coefficients for residual radioactive soil contaminants are selected from Appendix E; parameters for user input for groundwater protection are entered from Appendix B, Table B-1; and site-specific parameters are used, when appropriate. The RESRAD model is run with only the drinking water exposure pathway active (all other exposure pathways are suppressed). The graphical and numerical output for a 1,000-year time frame for the drinking water pathway are inspected (the RESRAD model can evaluate migration and decay of radionuclides for a 1,000-year time period). If the concentration of a soil contaminant in drinking water is zero at all times, the contaminant does not reach groundwater. If a soil contaminant at its residual concentration is shown not to reach groundwater, further remediation is not required.

C.3.1 Application of RESRAD to Nonradioactive Contaminants

The RESRAD model is only applied to nonradioactive contaminants if they fail to meet cleanup levels calculated using the 100 times rule. Although RESRAD is intended to perform pathway analysis for exposures to radioactive materials, the calculations for environmental transport can be applied to any metal. Nonradioactive contaminants are introduced into the model using, as surrogates, radioisotopes with long half-lives. The ideal surrogate would have a half-life greater than 100,000 years (such as thorium-232 without daughter ingrowth). Because the model can be evaluated over a 1,000-year period, the effects of radioactive decay on the final result would be less than 0.7%.

Once a surrogate radionuclide is selected for a metal, it is entered into the program and assigned the distribution coefficient, from Appendix E, of the metal it is simulating. There is no need to convert to activity-based surrogate concentrations; the RESRAD output will be in the same units as the nonradionuclide input value. The RESRAD model is run as described above using the parameters from Appendix B for the drinking water pathway, and the graphical and numerical output are inspected. If the concentration of a soil contaminant in drinking water is zero at all times, the contaminant does not reach groundwater. If a soil contaminant at its residual concentration is shown not to reach groundwater, further remediation is not required.

C.3.2 Protection of the Columbia River

To achieve protection of the Columbia River, the calculation of RAGs for residual soil contamination must consider two additional contaminant transport steps beyond the migration of contaminants through the soil column and their subsequent leaching into groundwater. The additional contaminant transport steps are as follows:

1. The transportation, from beneath the waste site to near-river wells (the point of compliance), of contaminants that have leached to groundwater

2. The mixing of groundwater contaminant concentrations with river water within the substrate at the groundwater/river interface.

The model that addresses these two steps is the dilution attenuation factor (DAF) model, summarized in Appendix D. This model accounts for the time required for a contaminant to travel through the groundwater underlying a site to the river, radionuclide decay during that travel-time period, and a 1:1 dilution factor applied to contaminant concentrations measured in near-river wells (to account for the difference in concentration between the near-river well and the substrate at the groundwater/river interface). In evaluating contaminant transport time, the model uses a 1,000-year period (starting from site closeout) and considers the effect of retardation as contaminants move from under the waste site to the river. As appropriate, dilution factors greater than 1:1 will be evaluated on a constituent-specific basis using Hanford Site data.

C.3.3 Application of Criteria for Protection of Groundwater and Surface Water

Residual contaminant concentrations remaining in soil after remediation must be at levels considered protective of groundwater and the Columbia River. The process for determining soil concentrations that are protective of groundwater and the river depends on whether the contaminant is a radionuclide or nonradioactive contaminant.

The *Model Toxics Control Act* (*Washington Administrative Code* [WAC] 173-340) states that concentrations of residual nonradioactive contaminants are considered protective of groundwater at levels equal to or less than 100 times the groundwater cleanup levels (i.e., the RAGs presented in Table 2-3) established in accordance with WAC 173-340-720, unless it can be demonstrated that a higher soil concentration is protective of groundwater at the site (WAC 173-340-740[3][a][ii][A]). The 100 times rule is applied to nonradioactive contaminants as the first step in calculating residual soil concentrations that are protective of groundwater. If residual concentrations exceed cleanup levels calculated using the 100 times rule, site-specific modeling (e.g., RESRAD) will be performed.

The 100 times rule does not apply to residual radionuclide contaminants. For radionuclides, groundwater protection is demonstrated through technical evaluation using RESRAD.

The same methodology applied to residual soil contamination to ensure protection of groundwater is applied to ensure protection of the Columbia River. To be protective of the Columbia River, residual soil concentrations of nonradioactive contaminants must also be less than or equal to 100 times applicable state and federal standards (maximum contaminant levels and ambient water quality criteria) for surface water (WAC 173-201A and 40 *Code of Federal Regulations* 131, respectively). For residual nonradioactive contaminants, protection of the river is achieved by reducing concentrations remaining in soil after remediation to concentrations less than or equal to 100 times the RAG after the DAF has been applied. If residual concentrations exceed river protection cleanup levels calculated using the 100 times rule, site-specific modeling will be performed. For residual radionuclide contaminants shown by the RESRAD model to reach groundwater, protection of the river is achieved by reducing concentrations remaining in soil after remediation to concentrations less than or equal to the value calculated by RESRAD to achieve the RAG after the DAF has been applied.

C.4 REFERENCES

40 CFR 131, "Water Quality Standards," *Code of Federal Regulations*, as amended.

ANL, 1993, *Manual for Implementing Residual Radioactive Materials Guidelines Using RESRAD,* Version 5.0, ANL/EAD/LD-2, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

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WAC 173-340, "Model Toxics Control Act--Cleanup," *Washington Administrative Code*, 1996.

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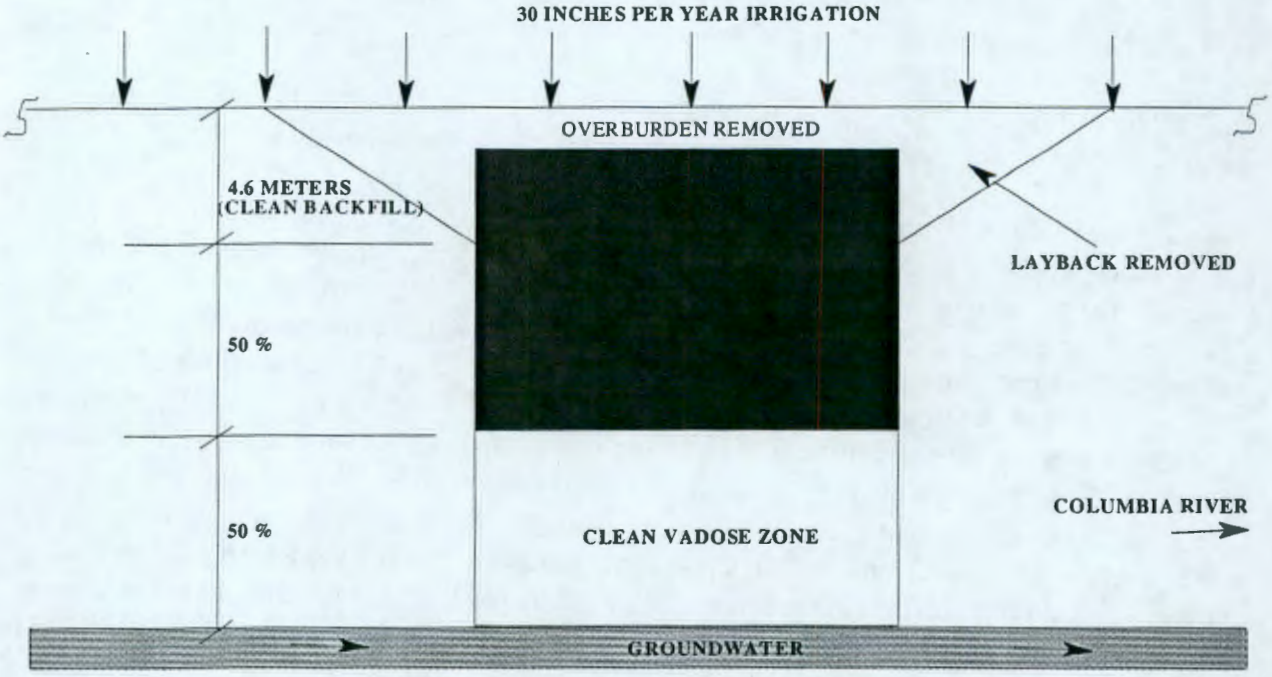
EPA, 1989, *Determining Soil Response Action Levels Based on Potential Contaminant Migration to Groundwater: A Compendium of Examples*, EPA/540/2-89/057, U.S. Environmental Protection Agency, Washington, D.C.

Figure C-1. Generic Site Model.



APPENDIX D

DESCRIPTION OF DILUTION ATTENUATION FACTORS

APPENDIX D

DESCRIPTION OF DILUTION ATTENUATION FACTORS

D.1 ESTIMATING GROUNDWATER/RIVER DILUTION ATTENUATION FACTORS

Soil cleanup to protect surface water in the Columbia River involves calculating dilution factors between groundwater and the river, and calculation of the attenuation of radionuclides as they migrate in groundwater to the river. These dilution attenuation factors (DAFs) are used in conjunction with the river protection remedial action goals (RAGs) to calculate RAGs (after the DAF has been applied) that are concentrations in groundwater underlying a site that are protective of the river.

D.2 CALCULATION METHOD

This section describes the methodology for calculating DAFs. An example is presented below on how to calculate DAFs and how to use DAFs to calculate RAGs based on the DAF.

The first step is to calculate the time required for a contaminant to reach the river from groundwater underlying a site. This time is calculated as follows:

$$T = \left(\frac{D}{V_w}\right) \times R_f$$

where:

T = time for contaminant to reach the river (yr)
D = distance from waste site to the river (m)
V_w = average pore velocity in groundwater (m/yr)
R_f = retardation factor in groundwater (unitless).

Distances between Remedial Design Group 1 waste sites and the river are presented in Table D-1. The distance selected to calculate DAFs for this remedial design report was 200 m (660 ft). The average pore velocity in groundwater is assumed to be 27.82 m/yr (91.25 ft/yr) (DOE-RL 1995).

Table D-1. Distances to the Columbia River.

Site	Distance to the River (m)
116-B-1	200
116-B-11	170
116-C-1	250
116-C-5	250
116-B-13	200
116-B-14	170

The relative retardation factor (R_f) values are estimated from soil/water distribution coefficients (K_d [mL/g]) with the following relationship (WHC 1990):

$$R_f = 1 + \left(\frac{P_b}{N_e} \times K_d \right)$$

where:

P_b = bulk density in soil (g/cm^3, noting that 1 cm^3 = 1 mL)
n_e = effective porosity at saturation of soil (WHC 1990).

The distribution coefficients are developed as described in Appendix E and are summarized in Table D-2. The bulk density in soil and effective porosity values are presented in Table D-3.

Table D-2. Distribution Coefficient (K_d) Values. (2 Pages)

Contaminant	Distribution Coefficient (K_d) Values (mL/g)
Ag-108m	90
Am-241	200
C-14	200
Cs-134	50
Cs-137	50
Co-60	50
Eu-152	200
Eu-154	200
Eu-155	200
H-3	0
K-40	4

Table D-2. Distribution Coefficient (K_d) Values. (2 Pages)

Contaminant	Distribution Coefficient (K_d) Values (mL/g)
Na-22	4
Ni-63	30
Pu-238	200
Pu-239/240	200
Ra-226	100
Sr-90	25
Tc-99	0
Th-228	200
Th-232	200
U-234	2
U-235	2
U-238	2
Antimony	1.4
Arsenic	3
Barium	25
Cadmium	30
Chromium (III)	200
Chromium (VI)	0
Lead	30
Manganese	50
Mercury	30
Zinc	30
Aroclor 1260	530
Benzo(a)pyrene	5,500
Chrysene	200
Pentachlorophenol	53

Table D-3. Parameters Used to Calculate Relative Retardation Factors (R_f).

Parameter	Value	Source
Bulk density	1.7 g/cm^2	DOE-RL 1995
Effective porosity at saturation	0.25	DOE-RL 1995

Over the time period T, radionuclide contaminants in groundwater will decay as shown below:

$$\frac{C_{gw}}{C_{gw-onsite}} = 0.5^{T/t_{1/2}}$$

where:

C_{gw} = concentration in groundwater at the groundwater/river interface (substrate) (pCi/L)
$C_{gw\text{-}onsite}$ = concentration in groundwater underlying the site (pCi/L)
$t_{1/2}$ = radionuclide half-life (yrs), presented in Table D-4.

Table D-4. Radionuclide Half-Lives.

Radionuclide	Radionuclide Half-Life (yr)
Am-241	432
C-14	5.73E+03
Cs-134	2.06
Cs-137	30.2
Co-60	5.27
Eu-152	13.6
Eu-154	8.8
Eu-155	4.96
H-3	12.3
K-40	1.28E+09
Na-22	2.6
Ni-63	100
Pu-238	87.8
Pu-239/Pu-240	2.439E+04
Ra-226	1,600
Sr-90	28.6
Tc-99	2.13E+05
Th-228	1.91
Th-232	1.41E+10
U-233/U-234	1.59E+05
U-235	7.04E+08
U-238	4.47E+09

Concentrations in groundwater underlying a site corresponding to concentrations in near-river wells (the compliance point for the groundwater/river interface) are estimated using a dilution

factor that accounts for mixing of groundwater and surface water in the river substrate. A comparison of near-river wells, seeps, and river water indicates that groundwater/river dilution factors can range from <2 to 10 (WHC 1993). A groundwater/river dilution factor of 1:1 was specified in the 100-HR-3 and 100-KR-4 Record of Decision (EPA 1996).

This approach is summarized as follows to develop the DAF:

$$C_{river} \times 2 = C_{gw}$$

$$C_{gw-onsite} = \frac{C_{river} \times 2}{0.5^{T/t_{1/2}}}$$

$$C_{gw-onsite} = \frac{C_{river} \times 2}{0.5^{(D/V_w \times R_f)/t_{1/2}}}$$

D.3 METHODOLOGY APPLIED

The initial step in calculating concentrations in soil protective of the Columbia River is selecting surface water concentrations protective of human health and the environment. For an individual contaminant, the most restrictive value from the following is applicable: Washington State surface water quality criteria (*Washington Administrative Code* [WAC] 173-201A-0450), federal ambient water quality criteria developed in accordance with the *Clean Water Act*, WAC 173-340 Method B values, and maximum contaminant levels or, if more restrictive, 1/25th of the derived concentration guide in surface water. The RAGs protective of the Columbia River are summarized in Table 2-4.

These concentrations are used to calculate the corresponding concentrations in groundwater underlying the site that are protective of the river. The following example is presented for plutonium-239:

$$\frac{1.2\ \text{pCi/L} \times 2}{0.5^{[((200\text{m}/27.82\text{m/yr})\times 1361)/24390\text{yr}]}} = 3.17\ \text{pCi/L}$$

where:

$$R_f = 1361 = 1 + [(1.7 g/cm^3 / 0.25) \times 200.]$$

This is the concentration in groundwater underlying a site (200 m [660 ft] from a near-river well) that corresponds to the RAG protective of the river for plutonium-239 (i.e., the RAG after the DAF has been applied). The RESRAD model is used to calculate a value in soil that meets this RAG after the DAF has been applied.

D.4 REFERENCES

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APPENDIX E

DISTRIBUTION COEFFICIENTS FOR CONTAMINANTS IN SOIL

APPENDIX E

DISTRIBUTION COEFFICIENTS FOR CONTAMINANTS IN SOIL

The distribution coefficient (K_d) is an empirical parameter that represents the tendency for a chemical substance to adsorb to soil. Typically, it is measured in the laboratory as the ratio of concentration in soil (C_s) to concentration in water (C_w), at equilibrium, as shown below:

$$K_d = \frac{C_s}{C_w}$$

The greater the extent of adsorption in soil, the greater the value of K_d.

Values for K_d can be used in models to quantify the amount of contaminant in soil that can leach to groundwater. K_d values measured for an individual substance can vary substantially based on differences in soil properties. For example, the range of K_d values for plutonium and zinc measured in different soils can span four orders of magnitude (Dragun 1988, Baes and Sharp 1983). The variables affecting K_d include the relative abundance of different cations and anions in soil, soil pH, reduction-oxidation potential, cation exchange capacity, and organic matter content (Dragun 1988, Barney 1978).

Ideally, the K_d value to model leaching potential in Hanford Site soils should be based on site-specific measurements. However, sole reliance on site-specific measurements generally is not feasible. An alternate approach to developing K_d values for modeling is to (1) identify the range of K_d values measured in or under conditions similar to those encountered in Hanford Site soils, and (2) select a value that provides a conservatively reasonable estimate of contaminant leaching to groundwater. These selected values can be used to develop remedial action goals in soil.

E.1 METHODOLOGY

Several studies have compiled K_d values for a variety of soil, sediment, and leachate conditions at the Hanford Site. These values generally span a range depending on soil and leachate (liquid waste stream) conditions. These conditions include varying combinations in soils and leachate of (1) high or low salt concentrations, (2) high or low organic matter concentrations, and (3) acid (low pH) or neutral/basic (moderate to high pH) conditions.

Selecting reasonable values for K_d involved evaluating the characteristics of Hanford Site soils and identifying the K_d value corresponding the closest to those characteristics. The hierarchy of data used to select K_d values was to use Hanford Site-specific data in preference to more general compilations of K_d values in the literature. The selected values were compared with the range of

general literature values. Finally, uncertainties in the data were discussed to support the selected K_d value.

E.2 HANFORD SITE SOIL CHARACTERISTICS

For purposes of selecting K_d values from the literature, most Hanford Site soils are characterized as low-salt, low-organic matter content with neutral to basic pH (Serne and Wood 1990). Hanford Site soils typically are sandy with very little organic carbon content (Ames and Serne 1991). Soil pH measured in 100 Area soils range from 6.5 to 7.66. Total organic carbon concentrations range from 600 to 1,640 parts per million (ppm) (DOE-RL 1994).

E.3 K_d DATA SOURCES

The principal sources of information on Hanford Site-specific K_d values consulted in this analysis were Ames and Serne (1991) and Serne and Wood (1990). These references provided information on most of the radionuclide and nonradioactive inorganic contaminants in soil in the 100 Areas. Ames and Serne (1991) provided ranges of K_d values for different waste stream characteristics (high/low dissolved solids, high/low organic content, and low/neutral to high pH); these parameters are more variable than soil characteristics at the Hanford Site. Ames and Serne also recommended conservative estimates of K_d values for use in modeling contaminant leaching (WHC 1990). Ames and Serne (1991) recommended K_d values for all of the contaminants of potential concern, except for carbon, arsenic, antimony, thorium, and radium. Serne and Wood (1990) summarized available information on K_d values, and identified changes in K_d values with changing conditions in soil. These references did not reveal information on K_d values for thorium and arsenic. Information on these two contaminants in soil was developed from the range of K_d values compiled by Baes and Sharp (1983). Baes and Sharp presented ranges of K_d values for 222 agricultural soils and clays between pH 4.5 and 9. The K_d values presented in these sources are summarized in Table E-1.

E.4 SELECTED K_d VALUES

The K_d values selected for modeling contaminant concentrations leaching to groundwater are summarized in Table E-1. Uncertainties in the data for selected contaminants are discussed below.

Antimony: Estimates of K_d for antimony at the Hanford Site range from 0 to 40 (Ames and Serne 1991). Studies of the soil chemistry and observed mobility of antimony-containing waste have resulted in K_d values ranging from <1 to >1,000 (Ames and Rai 1978). A value of 1.4 was selected as a K_d for antimony in Hanford Site soils.

Table E-1. Summary of Soil/Water Distribution Coefficients. (2 Pages)

Contaminants of Potential Concern	K_d in the FFS[a]	Revised K_d Value	Source for Revised K_d Value	Ames and Serne (1991)		Baes and Sharp (1983)	
				Recommended Value	Range	Geometric Mean	Observed Range
Silver-108m	90	90	ANL 1993	--	--	--	--
Americium-241	200	200	Ames and Serne 1991	200	100 to 500	810	1.0 to 47,230
Carbon-14	0.05	200[b]	BHI 2002a	NA	NA	5	0 to 10
Cesium-137	50	50	Ames and Serne 1991	50	50 to 3,000	1,110	10 to 52,000
Cobalt-60	50	50	Ames and Serne 1991	50	10 to 3,000	55	0.2 to 3,800
Europium-152	200	200	Ames and Serne 1991	200	100 to 500	--	--
Europium-154	200	200	Ames and Serne 1991	200	100 to 500	--	--
Europium-155	200	200	Ames and Serne 1991	200	100 to 500	--	--
Tritium (H-3)	0.05	0	Serne and Wood 1990	--	--	--	--
Nickel-63	30	30	Ames and Serne 1991	4	1 to 30	--	--
Plutonium-238	25	200	Serne and Wood 1990	25	100 to 2,000	1,800	11 to 300,000
Plutonium-239/240	25	200	Serne and Wood 1990	25	100 to 2,000	1,800	11 to 300,000
Strontium-90	25	25	Ames and Serne 1991	25	20 to 200	27	0.15 to 3,300
Technetium-99	0.05	0	Serne and Wood 1990	0	0	--	--
Thorium-232	0.05	200	Ames and Rai 1978	--	--	60,000	2,000 to 510,000
Uranium-233/234	2	2	Serne and Wood 1990	2	2 to 2,000	45	10.5 to 4,400
Uranium-235	2	2	Serne and Wood 1990	2	2 to 2,000	45	10.5 to 4,400
Uranium-238	2	2	Serne and Wood 1990	2	2 to 2,000	45	10.5 to 4,400
Antimony	0.05	1.4	Ames and Rai 1978	0	0 to 40	--	--
Arsenic	0.05	3	Baes and Sharp 1983	--	--	303 (As III); 6.7 (As V)	1.0 to 8.3 (As III); 1.9 to 18 (As V)
Barium	25	25	Ames and Serne 1991	25	20 to 200	--	--
Cadmium	30	30	Ames and Serne 1991	30	100 to 200	6.7	1.26 to 26.8

Table E-1. Summary of Soil/Water Distribution Coefficients. (2 Pages)

Contaminants of Potential Concern	K_d in the FFS[a]	Revised K_d Value	Source for Revised K_d Value	Ames and Serne (1991)		Baes and Sharp (1983)	
				Recommended Value	Range	Geometric Mean	Observed Range
Chromium (hexavalent)	0.05	0	Ames and Serne 1991, Thornton 1995	0 (Cr VI)	0 (Cr VI)	37	1.2 to 1,800
Lead	30	30	Ames and Serne 1991	30	100 to 200	99	4.5 to 7,640
Manganese	50	50	Ames and Serne 1991	50	10 to 3,000	150	0.2 to 10,000
Mercury	30	30	Ames and Serne 1991	30	100 to 200	--	--
Zinc	30	30	Ames and Serne 1991	30	100 to 200	16	0.1 to 8,000
Aroclor 1260 (PCB)	530	530	EPA 1989	--	--	--	--
Benzo(a)pyrene	5,500	5,500	EPA 1989	--	--	--	--
Chrysene	200	200	EPA 1989	--	--	--	--
Pentachlorophenol	53	53	EPA 1989	--	--	--	--

[a] *100 Area Source Operable Unit Focused Feasibility Study* (DOE-RL 1995).
[b] The K_d of 200 for carbon-14 will be applicable to the 100 Areas, except for the 100-K Area where a site-specific value will be established prior to closeout of the waste sites.
NA = not applicable
PCB = polychlorinated biphenyl

Arsenic: Estimates of K_d have not been developed for arsenic at the Hanford Site. The range of values cited in the literature are 1 to 8.3 for As III (geometric mean of 3.3) and 1.9 to 18 for arsenic V (geometric mean of 6.7) (Baes and Sharp 1983). A value of 3 was selected as a K_d for arsenic in Hanford Site soils.

Carbon-14: An estimate of the K_d for carbon-14 has been developed for the 100 Areas of the Hanford Site. The leach testing of 100-F Area soils, documented in the *Cleanup Verification Package for the 100-F-19:1 and 100-F-19:3 Reactor Cooling Water Effluent Pipelines, 100-F-34 Biology Facility French Drain, and 116-F-12 French Drain*, Appendix D, "100-F Area Soil Hexavalent Chromium and Carbon-14 Leachability Study Summary Report" (BHI 2002a), indicates that carbon-14 was not detected in the leachate. Carbon-14 soil concentrations up to 48.7 pCi/g were used in the leach testing with no resulting carbon-14 detections in the water leachate. Values for K_d in 100-F Area soils are likely to be appropriate throughout the 100 Areas due to similarities in soil conditions (DOE 1999). Based on 100 Area leach study results, a K_d value of 200 was selected for carbon-14, except for the 100-K Area, where a site-specific value will be established prior to close out of waste sites.

Cesium: Ames and Serne (1991) recommended a K_d of 50 from values ranging from 50 to 3,000. Baes and Sharp (1983) cite a range from 10 to 52,000, with a geometric mean of 1,100. According to Serne and Wood (1990), the available data indicate that a minimum value of 200 is reasonable for ambient conditions in soil at the Hanford Site (near neutral pH, low dissolved-

solids concentrations, and low organic-matter content); the value of 200 was selected as a K_d for cesium based on data evaluated by Serne and Wood (1990).

Chromium: The mobility of chromium in soil will vary greatly with valence. Chromium VI is highly mobile in soil and has been estimated to have a K_d of zero (Ames and Serne 1991). However, chromium VI is readily reduced in soil to chromium III by the presence of ferrous ion and organic matter. A minor amount of chromium III can be oxidized to chromium VI through the presence of manganese oxides in soils and sediments (Thornton 1995). A suggested K_d value for chromium III is 200 mL/g.

Plutonium: Ames and Serne (1991) recommended a K_d of 25, with a range from 100 to 2,000. Baes and Sharp (1983) cite a range from 11 to 300,000, with a geometric mean of 1,800. Serne and Wood (1990) cite studies in which plutonium sorption in a pH range from 4 to 8.5 was high, with K_d >1,980. Based on the available data, Serne and Wood (1990) recommended a range of K_d values from ~100 to 1,000 for ambient soil conditions at the Hanford Site. Data reviewed by Serne and Wood (1990) appear to show similarities in the behavior of plutonium and americium in soil, while Ames and Serne (1991) recommend a K_d of 200 for americium. Based on this range of information, a K_d of 200 was selected for plutonium.

Radium: Estimates of K_d have not been developed for radium at the Hanford Site, and there were no data cited in Baes and Sharp (1983). ANL (1993) compiled data indicating K_d values at acidic pHs (2-6) ranging from 0 to 60, and K_d values at neutral/basic pHs (7-7.7) ranging from 100 to 2,400. Data summarized in Ames and Rai (1978) indicate K_d values at neutral/basic pHs ranging from 214 to 354. A conservative estimate of 100 was selected as a K_d for radium in Hanford Site soils.

Thorium: Estimates of K_d have not been developed for thorium at the Hanford Site. The range of literature values cited by Baes and Sharp (1983) is from 2,000 to 510,000. Values for K_d at a pH of 8.15 in medium sands (40-130) and very fine sands (310-470) (ANL 1993) are likely to be appropriate for soil conditions at the Hanford Site. The higher K_d values appear to be associated more with silty-clay soils (Ames and Rai 1978). Distribution coefficient values for thorium are lower with low soil pH. A conservative estimate of 200 was selected as a K_d for thorium in Hanford Site soils.

Uranium: Ames and Serne (1991) recommend a K_d of 2 for uranium based on an observed range from 2 to 2,000. Baes and Sharp (1983) cite a range from 10.5 to 4,400, with a geometric mean of 45. Serne and Wood (1990) suggest that uranium would sorb poorly to soil under neutral and basic conditions, and concluded that additional data were required to support a recommended K_d value. Uranium has been detected in groundwater at 100 Area sites, suggesting that it has some mobility in soil. While it is likely that K_d values are higher, a K_d of 2 was selected to model contaminant leaching.

E.5 LEACH TESTS TO DETERMINE DISTRIBUTION COEFFICIENTS

The regulatory agencies allow for the development and use of site-specific K_d values to evaluate protection of groundwater and the Columbia River from residual contaminants in soil and other media. Leach tests have been performed at the Hanford Site for hexavalent chromium at the 100-D, 100-H, and 100-F Areas. Leach tests for carbon-14 have also been performed at the 100-F Area. The results of the carbon-14 leach tests were used to select a K_d value of 200 mL/g as described in Section E.4, "carbon-14". Based on an agreement with the regulators, hexavalent chromium leach test results are used to compare residual soil concentrations to hexavalent chromium concentrations in leach test soils that did not produce leachate that exceeded the groundwater and river water quality criteria. If residual soil concentrations are below the hexavalent chromium concentrations that produced leachate exceeding water quality criteria, the site is determined to be protective of groundwater and the river. Results and application of the hexavalent chromium leach tests are presented in the "100-F Area Soil Hexavalent Chromium and Carbon-14 Leachability Study Summary Report" (BHI 2002a, Appendix D). In the 300 Area, leach tests were used to develop revised K_d values and cleanup levels for uranium to evaluate protection of groundwater and the Columbia River. This effort is described in *Protection of 300 Area Groundwater from Uranium-Contaminated Soils at Remediated Sites* (BHI 2002b).

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APPENDIX F

100 AREA SOURCE REMEDIATION SITES PUBLIC INVOLVEMENT PLAN

APPENDIX F

100 AREA SOURCE REMEDIATION SITES PUBLIC INVOLVEMENT PLAN

F.1 OVERVIEW

This plan outlines public involvement activities that were conducted for each interim action record of decision (ROD), and also activities that will be conducted during the 100 Area source remediation sites remedial design and remedial action. The interim action RODs signed by the Tri-Parties (the U.S. Environmental Protection Agency [EPA], the Washington State Department of Ecology [Ecology], and the U.S. Department of Energy, Richland Operations Office [RL]) defined remedial action as excavation, treatment as appropriate or required, and disposal of contaminated soils and debris from these sites.

F.2 100 AREA REMEDIAL ACTION PUBLIC INVOLVEMENT ACTIVITIES

The following outlines the specific public involvement activities that have been conducted for the 100 Area remedial actions. These events addressed the activities pertaining to ROD proceedings for the 100 Areas.

F.2.1 1995 Record of Decision

The proposed plan describing the cleanup action for the high-priority waste sites in 100 Areas was issued for public comment on June 26, 1995. The public comment period for this proposed plan was held June 26, 1995, through August 9, 1995. The ROD was signed in September 1995 (EPA 1995).

F.2.2 1997 Record of Decision Amendment

The proposed plan that would amend the 1995 ROD to increase the number of waste sites to be remediated in the 100 Areas was issued for public comment on December 16, 1996. The public comment period for this proposed plan was held December 16, 1996, through January 15, 1997. The ROD Amendment was signed in April 1997 (EPA 1997).

F.2.3 Remaining Sites Record of Decision

The proposed plan that addressed cleanup of remaining miscellaneous waste sites at the 100 Areas was issued for public comment on November 2, 1998. The public comment period for this proposed plan was held November 2, 1998, through December 1, 1998. The Remaining Sites ROD was signed in August 1999 (EPA 1999).

F.2.4 100 Area Burial Grounds Record of Decision

The proposed plan that discussed the alternatives analyzed for cleanup of 45 burial grounds in the 100 Areas and provided the recommended cleanup action was issued for public comment on May 22, 2000. The public comment period for this proposed plan was held May 22, 2000, through June 20, 2000. A public meeting was held on June 14, 2000 in Hood River, Oregon, to discuss the cleanup action and allow the public to provide their input. The 100 Area Burial Grounds ROD was signed in September 2000 (EPA 2000).

F.3 PUBLIC INVOLVEMENT PLANNING

This public involvement plan outlines the strategy to be used to provide information during the remedial design and remedial action processes. Throughout the public involvement process, decision making is the responsibility of the Tri-Parties.

F.3.1 Actions to be Taken During Remedial Design

- Update the Hanford Advisory Board's Environmental Restoration Committee on remedial design progress; the committee will provide this information to the full board (as needed or requested).
- Provide government-to-government consultation with the Native American Tribes during remedial design, periodically during remedial actions, and/or when pertinent information becomes available (as needed or requested). RL will concurrently transmit documents to the Native American Tribes, Ecology, and the EPA.
- Presentation to Natural Resource Trustee Council (as needed or requested).
- Information for the general public (Hanford Update articles).

F.3.2 Actions to be Taken During Remedial Action

Actions will be taken to provide information to interested stakeholders as pertinent information becomes available.

- Update the Hanford Advisory Board's Environmental Restoration Committee on remedial action progress; the committee will provide this information to the full board (as needed or requested).
- Provide government-to-government consultation with the Native American Tribes (as needed or requested).
- Presentation to Natural Resource Trustee Council (as needed or requested).

- Information for the general public (Hanford Update articles).
- Prepare a fact sheet to describe the 100 Area remedial action progress (as needed).

F.3.3 Actions to be Taken for an Explanation of Significant Difference to the Record of Decision

It may be determined that a "significant change" to the selected remedy is necessary if waste is left in place at large sites, thereby precluding unrestricted use. Significant changes are defined as changes that significantly modify the scope, performance, or cost of a component of the remedy as presented in the ROD. All significant changes shall be addressed in an ESD.

- Update the Hanford Advisory Board's Environmental Restoration Committee on the ESD; the committee will provide this information to the full board (as requested).
- Provide government-to-government consultation with the Native American Tribes on the ESD (as requested).
- Presentation to Natural Resource Trustees (as requested).
- Prepare a fact sheet to describe the ESD (send to mailing list).
- Information for the general public (Hanford Update articles).
- Notify the public regarding the decision to plug-in newly discovered waste sites through the periodic publication of explanations of significant difference (ESDs).

If the lead regulatory agency decides to invoke the "balancing factor" provisions of the ROD, a 30-day public comment period will be held.

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APPENDIX G

GUIDANCE FOR CLEANUP VERIFICATION PACKAGES

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ACRONYMS

CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
CVP	cleanup verification package
DAF	dilution attenuation factor
DCG	derived concentration guideline
DOE	U.S. Department of Energy
DQA	data quality assessment
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
K_d	distribution coefficient
MCL	maximum contaminant level
MPC	maximum permissible concentration
MS	matrix spike
MSD	matrix spike duplicate
MRDS	man-carried radiological data system
NaI	sodium iodide
NBS	National Bureau of Standards
ORL	occupational radiation limit
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
PQL	practical quantitation limit
RAG	remedial action goal
RAO	remedial action objective
RDR/RAWP	remedial design report/remedial action work plan
RESRAD	RESidual RADioactivity (dose model)
RL	DOE, Richland Operations Office
ROD	record of decision
RPD	relative percent difference
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	*Washington Administrative Code*

APPENDIX G

GUIDANCE FOR CLEANUP VERIFICATION PACKAGES

G.1 INTRODUCTION

G.1.1 Preface

The purpose of this appendix is to provide guidance to assist both authors and readers of cleanup verification packages (CVPs). By providing a detailed description of CVPs, readers will be able to understand the details of the CVP process. Authors will use this appendix as guidance for the cleanup verification process, and as guidance for preparing CVP documents.

G.1.2 Scope

The scope of this guidance is limited to the CVPs for 100 Area remedial actions covered by this remedial design report/remedial action work plan (RDR/RAWP). This is a guidance document, not a requirements document. Deviations from the guidance are acceptable; however, they should be documented in the CVP along with corresponding rationale.

The following are three potential examples where it may be appropriate to deviate from this guidance:

- A small waste site is remediated; all radionuclides and chemical constituents are below RAGs. A decision is made to attach the raw analytic data to the TPA-MP-14 waste site reclassification form with a location map and a brief description of the remedial action. No other effort may be needed for reclassification or cleanup verification of this waste site.

- Site-specific guidance from the decision makers specifically provides an alternate method for a portion of the CVP or for an entire CVP. This site-specific guidance should be documented in either specific meeting minutes, by correspondence, or specifically noted in the alternate CVP approved by decision makers.

- Continuing process improvements may require deviation from this guidance in an effort to improve and streamline the CVPs. CVP process changes will be incorporated into this appendix during future revisions of this document. Material process changes and decision-maker concurrence with material CVP changes are documented in either meeting minutes or by correspondence.

The remainder of this guidance describes many of the steps and details of a CVP. It is not designed to serve as a textbook, general statistics primer, or RESidual RADioactivity (RESRAD) manual. The guidance describes how many of the CVPs are prepared.

G.1.3 Cleanup Verification Package Purpose

The purpose of the CVP is to document that the relevant waste site has been remediated in accordance with the applicable records of decision (RODs). The ROD provides the U.S. Department of Energy (DOE), Richland Operations Office (RL) with the authority and guidelines to conduct the remedial action. The preferred remedy specified in the RODs is excavation and disposal of contaminated materials at the Environmental Restoration Disposal Facility (ERDF). The ROD specifies the remedial action objectives (RAOs) and corresponding remedial action goals (RAGs). The RAOs are narrative statements that define the extent to which the waste sites require cleanup to protect human health and the environment. The RAGs are contaminant-specific numerical cleanup criteria developed to guide the remedial actions to meet the RAOs. Site-specific data evaluations are presented in the CVP to demonstrate that the waste site following remediation does not pose an unacceptable risk to human health and the environment, and groundwater and surface waters including the Columbia River. Regulator approval of the TPA-MP-14 waste site reclassification form is based on information summarized in the CVP.

A brief paragraph describing the location of the waste site and a figure showing the vicinity map and site plan are provided in this section of the CVP.

G.1.4 Document Organization

This section provides a brief overview of the organization of the CVP. A typical CVP may be organized as follows:

- Section 2.0 – Site Description and Supporting Information
- Section 3.0 – Summary of Remedial Action Objectives and Goals
- Section 4.0 – Remedial Action Field Activities
- Section 5.0 – Cleanup Verification Data Evaluation
- Section 6.0 – Evaluation of Remedial Action Goal Attainment
- Section 7.0 – Radionuclide Risk Information
- Section 8.0 – Statement of Protectiveness
- Section 9.0 – References
- Section 10.0 – Bibliography
- Appendices.

G.2 SITE DESCRIPTION AND SUPPORTING INFORMATION

The site history and site location are briefly summarized in this section of the CVP. The subsurface conditions, such as groundwater level beneath the site and depth to groundwater, are described. The contaminants of concern (COCs) and contaminants of potential concern (COPCs) for the site are listed in this section.

G.2.1 Site History

A brief description of the site history, waste disposal history, site location, and site physical dimensions are discussed in this section.

G.2.2 Subsurface Conditions

The general subsurface geology for the applicable operable unit is discussed in this section.

G.2.3 Contaminants of Concern

Waste site COCs and COPCs identified through process knowledge are listed in the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2004) or other appropriate source, and are also listed in this section. During site remediation and waste characterization additional COCs/COPCs may be identified for the site. The rationale for the final site COC list is given in this section.

G.3 SUMMARY OF REMEDIAL ACTION OBJECTIVES AND GOALS

G.3.1 Remedial Action Objectives

The RAOs are broad guidelines intended to define and guide the remediation work. The RAOs are presented in the appropriate ROD. A brief summary of the RAOs is presented below. For more detailed information on the RAOs, see Section 2.0 of this RDR/RAWP and the RODs (EPA 1995, 1997a, 1999).

1. Protection from direct exposure. Protect human and ecological receptors from exposure to contaminants in soils, structures, and debris by dermal exposure, inhalation, or ingestion of radionuclides, inorganics, or organics.

2. Groundwater and river protection. Control the sources of groundwater contamination to minimize the impacts to groundwater resources, protect the Columbia River from further adverse impacts, and reduce the degree of groundwater cleanup that may be required under future actions.

3. Unlimited future land use. To the extent practicable, return soil concentrations to levels that allow for unlimited future use and exposure. Where it is not practicable to remediate to levels that will allow for unrestricted use in all areas, institutional controls and long-term monitoring will be required.

G.3.2 Remedial Action Goals

The RAGs are the specific numeric goals applied to evaluate the attainment of the RAOs. In accordance with the RODs and RDR/RAWP, the RAGs have been developed to support a rural-residential exposure scenario.

In the rural-residential scenario, an individual is assumed to live in a residence on top of the waste site and to spend 60% of his/her time at that residence. It is further assumed that he/she consumes crops raised in a backyard garden, meat and milk from locally-raised livestock, and meat from local game animals and fish. Residual (i.e., post-cleanup) contaminant concentrations in the shallow zone (i.e., less than 4.6 m [15 ft]) soils are assumed for the soils in which crops are raised and on which animals providing meat and milk are raised. Water that is used by the resident for drinking, showering, and watering livestock is assumed to be taken from groundwater derived from surface water that has infiltrated through the deep zone (i.e., greater than 4.6 m [15 ft]) soils beneath the site. In addition to the pathways already described, the resident is also assumed to be exposed to any direct gamma radiation associated with residual shallow zone soils. The scenario assumes no contact with an exposure to soils in the deep zone (i.e., below 4.6 m [15 ft]).

A more detailed description of the rural-residential scenario and how it is applied is provided in Section 3.0 of this RDR/RAWP.

G.3.2.1 Direct Exposure RAGs. Under the rural-resident scenario, direct exposure RAGs are applicable to soils that are less than 4.6 m (15 ft) below ground surface (shallow zone soils including overburden). Direct exposure RAGs are listed in Table G-1 and summarized below.

- **Radionuclide COCs:** Dose above background of less than 15 mrem/yr (this RAG must be met for 1,000 years).
- **Nonradionuclide COCs:**
  - Hazard quotient of less than 1.0 for noncarcinogenic contaminants
  - Excess cancer risk of less than 1×10^{-6} for individual carcinogenic contaminants
  - Cumulative excess cancer risk of less than 1×10^{-5}
  - Cleanup verification sample results pass the *Model Toxics Control Act Cleanup Regulations* (*Washington Administrative Code* [WAC] 173-340-740[7][e]) three-part test.

Table G-1. Summary of Remedial Action Goals.

COCs	Direct Exposure RAG	Groundwater RAG[a] (pCi/L)	Columbia River RAG[a] (pCi/L)
Radionuclides			
Americium-241	15 mrem/yr (cumulative)[b]	1.2 pCi/L[a]	1.2 pCi/L[a]
Cobalt-60		4 mrem/yr (cumulative)[b]	4 mrem/yr (cumulative)[b]
Cesium-137			
Europium-152			
Europium-154			
Europium-155			
Nickel-63			
Plutonium-238	15 mrem/yr (cumulative)[b]	1.6 pCi/L[a]	1.6 pCi/L[a]
Plutonium-239/240		1.2 pCi/L[a]	1.2 pCi/L[a]
Strontium-90		8[c]	8[c]
Uranium-238		21.2[d]	21.2
Nonradionuclides			
COCs	**Direct Exposure RAGs (mg/kg)**	**Soil RAG for Groundwater Protection (mg/kg)**	**Soil RAG for Columbia River Protection (mg/kg)**
Total chromium	80,000[e]	18.5[f]	32[g]
Hexavalent chromium	400[h] 2.1[e]	8[f]	2.0[g]
Mercury	24[h]	0.33[i]	0.33[i]
Lead	353[j]	10.2[i]	10.2[i]

[a]Depending on the ROD, alpha emitters must meet either a gross particle activity standard of 15 pCi/L or 1/25th of the derived concentration guideline from DOE Order 5400.5.
[b]Lookup values that correspond to the 15 mrem/yr dose rate and a generic site model are presented in this RDR/RAWP.
[c]Promulgated groundwater protection standard. Strontium-90 also contributes to the 4 mrem/yr (cumulative) dose standard for beta and gamma emitters.
[d]Since the time of Interim Action ROD (EPA 1995) signature, the U.S. Environmental Protection Agency has promulgated a maximum contaminant level (MCL) of 30 µg/L for total uranium (65 *Federal Register* 76708) that is more restrictive than the uranium limits used in the ROD and this RDR/RAWP. Based on the isotopic distribution of uranium in the 100 Areas, the 30 µg/L MCL corresponds to 21.2 pCi/L as discussed in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per liter in Groundwater* (BHI 2001).
[e]WAC 173-340-750(3) Method B carcinogenic cleanup limit based on the inhalation exposure pathway. Calculation is presented in the *Calculation of Hexavalent Chromium Carcinogenic Risk* (BHI 2000a).
[f]Soil RAG based on WAC 173-340-740(3)(a)(ii)(A), January 1996.
[g]Soil RAG based on "100 times dilution attenuation factor (DAF) times surface water quality" rule.
[h]WAC 173-340-740(3) Method B noncarcinogenic cleanup limit.
[i]The WAC 173-340-740(3)(a)(ii)(A) (January 1996), and/or "100 times DAF times surface water quality" soil values were less than Hanford Site or Washington State soil background values; therefore, background values are used as the soil RAG.
[j]Derived from the *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children* (EPA 1994).

G.3.3 Groundwater and River Protection RAGs

Groundwater and river protection RAGs are applicable to all vadose zone soils (shallow and deep zone soils). The groundwater and river protection RAGs are listed in Table G-1 and summarized below.

- **Beta- and gamma-emitting radionuclide COCs:** Meet "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* [CFR] 141.5) dose standards (4 mrem/yr total body or organ dose) for a period of 1,000 years starting from site cleanup.

- **Alpha-emitting radionuclide COCs:** Meet "National Primary Drinking Water Regulations" (40 CFR 141.5) (15 pCi/L excluding radon and uranium). The drinking water maximum contaminant level (MCL) for uranium is 30 μg/L, which corresponds to a concentration of 21.2 pCi/L.

- **Nonradionuclide COCs:** Meet the individual RAGs based on WAC 173-340-740(3)(a)(ii)(A) (January 1996), the "100 times dilution attenuation factor (DAF) times surface water quality" rule, Hanford Site or Washington State background, the laboratory analytical practical quantitation limit (PQL) listed in Table G-1 with cleanup verification sample results passing the WAC 173-340-740(7)(e) three-part test, or demonstrate by site-specific modeling or other methods (e.g., leachability testing) that residual COC levels do not pose an unacceptable threat to groundwater or surface water for 1,000 years (i.e., residual soil levels do not have the potential to exceed groundwater or river water RAGs).

G.4 REMEDIAL ACTION FIELD ACTIVITIES

G.4.1 Excavation and Disposal

A description of the excavation and disposal activities is given in this section. The pre- and post-remediation topographic contours are shown in a figure. Necessary information includes the dates of waste site excavation, description of materials excavated, disposal location of waste material, general excavation dimensions and elevations, and amount of material disposed of from the site.

Additionally, the CVP will include significant materials that may have been left at the site, and what significant materials were removed.

G.4.2 Field Screening and In-Process Sampling

Field screening and in-process sampling are conducted during the site remedial action as specified in the 100 Area SAP (DOE-RL 2004). Both techniques are used to guide the excavation to quickly assess for the presence and level of contamination, and to assess when remediation is complete. Field screening is applicable to those sites (typically the large liquid effluent sites) where radionuclides are primary COCs and generally includes using a radiological data mapping system survey and hand-held sodium iodide (NaI) detectors. In-process sampling

generally consists of gamma energy analyses and nonradionuclide analyses. A description of each general technique is discussed below.

G.4.2.1 Radiological Data Mapping System Survey. When the excavation reaches the subcontract design limits, a radiological data mapping system survey (i.e., the man-carried radiological data system [MRDS], laser-assisted ranging and data system, or similar technology) is deployed to determine if further excavation is warranted. In the case of the MRDS technology, NaI gamma-energy detector equipment is mounted to a portable cart (or backpack) that is pulled (or carried) around the site by an operator. The operator stops at regular intervals and allows the equipment to count the radioactivity at that location. Global positioning system (GPS) coordinate information is transmitted with the radioactivity readings to computers in a nearby van. Operators in the van process the data, and maps of radioactivity at the site are plotted. If hot spots are detected during the survey, further excavation may be planned. The surveys are performed over a minimum of 50% of the site in accordance with field screening procedures. The data collection and mapping efforts are documented in the project files.

G.4.2.2 Sodium Iodide Detector. If hot spots are identified during site excavation field screening, analysts attempt to confirm the presence of the hot spot with a hand-held NaI detector. If the hot spot is found, a sample is collected and analyzed using gamma energy analyses. If the hot spot is not confirmed, the radiological mapping survey results at that particular location are reevaluated.

G.4.2.3 Laboratory Analysis. In-process samples are collected for quick-turnaround laboratory analyses of radionuclides and nonradionuclides at onsite and offsite laboratories. They are used to guide excavation (particularly at sites where nonradionuclides are the primary COCs) and to distinguish between potentially clean materials and contaminated materials for disposal at ERDF. Data from these samples are used to corroborate data obtained from field screening and to assist in waste characterization. The field screening and in-process sampling and analysis efforts are documented in field logbooks and in the project files.

G.4.3 Variance Sampling and Analysis

When a site is ready (based on field screening) for variance/cleanup verification sampling, the sample designs are developed for each decision unit (e.g., shallow zone, deep zone, overburden) in accordance with the 100 Area SAP (DOE-RL 2004), the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (100 Area Burial Grounds SAP) (DOE-RL 2001), and the *Instruction Guide for Remediation of the 100 Area Waste Sites* (BHI 2003). The layout and orientation of the sampling designs are based on the size and shape of the decision unit.

The sampling designs are used to verify site status after remedial action excavation. If statistical sampling is used, random samples are collected to assess variability in contaminant levels (variance assessment). Each decision unit is separated into several sampling areas. Within each of these sampling areas, a 16-node grid is established and random sampling locations are chosen. Based on the variance sample results, samples are then taken from the random points in each sampling area and are composited for analysis. These cleanup verification samples are used to

verify that the site meets the RAGs. If focused sampling is used, the worst-case values are compared to the RAGs directly to verify cleanup.

The sample design is documented in a calculation brief and is included in an appendix to the CVP.

If required, variance analysis may be performed after field screening to indicate that RAGs are met. Variance analysis (as described in the 100 Area SAP, Section A.6 [DOE-RL 2004]) determines the site-specific number of verification samples. The analysis is based on the minimum detectable difference approach presented in U.S. Environmental Protection Agency (EPA) guidance (EPA 1993). In this approach, contaminant variability is quantified and used to determine the number of samples required per EPA guidance to represent the site for clean site verification.

If variance samples are collected, they are collected from random sampling locations and submitted for analysis in accordance with the 100 Area SAP, 100 Area Burial Grounds SAP, and the instruction guide (DOE-RL 2004, 2001; BHI 2003, respectively). The data are used for a preliminary assessment of whether the direct radionuclide exposure RAGs and variance requirements have been met. The data may indicate a low degree of variability and contaminant levels below the lookup values or RAGs.

This variance sampling section of the CVP briefly describes the variance sampling, including sampling dates, number of variance samples, and type of analyses. The results of the variance analysis generally indicate that the number of verification samples to be taken is less than the default number of four; therefore, four final verification samples are usually collected from each shallow zone decision subunit. Variance analysis results and calculations are included in an appendix to the CVP.

G.4.4 Cleanup Verification Sampling and Analysis

Final cleanup verification samples are generally collected following variance sampling, analysis, and data evaluation; however, depending on schedule needs, it is also acceptable to collect the variance and verification samples simultaneously. The 100 Area Burial Grounds SAP (DOE-RL 2001) does not require variance sampling. Each verification sample is a composite formed by combining samples collected at four randomly-selected nodes within each sampling area. The sample design methodology and sample location figures are presented in the calculation briefs for variance analysis and sample design in an appendix to the CVP.

The division of the site excavation into decision units (e.g., shallow zone and deep zone) is a function of the applicable RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to soils within 4.6 m (15 ft) of the ground surface. This soil zone is referred to as the shallow zone. The groundwater protection and river protection RAGs are applicable to soils greater than 4.6 m (15 ft) below the ground surface. This soil zone is referred to as the deep zone. If a site is relatively clean and will meet the direct exposure cleanup criteria throughout the site excavation, it is appropriate to handle the entire site as a shallow zone decision unit.

A brief explanation regarding the remedial excavation decision units and cleanup verification sampling is included in this section. Discussion regarding the rationale for using a single shallow zone decision unit or dividing the site into separate shallow and deep zone decision units is given. Sampling dates and the number of samples collected per decision unit are discussed in this section.

G.5 CLEANUP VERIFICATION DATA EVALUATION

This section presents the process that the cleanup verification data undergoes for data quality assessment (DQA) and prior to RAG attainment assessment.

G.5.1 Data Quality Assessment Process

The DQA has been integrated into the CVP and is presented here as a subsection.. The DQA is very briefly summarized in the body of the CVP, with the detailed DQA (as represented with the following sections) placed in an appendix to the CVP. The DQA process involves the scientific and statistical evaluation of data to determine if the data are of the right type, quality, and quantity to support the intended use (EPA 1996). The DQA process completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objective (DQO) process. The DQA methodology is performed in accordance with BHI-EE-01, *Environmental Investigations Procedures,* Procedure 1.22, "Data Quality Assessment."

The DQA process is not intended to be a definitive analysis of a project or problem, but instead provides an initial assessment of the reasonableness of the data that have been generated (EPA 1996).

The DQA focuses on the laboratory data, statistical error tolerances, and the overall DQO, specifically by addressing the question, "Are the data of the right type, quality, and quantity to support their intended use?" The intended use of the data is to make the appropriate decision regarding whether the site meets the RAOs as defined by the RAGs. The site closeout or cleanup decision rules are the RAGs. Completion of a CVP following this guidance inherently is the functional equivalent of performing a DQA for a waste site.

The DQA is not performed on field screening data, as field screening data are not used in decisions regarding the rejection of null hypothesis. Thus, field decisions will be made based on the field screening data with the understanding that the decision to remediate a site shown to be contaminated based on field readings may not be within error tolerances. This is a risk management decision and is deemed as an acceptable risk by project decision makers.

G.5.1.1 Error Tolerances.

- Type I – false-positive error (site does not meet RAGs when data indicate that it does): A 5% false-positive rate is consistent with the need to calculate a 95% upper confidence limit (UCL) of the mean and was selected for the statistical calculations (DOE-RL 2004).

- Type II – false-negative error (site meets RAGs when data indicates that it does not): The sample design methodology is designed based on a false-negative error rate of 20%.

G.5.1.2 Data Validation. After sampling is completed, a minimum of 5% of the verification sample data packages are validated to Level C per BHI-EE-01, Procedure 2.5, "Data Package Validation Process." Level C validation procedures are specified in *Data Validation Procedure for Chemical Analysis* (BHI 2000b) and *Data Validation Procedure for Radiochemical Analysis* (BHI 2000c).

Under the Level C validation procedure, the following items are reviewed, as appropriate, for each analytical method:

- Sample holding times
- Method blanks
- Matrix spike (MS) recovery
- Surrogate recovery
- MS/matrix spike duplicate (MSD) results
- Sample replicates
- Associated batch laboratory control sample results
- Data package completeness.

For CVPs and related documents (e.g., leachability study reports, data summary reports), all laboratory-applied "J" flags on radionuclide results will be deleted. A footnote will be included in the radionuclide data summary tables indicating that, because of laboratory reporting conventions, these results may have a nonrelevant "J" qualifier in the Hanford Environmental Information System database and/or on the analytical report.

Where the "J" qualifier is applied through the validation process, the qualifier will not be deleted and the traditional "estimated" footnote will be presented. The footnote will also direct the reader to the DQA section of the document. The DQA section provides additional discussion regarding the reasons why the "J" qualifier was applied during validation, and also discusses the usability of the data.

Data flagged as below detection limits (i.e., "U") indicate that the analyte was analyzed for but not detected, and the concentration shown is the PQL. Data flagged as rejected (i.e., "R") indicate that the data are not useable due to a quality assurance/quality control deficiency. All other validated results are considered accurate within the standard errors associated with the methods.

The adequacy of laboratory quality assurance/quality control is evaluated as a subset of the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, and comparability) in the 100 Area SAP (DOE-RL 2004). The laboratory data are validated by a contractor, which reports whether the laboratory met the required target detection limits, precision (+/-30%), accuracy (+/-30%), and completeness (>90%). The proportion of analytical results in which the detection limits exceed the 100 Area SAP target detection limits are noted in the data evaluation section of the DQA.

Reported analytical detection levels are compared to the specified detection limits in the 100 Area SAP (DOE-RL 2004). The data validation notes any analyses in which the detection limit or minimal detectable activity was above the 100 Area SAP-specified detection limits. The detection limits are based on optimal conditions. Interferences and different matrices may significantly affect the values shown. Exceeding the specified detection limits does not necessarily invalidate the data for decision-making purposes; however, the exceedances need to be evaluated on a case-by-case basis within the DQA.

A statement is made regarding acceptability of the MS/MSD samples percent recoveries and relative percent differences (RPDs). Acceptable limits are in the 100 Area SAP.

G.5.1.3 Supplementary Data Evaluation. If formal data validation did not include evaluation of all cleanup verification samples taken from a site, investigators review the study objectives in the 100 Area SAP to determine the context for analyzing the data. This evaluation encompasses all verification samples. The context for analyzing the data includes a comparison of analytical results to the PARCC parameters as specified in the 100 Area SAP. This section of the CVP summarizes the results of that comparison and presents an evaluation of the affected data.

Reported analytical detection levels are compared to the specified detection limits in the "Analytical Performance Requirements" table of the 100 Area SAP (DOE-RL 2004). The proportion of validated data with reported analytical detection levels above the specified detection limits are noted. Data qualification is not required if the reported analytical detection levels are sufficiently less than the RAGs and the associated data are of sufficient quality for decision-making purposes.

Analytical accuracy and precision are evaluated by examining and comparing the percent recovery and RPD between the main and duplicate samples. Only the COCs detected at five times the detection limit (or greater) are used for data analysis with regards to accuracy and precision. If all percent recoveries for laboratory control samples and inorganic MS and MSD were within acceptable limits, then the samples compare favorably.

G.5.1.3.1 Field Blank Samples. Field blank samples are collected to detect any contamination from sampling equipment, cross-contamination from previously collected samples, or contamination from conditions during sampling.

The blank sample results and anomalies are discussed in this section of the CVP.

G.5.1.3.2 Field Duplicate Samples. Duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the duplicate samples for each COC. Only analytes with values above five times the detection limits for both the master and duplicate samples are compared. The RPD of the results is described in this section of the CVP, and those that fall outside the +/-30% range are discussed.

G.5.1.3.3 Field Split Samples. Split samples are collected and analyzed by different laboratories to provide a relative measure of the degree of variability in the sampling, sample handling, and analytical techniques used by commercial laboratories. The field master and split samples are evaluated by computing the RPD of the split samples for each COC. Only analytes with values above five times the detection limits for both the master and split samples are compared. The RPD of results is described in this section of the CVP, and those that fall outside the +/-30% range are discussed and a decision made as to the usability of the data.

If split samples are collected by regulatory agencies, the results are discussed in this section. Regulatory split sample data are compared to verification samples using RPD as described in Section II.5.4 of the 100 Area SAP (DOE-RL 2004).

G.5.2 Cleanup Verification RAG Evaluation Process

This section discusses the calculations and modeling necessary for assessing and demonstrating RAG attainment.

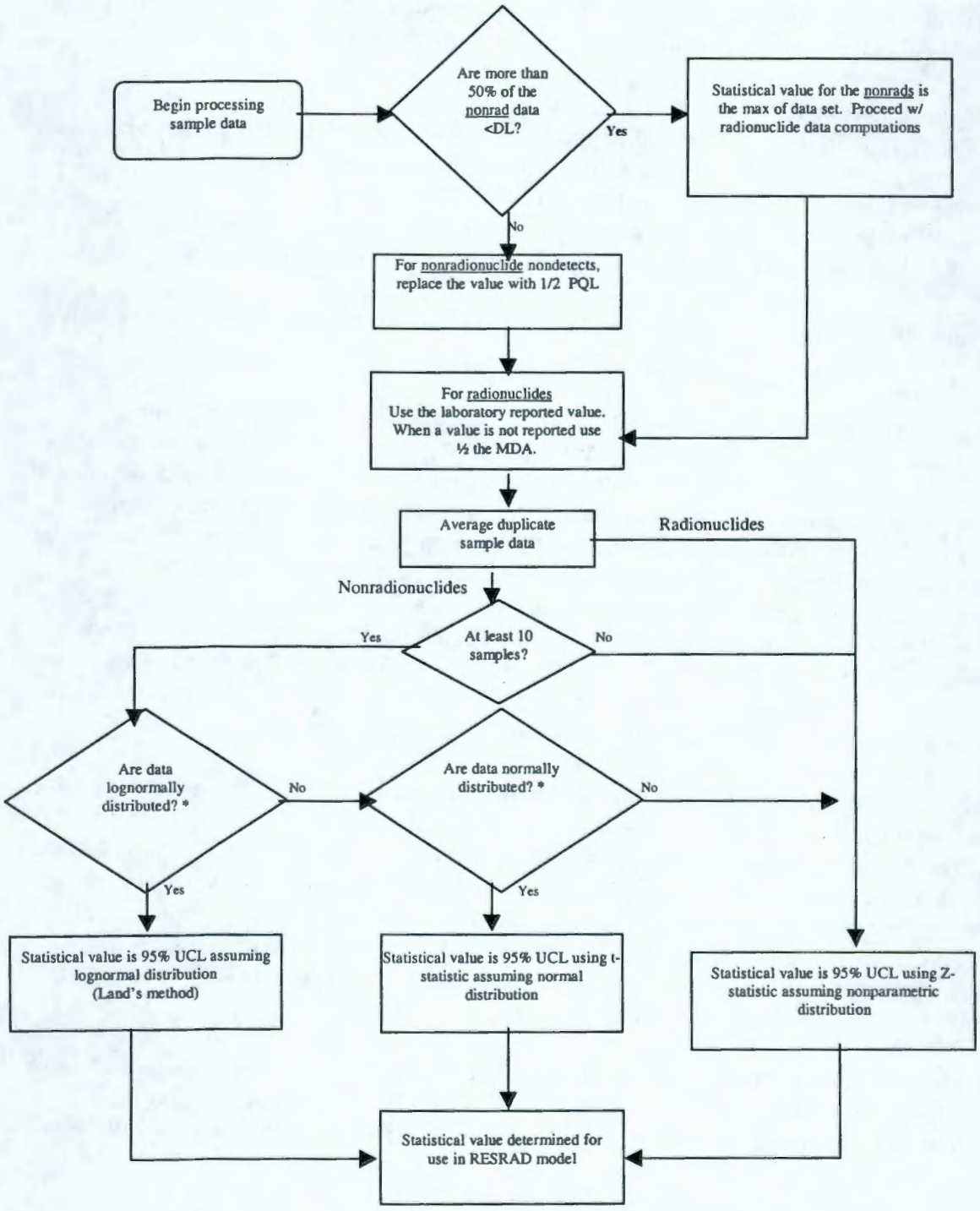
G.5.2.1 Contaminants of Concern 95% Upper Confidence Limit. The primary statistical calculation to support cleanup verification is the 95% UCL on the arithmetic mean of the data. The 95% UCL values for each COC are computed for each decision unit (e.g., for the shallow and deep zones and overburden, as appropriate). For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set. A flowchart depicting the calculation methodology is presented in this section (Figure G-1), and the following subsections describe the methodology.

- **Radionuclides:** The 95% UCL is calculated on the arithmetic mean for each radionuclide COC. The laboratory reported values, including negative values, are used in the UCL calculation. If a UCL is negative, the value is rounded to zero. In instances where the laboratory does not report a value below the minimum detectable activity, half of the minimum detectable activity value is used in the 95% UCL value for all radionuclide nonparametric formulae that is used to calculate the 95% UCL value for all radionuclide verification data sets.

- **Nonradionuclides:** For nonradionuclides, the distribution of large data sets (10 or more data points per component) is examined per the guidelines presented in *Statistical Guidance for Ecology Site Managers* (Ecology 1992) and in *Statistical Guidance for Ecology Site Managers, Supplement S-6* (Ecology 1993). Small data sets (less than 10 data points per component) are evaluated in accordance with Section 5.2.1.4 of the site managers guidelines (Ecology 1992).

  For nonradionuclide data flagged with "U" (i.e., less than detection), a value equal to half the PQL is used in the 95% UCL calculation. Also, if greater than 50% of the verification sample results for nonradionuclide COCs are below detection, then the statistical value is set equal to the maximum detected concentration from the sample data set.

Figure G-1. Statistical Value Calculation Decision Diagram.



Use W-test for distribution evaluation (uncensored data), or probability plot method for data sets with censored data, censored value taken at ½ PQL (nonrad)

The statistical values represent the COC concentrations for each decision unit (e.g., shallow zone or deep zone soils). Statistical values are established in the 95% UCL calculations for compliance with cleanup standards calculation brief, where the data are evaluated per WAC 173-340 guidance. The calculation brief is included in an appendix to the CVP.

Uranium background concentrations are accounted for in shallow and deep zone soils. Anthropogenic and naturally occurring radionuclide background are accounted for in overburden soil. Background is accounted for by subtracting the background concentration from the statistical value. These statistical values, after subtracting for background, are used in the RESRAD modeling and risk calculations for evaluation of RAOs and RAG attainment. The verification sampling statistical values for the site are presented in a table in the CVP.

The statistical value for each COC is compared to the cleanup criteria to evaluate attainment of direct exposure RAGs.

G.5.2.2 Site-Specific Cleanup Verification Model. Section 5.0 of Appendix B of this RDR/RAWP describes a hierarchical method for determining when deep zone modeling may be needed. Initially, a simple site model is assumed where the deep zone statistical values represent remaining soil concentrations for the entire deep zone (i.e., from 4.6 m [15 ft] below ground surface to groundwater). This is a simple and conservative model in that the soil samples used to calculate the deep zone statistical values were collected very near the source of the contamination and are expected to be at higher concentrations than other deep zone soil. If the site meets the RAGs using this simple model, a more detailed model is not necessary. In the event that the simple model is too conservative, a more detailed model is developed using site-specific or analogous site information to show that contaminant concentrations decrease with depth. This more detailed model is then used for RAG attainment evaluation.

G.5.2.3 RESRAD Modeling. The individual radionuclide cleanup verification statistical values are entered into the RESRAD computer code (ANL 2002) based on the site model to estimate the dose, and to estimate the impact on groundwater and the river from residual COC concentrations. The RESRAD model is primarily intended for radionuclide contaminants. However, the system can also be used for nonradionuclides and is used to evaluate the potential for nonradionuclide COCs to reach groundwater. Overviews of the model runs are provided below. RESRAD analysis is documented in a calculation brief included in an appendix to the CVP. A summary of the RESRAD input parameters is provided in Appendix B of this RDR/RAWP.

G.5.2.3.1 Shallow Zone Direct Exposure Dose and Risk Evaluation. The cleanup verification values and site-specific parameters are entered into RESRAD for analysis of (1) total radionuclide dose (effective dose mrem/yr) and (2) estimated risk attributable to radionuclides.

G.5.2.3.2 Protection of Groundwater Evaluation. The cleanup verification values (radionuclide and nonradionuclide [if necessary] COCs) and site-specific parameters are entered into RESRAD for analysis of the individual radionuclide COC groundwater concentrations from residual COC concentrations in soil.

G.5.2.4 Drinking Water/Groundwater Dose Assessment. RESRAD estimates the site impact to groundwater. These radionuclide, RESRAD estimated, groundwater concentrations are used for calculating individual organ doses received from drinking water. A detailed approach for calculating the individual dose rates is given in Section G.6.

G.6 EVALUATION OF REMEDIAL ACTION GOAL ATTAINMENT

The previous section discussed how the cleanup verification data is modeled and used for calculating statistical values, risk, dose, and estimated groundwater impact for use in site RAG attainment evaluation. This section discusses how the data from this effort is used in demonstrating RAG attainment.

G.6.1 Attainment of Direct Exposure Soil Cleanup Standards

G.6.1.1 Attainment of Radionuclide Direct Exposure Standards. The RESRAD computer code (ANL 2002) is used to demonstrate that the direct exposure radionuclide dose limit of 15 mrem/yr above background is not exceeded. For the shallow zone and overburden decision units, all contaminant pathways contribute to the direct exposure dose estimate. For the deep zone decision unit, only the water-dependent pathways contribute to the direct exposure dose estimate.

The statistical value (95% UCL) is used for input to the RESRAD model. The direct radiation exposure dose to the resident living in his/her basement is conservatively estimated by substituting (for analysis purposes) a case where the resident is standing on level ground with the soil containing concentrations representative of residual (i.e., post-cleanup) shallow zone soils. (This is conservative because it ignores the potential shielding effects of concrete basement walls and any clean backfill between residual soils and the basement walls.) The results of the RESRAD direct exposure dose estimate are presented in a figure. This dose represents the summed dose contributions from soils at the relevant time frames. This computation is summarized in a calculation brief. The actual doses at the waste site will be considerably less than these calculations because the site will be backfilled with clean fill soil.

G.6.1.2 Attainment of Nonradionuclide Direct Exposure Cleanup Standards

G.6.1.2.1 Attainment of Remedial Action Goals. The shallow zone statistical value for the COC is compared to the cleanup criteria to evaluate the attainment of direct exposure RAGs. Comparison of nonradionuclide direct exposure RAGs to the shallow zone statistical values is summarized in a table.

G.6.1.2.2 Attainment of Noncarcinogenic Risk Standards. For noncarcinogenic COCs, WAC 173-340-740(5)(a) and (b) specifies the evaluation of the hazard quotient, which is given as daily intake divided by a reference dose (DOE-RL 1995). For cleanup actions under the Interim Action ROD (EPA 1995), a comparable conservative approach is used to demonstrate attainment of the noncarcinogenic risk requirements.

The direct exposure nonradionuclide RAGs for soil are based on the WAC 173-340-740(3) Method B limits. These cleanup limits were set to be compliant with a hazard quotient of 1.0; therefore, the ratio of the cleanup verification statistical values to the cleanup limits (lookup value obtained from Table 2-1 of this RDR/RAWP) provides a conservative approach to addressing the hazard quotient.

The fraction of cleanup level (Fc) is calculated as follows:

$$Fc = S/V$$

where:

Fc = fraction of cleanup level (dimensionless)
S = statistical value of the COCs (in mg/kg)
V = lookup value (WAC 173-340-740(3) Method B derived, direct exposure RAG in mg/kg).

If the Fc is less than 1 for an individual COC, then the hazard quotient has been addressed.

For multiple COCs, a sum of the individual COC Fc values was used to address the hazard index or cumulative hazard quotient. The Fc values for all noncarcinogenic COCs were summed. If that sum was less than 1, then the hazard index or cumulative hazard quotient has been addressed.

G.6.1.2.3 Attainment of Carcinogenic Risk Standards. For individual carcinogenic nonradionuclide COCs, the WAC 173-340-750(3) Method B cleanup limits are based on an incremental cancer risk of 1×10^{-6}. For cumulative carcinogenic COCs, the cumulative excess cancer risk must be less than 1×10^{-5}. If a linear relationship is assumed between environmental concentration and risk, the ratio (Fc) of the statistical value from the verification samples divided by the WAC 173-340-750(3) Method B limit, multiplied by 10^{-6}, is an estimate of the risk associated with the statistical value.

For multiple carcinogenic COCs, the risks of the individual COCs (described above) are summed. If no risk associated with a single COC exceeds 1×10^{-6}, and if the sum of the individual COC risk does not exceed 1×10^{-5}, then the WAC 173-340-750(5)(a) and (b) Method B risk requirement has been addressed for this remedial action.

For the shallow zone, the individual COC and cumulative risk value are checked against the individual and cumulative WAC 173-340-750(5)(a) and (b) risk limits. This type of calculation is performed and documented in the 95% UCL calculation brief, which is included in an appendix to the CVP.

G.6.2 Attainment of Groundwater Remedial Action Goals

The groundwater RAGs are applicable to all decision units (e.g., shallow zone, deep zone, and overburden).

G.6.2.1 Radionuclides. The estimated groundwater concentrations for all the radionuclide COCs contributed by the soils in the shallow zone (and deep zone, if present) are determined by RESRAD modeling, which is documented in a calculation brief. If the groundwater concentrations predicted by RESRAD indicate that COCs impact groundwater, then a separate calculation is needed to determine compliance with groundwater dose standards.

Depending on the ROD, the "National Primary Drinking Water Regulations" (40 CFR 141.66) establish a gross-alpha particle standard of 15 pCi/L for alpha-emitting radionuclides (excluding radon and uranium), or DOE Order 5400.5 establishes derived concentration guidelines (DCGs) for alpha emitters. For the DCG-based limits, 1/25th of the DCG is used.

The 40 CFR 141.66 regulations establish a 4 mrem/yr dose standard for beta- and gamma-emitting radionuclides in drinking water. They also specify the method of calculating dose: the individual organ-dose calculational method given in National Bureau of Standards (NBS) Handbook 69 (NBS 1963).

To determine if any organ receives a dose of more than 4 mrem/yr, the dose to each organ is calculated from the COC radionuclide mixture.

The "National Primary Drinking Water Regulations" establish an MCL for total uranium of 30 μg/L.

There is a critical organ for each radionuclide (i.e., the organ that receives the highest dose from ingestion of that radionuclide). The critical organs for each radionuclide are determined from the maximum permissible concentration (MPCs) listed in Table 1 of NBS Handbook 69 (NBS 1963), and are denoted in bold in Table G-2. The factor C_4 (i.e., the concentration that will produce a dose of 4 mrem/yr to that organ) is calculated for each organ and radionuclide and compared to the applicable MPC. The equation for the calculation of C_4 for radionuclide "A" and organ "x" is as follows:

$$C_4^A (x) = 4.4 \times 10^6 \text{ (MPC/ORL)}.$$

The term "ORL" is the occupational radiation limit (in rems) for the organ given in the *National Primary Drinking Water Regulations* (EPA 1976). The ORLs for the individual organs are listed below:

- Total body - 5
- Gonads - 5
- Thyroid - 30
- Bone - 29.1
- Other organs - 15.

The C_4 factors for the COCs are summarized in Table G-2.

Table G-2. Factors for Calculating Radionuclide-Specific Organ Doses Using Methodology Mandated by the Safe Drinking Water Act for Comparison to the 4 mrem/yr Standard for Beta and Gamma Emitters.

Radionuclide	Organ	4 mrem/yr Equivalent Concentration (C_4 in pCi/L)[a]
Cobalt-60	**GI(LLI)**	100
	Total Body	900
	Liver	3,000
Cesium-137	Bone	80
	GI(LLI)	2,000
	Total Body	200
	Liver	60
Europium-152	Bone	30,000
	GI(LLI)	200
	Total Body	2E+05
	Liver	1E+05
Europium-154	Bone	5,000
	GI(LLI)	60
	Total Body	7E+04
	Liver	6E+04
Europium-155	Bone	1E+05
	GI(LLI)	600
	Total Body	9E+05
	Liver	6E+05
Strontium-90	**Bone**	8
	GI(LLI)	100
	Total Body	8
Nickel-63	**Bone**	50
	GI(LLI)	3,000
	Total Body	2,000
	Liver	600
Carbon-14	Total Body	9,000
	Bone	2,000

NOTE: Critical organs are shown in bold.
[a]Calculated by methodology given in *National Interim Primary Drinking Water Regulations*, Appendix IV, "Dosimetric Calculations for Man-Made Radioactivity" (EPA 1997b).
GI(LLI) = gastrointestinal tract-lower large intestine

The cumulative dose for each organ at time "t" needs to be calculated separately and the sum of fractions equation (EPA 1976) calculated, as shown below. If a radionuclide does not have an MPC for the organ of interest, the C_4 factor for total body dose is used in the calculation. The calculations performed are documented in the comparison to drinking water standards calculation brief. The organs for which doses need to be computed are total body, bone, gastrointestinal tract-lower large intestine, and liver. The individual organ doses are compared to 4 mrem/yr. Using this methodology, the doses are not summed for different organs for the comparison to 4 mrem/yr.

$$Dose_{organ\ x}(t) = [ConcA(t)/C_4^A(x) + ConcB(t)/C_4^B(x) + \ldots] \times (4\ mrem/yr)$$

If the dose for organ "x" is less than 4 mrem/yr, then the standard is met.

A table is provided in the CVP (Table G-3 in this appendix) that shows the total peak concentration for each detected radionuclide COC and provides the individual RAGs for comparison. A figure is provided in the CVP that shows the calculated dose to organs from groundwater. These are documented in a calculation brief.

Table G-3. Estimated Peak Radionuclide Groundwater Concentrations (Summed over Shallow and Three Deep Zone Levels) Compared to RAGs.

Radionuclide	Peak Concentration (pCi/L)	Approximate Time of Peak Concentration (years)	RAG (pCi/L)
Americium-241	0	0	15
Carbon-14	0	0	2,000
Cobalt-60	0	0	100
Cesium-137	0	0	60
Europium-152	0	0	200
Europium-154	0	0	60
Europium-155	0	0	600
Nickel-63	0	0	50
Plutonium-238	0	0	15
Plutonium-239/240	0	0	15
Strontium-90	0	0	8

G.6.2.2 Nonradionuclides. If the statistical value of a COC is below the soil background value, the COC is not considered further in the groundwater protection evaluation, and the groundwater protection RAG is considered to be attained.

To determine the RAG for a contaminant in soil that is protective of groundwater, WAC 173-340-740(3)(a)(ii)(A) (January 1996) is applied (as a first test) to the groundwater action level for each COC. Application of WAC 173-340-740(3)(a)(ii)(A) (January 1996),

involves a conversion of groundwater action levels (μg/L) to equivalent soil action levels (mg/kg). This calculation is based on a kg/L density conversion factor assumption. For example, a RAG of 1 μg/L has a corresponding soil equivalent RAG of 0.1 mg/kg (e.g., 1 μg/L = 0.001 mg/L, 0.001 mg/L ÷ 1 kg/L = 0.001 mg/kg, 100 x 0.001 mg/kg = 0.1 mg/kg). After conversion of the groundwater action level to a soil equivalent value, the COC statistical values can be compared directly to the RAG soil equivalent value. Per WAC 173-340-740(3)a, the COC statistical values that are less than the RAG soil equivalent value are considered protective of the groundwater.

If the statistical value of a COC is determined to be equal to or lower than the analytical method PQL, which is the lowest detectable value, but the PQL is greater than the cleanup RAG, the RAG is considered to have been attained in accordance with WAC 173-340-707. For example, the groundwater action level for polychlorinated biphenyls (PCBs) is 0.01 μg/L (or 0.00001 mg/L), which after applying WAC 173-340-740(3)(a)(ii)(A) (January 1996) provides a soil RAG of 0.001 mg/kg. Direct comparison of the statistical value to this soil RAG is inappropriate because the PQL at which PCBs are detectable is greater than 0.001 mg/kg. Therefore, in this case, the PQL for PCB analysis and the corresponding statistical value are considered protective of the groundwater. In cases where the COC analytical PQL is below the RAG, the statistical value is directly compared to the soil equivalent RAG.

If attainment of the groundwater RAGs are not met under WAC 173-340-740(3)(a)(ii)(A) (January 1996), a more detailed site-specific evaluation is performed using RESRAD modeling. Nonradionuclide COCs are modeled by using an equivalent radionuclide surrogate with a long half-life (>1,000 years) with the distribution coefficient (K_d) set at the actual K_d of the nonradionuclide constituent. Appendix E presents K_d values to be used in RESRAD calculations. The resulting groundwater concentration calculated by RESRAD is then compared directly to the action levels for groundwater.

G.6.3 Attainment of Columbia River Remedial Action Goals

G.6.3.1 Radionuclides. The individual radionuclide Columbia River RAG is equivalent to the groundwater RAG[1]; therefore, if the individual radionuclide groundwater RAG is attained, the individual Columbia River RAG is also attained.

G.6.3.2 Nonradionuclides. If the statistical value of a COC is below the background value, it is not considered further in Columbia River protection cleanup verification evaluation, and the Columbia River RAG has been attained.

To determine soil RAGs for other nonradionuclide contaminants that are protective of surface water, the "100 times surface water quality times DAF" rule is applied (as a first test) to the surface water protection action level for each COC. Application of the "100 times surface water quality times DAF" rule involves a conversion of surface water protection action levels (μg/L) to equivalent soil action levels (mg/kg). This calculation is based on a 1-kg/L density conversion

[1] Because there are no ambient water quality criteria for radionuclides, the groundwater action levels apply to river protection.

factor assumption. A DAF based on a dilution of 2:1 has been established in Appendix D for nonradionuclides. The "100 times surface water quality times DAF" rule is then applied to provide a soil equivalent RAG that is protective of the Columbia River. The statistical value is then directly compared to the soil equivalent RAG for surface water protection. If the statistical value is lower, the Columbia River RAGs are attained.

If the statistical value of a COC is determined to be equal to the analytical method PQL, but the PQL is greater than the cleanup RAG, the RAG is considered to have been attained in accordance with WAC 173-340-707. For example, the ambient water quality criterion for PCBs is 0.014 μg/L (or 0.000014 mg/L), which after applying a DAF and WAC 173-340-740(3)(a)(ii)(A) (January 1996), provides a soil RAG of 0.0028 mg/kg. In this case, a direct comparison of the statistical value to the RAG of 0.0028 mg/kg is not made because the PQL for PCB analysis (i.e., statistical value) is considered protective of the Columbia River.

If the Columbia River RAG is not attained by these methods, then the statistical values are modeled using RESRAD (as described in Appendix B) to determine if nonradionuclides reach the groundwater within 1,000 years after remediation. If these nonradionuclides do not reach the groundwater, then they do not reach the Columbia River; thus, Columbia River RAGs are attained.

If RESRAD modeling indicates that contaminants do reach the groundwater within 1,000 years, the travel time in the groundwater underlying the site to the Columbia River is estimated as described in Appendix C. If contaminants do not reach the Columbia River within 1,000 years in concentrations exceeding the RAGs, then Columbia River RAOs are attained.

G.6.4 WAC 173-340-740(7)(e) Three-Part Test for Nonradionuclides

This section documents application of the WAC 173-340-740(7)(e) three-part test for nonradionuclides using the most restrictive RAGs applicable for each zone. (The most restrictive RAG is defined as the lowest of the direct exposure, groundwater protection, and river protection RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to the shallow zone and overburden. Groundwater and river protection RAGs are applicable to the deep zone.) The WAC 173-340-740(7)(e) three-part test consists of the following criteria: (1) the cleanup verification statistical value must be less than the cleanup level, (2) no single detection can exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10%. The duplicate sample is treated as a separate sample for the three-part test. The split sample is only used for DQA purposes and is not included in the three-part test.

A table is used to summarize the results of the WAC 173-340-740(7)(e) three-part test for the overburden, shallow zone, and deep zone sample data sets. For each nonradionuclide COC, the table lists the most restrictive applicable RAG, the maximum detected value, the total number of samples collected, and the number of samples exceeding the most restrictive RAG. The final column of the table describes the result of applying the three criteria using the values listed in the preceding columns.

G.7 RADIONUCLIDE RISK INFORMATION

The radionuclide RAG for direct exposure is derived from the Interim Action ROD (EPA 1995), and is expressed in terms of an allowable radiation dose above background (i.e., 15 mrem/yr). The RAG evaluation involved using the RESRAD model to estimate total annual radiation doses for 1,000 years for comparison to the RAG. Radiation presents a carcinogenic risk, and the RESRAD model also calculates the excess lifetime cancer risk associated with the estimated radiation doses. The "National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300) presents a target range for residual risk of 10^{-4} to 10^{-6}. A figure illustrates excess lifetime cancer risk as estimated using the RESRAD model. Because of radioactive decay, the risk decreases over time.

G.8 STATEMENT OF PROTECTIVENESS

This section of the CVP reiterates the achievements demonstrated within the site-specific CVP. If all cleanup criteria have been met, the site should be verified to be remediated, the remedial action objectives have been attained, and the site may be backfilled.

G.9 REFERENCES

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APPENDIX H

REVEGETATION PLAN FOR THE 100 AREA

APPENDIX H

REVEGETATION PLAN FOR THE 100 AREA

H.1 INTRODUCTION

This revegetation plan is for the 100 Area waste sites covered in this remedial design report/remedial action work plan, which will be remediated as part of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* Remedial Action Project. Each remediated site and the associated support facilities (e.g., roads, spoils piles) that are disturbed during remediation will be revegetated under this plan.

This plan is generic; site-specific conditions will be evaluated and adjustments made when necessary. For example, at those sites where confirmatory sampling shows that remediation is not necessary, revegetation will depend on the current vegetative cover. Some of the sites will require no additional work, and others can be reseeded as they are. Consultations with Native American Tribes and the Natural Resource Trustee Council will also be made, as appropriate, for additional input.

This revegetation plan is built on the information provided in the *Revegetation Manual for the Environmental Restoration Contractor* (BHI 1997), the *Hanford Site Biological Resources Management Plan* (DOE-RL 2001a), the preliminary results of the *2001 Environmental Restoration Contractor Revegetation Monitoring Report* (BHI 2001), and from other revegetation that has occurred across the Hanford Site.

H.2 MITIGATION ACTION PLAN

A mitigation action plan has been prepared for the 100 Areas and 600 Area of the Hanford Site (DOE-RL 2001b). The majority of the sites identified in the mitigation action plan and this revegetation plan are waste sites to be remediated and areas impacted by remediation activities. Some sites, especially those in the 100-IU-2 and 100-IU-6 Operable Units, have naturally revegetated to a native shrub-steppe community providing high-quality vegetative cover. These sites will be identified in field surveys prior to initiation of remediation. If confirmatory sampling or remedial actions have the potential for disturbing species of concern, or removing high-quality habitat, supplemental mitigation (in addition to actions listed in the mitigation action plan) may be required. An ecological survey will be completed for all sites, and the need for additional mitigation will be identified in the survey report.

H.3 SITE DESCRIPTIONS

The current vegetation status for most of the waste sites to be remediated and the nearby areas for support facilities during remediation can be estimated from *Vegetation Communities Associated with the 100-Area and 200-Area Facilities on the Hanford Site* (Stegen 1994), which developed vegetation community maps for all of the 100 Areas. The vegetative status of each of

the 100 Areas varies, but the range is from totally nonvegetated within the 100-K Area perimeter fence to a mixture of nonvegetated and vegetated with low-quality communities, such as cheatgrass/Russian thistle (*Bromus tectorum/Salsola kali*) and rabbitbrush/cheatgrass (*Chrysothamnus nauseosus/Bromus tectorum*) at the 100-F Area. The soils at most of these sites consist of backfill from site stabilization. The nonvegetated sites have been kept free of plants through the use of herbicides. Before the 100 Area reactor facilities were constructed, much of the land along the river was in agricultural production. Before farming, the area is assumed to have been in a mixture of shrub-steppe and grasslands, dominated by sagebrush (*Artemisia tridentata*) and Sandberg's bluegrass (*Poa sandbergii*). Some of the wildlife that use the 100 Areas include mule deer, coyote, geese, and rodents such as Great Basin pocket mice and deer mice.

H.4 PURPOSE OF REVEGETATION

The goal of restoration is to revegetate the waste sites and support areas to communities dominated by native plant species. Shrubs such as sagebrush and rabbitbrush will be planted to provide habitat and structure for nesting birds. Native grasses and forbs that are adapted to the site conditions will be planted to provide an understory. Because of the large amount of land that will be revegetated, the methods used will reflect what is feasible on a large-scale effort.

H.5 TOPSOIL

Fine-grained topsoil, such as sandy loam, is of low availability on the Hanford Site. In the few places where it exists, such as McGee Ranch and the Fitzner-Eberhardt Arid Lands Ecology Reserve, removal may cause unacceptable ecological effects at the borrow sites. Thus, backfill from nearby borrow pits will be used. The backfill is usually from the Hanford formation, which is gravels, sands, and silts with many intermixed cobbles. The number of larger cobbles and boulders increases with increasing distance up the river, with more at the 100-B/C Area and less at the 100-F Area.

For some sites, such as those at the 100-IU-2 and 100-IU-6 Operable Units (near the old Hanford and White Bluffs townsites), the material to be used as backfill may be a much sandier soil than in the Hanford formation borrow pits. The plant species seeded will be selected based on the soils to be revegetated and seed availability.

The backfill material from the borrow pits was originally deposited by the river, and a slow, natural revegetation of this backfill can be seen at the borrow sites that have been abandoned. Native species, including sagebrush and Sandberg's bluegrass, have become established and appear to out-compete nonnative species. The density of the vegetative cover at the abandoned borrow pits, however, is less than at other sites such as the old fields, which are usually dominated by cheatgrass and tumblemustard (*Sisymbrium altissimum*). The soils at the abandoned fields consist of much finer grained materials, with greater moisture-holding capacity and nutrient properties than the borrow sites. These fine-grained soils tend to favor cheatgrass, which often excludes establishment of shrubs.

Other sources of backfill that may be considered for use in the future include uncontaminated concrete rubble from nearby demolished buildings. If secondary material is used, it will be placed at least 2 to 3 m (6 to 10 ft) below final grade to allow sufficient soil for plant rooting.

H.6 SITE PREPARATION

For those sites currently not vegetated, the clean overburden can be used in the bottom of the excavation and new material from the borrow pits placed on top. For those sites that are currently vegetated, the top 15 to 30 cm (6 to 12 in.) of clean overburden will be saved and used as the topsoil for the excavation. If needed, this material may be spread into a thinner layer (about 5 to 10 cm [2 to 4 in.]) and used as topsoil for several adjacent sites.

The final surface contour will be graded to match the surrounding terrain by creating gentle slopes instead of flat surfaces. Any large boulders remaining should be buried deep in the excavation or randomly grouped on the surface to create additional wildlife habitat. For those sites not requiring backfill to match the surrounding grade, depressions may remain. The depressions should have sides no steeper than 3:1 or 4:1, and irregular grade to more closely match the surrounding native terrain.

H.7 SPECIES TO BE PLANTED

Native species of a Hanford genotype will be used for a majority of revegetation efforts. Sandberg's bluegrass and needle-and-thread grass (*Stipa comata*) have been collected on the Hanford Site and grown as an agricultural crop to provide a large quantity of seeds for revegetation. Seeds of other native plants, such as sagebrush, yarrow (*Achillea millefolium*), Carey's balsamroot (*Balsamorhiza careyana*), pine bluegrass (*Poa scabrella*), and snow buckwheat (*Eriogonum niveum*) may also be collected on the Hanford Site, and will be added to the planting mixture as available and as appropriate to each site. Additional species that may be collected include scurf pea (*Psoralea lanceolata*) rhizomes and seeds of sand dropseed (*Sporobolus cryptandrus*) for use at sandy sites. Additional seeds of other species may be provided by the Tribes and Trustees and combined with the species described above.

Guidance on seeding rates is provided in the revegetation manual (BHI 1997). The methods used for seeding will vary depending on soil type and conditions. For example, drill-seeding works best on soils with minimal amounts of rock while broadcast or hydro-seeding may be preferable on rocky soils. Seeds that are uncleaned or of an unsuitable shape or size may be broadcast over the site before the other seeds are planted. The action of the planting and mulching equipment will help set the broadcast seeds. Areas that have been used for support facilities and haul roads may have excessively compacted ground, making the area unsuitable for planting. If necessary, the soils in these areas will be loosened by ripping the soil with heavy equipment. If a seed drill is not appropriate at these areas, broadcast seeding (with subsequent harrowing or disking) or hydro-seeding may be used to plant seeds. Seeding each year will occur between November and mid-January.

Sagebrush tublings will be planted between November and January in the backfilled areas at a density ranging between 500 to 1,000 plants/ha (200 to 400 plants/acre) depending on the site.

H.8 FERTILIZER AND STRAW MULCH

While the usefulness of fertilizers is sometimes in question when seeding native species, the backfill material excavated from borrow pits is often deficient of nutrients. The cobble composition of excavated backfill material does not promote the establishment of cheatgrass as does finer grained topsoil. Therefore, the addition of some fertilizers may help the native planted species get established. To help clarify the role of fertilizer on native plant establishment, different types of fertilizer and rates may be applied to parts of revegetation sites. The success of each fertilized area will be monitored and compared after the first and second years for plant establishment and cost effectiveness. The fertilizer will be applied at the same time as the seeds, and the type and rate will be on a site-specific basis.

Straw mulch will be spread on the surface at a rate of 4.5 metric tons/ha (2 tons/acre) and crimped into the seedbed.

H.9 IRRIGATION

When irrigation is feasible, it will generally occur only at the time of initial seeding. No additional irrigation is planned at this time. The presence of cobble and larger gravels used as backfill on the sites act as a mulch, helping to conserve moisture. The effects of supplemental irrigation on restoration success were tested on the 116-C-1 restoration site during 1999 and 2000. Half of the site received 5 cm (2 in.) of supplemental water in the spring of each year while the other half only received the natural precipitation. Vegetation analysis of the two plots showed that species diversity was slightly higher on the nonirrigated side and that the total canopy cover (amount of ground covered by vegetation) was identical on both sites (BHI 2000). This relationship remains the same in the 2001 vegetation analysis (BHI 2001). The results at this test site indicate that supplemental irrigation in the spring did little to improve the rate of recovery. Vegetation analyses from other similar revegetation sites indicate that it is more beneficial to add supplemental water during the planting process than to increase germination.

H.10 MONITORING AND SUCCESS CRITERIA

The revegetated areas will be monitored for 5 years following planting. Monitoring each site and support area is not practical; therefore, monitoring will only be done on representative sites. The number of representative sites will vary, depending on the number and distribution of the sites revegetated each year.

Monitoring will be done using methods from *Steppe Vegetation of Washington* (Daubenmire 1970) to estimate percent canopy cover and frequency of occurrence for each species. A list of all species observed on the sites, including those not captured in the sampling plot frames, will

be recorded. If the canopy cover of seeded plants is less than 1% in the spring of the second year, reseeding may occur the following fall if the cause of the reduced success can be identified and rectified. After 5 years, the criteria for success will be a total canopy cover of greater than 25% for native plants. If this is not achieved, the cause should be identified and rectified with additional plantings, fertilization, irrigation, or soil amendments, as applicable.

The vegetative cover and composition at each site following a revegetation effort will be site specific. There are several factors including seedbed, moisture regime, and topographic features that influence a native plant community establishment and success. Caution should be exercised when comparing success between different locations.

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