Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

13-AMRP-0265

JUL 30 2013

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

TRANSMITTAL OF THE 100-FR-1 OPERABLE UNIT INTERIM REMEDIAL ACTION REPORT, DOE/RL-2013-08, REVISION 0

Attached for your use is the, "100-FR-1 Operable Unit Interim Remedial Action Report, DOE/RL-2013-08, Rev. 0." If you have questions, please contact me or your staff may contact Tom Post, of my staff, at (509) 376-3232.

Sincerely,

Mark S. French, Federal Project Director
for the River Corridor Closure Project

AMRC:TCP

Attachment

cc w/attach:
C. J. Guzzetti, EPA
Administrative Record, H6-08

cc w/o attach:
S. L. Feaster, WCH
J. A. Lerch, WCH
D. L. Plung, WCH
J. P. Shearer, CHPRC

DOE/RL-2013-08
Rev. 0

100-FR-1 Operable Unit Interim Remedial Action Report

United States
Department of Energy

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100-FR-1 Operable Unit Interim Remedial Action Report

June 2013

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P.O. Box 550, Richland, Washington 99352

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ACRONYMS

ACM	asbestos-containing material
ARCL	allowable residual contamination level
BCM	bank cubic meter
BCY	bank cubic yard
bgs	below ground surface
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC	contaminant of concern
COPC	contaminant of potential concern
CVP	cleanup verification package
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
EAF	Experimental Animal Farm
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ESD	explanation of significant difference
FSB	fuel storage basin
NPL	National Priorities List
OU	operable unit
PCB	polychlorinated biphenyl
PPE	personal protective equipment
RAG	remedial action goal
RAO	remedial action objective
RCRA	*Resource Conservation and Recovery Act of 1976*
RDR/RAWP	remedial design report/remedial action work plan
RESRAD	RESidual RADioactivity
RI/FS	remedial investigation/feasibility study
RL	U.S. Department of Energy, Richland Operations Office
ROD	record of decision
RSVP	remaining sites verification package
RTD	remove, treat, dispose
SAP	sampling and analysis plan
TPH	total petroleum hydrocarbons
Tri-Parties	U.S. Department of Energy, Richland Operations Office, U.S. Environmental Protection Agency, and Washington State Department of Ecology
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
VCP	vitrified clay pipe
WAC	*Washington Administrative Code*
WIDS	Waste Information Data System
WSRF	waste site reclassification form

1.0 INTRODUCTION

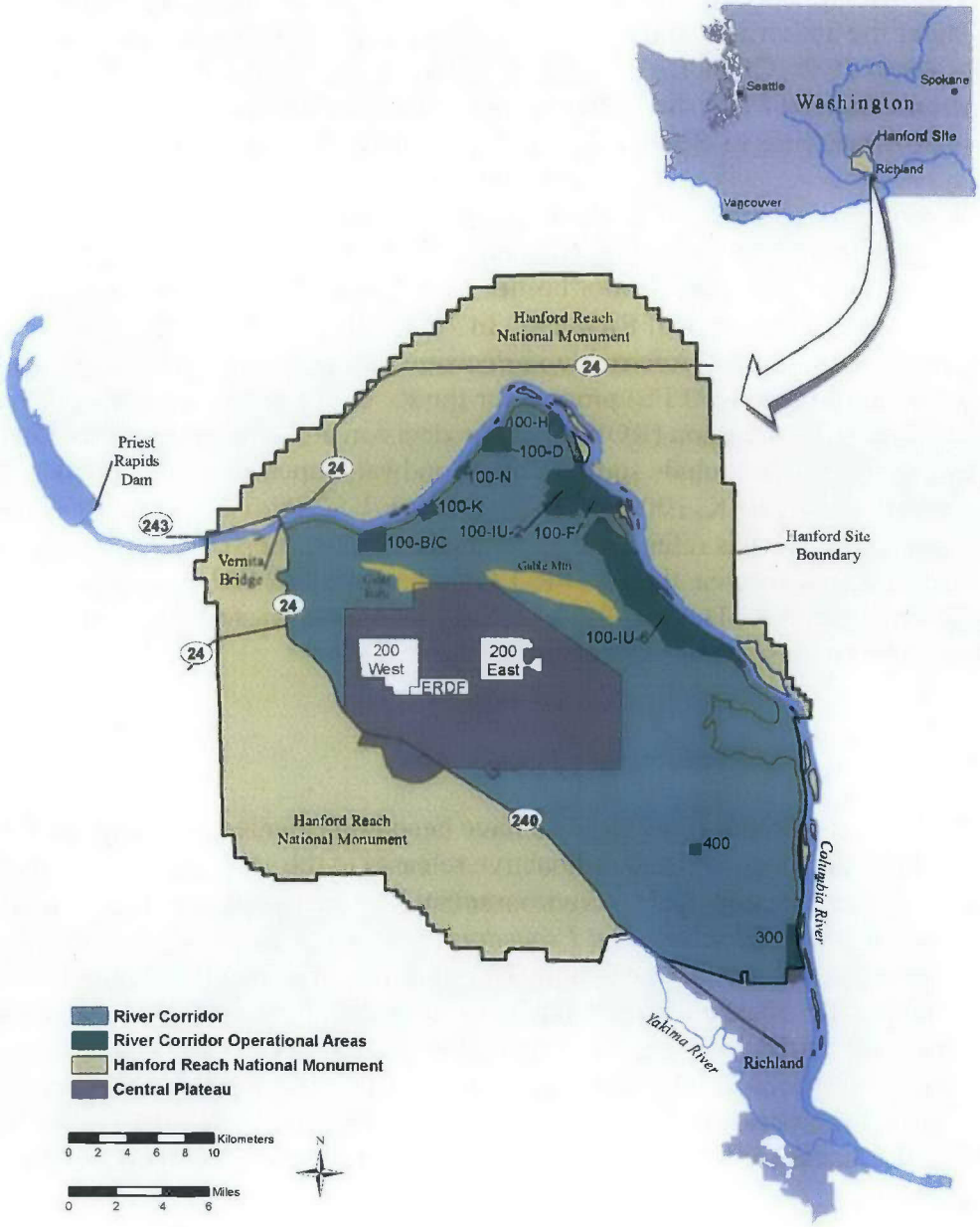
The Hanford Site is a 1,517-km^2 (586-mi^2) federal facility located in southeastern Washington State along the Columbia River (Figure 1-1). From 1943 to 1990, the primary mission of the Hanford Site was the production of nuclear materials for national defense. In 1989, the 100 Area was one of four areas at the Hanford Site placed on the National Priorities List (NPL) under the authority of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), as amended by the *Superfund Amendments and Reauthorization Action of 1986*. In 1990 the mission of the Hanford Site changed from producing nuclear materials to cleaning up residual radioactive and hazardous wastes.

The River Corridor is a sub-region of the Hanford Site that encompasses approximately 570 km^2 (220 mi^2) (Figure 1-1). The Columbia River borders the River Corridor towards the north and east. The remaining areas of the Corridor border the Central Plateau, the Hanford Reach National Monument, and the City of Richland. In 2007, the River Corridor was divided into six geographic areas, commonly referred to as decision areas, to organize the remedial investigation/feasibility study (RI/FS) process for the River Corridor and support development of six final action records of decision (RODs). These decision areas encompass both the 100 Area and 300 Area NPL sites and include source and groundwater operable units (OUs). The six decision areas (100-B/C, 100-K, 100-N, 100-D/H, 100-F/IU-2/IU-6 and 300) are shown in Figure 1-2 along with subareas referred to as segments. The 100-F/IU-2/IU-6 decision area includes the 100-F Reactor Area, the 100-FR-1 OU, the 100-FR-2 OU, and a portion of the 100-FR-3 Groundwater OU. The 100-FR-1 OU and associated waste sites within and outside of this boundary are the focus of this report (Figure 1-3).

1.1 PURPOSE AND SCOPE

Interim remedial actions in the 100-FR-1 OU have been implemented to mitigate potential impacts from hazardous chemical and radioactive releases to the soil column. This report has been prepared in accordance with U.S. Environmental Protection Agency (EPA) guidance in OSWER Directive 9320.2-22, *Close Out Procedures for National Priorities List Sites*, and documents cleanup actions performed on the Hanford Site. The report is a remedial action report that is being prepared to document the remedial actions that were conducted under interim action RODs and is not associated with interim remedial action reports that are generally used to document long-term remedies where it is anticipated that remedial action objectives (RAOs) will be achieved over a long period of time. This report also provides a summary of the background and history of the Hanford Site (inclusive of 100-FR-1 OU), construction information, and performance data.

Figure 1-1. Hanford Site Location Map.



WCH: \\Mcflight01\mcflightdata\HGIS\MapDocuments\SiteWide\Hanfordbasemap_sm.mxd Date: 4/16/2013

Figure 1-2. Decision Area and Segment Location Map.

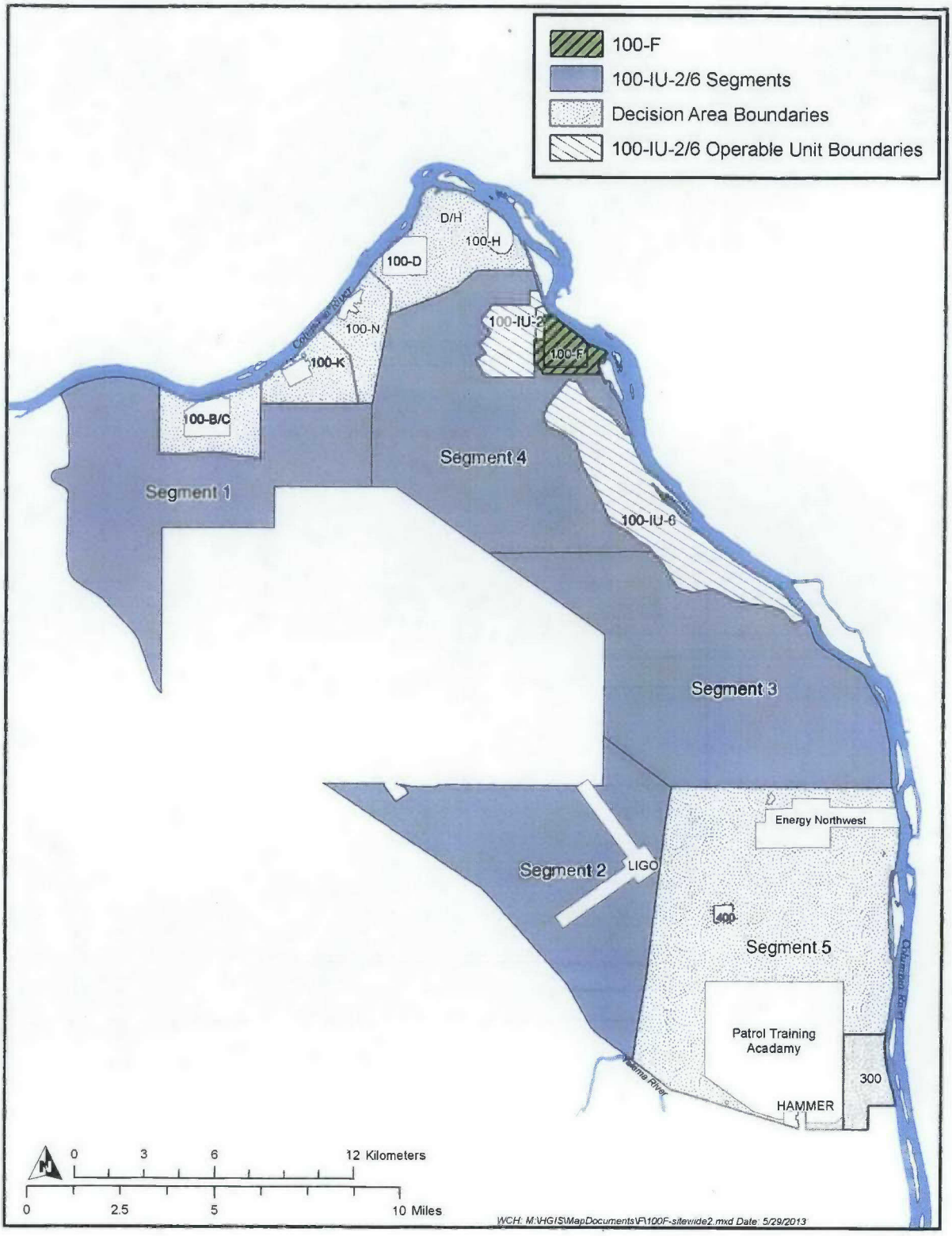
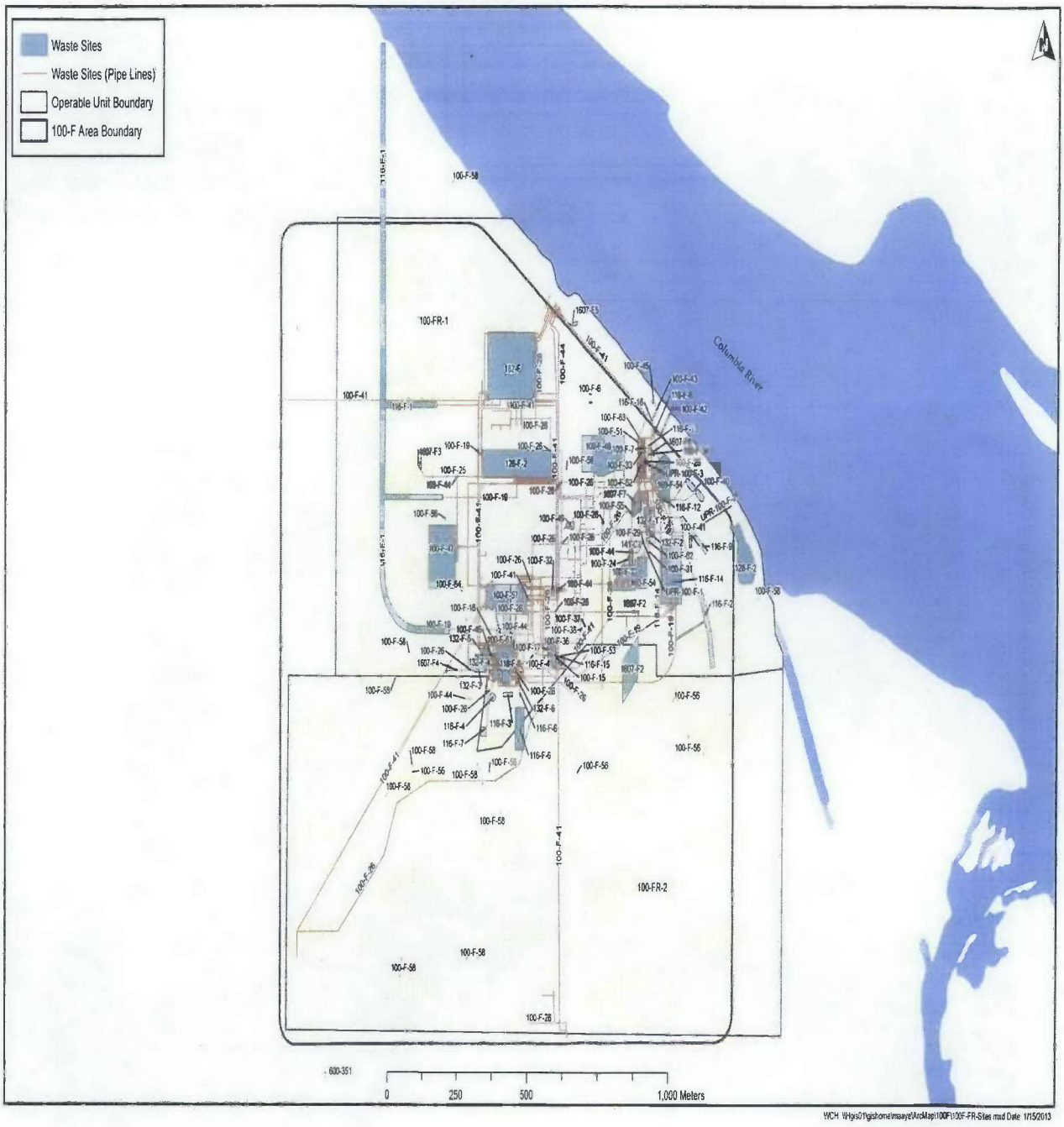


Figure 1-3. 100-FR-1 Operable Unit Waste Site Location Map.



Information provided herein presents input for future decision making and evaluation of technology. This report addresses the 100-FR-1 OU waste sites identified in the following decision documents, where RAOs and remedial action goals (RAGs) have been achieved:

- *Amendment to the 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 1997)

- *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* (Remaining Sites ROD) (EPA 1999)

- *Interim Action 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, Benton County, Washington (100-Area Burial Grounds)* (EPA 2000)

- *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2004)

- *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009)

- *100 Area "Plug-In" and Candidate Waste Sites for Fiscal Year 2010 – Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 1999 Interim Action Record of Decision for the 100 Area* (DOE-RL 2011)

- *Fact Sheet: 100 Area "Plug-In" and Candidate Sites for Fiscal Year 2011-Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 1999 Interim Action Record of Decision for the 100 Area* (DOE-RL 2012)

- *Action Memorandum, USDOE Hanford 100 Area National Priorities List (NPL) 105-F and 105-DR Reactor Buildings and Ancillary Facilities Hanford Site, Benton County, Washington* (EPA et al. 1998).

If new sites are identified, the EPA 2009 Explanation of Significant Difference (ESD) authorized that newly discovered waste sites in OUs included in the Remaining Sites ROD (EPA 1999) that meet the ROD requirements for plug-in or candidate sites should proceed in accordance with the provisions stated in the EPA 2009 ESD without publication of an additional ESD. Additions of plug-in and candidate sites are documented in the Hanford Site Administrative Record and published in a U.S. Department of Energy (DOE), Richland Operations Office (RL)-issued annual fact sheet that identifies the plug-in and candidate waste sites.

1.2 HANFORD SITE 100 AREA

The 100 Area is located along the southern banks of the Columbia River in the northeastern part of the Hanford Site and encompasses an area of approximately 68 km^2 (26 mi^2). The 100-F Area is the closest of the old Hanford Site production reactor areas upstream from the city of Richland. The 100-F Area is the farthest downstream reactor area on the Hanford Site. The 105-F Reactor was the third of the three original graphite-moderated plutonium production reactors built at the Hanford Site and operated from 1945 to 1965. The Experimental Animal Farm (EAF) operated adjacent to the 100-F Reactor site from 1945 to 1976 using animals to study the potential effects of occupational exposure of humans to ionizing radiation (DOE/RL-93-82, *Limited Field Investigation Report for the 100-FR-1 Operable Unit*).

Reactor and EAF operations in the 100-F Area resulted in the discharge of contaminated cooling water (process effluent), other liquids, and solid wastes to the soil column, groundwater, and Columbia River. The contaminated soil areas impacted by the discharges were identified as "waste sites" and grouped into "operable units" for the purposes of developing and implementing remedial actions under CERCLA.

The 100-FR-1 OU is one of three OUs associated with the 100-F Area. The 100-FR-1 and 100-FR-2 OUs are source operable units that include liquid effluent disposal sites, solid waste burial grounds, and the associated vadose zone. The 100-FR-3 OU includes the groundwater beneath the source OUs. Only the 100-FR-1 source OU remedial actions are addressed in this report.

1.2.1 100-FR-1 Operable Unit

The 100-FR-1 OU comprises the northern half of the 100-F Area and is located immediately adjacent to the Columbia River shoreline. The 100-FR-1 OU contains waste units associated with the original plant facilities constructed to support 105-F Reactor operations, cooling water retention basin systems, and biological laboratories used for studying the effects of radiation on plants and animals.

1.2.2 100-FR-2 and 100-FR-3 Operable Units

The 100-FR-2 source OU contains primarily burial grounds that received solid waste from the 105-F Reactor and from the EAF. Other waste sites in the 100-FR-2 OU include septic tanks, burn pits, a bottle disposal site, glass dumps, and experimental gardens (DOE/RL-90-30, *Remedial Investigation/Feasibility Study Work Plan for the 100-FR-1 Operable Unit, Hanford Site, Richland, Washington*).

The 100-FR-3 OU consists of contaminated groundwater beneath the 100-FR-1 and 100-FR-2 OUs as well as a large section of the 600 Area north of Gable Mountain. No active remediation of 100-FR-3 OU groundwater is under way. Previous and current groundwater monitoring are documented in annual site-wide reports, the most recent being DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*.

1.3 ENVIRONMENTAL SETTING

The Hanford Site is located within the semiarid Pasco Basin in the northern portion of the Columbia Plateau. Average annual precipitation on the Hanford Site is 16 cm (6.3 in.). PNL-10285, *Estimated Recharge Rates at the Hanford Site*, estimated 0.26 to 1.73 cm/yr (0.1 to 0.68 in./yr) recharge in the 100 Area. Bedrock beneath the site is basalt of the Columbia River Basalt Group. The top of the basalt in the 100 Areas ranges in elevation from 46 m (151 ft) above sea level near the 100-H Area to 64 m (210 ft) below sea level near the 100-B/C Area (the 100-B/C Area is approximately 140 to 150 m [459 to 492 ft] above sea level).

The Ringold Formation and Hanford formation (informal designation) cover the basalt throughout the 100 Area. The Ringold Formation is an interstratified sequence of unconsolidated clay, silt, sand, and gravel-to-cobble gravel deposited by the ancestral Columbia River. The Hanford formation consists of uncemented gravels, sands, and silts deposited by Pleistocene cataclysmic flood waters.

The direction of groundwater flow beneath the 100-F Area varies with the Columbia River stage. Under moderate river flow conditions the groundwater flow is toward the river in an east-northeast direction in the western portion of the 100-F Area and towards the southeast in the eastern part (DOE/RL-2011-118).

2.0 100-F AREA BACKGROUND

In anticipation of CERCLA NPL listing of the Hanford Site's 100 Areas in 1989, the EPA, Washington State Department of Ecology (Ecology), and DOE entered into the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989). The Tri-Party Agreement is a legally-binding agreement among the EPA, DOE, and Ecology (Tri-Parties) for the purposes of achieving compliance with the remedial action provisions of CERCLA and with treatment, storage, and disposal unit regulation and corrective action provisions of the *Resource Conservation and Recovery Act of 1976* (RCRA).

2.1 INTEGRATION WITH CERCLA CLEANUP ACTIONS

Source OU cleanup actions in the River Corridor are performed in accordance with several interim action RODs that provide a regulatory framework, establish cleanup objectives, and identify selected remedies. New waste sites identified and accepted in the Waste Information Data System (WIDS) as waste sites by the Tri-Parties may be added to the Remaining Sites ROD (EPA 1999) as "plug-in" sites per the provisions of the 2009 ESD if they meet the criteria for ROD sites for subsequent characterization and determination for additional remedial action.

2.2 REMEDIAL ACTION DECISIONS

In order to expedite the decision-making process to allow cleanup to begin as soon as possible, in 1991 the Tri-Parties adopted a "bias-for-action" approach for the remediation of the Hanford Site called the *Hanford Past-Practice Strategy* (DOE/RL-91-40). The "Past Practice Strategy" streamlined the RI/FS process for contaminated waste sites to allow remediation to begin earlier than is typically allowed under the traditional CERCLA process. The decision documents authorizing remediation for waste sites in the 100-FR-1 OU include the following:

- *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1 and 100-HR-1 Operable Units, Hanford Site, Benton County, Washington* (Interim Action ROD Amendment) (EPA 1997). This interim action ROD amendment increases the scope of the *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) by adding waste sites that received similar waste discharges. This interim action ROD amendment also eliminated soil washing as a possible treatment step for 100 Area liquid effluent disposal sites and provides guidance for revegetation in accordance with DOE/RL-96-19, *Mitigation Action Plan for Liquid Waste Sites in the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units.*

- *Action Memorandum for the 105-F and 105-DR Reactor Buildings and Ancillary Facilities, Hanford Site, Benton County, Washington* (EPA et al. 1998). This action memorandum documents the non-time critical removal action for the 105-F and 105-DR Reactor Buildings and Ancillary Facilities.

- *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* (Remaining Sites ROD) (EPA 1999). This interim action ROD directs remedial action for waste sites that have been termed "100 Area Remaining Sites for Remove, Treat, and Dispose" because of indicated adverse impacts to human health and the environment. In addition, this interim action ROD identifies "Candidate 100 Area Remaining Sites for Plug-in of Remove, Treat and Dispose" because information was insufficient to determine if remedial action is needed. This interim action ROD also directs remedial action at proximity, analogous, and discovery waste sites that can be shown to plug in to the "Remove, Treat, and Dispose" remedy.

- *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, 100-KR-2, Operable Units (100 Area Burial Grounds), Hanford Site, Benton County, Washington* (Burial Grounds ROD) (EPA 2000). This interim action ROD defines remedial action for areas used for near-surface disposal of solid wastes containing hazardous substances. The selected remedy includes removing contaminated soils, structures, and debris with disposal at the Environmental Restoration Disposal Facility (ERDF).

- *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Benton County, Washington* (EPA 2004). Since the issuance of the Remaining Sites ROD in 1999, ongoing remedial activities in the 100 Areas have identified 28 newly discovered waste sites, of which 4 were assigned to the 100-FR-1 OU. These sites were added using the "plug-in" approach to the 100 Area remove, treat, and dispose (RTD) remedy.

- *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009). This ESD added 99 waste sites that were "plugged in" and remediated in accordance with the Remaining Sites ROD or that have been remediated in accordance with the plug-in approach without prior issuance of an ESD. Also, this ESD added 87 newly discovered waste sites that were candidates for remediation, of which only 2 were assigned to the 100-FR-1 OU.

- *100 Area "Plug-In" and Candidate Waste Sites for Fiscal Year 2010 – Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 1999 Interim Action Record of Decision for the 100 Area* (DOE-RL 2011). The 2009 ESD authorized that additions of plug-in and candidate sites will be documented in the Administrative Record and a fact sheet will be published by DOE annually identifying the plug-in and candidate sites that have been added. This fact sheet added 43 waste sites, 5 that were assigned to the 100-FR-1 OU, that were remediated in accordance with the Remaining Sites ROD or that have been remediated in accordance with the plug-in approach without prior issuance of an ESD. In addition, the fact sheet lists 20 candidate sites that require further evaluation.

- *Fact Sheet: 100 Area "Plug-In" and Candidate Sites for Fiscal Year 2011-Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 1999 Interim Action*

Record of Decision for the 100 Area (DOE-RL 2012). This fact sheet added seven waste sites that were remediated in accordance with the Remaining Sites ROD or that have been remediated in accordance with the plug-in approach without prior issuance of an ESD. Two of these waste sites were assigned to the 100-FR-1 OU and one was assigned to the 100-FR-2 OU. The one 100-FR-2 waste site (600-351) is included as a part of this report. In addition, the fact sheet lists 17 candidate sites that require further evaluation.

The decision documents described above also direct remedial action at waste sites within other 100 Areas. However, this report only documents remedial action completed at waste sites in the 100-FR-1 OU, with the exception of the 600-351 waste site located in the 100-FR-2 OU.

Waste sites in the 100-FR-1 OU have a site classification/reclassification status of "Accepted," "Not Accepted," "Rejected," "No Action," and "Interim Closed Out." These statuses provide an indicator of the amount of remedial action implemented or required. For example, a classification of "Not Accepted" indicates that an assessment of the waste site was conducted and a determination was made that the site did not meet the criteria of a waste management unit. Candidate sites confirmed not to exceed the RAGs for any constituents are reclassified as "No Action" or "Rejected" (based on quantitative or qualitative data, respectively) per the waste site reclassification guidelines identified in RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures,* Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System"). When a waste site meets the RAGs and RAOs specified in an interim action ROD following remedial actions, the site is then reclassified as "Interim Closed Out." The use of the term "Closed Out" in this context referring to individual waste sites should not be confused with the "close out reports" used for deleting NPL sites (OSWER Directive 9320.2-22).

Regulator approval of site status is documented on a waste site reclassification form (WSRF), which is accompanied by a regulator-reviewed site-specific informal report discussing the reasons and justification for reclassification. The WIDS database serves as formal notification to the public that the site is no longer a candidate for remedial action and does not exceed RAGs and RAOs established in the Remaining Sites ROD (EPA 1999).

A total of 88 waste sites in the 100-FR-1 OU are specifically identified in the scope of this report and are listed in Table 2-1. In addition, one 100-FR-2 OU waste site (600-351) has also been included in this report because it had subsequently been identified after the *100-FR-2 Operable Unit Interim Remedial Action Report* (DOE/RL-2009-63) had been issued. The locations and classification/reclassification status of all waste sites covered by this report are shown in Figure 2-1.

Two accepted waste sites (i.e., remedial action has not been implemented) and a portion of a third waste site remain in the 100-FR-1 OU. These waste sites are associated with either the 105-F Reactor, the river pipelines, or the river shoreline and include the following: 118-F-8:2, 105-F Reactor Core and ISS Project; 100-F-39, 100-F River Effluent Pipelines; and 100-F-59, Riparian Area Contamination originating from 128-F-2. These sites will be addressed in the final action ROD.

Table 2-1. 100-FR-1 Operable Unit Waste Sites. (3 Pages)

WIDS Site Code/Name
100-F-4, 108-F Building 12-inch French Drain
100-F-5, 1717-F Building Drywell
100-F-6, 1716 FA Fuel Tank and Pump
100-F-7, Underground Fuel Tank – 1705-F Building
100-F-8, French Drains Near 105-F Gate
100-F-9, French Drain at East End of 105-F Storage Room (Northeast Corner)
100-F-10, French Drain at East End of 105-F Storage Room (Southeast Corner)
100-F-11, 108-F Building 18-inch French Drain
100-F-12, 36-inch French Drain at 105-F Building
100-F-15, 108-F Building Ventilation French Drain, Undocumented
100-F-16, 108-F Building 30-inch French Drain, Undocumented
100-F-17, 108-F Chemical Pump House, Chemical Storage Tanks at 108-F, Chemicals Used at 108-F Building
100-F-18, 105-F Condensate Drain Field, Underground Tank at 105-F Building, Undocumented
100-F-19, 100-F Reactor Cooling Water Effluent Underground Pipelines, Contaminated Underground Lines, Effluent Water System, 1904-F Process Sewer
100-F-21, Grounds Surrounding Deactivated Areas, Exclusion Area
100-F-23, 141-C Drywell
100-F-24, 145-F Drywell
100-F-25, 146-FR Drywells
100-F-26, 100-F Water Treatment Facility Underground Pipelines
100-F-29, 100-F Experimental Animal Farm Process Sewer Pipelines
100-F-30, 144-F Drywell
100-F-31, 144-F Sanitary Sewer System
100-F-32, 1717-F Underground Fuel Oil Tank
100-F-33, 146-F Aquatic Biology Fish Ponds
100-F-34, Biology Facility French Drain
100-F-36, 108-F Chemical Pump House, 108-F Biological Laboratory
100-F-37, French Drain Discovered Near Hydrant F-2
100-F-38, Yellow Stained Soil Near Hydrant F-2
100-F-40, Animal Farm Surface Impoundment
100-F-41, 100-F Service Water Pipelines, 100-F Clean Water Pipelines
100-F-42, 1904-F Spillway, 100-F-39:1 Flume
100-F-43, Spillway for PNL Outfall, 116-F-16 Spillway, 100-F-39:2
100-F-44, 100-F Miscellaneous Pipelines
100-F-45, Buried River Effluent Pipelines
100-F-46, 119-F Stack Sampling French Drain

Table 2-1. 100-FR-1 Operable Unit Waste Sites. (3 Pages)

WIDS Site Code/Name
100-F-47, 151-F Substation
100-F-48, 184-F Coal Pit Debris
100-F-49, 1716-F Maintenance Garage Lubrication Pit
100-F-51, 146-F Fish Laboratory Soil
100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil
100-F-53, 108-F Septic System
100-F-54, 100-F Animal Farm Pastures
100-F-55, 1607-F7 Contaminated Ash Layer
100-F-56, 100-F Surface Debris/Stains
100-F-57, 190-F Process Water Pump House Debris
100-F-58, 100-F Surface Debris Potentially Containing Asbestos
100-F-60, 100F Cast Iron Pipe
100-F-61, Stained Soil near 100-F-12
100-F-62, Animal Farm Septic Lines
100-F-63, Animal Farm Radioactive Effluent Lines
100-F-64, Yellow and Red Stained Area Along Railroad Tracks Near the 1713-FA
100-F-65, Green Stained Area Along Railroad Tracks Immediately West of 190-F
116-F-1, Lewis Canal
116-F-2, 107-F Liquid Waste Disposal Trench
116-F-3, 105-F Storage Basin Trench
116-F-4, 105-F Pluto Crib
116-F-5, Ball Washer Crib
116-F-6, 1608-F Liquid Waste Disposal Trench, 105-F Cooling Water Trench
116-F-7, 117-F Crib and Pipeline, 116-F-7 Seal Pit Water Crib and Pipeline
116-F-8, 1904-F Outfall Structure
116-F-9, Animal Waste Leaching Trench
116-F-10, 105-F Dummy Decontamination French Drain, 116-F-8, 105 Dummy/Perf Decontamination Crib, Perf Decontamination Drain
116-F-11, 105-F Cushion Corridor French Drain
116-F-12, 148-F French Drain
116-F-13, 1705-F Experimental Garden French Drain
116-F-14, 107-F Retention Basin, 107-F
116-F-15, 108-F Radiation Crib
116-F-16, PNL Outfall

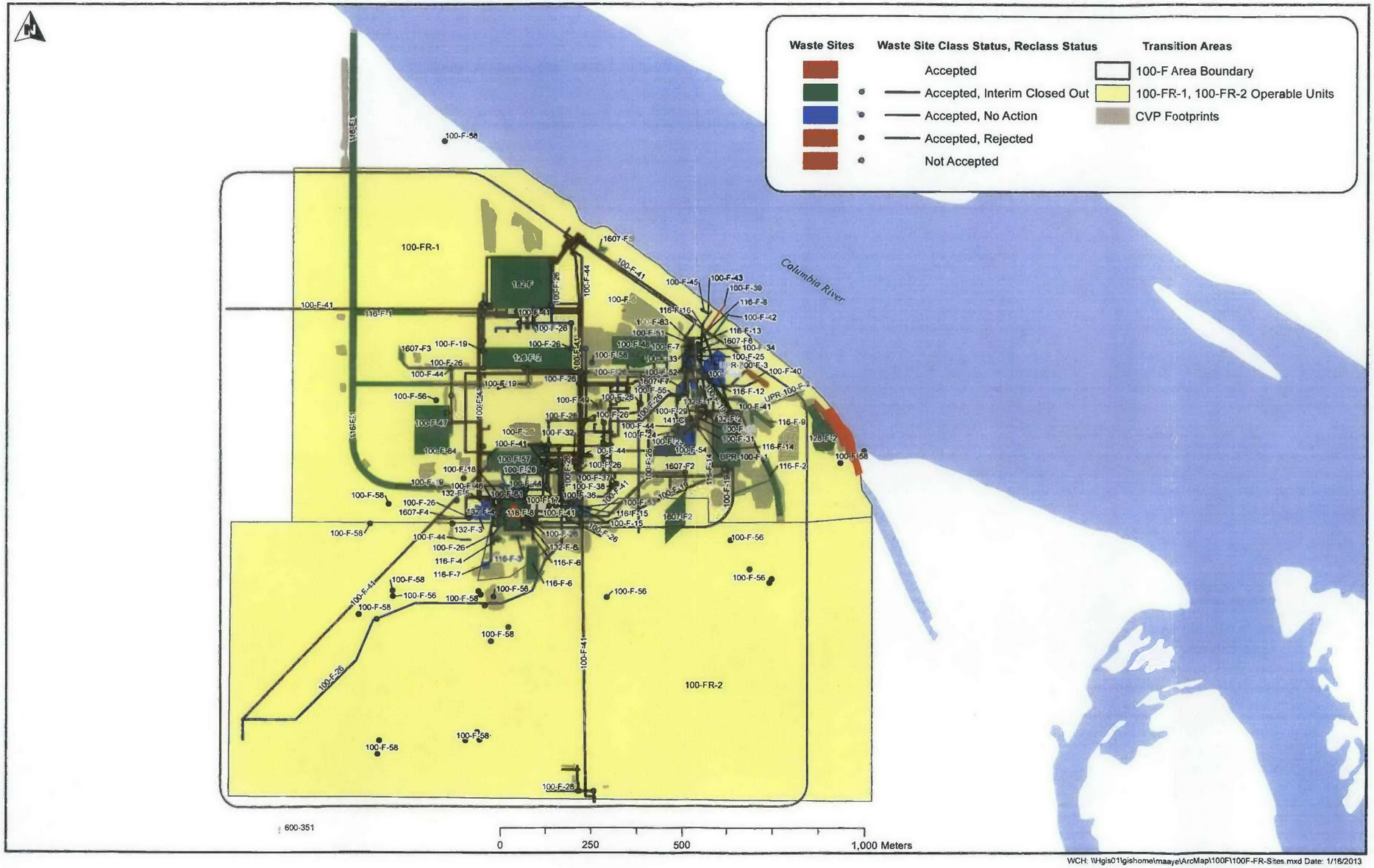
Table 2-1. 100-FR-1 Operable Unit Waste Sites. (3 Pages)

WIDS Site Code/Name
118-F-8, 105-F Reactor Building [a]
126-F-2, 183-F Clearwells
128-F-2, 100-F Burning Pit
132-F-1, 132-F-1 Chronic Feeding Barn, 141-F, 141-F Sheep Barn
132-F-2, Inhalation Laboratory, 144-F, 144-FB
132-F-3, 115-F Gas Recirculating Facility
132-F-4, 116-F Reactor Stack, 116-F Reactor Exhaust Stack, 132-F-4 Reactor Stack Demolition Site
132-F-5, 117-F Filter Building
132-F-6, 1608-F Waste Water Pumping Station, 1608-F Effluent Pumping Station, 132-F-6 Lift Station
141-C, 141-C Animal Barn, Large Animal Barn & Biology Laboratory, Hog Barn
1607-F2, 1607-F2 Septic Tank, 124-F-2, 1607-F2 Sanitary Sewer System
1607-F3, 1607-F3 Septic Tank, 124-F-3, 1607-F3 Sanitary Sewer System
1607-F4, 1607-F4 Septic Tank, 124-F-4, 1607-F4 Sanitary Sewer System
1607-F5, 1607-F5 Septic Tank, 124-F-5, 1607-F5 Sanitary Sewer System
1607-F6, 1607-F6 Septic Tank, 124-F-6, 1607-F6 Sanitary Sewer System
1607-F7, 141-M Building Septic Tank, 124-F-7
182-F, 182-F Reservoir
600-351, Stained Areas Outside of 100-F Area [b]
UPR-100-F-1, 141 Building Sewer Line Spill, UN-100-F-1, 141-C to 141-M Sewer Line Leak
UPR-100-F-2, Basin Leak Ditch, 107-F Basin Leak Ditch, 100-F-3
UPR-100-F-3, Mercury Spill

[a] Includes only 118-F-8:1, 118-F-8:3, and 118-F-8:4.
[b] Identified as a 100-FR-2 OU site.

OU = operable unit
PNNL = Pacific Northwest National Laboratory
WIDS = Waste Information Data System

Figure 2-1. 100-FR-1 Operable Unit Waste Sites with Site Status.



In parallel with continuing the cleanup actions in other parts of the River Corridor as outlined in the existing interim action RODs, the Tri-Parties are conducting the RI/FS process to develop final action cleanup decisions for the River Corridor.

2.3 EXPOSURE AND LAND-USE ASSUMPTIONS

The reasonably anticipated land use is important in CERCLA remedial actions in determining the appropriate extent of remediation. Future land use affects the types and frequency of exposures to residual contamination for both human and ecological receptors; thereby, influencing the amount of cleanup needed. Decisions on future land use at the Hanford Site had not been made at the time most of the interim action RODs for the 100 Area were issued. In the absence of such decisions, an assumption of "unrestricted use" was used for the 100 Area to select a cleanup remedy and establish cleanup goals, such that future use of the land would not be precluded by contamination left from past Hanford Site operations. The 100 Area cleanup scenario to attain unrestricted use was subsequently confirmed to be not inconsistent with the land-use plan developed in the "Hanford Comprehensive Land-Use Plan Environmental Impact Statement, Hanford Site, Richland, Washington; Record of Decision" (64 *Federal Register* 61615). Unrestricted surface use was represented by a hypothetical rural-residential scenario. The interim action RODs stated that remediation to this scenario would also be protective of ecological receptors in the 100 Area.

Under the 100 Area unrestricted surface use scenario represented by an individual in a rural-residential setting, a human living in the remediated areas is conservatively assumed to consume crops raised in a backyard garden, meat and milk from locally raised livestock, and meat from game animals and fish. The following exposure pathways are used to consider estimated doses from radionuclides in soil: inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure. Unrestricted land-use cleanup levels for chemicals or nonradionuclides are based on *Washington Administrative Code* (WAC) 173-340-740(3). The exposure pathway for residual nonradiological contamination is from ingestion of contaminated soil.

The final ROD for the 100-FR-1 OU will incorporate prevailing exposure and land-use assumptions through an RI/FS. The RI/FS will incorporate applicable or relevant and appropriate requirements contained in prevailing guidance and regulations to support final remedial action decisions that are protective of human health and the environment. As a result, the assumptions that serve as the basis for establishing cleanup goals in the final ROD may be different from those reflected in the interim action RODs. Section 5.2 provides additional discussion on the final remedial action decisions for the River Corridor OUs. Once final RAOs have been met for the OU, a final remedial action report will be prepared.

2.4 REMEDIAL ACTION REQUIREMENTS

Implementation of remedial actions at the 100-FR-1 OU waste sites in accordance with interim action RODs required implementation of the selected cleanup remedy to address actual or threatened releases.

The major components of the selected remedy, RTD, include the following:

- Planning and implementation of the remedial action according to an approved remedial design report/remedial action work plan (RDR/RAWP) document
- Stockpiling uncontaminated overburden and use for backfilling excavations when feasible
- Removal of contaminated soil, structures, and associated debris
- Disposing of contaminated materials at the Hanford Site's ERDF; the Waste Isolation Pilot Plant in Carlsbad, New Mexico; or other disposal facilities approved in advance by the EPA
- Treatment, as necessary, to meet waste acceptance criteria at an acceptable disposal facility
- Recontouring and backfilling of excavated areas and restoring viable habitat by revegetating the impacted area
- Identifying institutional controls to prevent exposure to contamination by limiting land or resource uses if needed
- Demonstrating that residual contamination concentrations are protective of humans and the environment.

As outlined in the 100 Area interim action RODs, RAOs are met by implementing the selected remedy with an "observational approach." The observational approach consists of two main steps: compilation of available data and the "characterize-and-remediate-in-one-step" methodology. The first step relies on recorded information from historical process operations and information from investigations addressing the nature and extent of contamination. This initial step of characterization is a prerequisite task to field remediation and is used to develop an initial understanding of site conditions. The second step of the observational approach proceeds with characterization (i.e., sampling and analysis) and RTD as needed. The candidate waste sites identified in the Remaining Sites ROD do not proceed to RTD if confirmatory sampling for pre-remediation characterization demonstrates that the waste site conditions meet RAGs.

The RTD remedy for the waste sites in the 100-FR-1 OU involved removing clean and contaminated soils, debris, and anomalous waste present within waste site boundaries. The materials exposed during excavation are monitored for radiological and hazardous chemical constituents as defined in DOE/RL-96-22, *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP), and DOE/RL-2001-35, *100 Area Burial Grounds Remedial Action*

Sampling and Analysis Plan (100 Area Burial Grounds SAP). During remediation of known dump sites or burial grounds, extra measures were taken for materials to be sorted for waste disposition. During excavation, soils are monitored for both radiological and chemical constituents. Activities are guided during excavation from data obtained from in situ analytical systems or in-process sampling using quick-turnaround laboratory analyses working concurrently with excavation.

Upon completion of remediation at each waste site, cleanup verification sampling and analyses are performed to verify attainment of cleanup criteria for all contaminants of concern (COCs) and contaminants of potential concern (COPCs). If analytical results indicate that cleanup criteria have not been achieved, then excavation will resume with appropriate analyses as guidance. Remediation proceeds until it can be demonstrated through a combination of field screening, in-process sampling, and verification sampling that cleanup goals have been achieved.

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 for cleanup verification at radioactive liquid effluent sites and remaining sites that required remedial action.

Specific RAOs associated with the selected remedy and the method for achieving the objectives through 100 Area remedial actions are discussed in DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP), and summarized in Table 2-2.

2.5 REMEDIAL DESIGN SUMMARY

The general design and approach for remediation of the 100-FR-1 OU waste sites is documented in the 100 Area RDR/RAWP (DOE/RL-96-17). The 100 Area RDR/RAWP describes the approach employed to remediate the 100-FR-1 OU and other waste sites. The 100 Area RDR/RAWP was prepared as specified in the 100 Area interim action RODs. The 118-F-8 waste site was remediated in accordance with DOE/RL-98-37, *Removal Action Work Plan for 105-DR and 105-F Building Interim Safe Storage Projects and Ancillary Facilities.*

Table 2-2. 100 Area Operable Unit Cleanup Objectives.

Remedial Action Objective	100 Area Compliance Methods
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.	Achieved through excavation to state of Washington WAC 173-340, "Model Toxics Control Act – Cleanup" levels for organic and inorganic chemical constituents in soil to support unrestricted (residential) use. Achieve human health total radiological dose standards of less than 15 mrem/yr above background for radionuclides in soil.
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.	Protection will be such that contaminant levels in soil after remediation do not result in an adverse impact to groundwater that could exceed any nonzero maximum contaminant level goals under the *Safe Drinking Water Act of 1974* or Method B cleanup levels under WAC 173-340, "Model Toxics Control Act - Cleanup." Protection will be such that contaminant levels in the soil after remediation do not result in an impact to groundwater and the Columbia River that could exceed the ambient water quality criteria under the *Clean Water Act of 1977* for protection of fish or Method B cleanup levels under WAC 173-340, "Model Toxics Control Act – Cleanup." Because there are no ambient water quality criteria for radionuclides, maximum contaminant levels from national primary drinking water standards were 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 subjected to any additional adverse risks.

WAC = *Washington Administrative Code*

3.0 CHRONOLOGY OF EVENTS

A chronology of major events associated with remediation of interim remedial action for the sites within the 100-FR-1 OU is presented in Table 3-1. A summary of associated events by waste site is depicted in Figure 3-1.

Table 3-1. 100-FR-1 Operable Unit Chronology. (5 Pages)

Year	Event
1993	*100 Area Excavation Treatability Study* (DOE/RL-94-16). *Approximately 700 metric tons (772 US tons) removed from the 116-F-4 Pluto Crib and disposed of at ERDF.*
1994	*100-F Reactor Site Technical Baseline Report Including Operable Units 100-FR-1 and 100-FR-2* (BHI-00031).
1995	*100 Area Source Operable Unit Focused Feasibility Study* (DOE/RL-94-61). *100-FR-1 Limited Field Investigation Report for the 100-FR-1 Operable Unit* (DOE/RL-93-82).
1996	*Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 0).
1997	*100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22, Rev. 0). *Amendment to the 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 1997).
1998	*Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 1). *100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22, Rev. 1). *Tri-Party Agreement Handbook Management Procedures* (RL-TPA-90-0001, Rev. 0)
1999	*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-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County Washington* (EPA 1999).
2000	*100 Area Burial Grounds Focused Feasibility Study Report* (DOE/RL-98-18). *100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22, Rev. 2). *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 2). *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, and 100-KR-2 (100 Area Burial Grounds) Operable Units, Hanford Site, Benton County, Washington* (EPA 2000).
2001	*100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (DOE/RL-2001-35). *100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22, Rev. 3). *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 3). RAGs and RAOs achieved at waste sites:: 116-F-5 August 116-F-4 November 1607-F6 November

Table 3-1. 100-FR-1 Operable Unit Chronology. (5 Pages)

Year	Event
2002	*Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 4). RAGs and RAOs achieved at waste sites: UPR-100-F-2 April 100-F-19:1 May 100-F-19:3 May 100-F-34 May 116-F-12 May 116-F-14 July 100-F-4 July 100-F-11 July 100-F-15 July 100-F-16 July 116-F-9 October
2003	RAGs and RAOs achieved at waste sites: 1607-F2 March 116-F-2 March 116-F-10 June 116-F-3 June 100-F-24 August 100-F-23 August 100-F-25 August UPR-100-F-3 August 100-F-19:2 September 100-F-29 September 116-F-11 September UPR-100-F-1 September 116-F-1 November 116-F-6 November 132-F-4:1 December 132-F-5 December 132-F-6 December 132-F-3 December

Table 3-1. 100-FR-1 Operable Unit Chronology. (5 Pages)

Year	Event
2004	*Explanation of Significant Difference for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Benton County, Washington* (EPA 2004). RAGs and RAOs achieved at waste sites:: 100-F-10 May 118-F-8:1 May 118-F-8:3 May 100-F-37 August 100-F-26:3 December 100-F-26:6 December
2005	*100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22, Rev. 4). *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 5). RAGs and RAOs achieved at waste sites: 100-F-26:5 July 100-F-7 February 100-F-9 February 100-F-12 February 100-F-18 February 116-F-7:1 February 100-F-26:2 May 100-F-26:11 May 100-F-26:1 July 100-F-26:5 July 182-F September 116-F-7:2 October 132-F-4:2 November
2006	RAGs and RAOs achieved at waste sites: 100-F-38 March 126-F-2 May 141-C May 132-F-1 August 100-F-31 August 100-F-33 August 100-F-43 September 116-F-16 September 1607-F5 September 100-F-42 September 116-F-8 September 1607-F7 October

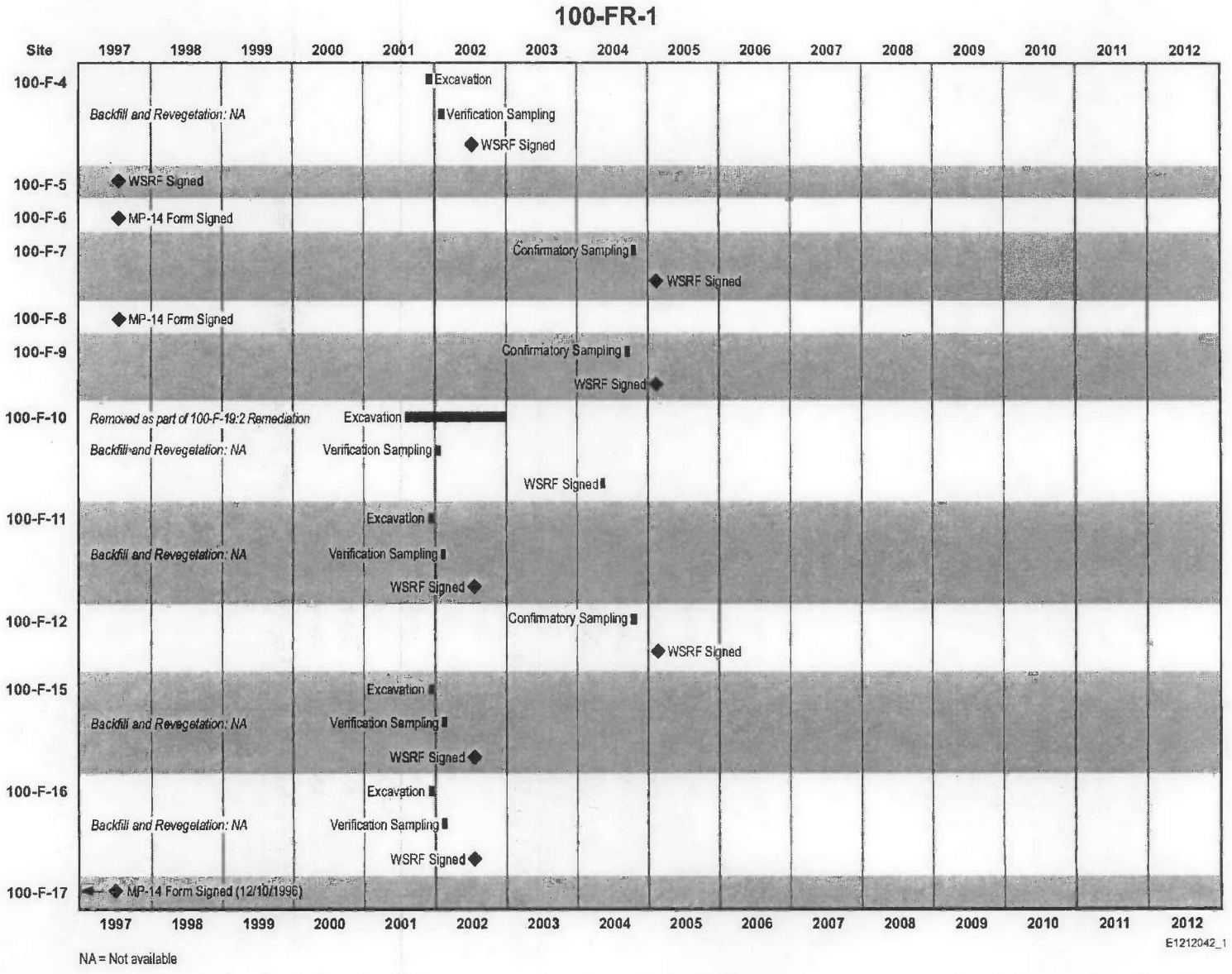
Table 3-1. 100-FR-1 Operable Unit Chronology. (5 Pages)

Year	Event
2007	*Explanation of Significant Difference for the Interim Action 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)* (EPA 2007). RAGs and RAOs achieved at waste sites: 100-F-44:1 April 1607-F3 April 100-F-36 May 116-F-15 May 100-F-26:10 December 1607-F4 December
2008	RAGs and RAOs achieved at waste sites in calendar year 2008: 100-F-26:14 February 100-F-26:13 March 118-F-8:4 March 100-F-26:15 March 100-F-26:8 March 100-F-54 April 100-F-26:12 April 100-F-44:2 May 100-F-52 June 100-F-46 August 100-F-44:4 September 100-F-26:9 October 128-F-2 December
2009	*100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22, Rev. 5). *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE/RL-96-17, Rev. 6). *Explanation of Significant Difference for the 100 Area Remaining Site Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009). RAGs and RAOs achieved at waste sites: 100-F-44:5 April 100-F-53:13 June
2010	*Fact Sheet: Annual Listing of Waste Sites Plugged into the Remove, Treat and Dispose Remedy in the 1999 Interim Action Record of Decision for the 100 Area* (DOE-RL 2011).

Table 3-1. 100-FR-1 Operable Unit Chronology. (5 Pages)

Year	Event
2011	RAGs and RAOs achieved at waste sites: 100-F-60 March 100-F-58 May 100-F-56:2 June 100-F-51 August 100-F-63 August 100-F-45 August 100-F-44:9 August 100-F-49 September 100-F-47 September 600-351 September 100-F-44:8 September 100-F-26:4 September 100-F-26:7 October 100-F-48 December 100-F-55 December 100-F-56:1 December 100-F-61 December 100-F-62 December
2012	RAGs and RAOs achieved at waste sites: 100-F-64 March 100-F-57:1 April 100-F-57:2 August 100-F-65 August 100-F-56:1 December 100-F-55 December Interim remedial action complete in the 100-FR-1 Operable Unit in December

Figure 3-1. Summary of Major 100-FR-1 Operable Unit Events. (12 Pages)



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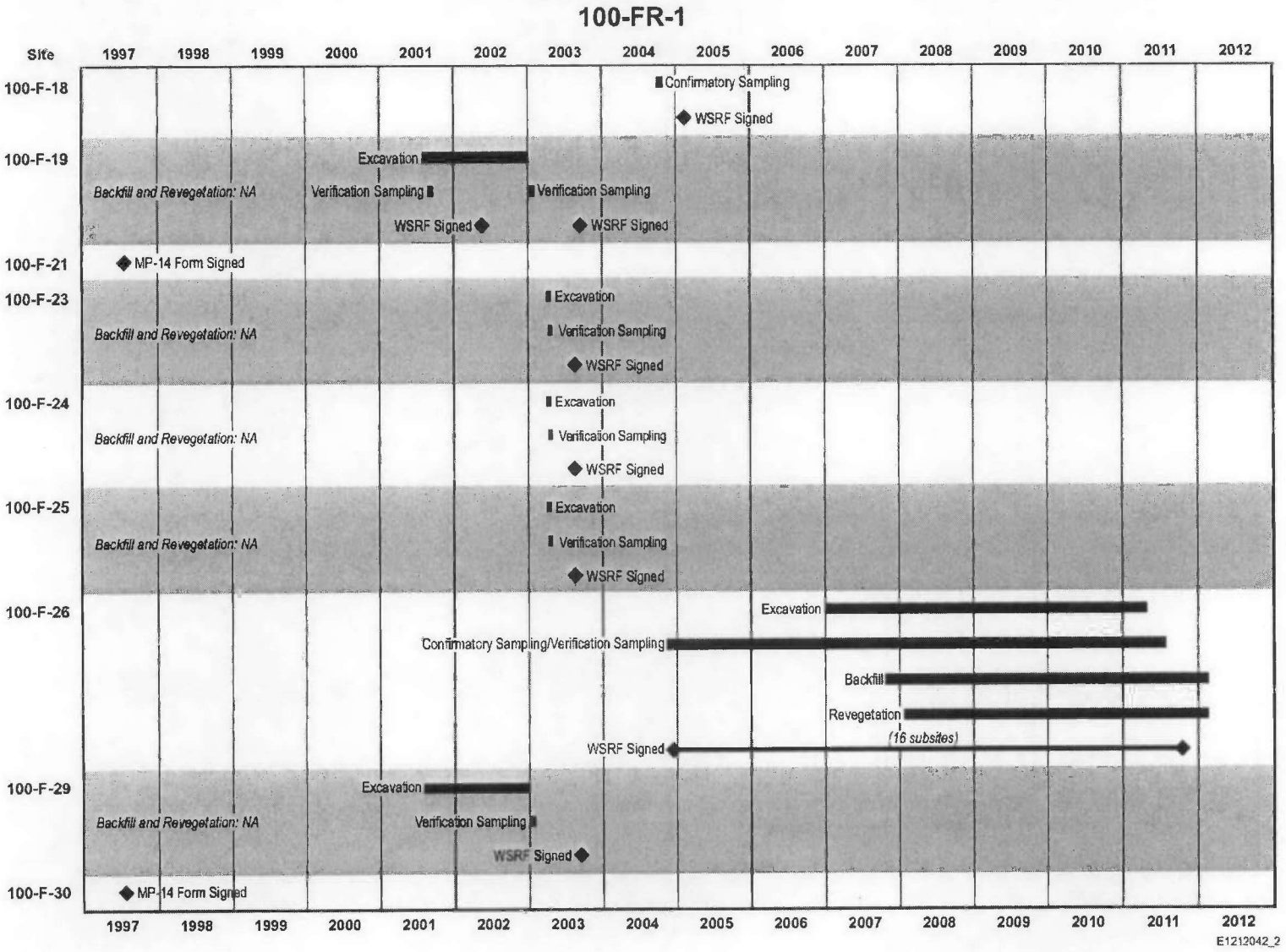
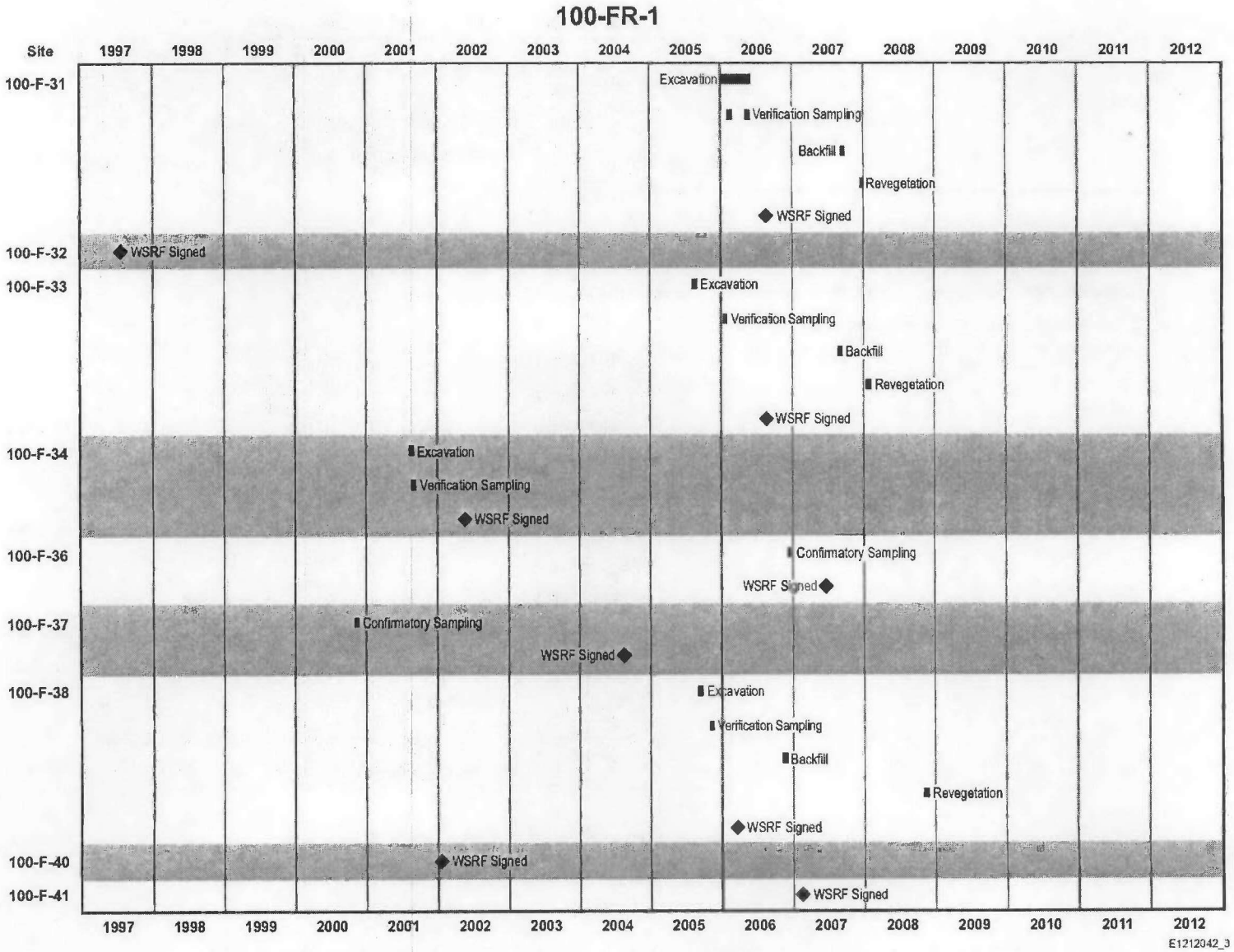


NA = Not available

Figure 3-1. Summary of Major 100-FR-1 Operable Unit Events. (12 Pages)



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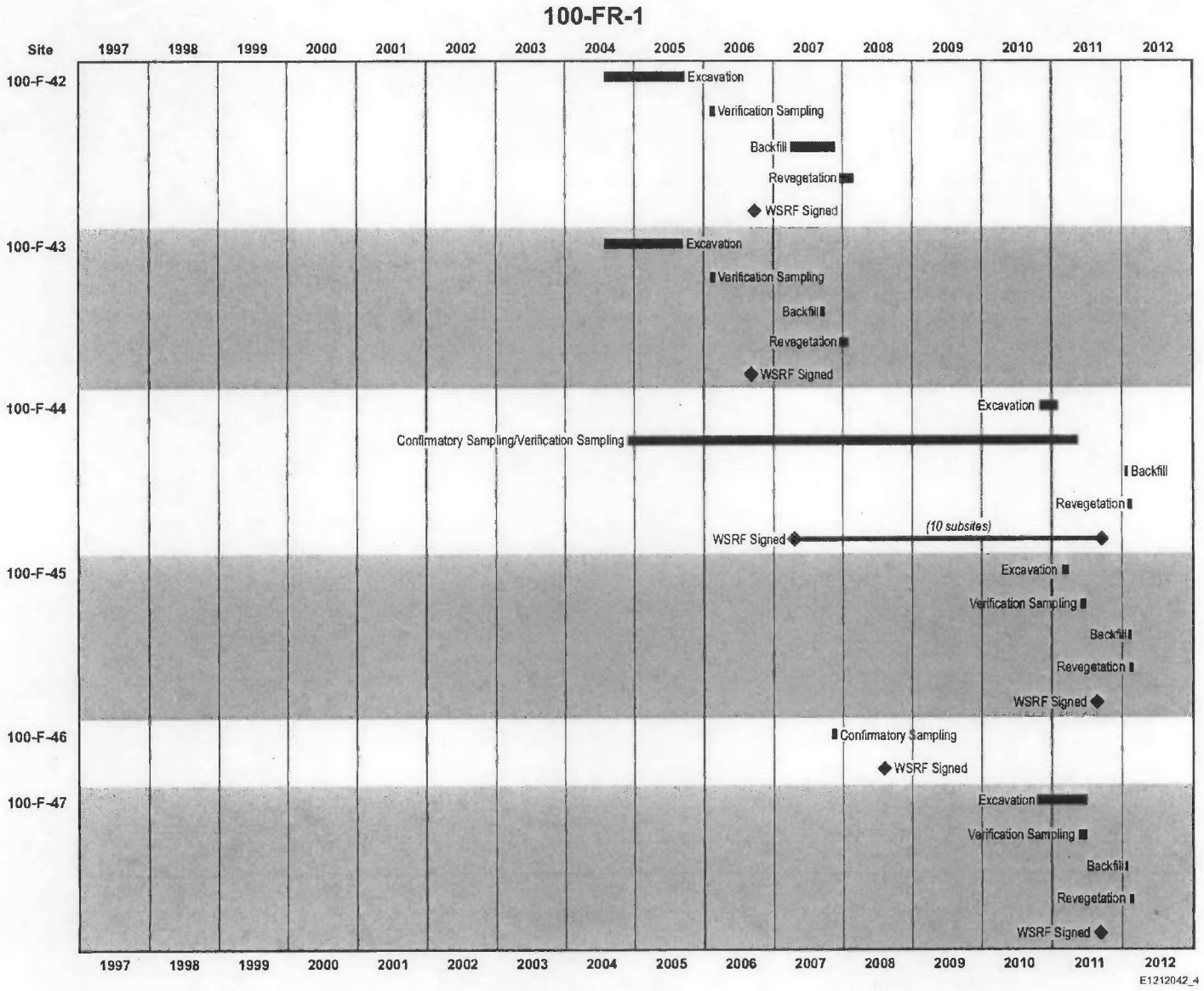

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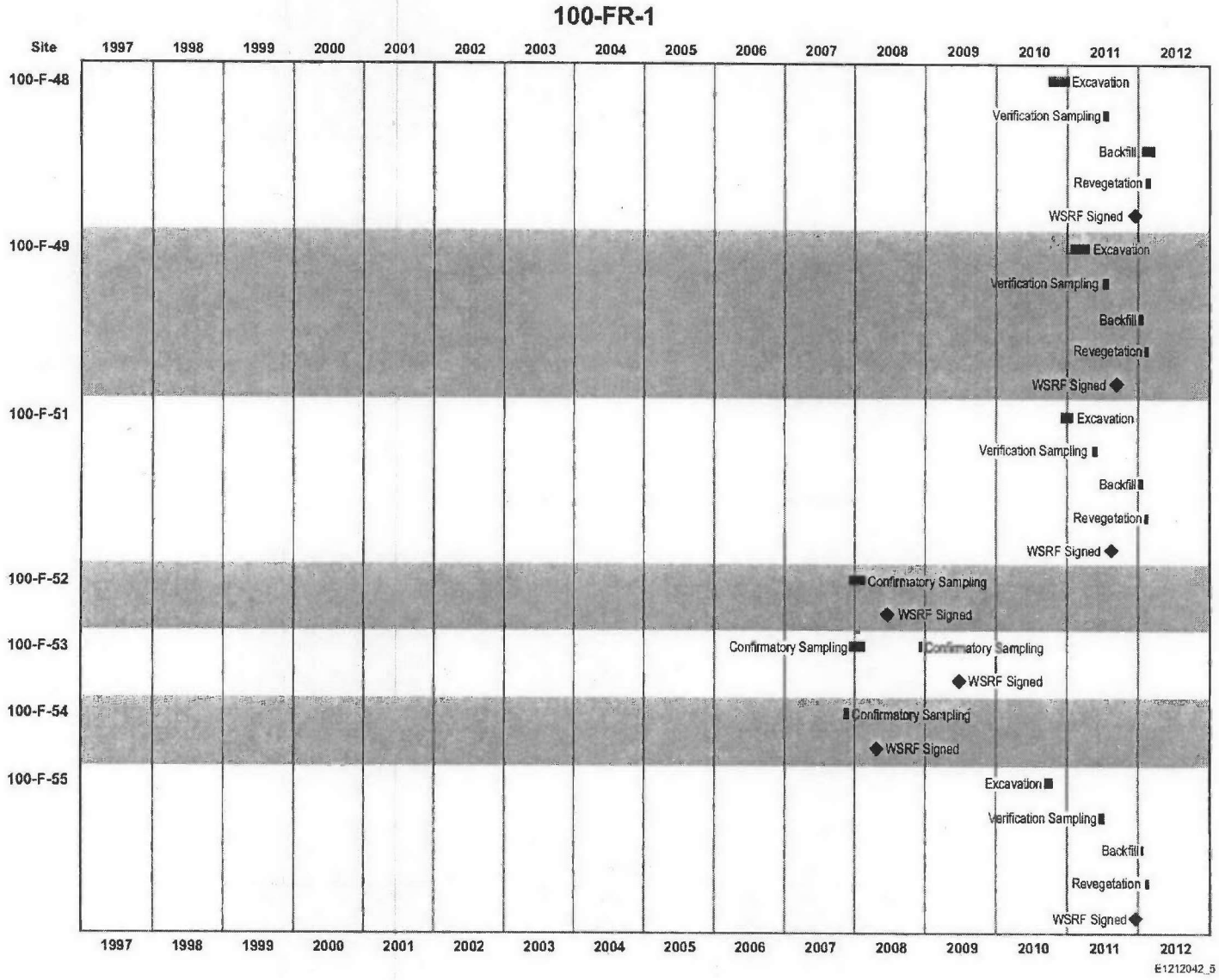

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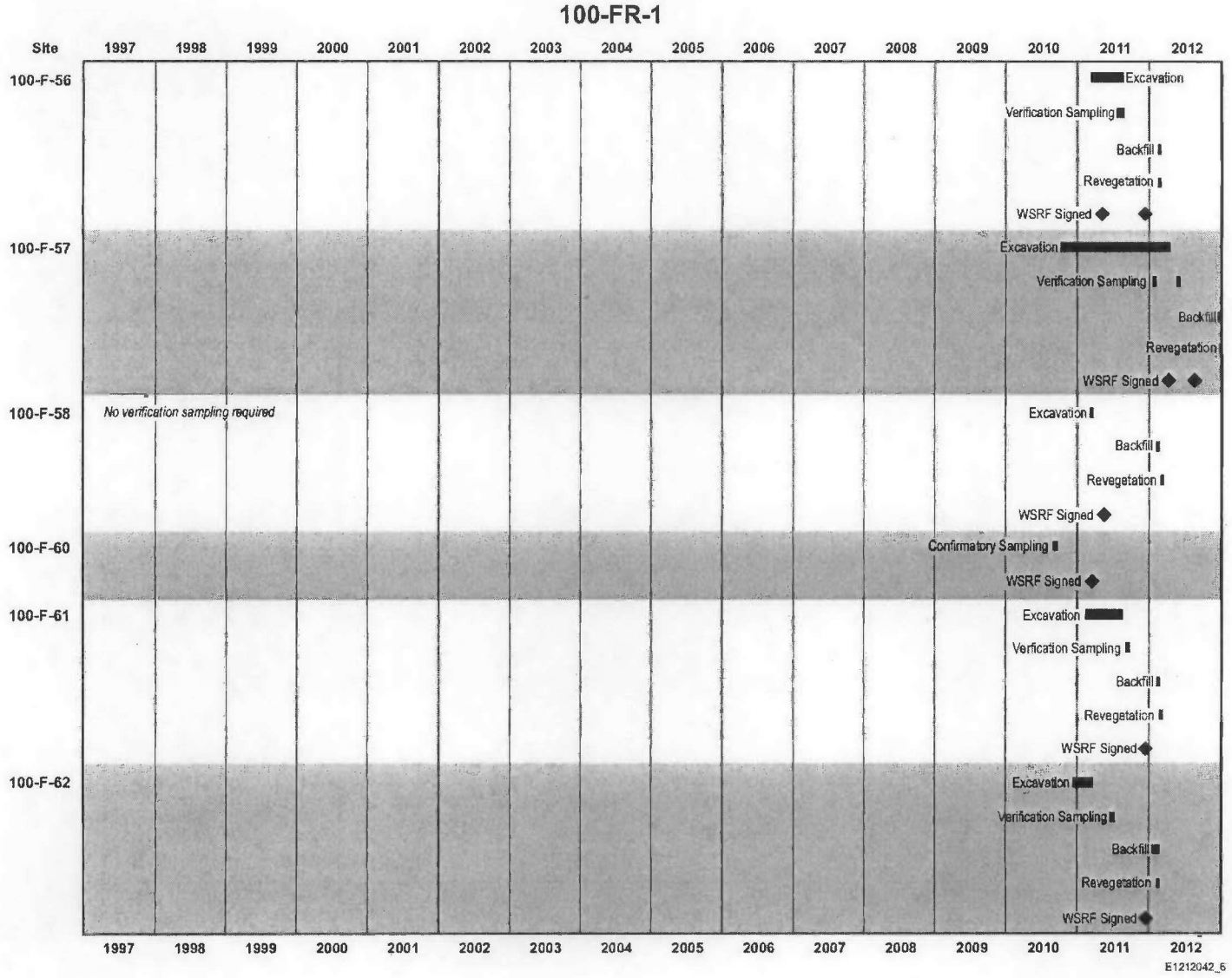

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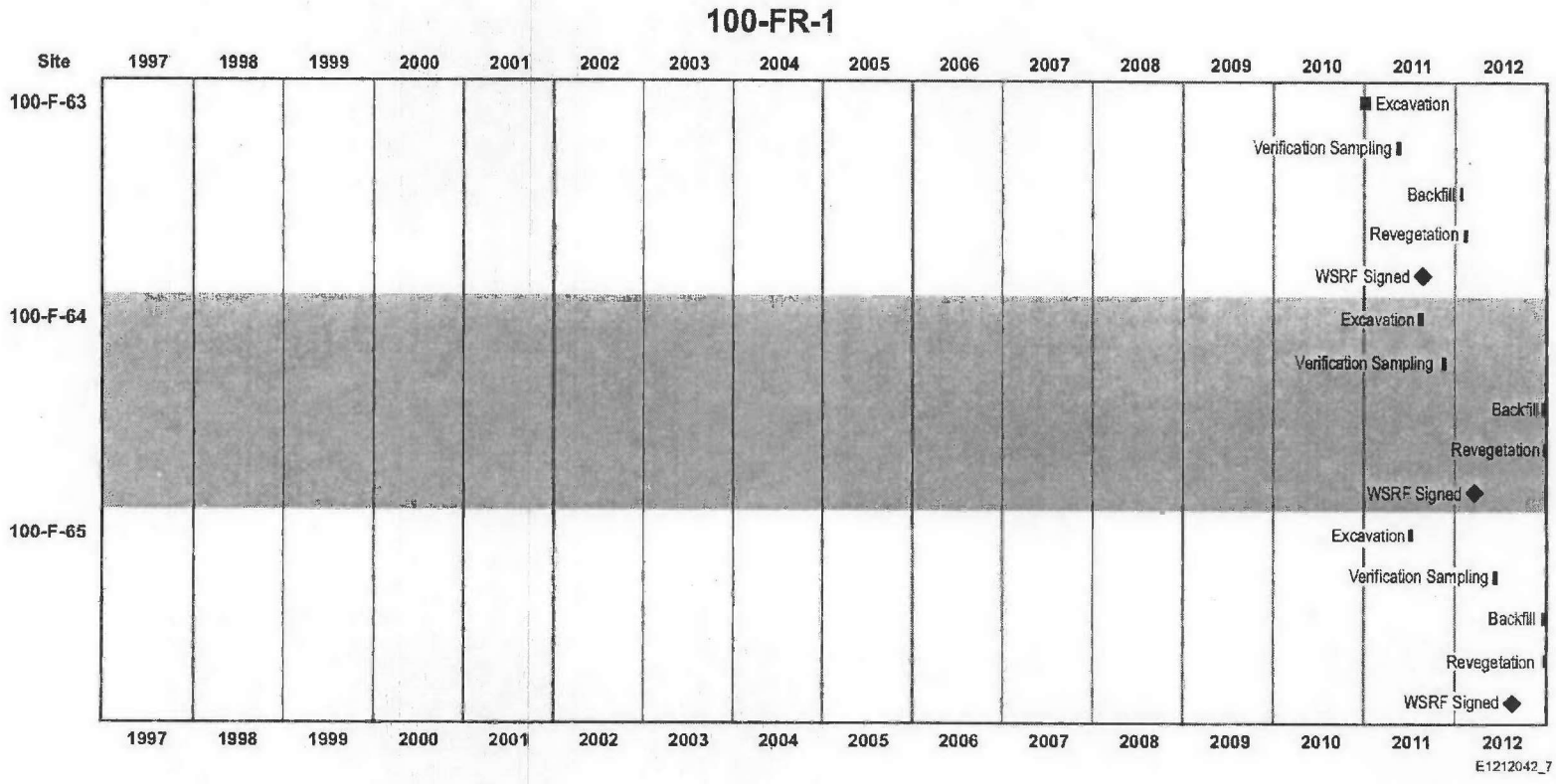

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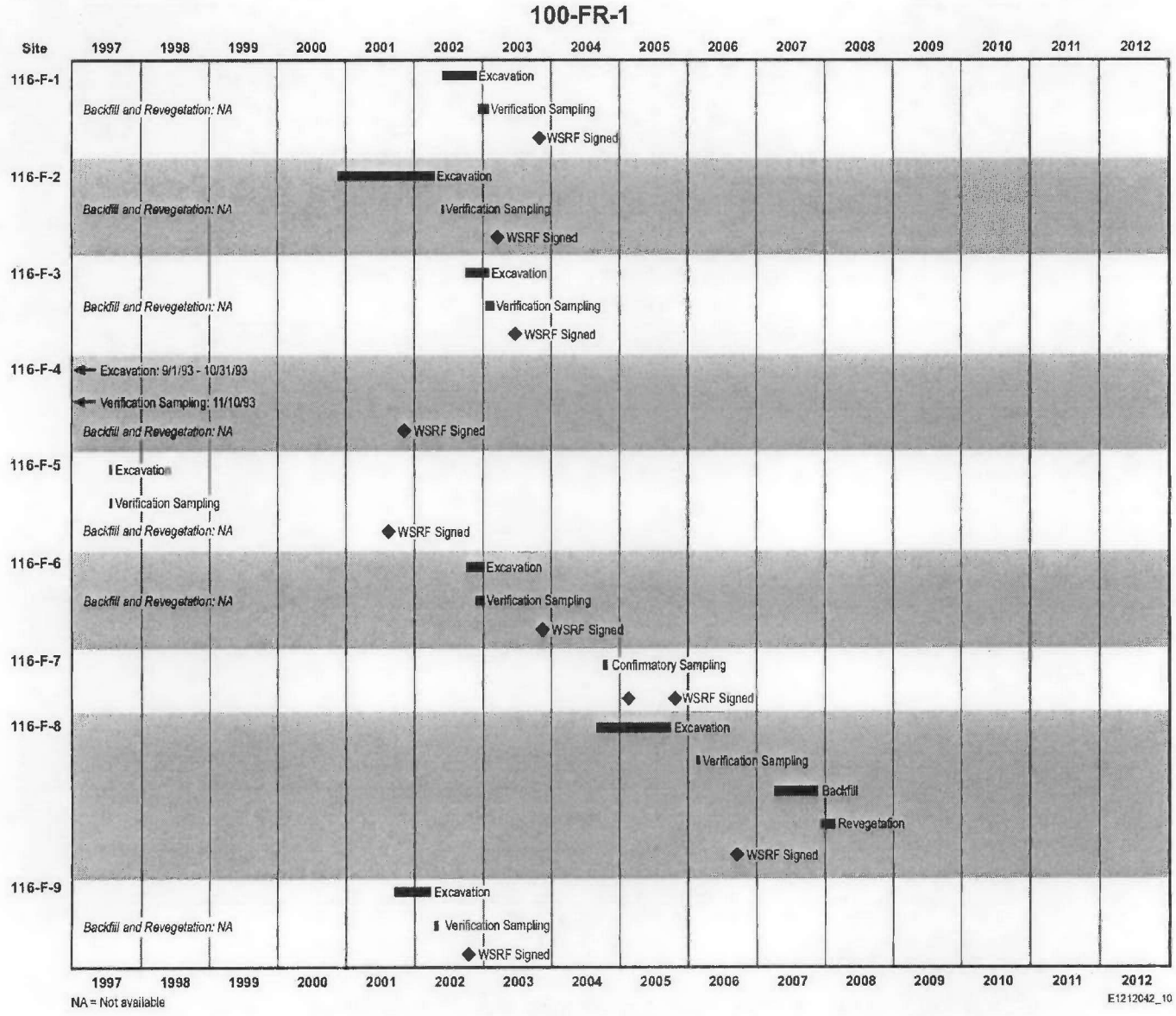

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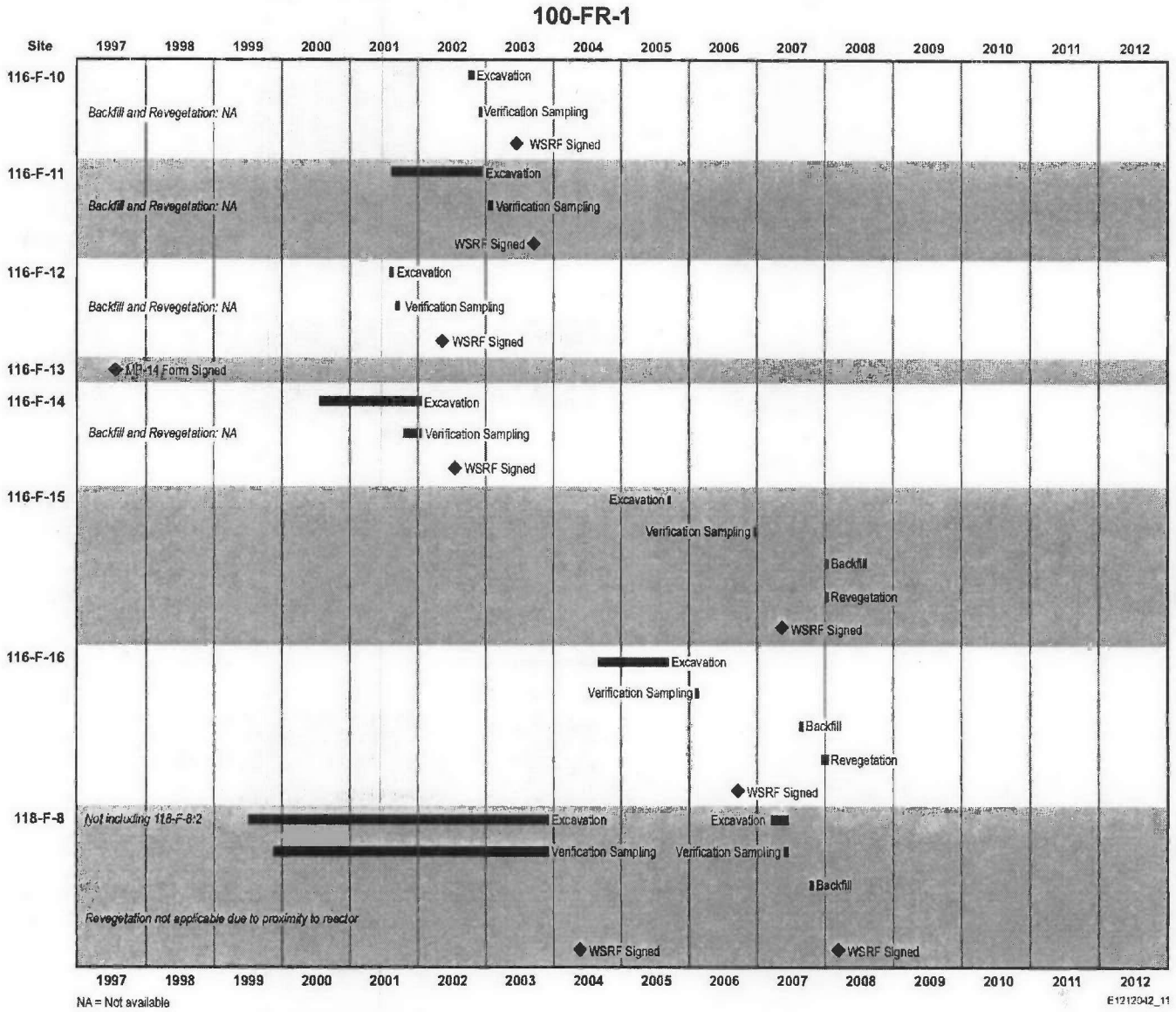

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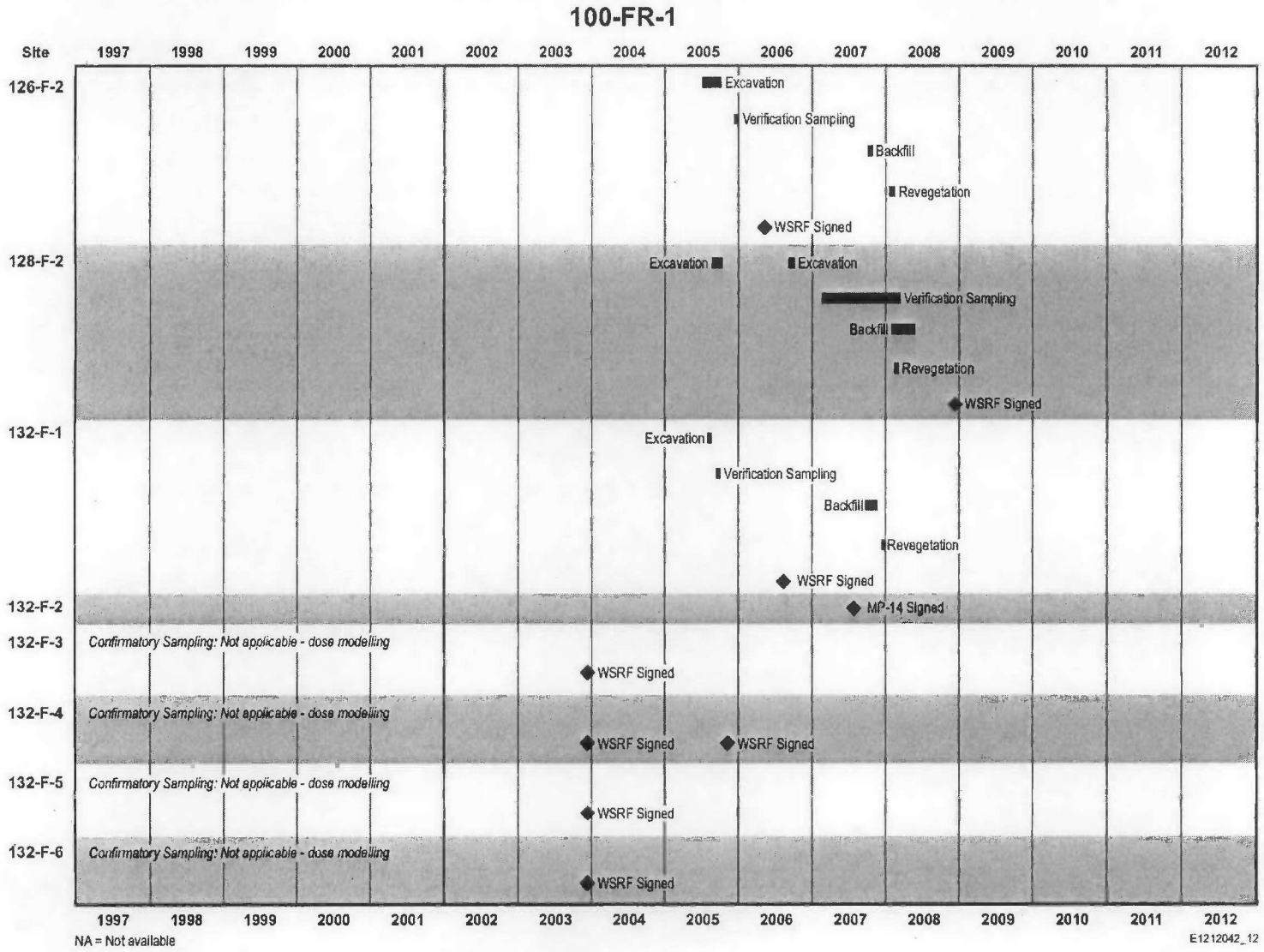

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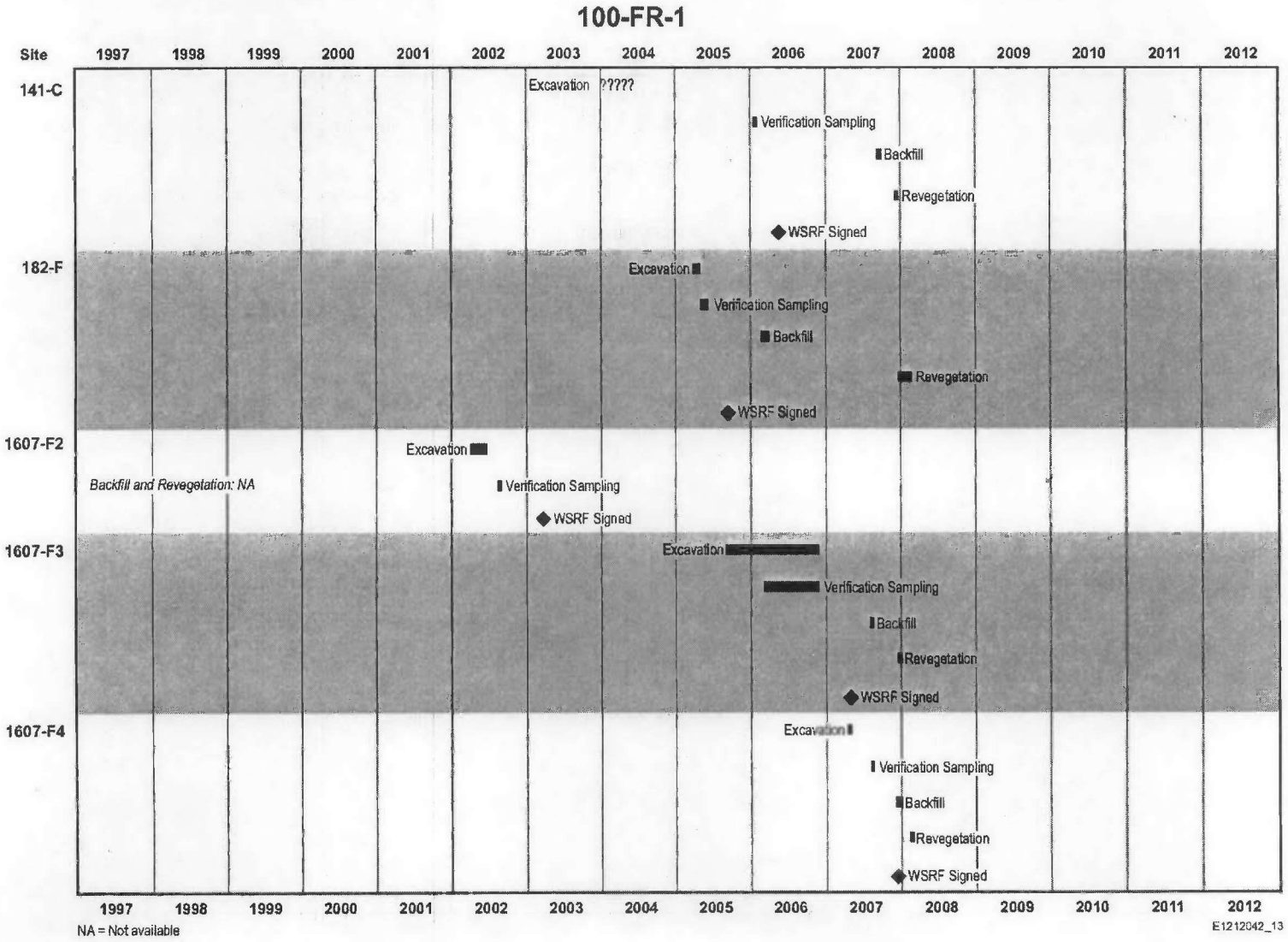

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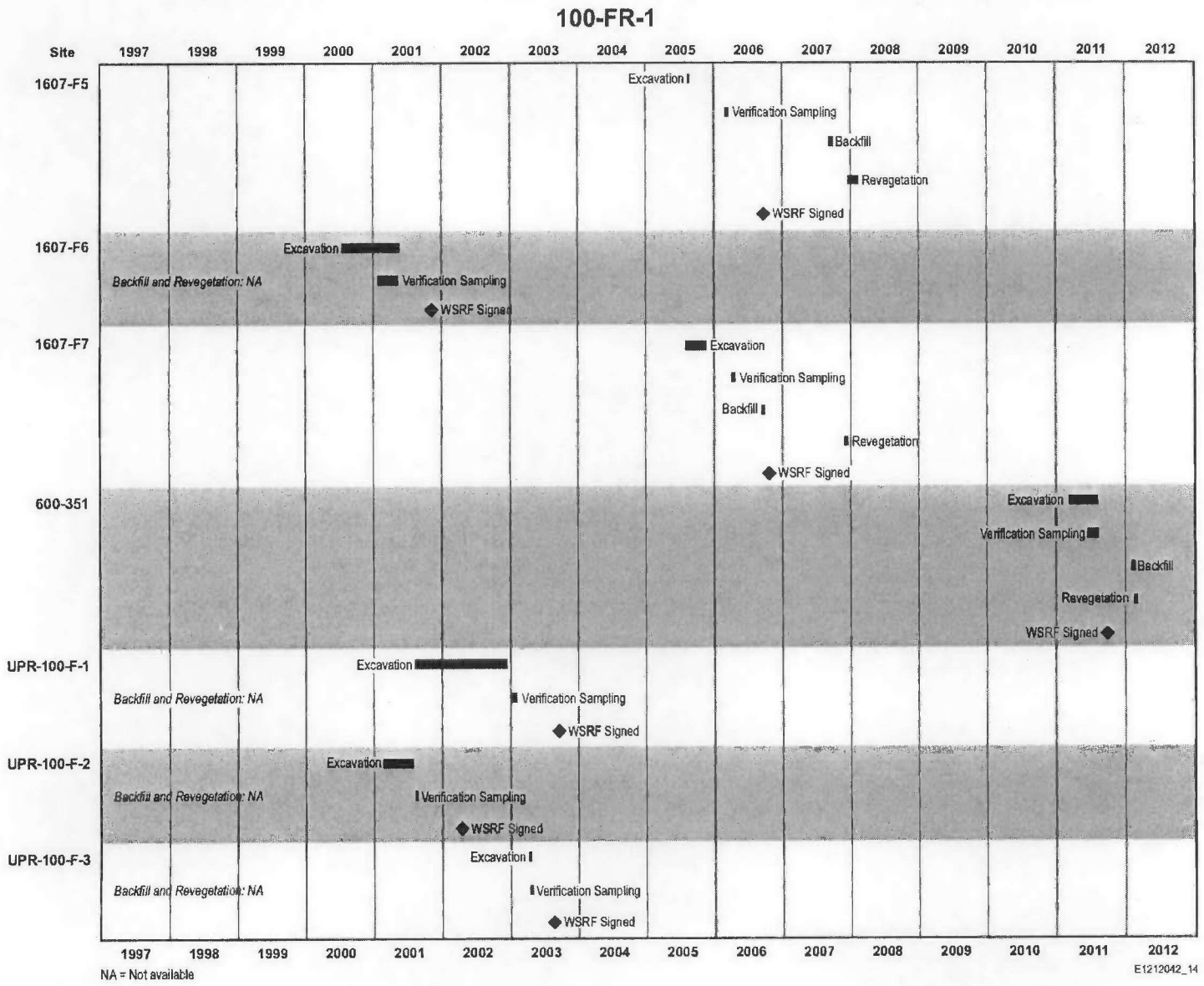

4.0 CONSTRUCTION ACTIVITY SUMMARY

Field operations supporting remedial actions at the 100-FR-1 OU began in 1993 and were completed in 2012. The work was performed under several remedial action subcontracts. The cleanup actions resulted in the disposal of more than 980,900 metric tons (1,081,000 US tons) of contaminated soil and debris at ERDF from the 100-FR-1 OU. Summaries of the remedial action approach and waste disposal activities for each waste site are presented in Tables 4-1 and 4-2, respectively. Table 4-3 identifies sites that were not accepted or were rejected as waste sites. Detailed information about each waste site and related construction activities is presented in the following subsections.

Table 4-1. Remedial Action Approach. (4 Pages)

WIDS Site Code	Site Type	WIDS Site Name and Aliases	Excavation Approach	Personal Protective Equipment [a]
100-F-4	French drain	108-F Building 12-inch French Drain	Direct load [b]	Level D
100-F-10	French drain	French Drain at East End of 105-F Storage Room (Southeast Corner)	Direct load	Level D
100-F-11	French drain	108-F Building 18-inch French Drain	Direct load [b]	Level D
100-F-15	French drain	108-F Building Ventilation French Drain, Undocumented	Direct load [b]	Level D
100-F-16	French drain	108-F Building 30-inch French Drain, Undocumented	Direct load [b]	Level D
100-F-19:1	Radioactive process sewer	105-F Reactor Cooling Water Effluent Underground Pipelines; 100-F-19:1 (North Group), and 100-F-19:3 (West Group)	Direct load	Level D
100-F-19:2	Radioactive process sewer	105-F Reactor Cooling Water Effluent Underground Pipelines; 100-F-19:2 (South Group)	Direct load	Level D
100-F-19:3	Radioactive process sewer	105-F Reactor Cooling Water Effluent Underground Pipelines; 100-F-19:1 (North Group), and 100-F-19:3 (West Group)	Direct load	Level D
100-F-23	French drain	141-C Drywell	Direct load	Level D
100-F-24	French drain	145-F Drywell	Direct load	Level D
100-F-25	French drain	146-FR Drywells	Direct load	Level D
100-F-26:4	Process sewer	South Process Pipelines	Direct load	Level D
100-F-26:7	Process sewer	100-F-26:7, Sodium Dichromate and Sodium Silicate Pipelines	Direct load stockpile, sort, loadout	Level B/C
100-F-26:8	Process sewer	1607-F1 Sanitary Sewer Pipelines	Direct load	Level D
100-F-26:9	Process sewer	1607-F2 Sanitary Sewer Pipelines	Direct load	Level D
100-F-26:10	Process sewer	1607-F3 Sanitary Sewer Pipelines	Direct load	Level D
100-F-26:12	Process sewer	72-inch Main Process Sewer Pipeline	Direct load	Level D
100-F-26:13	Process sewer	108-F Drain Pipelines	Stockpile, sort, loadout	Level D
100-F-26:14	Process sewer	116-F-5 Influent Pipelines, 116-F-5 Ball Washer Crib	Direct load	Level D
100-F-26:15	Process sewer	Miscellaneous Pipelines Associated with 1608-F Sump	Direct load	Level D

Table 4-1. Remedial Action Approach. (4 Pages)

WIDS Site Code	Site Type	WIDS Site Name and Aliases	Excavation Approach	Personal Protective Equipment [a]
100-F-29	Radioactive process sewer	100-F Experimental Animal Farm Process Sewer Pipelines	Direct load	Level D
100-F-31	Septic tank	144-F Sanitary Sewer System	Direct load	Level D
100-F-33	Unplanned release	146-F Aquatic Biology Fish Ponds	Stockpile, sort, loadout	Level D
100-F-34	French drain	Biology Facility French Drain	Direct load	Level D
100-F-38	Unplanned release	Yellow Stained Soil Near Hydrant F-2	Direct load	Level D
100-F-42	Outfall	1904-F Spillway, 100-F-39:1 Flume	Direct load	Level D
100-F-43	Outfall	Spillway for PNL Outfall, 116-F-16 Spillway, 100-F-39:2	Direct load	Level D
100-F-44:8	Process sewer	1717-F Fuel Oil Supply and Return Pipelines	Stockpile, sort, loadout	Level D
100-F-44:9	Process sewer	105-F Process Sewer Pipeline	Stockpile, sort, loadout	Level D
100-F-45	Radioactive Process sewer	Buried River Effluent Pipelines	Stockpile, sort, loadout	Level D
100-F-47	Electrical substation	151-F Substation	Direct load	Level D
100-F-48	Dumping area	184-F Coal Pit Debris	Direct load	Level D
100-F-49	Foundation	1716-F Maintenance Garage Lubrication Pit	Direct load, stockpile, sort, loadout	Level D
100-F-51	Unplanned release	146-F Fish Laboratory Soil	Direct load	Level D
100-F-55	Unplanned release	1607-F7 Contaminated Ash Layer	Stockpile, sort, loadout	Level D
100-F-56:1	Dumping area	100-F Garnet Sand Areas	Direct load	Level D
100-F-56:2	Dumping area	Other 100-F Surface Debris Areas	Direct load, hand pick up	Level D
100-F-57:1	Foundation	190-F Process Water Pump House Debris (Eastern Half)	Direct load, stockpile, sort, loadout	Level D
100-F-57:2	Foundation	190-F Process Water Pump House Debris (Western Half)	Direct load, stockpile, sort, loadout	Level D
100-F-58	Dumping area	100-F Surface Debris Potentially Containing Asbestos	Direct load	Level D
100-F-61	Unplanned release	Stained Soil Near 100-F-12	Direct load	Level D
100-F-62	Sanitary sewer	Animal Farm Septic Lines	Stockpile, sort, load	Level D
100-F-63	Radioactive process sewer	Animal Farm Radioactive Effluent Lines	Direct load	Level D
100-F-64	Unplanned release	Yellow and Red Stained Area Along Railroad Tracks Near the 1713-FA	Direct load	Level D
100-F-65	Unplanned release	Green Stained Area Along Railroad Tracks Immediately West of 190-F	Direct load	Level D

Table 4-1. Remedial Action Approach. (4 Pages)

WIDS Site Code	Site Type	WIDS Site Name and Aliases	Excavation Approach	Personal Protective Equipment [a]
116-F-1	Trench	Lewis Canal	Direct load, stockpile, sort, loadout	Level D
116-F-2	Trench	107-F Liquid Waste Disposal Trench	Direct load	Level D
116-F-3	Trench	105-F Storage Basin Trench	Direct load	Level D
116-F-4	Crib	105-F Pluto Crib	Direct load	Level D
116-F-5	Crib	Ball Washer Crib	Direct load	Level D
116-F-6	Trench	1608-F Liquid Waste Disposal Trench, 105-F Cooling Water Trench	Direct load	Level D
116-F-8	Outfall	1904-F Outfall Structure	Direct load	Level D
116-F-9	Trench	Animal Waste Leaching Trench	Direct load	Level D
116-F-10	French drain	105-F Dummy Decontamination French Drain, 116-F-8, 105 Dummy/Perf Decontamination Crib, Perf Decontamination Drain	Direct load	Level D
116-F-11	French drain	105-F Cushion Corridor French Drain	Direct load	Level D
116-F-12	French drain	148-F French Drain	Direct load	Level D
116-F-14	Retention basin	107-F Retention Basin, 107-F	Direct load	Level D
116-F-15	Sump	108-F Radiation Crib	Direct load	Level D
116-F-16	Outfall	PNL Outfall	Direct load	Level D
118-F-8:1	Reactor	105-F Reactor Ancillary Support Areas, Below-Grade Structures and Underlying Soils	Direct load	Level D
118-F-8:3	Reactor	105-F Reactor Fuel Storage Basin Underlying Soils	Direct load	Level D
118-F-8:4	Unplanned release	105-F Fuel Storage Basin West Side Adjacent and Side Slope Soils	Direct load	Level D
126-F-2	Dumping area	183-F Clearwells	Stockpile, sort, load	Level B/C/D
128-F-2	Burn Pit	100-F Burning Pit	Stockpile, sort, loadout	Level C/D
132-F-1	Laboratory	132-F-1 Chronic Feeding Barn, 141-F, 141-F Sheep Barn	Stockpile, sort, load out	Level D
141-C	Laboratory	141-C Animal Barn, Large Animal Barn & Biology Laboratory, Hog Barn	Stockpile, sort, loadout	Level D
182-F	Dumping area	182-F Reservoir	Stockpile, sort, loadout	Level D
600-351	Dumping area	Stained areas outside of 100-F Area	Direct load	Level D
1607-F2	Septic tank	1607-F2 Septic Tank, 124-F-2, 1607-F2 Sanitary Sewer System	Direct load	Level D
1607-F3	Septic tank	1607-F3 Septic Tank, 124-F-3, 1607-F3 Sanitary Sewer System	Stockpile, sort, loadout	Level D
1607-F4	Septic tank	1607-F4 Septic Tank, 124-F-4, 1607-F4 Sanitary Sewer System	Direct load	Level D
1607-F5	Septic tank	1607-F5 Septic Tank, 124-F-5, 1607-F5 Sanitary Sewer System	Stockpile, sort, loadout	Level D

Table 4-1. Remedial Action Approach. (4 Pages)

WIDS Site Code	Site Type	WIDS Site Name and Aliases	Excavation Approach	Personal Protective Equipment [a]
1607-F6	Drain/tile field	1607-F6 Septic Tank, 124-F-6, 1607-F6 Sanitary Sewer System	Direct load	Level D
1607-F7	Septic tank	141-M Building Septic Tank, 124-F-7	Direct load	Level D
UPR-100-F-1	Unplanned release	141 Building Sewer Line Spill, UN-100-F-1, 141-C to 141-M Sewer Line Leak	Direct load	Level D
UPR-100-F-2	Unplanned release	Basin Leak Ditch, 107-F Basin Leak Ditch, 100-F-3	Direct load	Level D
UPR-100-F-3	Unplanned release	Mercury Spill	Direct load	Level D

[a] Information was not available. The PPE used during waste site remediation was assumed based on analogous waste site approaches and input from the 100-F Area Field Remediation Team.
[b] The site was excavated as part of decontamination and decommissioning activities. The excavation approach is assumed based on analogous waste site approaches and available documentation.
PPE = personal protective equipment
WIDS = Waste Information Data System

Table 4-2. Environmental Restoration Disposal Facility Waste Disposal Summary for the 100-FR-1 Operable Unit. (3 Pages)

WIDS Site Code	Site Type	Mass Disposed to ERDF [a] (metric tons)
100-F-4	French drain	0 [b]
100-F-10	French drain	Mass included with 100-F-19:2 total [c]
100-F-11	French drain	0 [b]
100-F-15	French drain	0 [b]
100-F-16	French drain	0 [b]
100-F-19:1	Radioactive process sewer	56,335
100-F-19:2	Radioactive process sewer	39,347
100-F-19:3	Radioactive process sewer	Mass included with 100-F-19:1 total
100-F-23	French drain	458
100-F-24	French drain	259
100-F-25	French drain	809
100-F-26:4	Process sewer	1,923
100-F-26:7	Process sewer	2,164
100-F-26:8	Process sewer	1,052
100-F-26:9	Process sewer	3,084
100-F-26:10	Process sewer	4,332
100-F-26:12	Process sewer	6,584
100-F-26:13	Process sewer	1,317
100-F-26:14	Process sewer	1,587
100-F-26:15	Process sewer	185
100-F-29	Radioactive process sewer	Mass included with 100-F-19:2 total

Table 4-2. Environmental Restoration Disposal Facility Waste Disposal Summary for the 100-FR-1 Operable Unit. (3 Pages)

WIDS Site Code	Site Type	Mass Disposed to ERDF [a] (metric tons)
100-F-31	Septic tank	797
100-F-33	Unplanned release	2,024
100-F-34	French drain	Mass included with 100-F-19:1 total
100-F-38	Unplanned release	5.5
100-F-42	Outfall	Mass included with 116-F-8 total
100-F-43	Outfall	Mass included with 116-F-16 total
100-F-44:8	Process sewer	679
100-F-44:9	Process sewer	696
100-F-45	Radioactive process sewer	360
100-F-47	Electrical substation	32,922
100-F-48	Dumping area	33,615
100-F-49	Foundation	6,181
100-F-51	Unplanned release	573
100-F-55	Unplanned release	34
100-F-56:1	Dumping area	996
100-F-56:2	Dumping area	45
100-F-57:1	Foundation	6,803
100-F-57:2	Foundation	126,236
100-F-58	Dumping area	2
100-F-61	Unplanned release	1,518
100-F-62	Sanitary sewer	3,601
100-F-63	Radioactive process sewer	Mass included in 100-F-51 total
100-F-64	Unplanned release	707
100-F-65	Unplanned release	190
116-F-1	Trench	77,696
116-F-2	Trench	113,007
116-F-3	Trench	5,205
116-F-4	Crib	700
116-F-5	Crib	0 [d]
116-F-6	Trench	32,156
116-F-8	Outfall	4,900
116-F-9	Trench	49,405
116-F-10	French drain	848
116-F-11	French drain	Mass included in 100-F-19:2 total
116-F-12	French drain	Mass included in 100-F-19:1 total
116-F-14	Retention basin	212,015
116-F-15	Sump	86
116-F-16	Outfall	2,090

Table 4-2. Environmental Restoration Disposal Facility Waste Disposal Summary for the 100-FR-1 Operable Unit. (3 Pages)

WIDS Site Code	Site Type	Mass Disposed to ERDF [a] (metric tons)
118-F-8:1	Reactor	22,132
118-F-8:3	Reactor	Mass included in 118-F-8:1 total
118-F-8:4	Unplanned release	3739
126-F-2	Dumping area	28,986
128-F-2	Burn Pit	34,540
132-F-1	Laboratory	7624
141-C	Laboratory	2079
182-F	Dumping area	0
600-351	Dumping area	137
1607-F2	Septic tank	35,099
1607-F3	Septic tank	3,791
1607-F4	Septic tank	1,603
1607-F5	Septic tank	2,250
1607-F6	Drain/tile field	1,726
1607-F7	Septic tank	1,088
UPR-100-F-1	Unplanned release	Mass included in 100-F-19:2 total
UPR-100-F-2	Unplanned release	670
UPR-100-F-3	Unplanned release	Mass included in 100-F-25 total
	Total	**980,900**

[a] Waste quantities were obtained from remaining sites verification packages/cleanup verification packages or the Waste Management Information System.
[b] The sites were excavated as part of decontamination and decommissioning activities and no waste quantities were specifically identified. The residual concentrations at the waste site meet the remedial action objectives specified in the interim action records of decision.
[c] Cleanup verification results and the assessment of protectiveness for 100-F-10 are included in the 100-F-19:2 CVP (CVP-2001-00003). However, cleanup documentation, including the waste site reclassification form, is provided in CVP-2001-00017 (118-F-8:1, 118-F-8:3).
[d] No contaminated material was encountered; therefore, no material from the waste site was disposed at ERDF.

CVP = cleanup verification package
ERDF = Environmental Restoration Disposal Facility
WIDS = Waste Information Data System

Table 4-3. Not Accepted and Rejected Waste Sites in the 100-FR-1 Operating Unit.

WIDS Site Code	WIDS Site Name and Aliases	WIDS Site Reclassification Status
100-F-5	717-F Building Drywell	Rejected
100-F-6	1716 FA Fuel Tank and Pump	Not Accepted
100-F-8	French Drains Near 105-F Gate	Rejected
100-F-17	108-F Chemical Pump House, Chemical Storage Tanks at 108-F, Chemicals Used at 108-F Building	Not Accepted
100-F-21	Grounds Surrounding Deactivated Areas, Exclusion Area	Not Accepted
100-F-30	144-F Drywell	Not Accepted
100-F-32	1717-F Underground Fuel Oil Tank	Not Accepted
100-F-40	Animal Farm Surface Impoundment	Rejected
100-F-41:1	Discovery Pipeline Between 182-F and 183-F	Rejected
100-F-41:2	Discovery Pipeline at 190-F	Rejected
100-F-41:3	Discovery Pipeline Southeast of 1704-F	Rejected
100-F-41:4	Discovery Pipeline on West Side of 115-F	Rejected
100-F-44:3	1607-F3 Sewer System Pipeline	Rejected
100-F-44:6	189-F Refrigeration Pipeline	Rejected
100-F-44:7	1717-F Blowdown Pipeline	Rejected
100-F-44:10	141-C Sewer Pipelines	Rejected
116-F-13	1705-F Experimental Garden French Drain	Not Accepted
132-F-2	Inhalation Laboratory, 144-F, 144-FB	Not Accepted

WIDS = Waste Information Data System

4.1 100-F-4, 100-F-11, 100-F-15, AND 100-F-16, 108-F BUILDING FRENCH DRAINS

4.1.1 History

The 100-F-4, 100-F-11, 100-F-15, and 100-F-16 french drains were located around the perimeter of the former 108-F Laboratory Building. The site was excavated and the four french drains were removed as part of the decontamination and decommissioning (D&D) of the 108-F Laboratory Building in 1999, but the site was not sampled to verify cleanup of the individual french drains at that time. The french drains were constructed of concrete, steel, or vitrified clay pipe (VCP) and buried to a depth that placed the upper drain surfaces at grade. The drains received small quantities of water as condensates that formed from steam lines or from the hood ventilation ducts mounted externally on the east wall of the 108-F Building. Gravel inside the drains allowed water to percolate into the below-grade soils. The 108-F Building operated from 1944 to 1973.

4.1.2 Excavation Operations

Removal of the backfill materials that had been placed over the areas excavated during the 1999 108-F D&D activities began on December 3, 2001. Soils removed from the french drain areas during the December 2001 efforts were stockpiled and used again as backfill after completion of verification sampling. The locations of the test pits excavated for the 100-F-4, 100-F-11, and 100-F-16 french drains were established based on geological survey data, placing the test pits at the known former locations of the french drains. Geological surveys were also used to determine the reference surface elevation to ensure that samples were taken from soil below the backfill placed over the sites following the 1999 108-F D&D activities. The elevation at the bottom of the 100-F-4 french drain excavation was 121.7 m (399.2 ft) upon completion (with a depth of 4.7 m [15.5 ft] based on reference backfill elevation). The elevation at the bottom of the 100-F-11 french drain excavation was 126.9 m (416.3 ft) upon completion (with a depth of 5.6 m [18.4 ft] based on reference backfill elevation). The elevation at the bottom of the 100-F-16 french drain excavation was 123.0 m (403.5 ft) upon completion (with a depth of 3.3 m [10.8 ft] based on reference backfill elevation). On December 5, 2001, the removal of backfill materials was completed.

4.1.3 Verification Sampling

Cleanup verification sampling began on February 5, 2002, and was finished on February 7, 2002. The area was divided into two decision units: shallow zone and overburden stockpile. All four french drains were excavated, sampled, and evaluated as shallow zone sites.

Four samples were collected from the 100-F-15 french drain shallow zone decision subunit. The shallow zone decision unit contained one decision subunit, which was divided into four sampling areas. One composite cleanup verification sample was obtained from each sample area. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area. The overburden stockpile decision unit also contained one decision subunit, which was divided into four sampling areas. One composite cleanup verification sample was collected from each sample area.

For the 100-F-4, 100-F-11, and 100-F-16 french drains, focused sampling was used in order to sample the soil with the highest residual COC concentrations. The location of the samples for the test pits at the 100-F-4, 100-F-11, and 100-F-16 french drains were established based on geological survey data. Based on the similarity among the four french drains, as well as the information obtained from the D&D remediation of 108-F Laboratory Building, the 100-F-4, 100-F-11, and 100-F-16 french drain sites were accepted by the regulators as analogous sites for the 100-F-15 french drain.

4.1.4 Statement of Protectiveness

Sample data confirmed that remedial actions at the 100-F-4, 100-F-11, 100-F-15, and 100-F-16 waste sites achieved the RAOs and corresponding RAGs established in the interim action ROD. The remaining soil at the 100-F-15 waste site has been sampled, analyzed,

and evaluated. The results of this effort indicate that the overburden materials from the 100-F-15 waste site do not contain COCs at concentrations exceeding RAGs and can be used as backfill. These results indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site do not pose a threat to groundwater and the Columbia River. By analogy and focused sampling, the 100-F-4, 100-F-11, and 100-F-16 french drains are verified to be remediated in accordance with the interim action ROD and were backfilled. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of these sites to "Interim Closed Out."

4.2 100-F-5, 1717-F BUILDING DRYWELL

This site is a 1.2-m (48-in.)-diameter french drain (drywell). The drywell was constructed per the Hanford Standard AC-5-3 and was surrounded by a steel post and chain barrier. The purpose of the site was to receive boiler steam condensate from blowdown valves. A 10-cm (4-in.) pipeline connected the boilers of the 1717-F Building to the drywell. Steam condensate is nondangerous/nonradioactive, and therefore the site was reclassified as "Rejected."

4.3 100-F-6, 1716-FA FUEL TANK AND PUMP

This site is the 1716-FA Automotive Repair Shop gas tanks and gas pumps. The fuel tank was in use during construction of the 100-F Area in the mid-1940s, but was likely removed at the end of the construction activities. A geophysics survey in 2005 showed no evidence of a buried tank. The surrounding area is covered with cobbles and rocks with sparse vegetation, primarily rabbitbrush and grasses. The site was classified as "Not Accepted."

4.4 100-F-7, UNDERGROUND FUEL TANK, 1705-F BUILDING

4.4.1 History

The site was the location of an underground fuel tank that supplied the oil furnace in the 1705-F Building heater room. The tank was installed in 1948, was 3 m (10 ft) long by 1.5 m (5 ft) wide, and had a capacity of 3,800 L (1,000 gal) (*Building No. 1705 Radio-Botany Laboratory Outside Lines*, HW 1948). When the 1705-F Building and surrounding facilities were demolished in 1975, no mention was made to indicate the tank was also removed. Various site walkdowns and surveys also did not confirm the presence of the tank.

4.4.2 Investigation

Confirmation sampling was conducted in October 2004 within a test pit excavated to a depth of 2.4 m (8 ft) where native soil was encountered. A focused sampling approach was selected for the 100-F-7 waste site based on historical data, process knowledge, geophysical survey results, site walkdown observations, and other available information to assess the presence of the tank and any contaminated media. A soil sample consisting of 15 aliquots distributed along the bottom of the test pit was collected and submitted for laboratory analyses.

4.4.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that the 100-F-7 waste site meets the objectives for "No Action" as established in the interim action ROD and the site has been reclassified as "No Action." These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

4.5 100-F-8, FRENCH DRAINS NEAR 105-F GATES

The site consists of two french drains located near the main (north) entrance gate to the 105-F Reactor Building security fence. The two french drains were constructed of 91-cm (36-in.) concrete pipe of unknown length buried to a depth that places their upper surfaces a few inches above grade. Both drains were of the type frequently used to receive steam condensate from aboveground steam lines. Steam condensate is nondangerous/nonradioactive, and therefore the site was "Rejected."

4.6 100-F-9, FRENCH DRAINS AT EAST END OF 105-F STORAGE ROOM (NORTHEAST CORNER)

4.6.1 History

The 100-F-9 french drain was located adjacent to the northeast corner of the easternmost portion of the 105-F Reactor Building footprint. The site received steam condensate from one or more 2.5-cm (1-in.) steel pipelines from steam heaters that serviced the 105-F lunchroom, shower, and locker rooms. The french drain was a 91-cm (36-in.) concrete pipe, cobble filled, with the upper surface a few inches above grade. The french drain was likely removed during the 105-F Miscellaneous Storage Room demolition in 1999 during 105-F Reactor decommissioning activities.

4.6.2 Investigation

A focused sampling approach was designed and implemented for confirmatory sampling at the 100-F-9 waste site. A test pit was excavated and no signs of concrete pipe filled with cobble were found; however, pieces of VCP 5 cm (2 in.) thick and concrete were observed in fill material from 1.8 to 2 m (6 to 7 ft) below ground surface (bgs). Native soil was encountered at 2 m (7 ft) bgs. One soil sample was collected and submitted for laboratory analyses.

4.6.3 Statement of Protectiveness

The confirmatory sampling results demonstrates that the 100-F-9 waste site meets the objectives for "No Action" as established in the interim action ROD and the site has been reclassified as "No Action." These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

4.7 100-F-10, FRENCH DRAIN AT THE EAST END OF THE 105-F STORAGE ROOM

4.7.1 History

The 100-F-10 waste site consisted of a 91-cm (36-in.) concrete pipe buried at an unknown depth. The upper surface of the pipe was a few inches above grade and cobble filled. The site was fed by one or more 2.5-cm (1-in.) steel pipes from the 105-F Building. A 1.9-cm (0.75-in.) pipe also entered the top of the drain. The drain was in use from 1944 to 2002.

4.7.2 Excavation Operations

The 100-F-10 french drain was removed in its entirety during excavation of the 100-F-19:2 pipeline. See Section 4.11.4 for details.

4.7.3 Verification Sampling

Cleanup verification sampling for the 100-F-10 waste site was conducted as part of the 100-F-19:2 pipeline verification sampling. See Section 4.11.5 for details.

4.7.4 Statement of Protectiveness

The verification sample results confirm that remedial action at the 100-F-10 french drain has achieved the RAOs and corresponding RAGs established in the interim action ROD. These results also indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual

concentrations throughout the site pose no threat to groundwater or the Columbia River. The acceptability of unrestricted direct exposure to deep zone soils has not been demonstrated; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.8 100-F-12, 36-INCH FRENCH DRAIN AT 105-F BUILDING

4.8.1 History

The 100-F-12 waste site is located northeast of the 105-F Reactor. The site consists of a french drain, and a 0.9-m (3-ft)-diameter concrete pipe, buried to an unknown depth. The upper surface of the drain was a few inches above grade and had a steel lid (manhole cover) marked "confined space." The drain was fed by four 19-mm (0.75-in.) and one 25-mm (1-in.) steel pipes coming from the northeast corner of the 105-F Building. Based on the pipe size it is believed that these pipes may have been steam condensate lines associated with the building's steam heaters.

4.8.2 Investigation

A focused sampling approach was used based on historical information, process knowledge, and a site walkdown. A test pit was excavated and a sample of the drain contents was collected and analyzed.

4.8.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that the 100-F-12 waste site meets the objectives for "No Action" as established in the interim action ROD and the site has been reclassified as "No Action." These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

4.9 100-F-17, 108-F CHEMICAL PUMP HOUSE AND STORAGE TANKS

The site is the former 108-F Building that was originally built to be used as a chemical pump house to hold and pump various chemicals needed in reactor water treatment and reactor purging (internal cleansing). It contained many holding and mixing tanks and pumps, along with storage bins for dry materials, conveyor systems, hoppers, and power shovels. Shortly after the 105-F Reactor began operation, it was determined that such treatment would not be required and cooling water treatment could be performed elsewhere in the system. The chemical storage tanks that were originally located on the west side of the building were removed. The site was classified as "Not Accepted."

4.10 100-F-18, 105-F CONDENSATE DRAIN FIELD AND UNDERGROUND TANK

4.10.1 History

The 100-F-18 condensate drain field and underground tank waste site is located adjacent to the north wall of the reactor supply fan room of the 105-F Reactor Building. The site was a 0.9-m (36-in.) steel tank of unknown depth and associated drain field.

4.10.2 Investigation

A focused sampling design was implemented in October 2004. The 100-F-18 waste site was investigated through field observations and focused sampling and analysis. One test trench was excavated to native soil to determine if remnants of the tank structure and drain field were present. No remnants of the tank or drain field were found, indicating that the tank and drain field (if present) were likely removed during the 105-F Reactor Interim Safe Storage Project. One soil sample and one field duplicate sample were collected from the bottom of the test trench.

4.10.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that the 100-F-18 waste site meets the objectives for "No Action" as established in the interim action ROD and the site has been reclassified as "No Action." These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil and contaminant levels remaining in the soil are protective of groundwater and the Columbia River. This site does not have a deep zone; therefore, no deep zone institutional controls are required.

4.11 100-F-19, REACTOR COOLING WATER EFFLUENT PIPELINES

For the purpose of this report and to be consistent with project closeout documentation, the north/west and south sections of the 105-F Reactor cooling water effluent pipelines are discussed separately in this section.

4.11.1 History

The 105-F Reactor Cooling Water Effluent Pipelines were underground pipelines that transported radioactive effluent from the reactors. Cooling water passed through the reactor cores, absorbing thermal energy from the nuclear process that became contaminated with radioactive activation and fission products. Effluent water passed from the reactor's rear face and flowed by gravity through the effluent pipelines, junction boxes, and diversion boxes to the retention basins. The effluent water was held in retention basins for a short period to allow thermal and radiological cooling before being released through the outfall structures to the Columbia River.

The cooling water effluent pipelines were divided into three subsites. The 100-F-19:1 subsite includes piping that ran north-northwest from the north side of the 116-F-14 retention basin to the 116-F-8 outfall structure and also includes a second underground effluent pipeline that extended northwest from the 116-F-14 retention basin to a junction box and to the 116-F-6 outfall structure. The 100-F-19:2 subsite consisted of three effluent lines that transported 105-F Reactor cooling water from the reactor core to the 107-F retention basin. The lines that ran between the 105-F Reactor Building and the 107-F retention basin were underground in the western section and above ground for the remainder. In 1977, the above-ground portions of each line were removed, cut into sections, and placed in the retention basin. The 100-F-19:3 subsite included sections of effluent pipelines located north of the reactor running west from the 182-F reservoir and the 126-F-12 (183-F) clearwell to the 116-F-1 Lewis Canal. This subsite also includes piping running in a north-south direction between the 182-F reservoir and the 126-F-12 (183-F) clearwell.

4.11.2 100-F North and West Pipeline Excavation Operations (100-F-19:1 and 100-F-19:3)

The 100-F-19:1 subsite remedial action began on August 7, 2001. Excavation of the site involved removing overburden materials, pipelines, french drains, and contaminated soil.

Shallow zone excavation occurred both in the vicinity of the 100-F-19:3 west pipelines and in the vicinity of the 100-F-19:1 north pipelines, with a maximum depth of 4.6 m (15 ft). The deep zone excavation occurred in the southern half of the 100-F-19:1 north pipelines section of the remedial action, with an approximate maximum depth of 5 m (16 ft).

At the completion of remedial action in August 2001, the excavation was approximately 25,710 m^2 (276,740 ft^2) in area. Approximately 56,335 metric tons (62,099 US tons) of contaminated materials from the site was disposed at ERDF.

4.11.3 100-F North and West Pipeline Verification Sampling (100-F-19:1 and 100-F-19:3)

Cleanup verification sampling began on September 7, 2001, and concluded September 25, 2001. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area.

The 100-F-19:1 subsite consisted of shallow zone and deep zone decision units. The shallow zone consisted of the excavation sidewalls and floor that were less than 4.6 m (15 ft) bgs. The deep zone consisted of the portions of the excavation sidewalls and excavation floor that were more than 4.6 m (15 ft) bgs. The shallow zone decision unit contained 5 decision subunits, which were divided into 20 sampling areas. The deep zone decision unit contained two decision subunits, which were divided into six sampling areas. The final verification samples were submitted to offsite laboratories for analysis.

4.11.4 100-F South Pipeline Excavation Operations (100-F-19:2)

Remedial action at the 100-F-19:2 subsite began in August 2001 and was completed in December 2002. Excavation of the site involved removing the overburden materials, piping, debris, and underlying contaminated soil. The excavation was approximately 19,000 m^2 (205,000 ft^2) in area with a maximum depth of approximately 5 m (16 ft) and an average depth of approximately 4 m (13 ft). Approximately 39,347 metric tons (43,373 US tons) of material including soil, debris, and piping was removed from the 100-F-19:2 subsite and disposed at ERDF. The 100-F-10 french drain was also removed in its entirety during excavation of the 100-F-19:2 pipeline.

4.11.5 100-F South Pipeline Verification Sampling (100-F-19:2)

Cleanup verification sampling began on January 3, 2003, and concluded on January 21, 2003. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area.

The 100-F-19:2 subsite consisted of shallow zone and deep zone decision units. The site was excavated to a maximum depth of approximately 5 m (16 ft), with the shallow zone consisting of the excavation sidewalls to a depth of 4.6 m (15 ft) and the deep zone consisting of the excavation sidewalls below 4.6 m (15 ft) together with the floor of the excavation. All deep zone samples were collected below 4.6 m (15 ft). The shallow zone decision unit contained 5 decision subunits, which were divided into 20 sampling areas. The deep zone decision unit contained two decision subunits, which were divided into six sampling areas. One composite cleanup verification sample was collected from each shallow zone and deep zone. The final verification samples were submitted to offsite laboratories for analysis.

4.11.6 Statement of Protectiveness

The verification sample results confirm that remedial action at the 100-F Reactor cooling water effluent north, south, and west pipeline subsites have achieved the RAOs and corresponding RAGs established in the interim action ROD. The remaining soils at these sites have been sampled, analyzed, and evaluated. The results of this effort indicate that the materials from the 100-F-19:1, 100-F-19:2, and 100-F-19:3 subsites containing COCs at concentrations exceeding RAGs have been excavated and disposed at ERDF. These results also indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. The acceptability of unrestricted direct exposure to deep zone soils has not been demonstrated; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.12 100-F-21, GROUNDS SURROUNDING EXCLUSION AREA

This site is all the grounds within the fenced 100-F exclusion area that are not part of waste sites. Because the area in this site is uncontaminated by definition, it was "Not Accepted" as a waste site.

4.13 100-F-23, 141-C DRYWELLS

4.13.1 History

The 100-F-23 waste site is located east of the 116-F-14, 107-F Retention Basin. The 100-F-23, 141-C french drain received liquid waste from the 141-C Building, which housed plant and animal research on the effects of ionizing radiation. The french drain received liquid wastes from animal pens and 141-C Building research laboratories.

4.13.2 Excavation Operations

Remedial action at the 100-F-23 waste site began and was completed on April 12, 2003. Excavation of the site involved removing the overburden materials and underlying contaminated soil. The elevation of the bottom of the excavation was approximately 124 m (408 ft) upon completion. The excavation was approximately 170 m^2 (1,829 ft^2) in area with a maximum depth of approximately 3.4 m (11 ft). No pipeline structure associated with this site was discovered during excavation. Approximately 458 metric tons (505 US tons) of material from the site was disposed at ERDF.

4.13.3 Verification Sampling

Cleanup verification sampling began and was finished on April 16, 2003. The 100-F-23 waste site consisted only of a shallow zone decision unit, composed of the excavation sidewalls and the floor of the excavation. The site was excavated to a depth of approximately 3.4 m (11 ft). The shallow zone decision unit contained one decision subunit, which was divided into four sampling areas. One composite cleanup verification sample was collected from each sample area. The final verification samples were submitted to offsite laboratories for analysis.

4.13.4 Statement of Protectiveness

The sample results confirm that remedial action at the 100-F-23 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The remaining soil at the 100-F-23 waste site has been sampled, analyzed, and evaluated. These results indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site do not pose a threat to groundwater and the Columbia River. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.14 100-F-24, 145-F DRYWELL

4.14.1 History

The 100-F-24 waste site is located east of the 116-F-14, 107-F Retention Basin. The 100-F-24 waste site was a french drain associated with the 145-F Animal Monitoring Laboratory, which housed animal research on the effects of ionizing radiation. The french drain is believed to have received liquid wastes from 145-F Building research laboratories.

4.14.2 Excavation Operations

Remedial action at the 100-F-24 waste site began and was completed on April 12, 2003. Excavation of the site involved removing the overburden materials and underlying contaminated soil. The elevation of the bottom of the excavation was approximately 125 m (410 ft) upon completion. The excavation was approximately 113 m^2 (1,216 ft^2) in area with a maximum depth of approximately 2.7 m (8.9 ft). The pipeline structure associated with this waste site was discovered during remediation, was entirely within the footprint of the excavation, and was removed during remediation. Approximately 259 metric tons (286 US tons) of material from the site was disposed at ERDF.

4.14.3 Verification Sampling

Cleanup verification sampling began and was finished on April 16, 2003. The 100-F-24 waste site consisted only of a shallow zone decision unit, composed of the excavation sidewalls and the floor of the excavation. The site was excavated to a depth of approximately 2.7 m (8.9 ft). The shallow zone decision unit contained one decision subunit, which was divided into four sampling areas. One composite cleanup verification sample was collected from each sample area. The final verification samples were submitted to offsite laboratories for analysis.

4.14.4 Statement of Protectiveness

The sample results confirm that remedial action at the 100-F-24 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD and the site has been reclassified in WIDS as "Interim Closed Out." The remaining soils at the 100-F-24 waste site have been sampled, analyzed, and evaluated. These results indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site do not pose a threat to groundwater and the Columbia River.

4.15 100-F-25, 146-FR DRYWELLS AND UPR-100-F-3 MERCURY SPILL

4.15.1 History

The 100-F-25 waste site is located south-southwest of the 116-F-8 outfall site. The 100-F-25, 146-FR Drywells were a pair of french drains associated with the 146-F and 146-FR Aquatic Biology and Fish Ponds Laboratories, which both housed research on the effects of ionizing radiation on fish. The french drains are believed to have received liquid wastes from 146-F and 146-FR research laboratories and ponds. The UPR-100-F-3 Mercury Spill was an unplanned release that occurred at the northeast corner of the 146-FR Building. The UPR-100-F-3 waste site falls entirely within the footprint of the 100-F-25 waste site remedial excavation.

4.15.2 Excavation Operations

Remedial action at the 100-F-25 waste site, which was co-located with UPR-100-F-3, began and was completed on April 12, 2003. Excavation of the site involved removing the overburden materials and underlying contaminated soil. The elevation at the bottom of the excavation was approximately 122 m (400 ft) upon completion. The excavation was approximately 243 m^2 (2,615 ft^2) in area with a maximum depth of approximately 4 m (13 ft). The pipeline structure associated with these sites discovered during remediation of the site was entirely within the footprint of the excavation and was removed during remediation. Approximately 809 metric tons (892 US tons) of material from the site was disposed at ERDF.

4.15.3 Verification Sampling

Cleanup verification sampling began and was finished on April 16, 2003. The 100-F-25 waste site consisted only of a shallow zone decision unit, composed of the excavation sidewalls and the floor of the excavation. The site was excavated to a depth of approximately 4 m (13 ft). The shallow zone decision unit contained one decision subunit, which was divided into four sampling areas. One composite cleanup verification sample was collected from each sample area. The final verification samples were submitted to offsite laboratories for analysis.

4.15.4 Statement of Protectiveness

The sample results confirm that remedial action at the 100-F-25 and UPR-100-F-3 waste sites achieved the RAOs and corresponding RAGs established in the interim action ROD and the site has been reclassified in WIDS as "Interim Closed Out." The remaining soil at the 100-F-25 and UPR-F-3 waste sites has been sampled, analyzed, and evaluated. These results indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site do not pose a threat to groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.16 100-F-26, 100-F WATER TREATMENT FACILITY UNDERGROUND PIPELINES

4.16.1 History

The 100-F-26 waste site encompasses the upstream (pre-reactor) process sewers for the 100-F Area, including all underground water lines used to transport reactor cooling water between water treatment facilities and the 105-F Reactor Building. These include potentially contaminated underground lines between buildings and to drainage facilities. For confirmatory sampling efforts, the 100-F-26 waste site was administratively divided into 16 subsites for decision-making purposes based on the use of the pipelines (e.g., sanitary versus process sewers), expected sources of contamination, potential differing remedial action determinations, and geographical location. The 16 subsites are listed in Table 4-4.

Table 4-4. 100-F Water Treatment Facility Pipeline Subsite Closure Summary.

Subsite	Site Name	Decision
100-F-26:1	North Process Sewer Collection Pipelines	No Action
100-F-26:2	Process Water Pipelines to the Aquatic Biology and Strontium Gardens	No Action
100-F-26:3	184-F Powerhouse Pipelines	No Action
100-F-26:4	South Process Pipelines	RTD
100-F-26:5	190-F Bypass Pipelines	No Action
100-F-26:6	190-F Reservoir Pipelines	No Action
100-F-26:7	Sodium Dichromate and Sodium Silicate Pipelines	RTD
100-F-26:8	1607-F1 Sanitary Sewer Pipelines	RTD
100-F-26:9	1607-F2 Sanitary Sewer Pipelines	RTD
100-F-26:10	1607-F3 Sanitary Sewer Pipelines	RTD
100-F-26:11	1607-F4 Sanitary Sewer Pipelines	No Action
100-F-26:12	72-in. Main Process Sewer Pipeline	RTD
100-F-26:13	108-F Drain Pipelines	RTD
100-F-26:14	116-F-5 Influent Pipelines	RTD
100-F-26:15	Miscellaneous Pipelines Associated with 1608-F Sump	RTD
100-F-26:16	Reactor Cooling Water Pipelines	No Action

RTD = remove, treat, dispose

4.16.2 No Action 100-F-26 Subsites

4.16.2.1 100-F-26:1 Investigation. The 100-F-26:1 subsite is a network of reinforced concrete pipe and VCP process sewers that received flow from the 182-F rreservoir and 183-F clearwells. The 100-F-26:1 subsite pipelines were stratified into five service areas based on the contributing discharges to pipeline segments from each of the two facilities. Samples of underlying soil and pipe scale/sediment were collected within each service area according to a stratified sampling design with focused sampling. Confirmatory sampling of the 100-F-26:1 subsite was conducted on December 1, 2004, through January 10, 2005. Analytical results of pipe scale/sediment and underlying soil samples for the 100-F-26:1 subsite were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection, with the exception of lead, mercury, silver, and aroclor-1254 in service areas 2, 3, and 4. For these four COPCs that exceeded the groundwater and river protection RAGs, the *100 Area Analogous Sites RESRAD Evaluation* (BHI 2005) indicates that the residual concentrations achieve the RAOs for groundwater and river protection. Based on these results, no remedial action is required for service areas 2, 3 and 4. In accordance with this evaluation, the confirmatory sampling results from scale and soil samples support a "No Action" reclassification of the 100-F-26:1 subsite.

4.16.2.2 100-F-26:2 Investigation. The 100-F-26:2 subsite consists of a 5-cm (2-in.) pipeline that exited the east side of the 190-F Pumphouse. The pipeline split and conveyed flow to both the Aquatic Biology Fish Ponds and the Strontium Gardens. Confirmatory sampling of the 100-F-26:2 subsite was conducted from November 17 through 18, 2004, according to a focused sampling approach. Analytical results of pipe scale/sediment and underlying soil samples for the 100-F-26:2 subsite were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.16.2.3 100-F-26:3 Investigation. The 100-F-26:3 subsite (184-F Power House Pipelines) is a network of process sewer pipelines that serviced the 184-F Powerhouse and 188-F Ash Disposal Basin. This site is analogous to the 100-B-14:6 subsite (184-B Power House Pipelines, Waste Site Reclassification Form 2004-010, dated May 10, 2004). Analytical results obtained from confirmatory sampling at the analogous 100-B-14:6 subsite indicate that the 100-F-26:3 subsite meets the RAOs. In accordance with the analogous evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.16.2.4 100-F-26:5 Investigation. The 100-F-26:5 subsite is an underground pipeline composed of 1.2-m (48-in.) reinforced concrete and 0.46-m (18-in.) VCPs. Confirmatory sampling of the 100-F-26:5 subsite was conducted between November 2004 and January 2005, according to a stratified sampling design with focused sampling. Analytical results of pipe scale/sediment and underlying soil samples for the 100-F-26:5 subsite were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a "No Action" reclassification of this site. However, institutional controls are required in the deep zone (greater than 4.6 m [15 ft]) to prevent excavation and drilling because mercury levels exceed direct exposure RAGs.

4.16.2.5 100-F-26:6 Investigation. The 100-F-26:6 subsite (190-F Reservoir Pipelines) is an underground pipeline that received flow from the reuse water reservoir portion of the 190-F Pumphouse. Waste water from the steam jet condensers was collected in the reuse water reservoir and pumped back to the main reservoir (182-F Building) during the winter months to maintain the temperature of the process water. This site is analogous to the 100-B-14:7 subsite (185-B/190-B Sump and Pipelines Sites, Waste Site Reclassification Form 2004-011, dated May 10, 2004). Analytical results obtained from confirmatory sampling at the analogous 100-B-14:7 subsite indicate that the 100-F-26:6 subsite meets the RAOs. In accordance with the analogous evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.16.2.6 100-F-26:11 Investigation. The 100-F-26:11 subsite consists of a VCP that received sanitary sewer influent from the 115-F Gas Recirculation Building. The VCP is approximately 54 m (178 ft) in length and terminates at the inlet to the 1607-F4 septic tank. Confirmatory sampling of the 100-F-26:11 subsite was conducted on November 22, 2004, using a focused sampling approach.

Analytical results of pipe scale and underlying soil samples for the 100-F-26:11 subsite were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection, excluding soil samples for lead and the pipe scale sample for aroclor-1260. These two COPCs exceed the groundwater and river protection RAGs. However, generic RESidual RADioactivity (RESRAD) model results for analogous sites and the *100 Area Analogous Sites RESRAD Evaluation* (BHI 2005) indicate that these residual concentrations of lead and aroclor-1260 achieve the RAOs for groundwater and river protection. In accordance with this evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.16.2.7 100-F-26:16 Investigation. The 100-F-26:16 subsite (Reactor Cooling Water Pipelines) consists of the cooling water tunnels that run between the 190-F Pumphouse and the 105-F Reactor. The tunnels were uncovered in 1987 as part of decommissioning activities and filled to grade with clean soil as documented in WHC-EP-0478, *Summary of the Hanford Site Decontamination, Decommissioning, and Cleanup: FY 1974 through FY 1990.* This document indicates that the pipelines inside the tunnels were removed and salvaged at the time of decommissioning of the water tunnels.

The 100-F-26:16 subsite was evaluated using the analogous site data from concrete and soil underlying the 105-C Cooling Water Tunnels (BHI-01050, *Verification Sampling of Soils Underlying 190-C Main Pumphouse and 105-C Water Tunnels - Data Summary*) and pipe scale inside the cooling water pipelines at the 100-B Reactor valve pit. Historical sampling of concrete and soil underlying the 105-C Cooling Water Tunnels (BHI-01050) and pipe scale inside the cooling water pipelines at the 100-B Reactor valve pit indicate that residual contamination meets the cleanup criteria. In accordance with this evaluation, sampling results support a "No Action" reclassification of this site.

4.16.3 Remedial Action at 100-F-26 Subsites

4.16.3.1 100-F-26:4 Excavation Operations and Verification Sampling. The 100-F-26:4 subsite consists of the process sewers formerly servicing the 105-F, 108-F, 189-F, 190-F, and 1717-F Buildings. The sample design defined six service areas based on the direction of flow in the pipelines and the facilities being serviced by the pipelines. Confirmatory sampling in December 2004 and January 2005 determined that four of the six 100-F-26:4 service areas achieved the RAOs and RAGs without remediation.

Service area 2 required remediation based on the presence of cesium-137, lead, mercury, total petroleum hydrocarbons (TPH), and aroclor-1260 above direct exposure RAGs. Remediation of service area 2 of the 100-F-26:4 pipeline subsite was performed from July 30 through October 11, 2007. The site was excavated to a depth of approximately 2.4 m (8 ft) below grade, resulting in approximately 540 bank cubic meters (BCM) (710 bank cubic yards [BCY]) of material. Verification sampling for service area 2 performed in September and October 2007 demonstrated that residual contaminant concentrations are protective of human health, groundwater, and the Columbia River. In accordance with this evaluation, the verification sampling results support an "Interim Closed Out" reclassification of this site.

A portion of the pipeline in service area 6 was determined to require remediation because there was insufficient information to conclude that the pipeline at that location did not need to be remediated. Remediation of the pipeline was performed from October 13, 2010, through January 5, 2011. Excavated materials including concrete, asphalt, clay pipe, rebar, and coal ash were staged onsite before disposal at ERDF. Approximately 818 m^3 (1,070 yd^3) of clean overburden was stockpiled separately from the other excavated material and will be used as fill following verification sampling. The remaining material, including 72 linear m (236 ft) of 30-cm (12-in.)-diameter clay pipe and a volume of 304 m^3 (400 yd^3) of contaminated soil, was stockpiled as waste for disposal at ERDF. Verification sampling was performed on May 16, 2011. The results demonstrated that residual contaminant concentrations are protective of human health, groundwater, and the Columbia River. In accordance with this evaluation, verification sampling results support an "Interim Closed Out" reclassification of this site

4.16.3.2 100-F-26:7 Excavation Operations and Verification Sampling. The 100-F-26:7 subsite comprised a pair of 7.6-cm (3-in.) steel pipelines that conveyed sodium dichromate and sodium silicate from the 108-F Chemical Pumping Building to the 190-F Water Treatment Building. Remedial action of the 100-F-26:7 subsite was initiated on January 12, 2011. The excavation continued through April 13, 2011, to a depth of approximately 1.5 to 2.67 m (5 to 8.8 ft). The excavation resulted in approximately 955 BCM (1,249 BCY) of contaminated soil and debris being removed, including 457.7 m (1,510.5 ft) of 7.6-cm (3-in.) steel pipe for disposal at ERDF. Approximately 911 BCM (1,192 BCY) of overburden material was stockpiled southwest of the excavation for use as clean backfill. Statistical verification sampling was conducted at the 100-F-26:7 subsite on July 21, 2011. Verification sampling results indicate that the residual concentrations meet the RAGs and associated RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the

verification sampling results support a reclassification of the 100-F-26:7 subsite to "Interim Closed Out."

4.16.3.3 100-F-26:8 Excavation Operations and Verification Sampling (Includes 1607-F1). The 100-F-26:8 subsite consisted of the underground pipelines that conveyed sanitary waste water from the 1701-F Gatehouse, the 1709-F Fire Station, and the 1720-F Administrative Office to the 1607-F1 septic tank.

Remediation of the 100-F-26:8 subsite was performed from January 8 to April 3, 2007. The site was excavated to approximately 3.4 m (11 ft) below grade resulting in a waste volume of approximately 464 BCM (607 BCY) of material stockpiled for eventual disposal, including removal of approximately 266 m (872 ft) of pipeline. The pipeline was encased in concrete beneath the road crossings and along most of its length. During remediation, a french drain was discovered on the west side of the 1709-F facility. Although this french drain was independent of the 100-F-28:8 pipelines, it was removed along with the 100-F-26:8 pipelines. Overburden material and other soils presumed to contain no residual contamination above cleanup levels were stockpiled south of the excavation for post-remediation verification sampling.

Verification sampling for the site was performed in April and August 2007. Verification sampling results indicate that the residual concentrations meet the RAGs and associated RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-F-26:8 subsite to "Interim Closed Out."

4.16.3.4 100-F-26:9 Excavation Operations and Verification Sampling. The 100-F-26:9 underground pipeline subsite consists of the sanitary sewers servicing the 105-F, 108-F, 184-F, 185-F, and 190-F Buildings, and the 1700-F administration and service buildings (1704-F, 1707-F, 1707-FA, 1713 F, 1717-F, 1719-F, and 1722-F). Confirmatory sampling occurred during December 2004 and January 2005. The sample design defined 11 service areas based on the direction of flow in the pipelines and the facilities being serviced by the pipelines. The results of the confirmatory sampling showed that 7 of the 11 service areas achieved the RAOs and RAGs without remediation. The remaining service areas (service areas 2, 9, 10, and 11) required remediation based on the presence of antimony, arsenic, barium, cadmium, hexavalent chromium, lead, mercury, benzo(a)pyrene, pentachlorophenol, and aroclor-1254 above direct exposure RAGs and/or soil RAGs for the protection of groundwater and the Columbia River.

Remediation of service areas 2, 9, 10, and 11 of the 100-F-26:9 pipeline subsite was performed from February 8 through October 30, 2007. The site was excavated to a depth of approximately 3.7 m (12 ft) below grade, resulting in approximately 1,360 BCM (1,780 BCY) of material disposed at ERDF. Approximately 6,340 BCM (8,290 BCY) of overburden and layback soil was removed and stockpiled for use as clean backfill. Verification sampling for the 100-F-26:9 pipeline site was performed between February 2007 and February 2008. The results demonstrated that the remediation reduced residual contaminant concentrations to levels protective of human health, groundwater, and the Columbia River. In accordance with this

evaluation, the verification sampling results support a reclassification of this site to "Interim Closed Out."

4.16.3.5 100-F-26:10 Excavation Operations and Verification Sampling. The 100-F-26:10 underground pipeline subsite consists of underground sanitary sewer pipelines associated with the 100-F-26 underground pipelines waste site that serviced the 182-F, 183-F, and 151-F Buildings and discharged to the 1607-F3 septic system. Confirmatory sampling occurred on November 19 and 22, 2004. The sample design defined two service areas based on the direction of flow in the pipelines and the facilities being serviced by the pipelines. Barium, copper, lead, mercury, nickel, total chromium, gamma chlordane, and aroclor-1260 were detected above the soil RAGs for protection of groundwater and the Columbia River; zinc was detected above the soil RAG for protection of the Columbia River; and hexavalent chromium exceeded the RAGs for direct exposure and protection of groundwater and the Columbia River. Based on evaluation of the confirmatory sample results, it was determined that remedial action of this pipeline subsite was necessary.

Remedial action at the 100-F-26:10 pipeline was performed from March 7 through 12, 2007. The site was excavated between 2.4 and 4.3 m (8 and 14 ft) below grade, resulting in approximately 1,900 BCM (2,500 BCY) of material disposed at ERDF, including removal of approximately 600 m (1,970 ft) of pipeline. Approximately 4,200 BCM (5,500 BCY) of overburden soil was removed and stockpiled for use as clean backfill. Verification sampling for the 100-F-26:10 pipeline subsite was performed in January and August 2007. Verification sampling results indicate that the residual concentrations meet the RAGs and associated RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-F-26:10 subsite to "Interim Closed Out."

4.16.3.6 100-F-26:12 Excavation Operations Verification Sampling. The 100-F-26:12 underground pipeline subsite consists of an approximately 308-m (1,011-ft)-long, 1.8-m (72-in.)-diameter east-west-trending reinforced concrete pipe that joined the north process sewer pipelines (100-F-26:1) and the south process pipelines (100-F-26:4) with the 1.8-m (72-in.)-diameter reactor cooling water effluent pipeline (100-F-19). Radiological field measurements and staining discovered during excavation of the 100-F-19 pipeline in August 2001 indicated that contamination was present within the 100-F-26:12 sewer pipe and its surrounding soils. The site was referred to remedial action without requiring any additional confirmatory sampling.

Remediation of the 100-F-26:12 subsite was performed from January 11 through October 4, 2007. The site was excavated between 4 m (13 ft) and 6 m (20 ft) below grade, resulting in approximately 2,900 BCM (3,800 BCY) of material disposed at ERDF. Approximately 23,340 BCM (30,530 BCY) of overburden soil was removed and stockpiled for use as clean backfill.

Verification sampling for the 100-F-26:12 pipeline subsite was performed between September and October 2007. The results of the verification sampling support a reclassification of this site to "Interim Closed Out."

4.16.3.7 100-F-26:13 Excavation Operations and Verification Sampling. The 100-F-26:13 subsite is a network of process sewer pipelines that received effluent from the 108-F Biological Laboratory and discharged to the 188-F Ash Disposal Area (126-F-1 waste site) and includes one 0.15-m (6-in.), two 0.2-m (8-in.), and one 0.31-m (12-in.)-diameter VCP segments encased in concrete. The 100-F-26:13 subsite was evaluated based on the December 29, 2004, to January 5, 2005, confirmatory sampling efforts to determine if remedial action would be required. The results from the confirmatory sampling effort for the 100-F-26:13 subsite indicated that residual concentrations of hexavalent chromium, lead, aroclor-1254, and aroclor-1260 in pipe sediment samples were at levels exceeding the direct exposure RAGs. As a result, remedial action was necessary at this subsite.

Because a portion of the 100-F-26:13 pipeline was located under the main access road to the 100-F Area, remediation of this subsite was performed in two stages. The first stage was performed between February 5 and March 27, 2007, and consisted of excavating and removing all pipeline segments except the portion underlying the main access road. The second stage included excavation and removal of the pipeline segment under the 100-F Area access road and was performed on August 24, 2007.

During the first stage of remediation, overburden material and other soils presumed to contain no residual contamination above cleanup levels were stockpiled near the excavation for post-remediation verification sampling. Contaminated materials were stockpiled in a staged waste area before being transported to ERDF. Approximately 580 BCM (760 BCY) of pipeline material and suspect contaminated adjacent and underlying soils were removed and stockpiled in the staged waste area for later disposal to ERDF. Excavation depths at the 100-F-26:13 subsite ranged from 4.3 to 5.2 m (14 to 17 ft) bgs. Verification sampling for the 100-F-26:13 subsite was performed in July and August 2007. Verification sampling results indicate that the residual concentrations meet the RAGs and associated RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of this site to "Interim Closed Out."

4.16.3.8 100-F-26:14 Excavation Operations and Verification Sampling. The 100-F-26:14 pipeline subsite consists of underground pipelines associated with the 116-F-5 Ball Washer Crib and remnants of process pipelines on the west side of the 105-F Building.

Portions of these pipelines were previously removed as evidenced by historical documentation as well as their absence during remediation. Confirmatory sampling was not performed because the presence of contamination related to the pipelines was already documented.

Remedial action at the 100-F-26:14 pipeline subsite was performed from February 1 through April 24, 2007. Remediation of the 100-F-26:14 pipeline subsite resulted in disposal of approximately 700 BCM (916 BCY) of material to ERDF. Approximately 900 BCM

(1,177 BCY) of overburden and layback soil was removed and stockpiled for use as clean backfill. Verification sampling for the 100-F-26:14 pipeline subsite was performed in August 2007. The results of the verification sampling support a reclassification of this site to "Interim Closed Out."

4.16.3.9 100-F-26:15 Excavation Operations Verification Sampling. The 100-F-26:15 subsite includes the miscellaneous pipelines associated with the 132-F-6, 1608-F Waste Water Pumping Station. Confirmatory sampling was not performed because the presence of contamination related to the pipelines was already documented. Remedial action at the 100-F-26:15 pipeline subsite was performed from January 29 through 31, 2007. Two distinct areas were excavated resulting in disposal of approximately 82 BCM (107 BCY) of contaminated materials. Verification sampling for the 100-F-26:15 subsite was performed in July 2007. In accordance with this evaluation, the verification sample results support a reclassification of this site to "Interim Closed Out."

4.16.4 Statement of Protectiveness

The 100-F-26 waste site encompasses the upstream (pre-reactor) process sewers for the 100-F Area, including all underground water lines used to transport reactor cooling water between water treatment facilities and the 105-F Reactor Building. Confirmation, verification sampling results, or both demonstrate that the 100-F-26 subsites have achieved the RAOs and corresponding RAGs established in the interim action ROD and have been reclassified as "No Action" and "Interim Closed Out" as applicable. The results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use and are protective of groundwater and the Columbia River. The 100-F-26 waste site deep zone does not require institutional controls, except at the 100-F-26:5 subsite. Because mercury levels exceeded the direct exposure RAG in the deep zone, institutional controls to prevent uncontrolled drilling or excavation are required.

4.17 100-F-29, 100-F EXPERIMENTAL ANIMAL FARM PROCESS SEWER PIPELINE; AND UPR-100-F-1, 141 BUILDING SEWER LINE SPILL

4.17.1 History

The 100-F-29 EAF process pipelines operated from 1945 until 1976 and consist of pipelines associated with research that examined the effects of ionizing radiation on plants and animals. The site includes all underground process sewer pipelines associated with the EAF, as well as clean waterlines and collocated septic sewer lines. These include 20-cm (8-in.), 15-cm (6-in.), and 8-cm (3-in.) pipelines made of concrete, vitrified clay, and steel, running between EAF facilities and waste disposal sites. Process sewers were installed to dispose of liquid wastes from animal pens, research laboratories, fish tanks, gardens, and other EAF research facilities.

The UPR-100-F-1 site was an unplanned release that occurred on March 13, 1971, when the main sewer line between the 141-C and 141-M Buildings became plugged and animal pen washwater discharged to surrounding soils. The release is associated with the 100-F-29 pipelines that were on the northeast end of the EAF hog barn (141-C). Approximately 64,000 L (17,000 gal) of washwater containing strontium-90 and plutonium-239 was released over an approximately 150 m^2 (1,600 ft^2) area. The water contained 4.0E-5 Ci of strontium-90 and 1.06E-6 Ci of plutonium-239.

4.17.2 Excavation Operations

Remediation of the 100-F-29 and UPR-100-F-1 waste sites was conducted along with the 100-F-19:2 pipelines. See Section 4.11.4 for details.

4.17.3 Verification Sampling

Cleanup verification sampling for the 100-F-29 and UPR-100-F-1 waste sites was conducted as part of the 100-F-19:2 pipeline verification sampling. See Section 4.11.5 for details.

4.17.4 Statement of Protectiveness

The verification sample results confirm that remedial action at the 100-F-29 and UPR-100-F-1 waste sites achieved RAOs and corresponding RAGs established in the approved interim action ROD. The remaining soils at these sites have been sampled, analyzed, and evaluated. These results also indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. The acceptability of unrestricted direct exposure to deep zone soils has not been demonstrated; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.18 100-F-30, 144-F-DRYWELL

The 100-F-30 drywell was located within the former Pacific Northwest Laboratory's EAF site and received rain water from the roof of the 144-F Building. During a site investigation on January 2, 1997, no evidence of a drywell was visible. The area is sparsely covered with rabbitbrush and grasses. The site was classified as "Not Accepted."

4.19 100-F-31, 144-F SANITARY SEWER SYSTEM

4.19.1 History

The 100-F-31 septic system was located within the former Pacific Northwest Laboratory's EAF site and in use from 1949 to 1976. It is believed that the 100-F-31 waste site received both animal and human septic waste. The 100-F-31 septic system supported the inhalation laboratories, also referred to as the 144-F Particle Exposure Laboratory (132-F-2 waste site), which housed animals exposed to particulate material. The 144-F Building was a one-story concrete block building with an office and six laboratories and included indoor and outdoor animal runs.

4.19.2 Excavation Operations

Remediation of the 100-F-31 waste site was completed in May 2006. Remediation of the 100-F-31 waste site consisted of the removal of the septic tank, drain field, associated piping, and overburden material. Approximately 350 BCM (460 BCY) of material was excavated and disposed at ERDF. The site was excavated to a maximum depth of 3 m (9.8 ft) bgs.

4.19.3 Verification Sampling

Verification sampling for the 100-F-31 waste site was performed on February 6, 2006 (phase 1) and May 17, 2006 (phase 2) as a result of the elevated levels of PCBs detected during the first verification sampling event. A total of 10 soil samples were collected on this grid within the remediation footprint for each phase of verification sampling. One soil sample was collected at each location by collecting 25 aliquots of surficial soils from within approximately 1 m (3 ft) of the staked location.

4.19.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-31 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The site does not have a deep zone; therefore, no deep zone institutional controls are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.20 100-F-32, 1717-F UNDERGROUND FUEL STORAGE TANKS

The 100-F-32 waste site was the location of three underground fuel oil storage tanks. The tanks were in use from 1965 to 1977. Each tank had a capacity of 94,625 L (25,000 gal). Each tank

was 10.7 m (35 ft) long and 2.4 m (8 ft) in diameter. Pipelines ran to the 1717-F Building (combined shops) through a pump pit immediately east of the tanks. A United Nuclear Industries monthly report for July 1977 indicated that the underground storage tanks for the 1717-F boilers were removed for salvage and the area backfilled with earth. The site was also excavated on February 22, 1988, to 1.5 m (5 ft) below grade level, 0.9 m (3 ft) below the tank top design depth to confirm the tanks were no longer in place. This site is classified as "Not Accepted."

4.21 100-F-33, 146-F AQUATIC BIOLOGY FISH PONDS

4.21.1 History

The 100-F-33 waste site is the location of the former 146-F Aquatic Biology Fish Ponds. The ponds were used from 1945 to 1976 for experiments designed to determine the effects of effluent wastewater from the 100-F Area on native fish. The ponds may have at some time contained combinations of Columbia River water, reactor cooling water effluent, sludge from the water purification area, condenser water, refrigeration cooling water, floor drainage containing radioactive substances, and substances used to inhibit corrosion. Laboratory reports also mention the presence of "Calol™," a standard lubricating oil used in the charging/discharging process of the reactor piles, in the area effluent water that was pumped to the ponds. This oil was noted as being very toxic to fish and, although it was only present in the wastewater on days that charging or discharging occurred, it may have reached concentrations of 20 parts per million. Unplanned releases of reactor cooling water occurred at this site. The ponds were constructed of reinforced concrete. Each of the six smaller ponds was 3.4 by 2.9 m (11 by 9.5 ft), with a center divider separating the tank into two numbered tanks. The larger rectangular pond was located just to the west, alongside the six small ponds, and had dimensions of 16 by 1.8 m (51 by 6 ft). The circular pond, located just south of the others, had a diameter of 9 m (30 ft). The outer walls of the ponds were removed and the ponds were backfilled in June 1975. Most of the southern two-thirds of the 100-F-33 waste site was excavated during remediation of the 1607-F6 septic system.

4.21.2 Excavation Operations

Remedial action of the northern portion of the 100-F-33 waste site was initiated on August 5 and continued through August 8, 2005. The site was excavated to a depth of 4.6 m (15 ft). Approximately 2,024 metric tons (2,231 US tons) of material including concrete debris, piping, and soil were removed from the site. Excavated soil and debris were staged at the site until disposal of the materials to ERDF, which occurred from September 19 to 21, 2005. Remediation of the southern portion was not performed because confirmatory sample results indicated that residual contaminant concentrations did not exceed RAGs. Additionally, much of the southern portion of the site was remediated during excavation and closeout performed for the 1607-F6 septic system.

4.21.3 Verification Sampling

Verification sampling for the 100-F-33 waste site was performed on January 24, 2006. A statistical sampling design was the preferred verification sampling approach for this site because the distribution of potential residual soil contamination over the study area (site) was uncertain. A total of 11 soil samples were identified on the grid within the remediation footprint. Thirty aliquots of soil were combined into one sample from the staging pile footprint for laboratory analysis.

4.21.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-33 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The site does not have a deep zone; therefore, no deep zone institutional controls are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.22 100-F-34, BIOLOGY FACILITY FRENCH DRAIN

4.22.1 History

The 100-F-34 french drain waste site was identified in 1997. The 0.56-m (22-in.)-deep drain was constructed of a vertical section of 0.74-m (29-in.)-diameter VCP. The site is located due south of the demolished 1705-F Experimental Gardens and may have been associated with a former greenhouse that was demolished in 1975. The purpose and period of use of the 100-F-34 waste site are not known.

4.22.2 Excavation Operations

The 100-F-34 waste site was excavated in conjunction with remedial action at the 100-F-19:1 pipeline. See Section 4.11.2 for details.

4.22.3 Verification Sampling

Cleanup verification sampling for the 100-F-34 waste site was conducted as part of the 100-F-19:1 pipeline verification sampling. See Section 4.11.3 for details.

4.22.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-34 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soil are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.23 100-F-36, 108-F CHEMICAL PUMP HOUSE, 108-F BIOLOGICAL LABORATORY

4.23.1 History

The 100-F-36 waste site is located east of the 105-F Reactor Building and is the location of the former 108-F Biological Laboratory. The 108-F Building was originally built as a chemical makeup facility in 1944 to support treatment of cooling water for use in the 105-F Reactor. In 1949, the building was converted to a biological laboratory to test the effects of radiation and contamination on plant and animal life. The 108-F Building was demolished in 1999. The soils underlying the footprint of the 108-F Building were not sampled at that time, due to future remedial actions planned in adjacent areas.

4.23.2 Verification Sampling

Confirmatory sampling at the 100-F-36 waste site was performed on December 5, 2006, according to a statistical design. A total of three statistical sample locations within the footprint of the 100-F-36 waste site were collected.

4.23.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 100-F-36 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Remedial actions were not required for deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "No Action."

4.24 100-F-37, FRENCH DRAIN DISCOVERED NEAR HYDRANT F-2

4.24.1 History

The 100-F-37 waste site is located east-northeast of the 100-F Reactor Building. It is in the northeast corner of the intersection of F Avenue and the north-south road that ran to the 100-F biological laboratory. This french drain was discovered when a trench for electrical conduit was being excavated on November 3, 2000.

4.24.2 Investigation

Sampling of the discolored stained soil associated with the french drain was performed on November 3, 2000, to support disposal of the concrete pipe that was removed during excavation of the electrical conduit trench. The results of the sample of the discolored stained soil are considered to be worst case for this site, and therefore no further confirmatory sampling at this site was needed. The test pit and/or borehole data show that contaminant depth distributions of barium and lead decrease to concentrations below background within less than 1.8 m (6 ft) below the elevation at which the contamination occurs. Therefore, the residual concentrations of barium and lead are protective of groundwater.

4.24.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 100-F-37 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. This site does not have residual contaminant concentrations that would require any deep zone institutional controls. In accordance with this evaluation, the sample data support a reclassification of this site to "No Action."

4.25 100-F-38, YELLOW STAINED SOIL NEAR HYDRANT F-2

4.25.1 History

The 100-F-38 Stained Soil site is located east-northeast of the 105-F Reactor Building. The 100-F-38 waste site was discovered in November 2000, while excavating a trench for the placement of electrical conduit that was to supply power to a field office. While excavating this trench, some yellow soil was encountered immediately north of fire hydrant F-2. This discolored soil appeared to be an isolated area associated with the disposal of yellow paint.

4.25.2 Excavation Operations

Remedial action at the 100-F-38 waste site occurred on September 15, 2005, and consisted of the excavation and loadout of approximately 5.4 metric tons (6 US tons) of material disposed

at ERDF. The depth of the excavation was approximately 0.9 m (3 ft), and there were no stockpile areas associated with the site. Because the 100-F-38 waste site is located in an office building parking lot prone to high traffic volumes, it posed a potential safety hazard.

4.25.3 Verification Sampling

Verification sampling for the 100-F-38 waste site was performed on November 2, 2005. Because of the potential hazard associated with an open excavation in a parking lot, three focused verification samples were collected and the excavation backfilled.

4.25.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-38 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.26 100-F-40, ANIMAL FARM SURFACE IMPOUNDMENT

The 100-F-40 waste site consisted of two surface ponds that received liquid via a ditch from the EAF. Based on interviews with EAF workers, photographs, and sample data, it is concluded that the ponds received only uncontaminated waste as a result of cleaning animal pens. In accordance with the evaluation, the site was "Rejected" as a waste site.

4.27 100-F-41, 100-F SERVICE WATER PIPELINE

The 100-F-41 waste site comprises all service water (i.e., raw, fire protection, export, filtered, and potable water) pipelines in the 100-F Area. These pipelines of various sizes were used only for the transport of raw river water and water treated by standard chemical and physical processes for drinking water treatment. During the 2006 100-F Area orphan sites evaluation, 43 additional service water pipelines were identified on historical drawings for inclusion within the 100-F-41 waste site. In addition, four pipelines discovered during previous confirmatory sampling activities were also determined to be service water pipelines (based on historical drawings). The four pipelines have been identified as subsites 1 through 4 of the 100-F-41 waste site. In accordance with process knowledge, 100-F-41 was "Rejected" as a waste site.

4.28 100-F-44, 100-F MISCELLANEOUS PIPELINES

4.28.1 History

100-F-44, 100-F Miscellaneous Pipelines waste site is a compilation of nine pipelines not previously addressed in any closure. The underground pipelines are collocated with those described in the 100-F-26 waste site (100-F Water Treatment Facility Underground Pipelines). Segments of pipelines were identified within the areas of the following former buildings: 105-F, 1717-F, 190-F, 1608-F, 141-C, and 189-F. The 100-F-44 waste site was administratively divided into 10 subsites for decision-making purposes based on the use of the pipelines, expected sources of contamination, and geographical location. The 10 subsites are identified in Table 4-5.

Table 4-5. 100-F-44 Miscellaneous Water Pipeline Summary.

Subsite	Site Name	Decision
100-F-44:1	Discovery Pipeline Near 182-F Reservoir	No Action
100-F-44:2	Discovery Pipeline Near 108-F Building	No Action
100-F-44:3	1607-F3 Sewer System Pipeline	Rejected
100-F-44:4	Discovery Pipeline in Silica Gel Pit	No Action
100-F-44:5	Process Sewer Pipelines	No Action
100-F-44:6	189-F Refrigeration Pipeline	Rejected
100-F-44:7	1717-F Blowdown Pipeline	Rejected
100-F-44:8	1717-F Fuel Oil Supply and Return Pipelines	RTD
100-F-44:9	105-F Process Sewer Pipeline	RTD
100-F-44:10	141-C Sewer Pipelines	Rejected

RTD = remove, treat, dispose

4.28.2 Rejected 100-F-44 Subsites

The 100-F-44:3, 100-F-44:6, 100-F-44:7, and 100-F-44:10 subsites are "Rejected" as waste sites. During excavation of 100-F-44:3 and 100-F-44:10 subsites, there was no evidence to support existence of the pipeline segments. The 100-F-44:6 and 100-F-44:7 subsites are service water pipelines used to support site operations. Based on the absence of potential chemicals and radionuclides in the service water type pipelines, the 100-F-44:6 and 100-F-44:7 sites were "Rejected" as waste sites.

4.28.3 No Action 100-F-44 Subsites

4.28.3.1 100-F-44:1 Investigation. The 100-F-44:1, Discovery Pipeline Near 182-F Reservoir subsite is a 20-cm (8-in.) carbon steel pipe that carried reservoir water from the 182-FA Pump Test Stand to the process sewer (100-F-26:1) via a junction box. Confirmatory samples of soil below the junction box and sediment/scale within the 100-F-26:1 pipeline were collected.

Analytical results of pipe scale/sediment and underlying soil samples were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.28.3.2 100-F-44:2 Investigation. The 100-F-44:2 subsite is a 5-cm (2-in.) steel pipeline that was discovered in a junction box during confirmatory sampling of the 100-F-26:4 subsite. The 100-F-44:2 pipeline feeds into the 100-F-26:4 process sewer pipeline from the 108-F Biology Laboratory at the junction box. Confirmatory sampling was performed on January 16, 2008. Confirmatory samples were collected from beneath the pipe at depth of 2 m (7 ft) below the ground surface. There was no sediment or scale inside the pipe. Analytical results of pipe scale/sediment and underlying soil samples were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.28.3.3 100-F-44:4 Investigation. The 100-F-44:4 subsite is a steel pipe discovered on October 17, 2004, during trenching to locate the 118-F-4 Silica Gel Pit. Confirmation sampling activities at the 100-F-44:4 subsite began on February 13, 2008, and were completed on February 21, 2008. Analytical results of sediment inside and underlying soil samples were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.28.3.4 100-F-44:5 Investigation. The 100-F-44:5 subsite is a network of reinforced concrete and steel pipelines that received process flow from the 190-F Building and discharged to a 1.07-m (42-in.)-diameter pipeline associated with the 100-F-19:3 reactor cooling water effluent pipelines. Confirmatory sampling was performed and the analytical results indicate that the residual concentrations of COPCs at this site meet the RAOs for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the confirmatory sampling results support a "No Action" reclassification of this site.

4.28.4 Remedial Action 100-F-44 Subsites

4.28.4.1 100-F-44:8 Excavation Operations and Verification Sampling. The 100-F-44:8, 1717-F Fuel Oil Supply and Return Pipelines subsite consisted of two 3.8-cm (1.5-in.)-diameter black steel pipes that connected the 100-F-32, 1717-F Underground Fuel Oil Tanks to the 1717-F Maintenance Shop and Offices building. The 100-F-44:8 pipelines were approximately 36 m (118 ft) long. The average depth of the pipelines is approximately 0.4 m (1.3 ft) below existing grade.

Remedial action at the 100-F-44:8 pipelines subsite began on October 27, 2010, and continued through January 19, 2011, to a maximum depth of 1.5 m (5 ft) across the entire excavation footprint. The excavation resulted in approximately 300 BCM (392 BCY) of contaminated soil and debris being removed for disposal. Two staging areas were developed during the excavation for storing soil prior to disposal at ERDF. Approximately 72 m (238 ft) of 3.81-cm

(1.5-in.)-diameter steel pipe, along with contaminated soil, piping, conduit, wires, concrete, and used personal protective equipment, were disposed at ERDF. Verification sampling was performed on April 14, June 13, and July 19, 2011. The results demonstrated that residual contaminant concentrations are protective of human health, groundwater, and the Columbia River. In accordance with this evaluation, verification sampling results support an "Interim Closed Out" reclassification of this site

4.28.4.2 100-F-44:9 Excavation Operations and Verification Sampling. The 100-F-44:9, 105-F Process Sewer Pipeline was a 46-cm (18-in.)-diameter steel process sewer pipeline that was approximately 43 m (140 ft) in length. The pipeline conveyed effluent from the east side of the 105-F Reactor Building and appeared to discharge to a 1.07-m (42-in.)-diameter pipeline associated with the 100-F-19:2, 100-F Reactor Cooling Water Effluent Underground Pipelines that have since been remediated.

Remedial action at the 100-F-44:9 subsite was performed from November 3, 2010, through January 5, 2011, to a depth of approximately 3 m (10 ft). The remediation resulted in approximately 307 BCM (401.5 BCY) of material being removed and disposed. Approximately 539 BCM (705 BCY) of overburden material was stockpiled east of the excavation for use as clean backfill. Verification sampling was performed on May 3 and 4, 2011. The results demonstrated that residual contaminant concentrations are protective of human health, groundwater, and the Columbia River. In accordance with this evaluation, verification sampling results support an "Interim Closed Out" reclassification of this site

4.28.5 Statement of Protectiveness

The 100-F-44 Miscellaneous Pipeline waste sites are a compilation of pipelines not previously addressed in any closure. Confirmation and verification sample results demonstrate that the 100-F-44 subsites have achieved the RAOs and corresponding RAGs established in the interim action ROD and have been reclassified as "No Action" and "Interim Closed Out" as applicable. The results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use and are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. Four subsites (100-F-44:3, 100-F-44:6, 100-F-44:7, and 100-F-44:10) are "Rejected" as waste sites.

4.29 100-F-45, BURIED RIVER EFFLUENT PIPELINES

4.29.1 History

The 100-F-45 pipeline sections are suspected to have resulted from the failure of the 100-F-39, 100-F River Effluent Pipelines, which are collocated with the 116-F-8, 1904-F outfall structure and the 100-F-42, 1904-F Spillway/Flume. The 100-F-45, Buried River Effluent Pipelines waste

site consisted of a piece of pipeline that was removed from the river, crushed, and buried in the riverbank. This buried section was believed to have been a piece that broke off the original 100-F river effluent pipeline. The soil in which it was buried is a mixture of sand, cobbles, and gravel. Prior to remediation, the site was covered with heavy overgrowth and a thick accumulation of tumbleweeds. Based on the results of historical investigations and a limited geophysical survey, it was believed that at least a 15-m (50-ft) section of 42-in.-diameter river effluent pipeline had been buried at this location since 1946.

4.29.2 Excavation Operations

Remedial action at the 100-F-45 waste site began on March 14 and continued through March 21, 2011, to a depth of approximately 0.5 to 2 m (1.7 to 6.6 ft). The excavation resulted in approximately 160 BCM (208 BCY) of contaminated soil and debris being removed including 15 m (50 ft) of 42-in.-diameter steel pipe for disposal at ERDF. Approximately 217 BCM (284 BCY) of overburden material was stockpiled southwest of the excavation for use as clean backfill. A small staging pile area was used for contaminated soil and pipe material, which was later loaded out and disposed at ERDF.

4.29.3 Verification Sampling

Verification sampling was conducted on April 26, 2011, for the excavation decision unit and on June 28, 2011, for the waste staging pile area and overburden soil stockpile decision units. The excavation decision unit was sampled prior to the other decision units because high river flows warranted the excavation to be backfilled with clean borrow soil to prevent the excavation from being washed out. A statistical sampling design was used to collect samples.

4.29.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-45 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.30 100-F-46, 119-F STACK SAMPLING FRENCH DRAIN

4.30.1 History

The 100-F-46 Stack Sampling french drain consisted of a 1.5- to 3-m (5- to 10-ft) long vertically buried gravel-filled pipe approximately 1 m (3 ft) in diameter. The upper portion of the pipe

extended a few inches above grade. Also included in this waste site is the 5-cm (2-in.) cast-iron pipeline that drained condensate from the 119-F Stack Sampling Building into the 100-F-46 french drain.

4.30.2 Investigation

Confirmatory sampling at the 100-F-46 french drain site was performed on November 29, 2007. A test pit was excavated to approximately 4.6 m (15 ft) depth, with no indication of either the french drain or the associated cast iron condensate pipeline. Confirmatory samples were collected from the excavator bucket of material that was taken from the bottom of the test pit. The 100-F-46 waste site was then backfilled.

4.30.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 100-F-46 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "No Action." These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. This site does not have residual contaminant concentrations that would require any deep zone institutional controls.

4.31 100-F-47, 151-F SUBSTATION

4.31.1 History

The 100-F-47, 151-F Substation waste site was located northwest of the 105-F Reactor Building and consisted of a fenced gravel-bed yard measuring 92.4 by 137 m (303 by 450 ft). The demolished 151-F Switch House, located along the eastern fence line, was a single-story concrete building that measured 24 m (80 ft) long, 9 m (30 ft) wide, and 3.4 m (11 ft) high. A reinforced-concrete cable pit ran beneath the switch house and measured 22 m (72 ft) long, 3.4 m (11 ft) wide, and 3.4 m (11 ft) deep. A railroad spur entered the switch yard from the south and then paralleled the east fence line. Polychlorinated biphenyl-containing oil was transferred, as needed, from a rail tanker on the railroad spur through more than 40 m (131 ft) of above-ground piping to transformers and oil circuit breakers in the yard.

4.31.2 Excavation Operations

Remediation of the 100-F-47 waste site was performed from October 20, 2010, through June 27, 2011, to a depth between 1 and 4.4 m (3 and 14.3 ft) across the entire excavation footprint. Due to the shallow nature of the contamination, no overburden was associated with this site. Approximately 14,500 BCM (19,000 BCY) of contaminated soil was directly loaded for disposal at ERDF.

4.31.3 Verification Samples

Verification sampling for the 100-F-47 waste site was conducted on May 10 and June 28, 2011. A statistical sampling design was used to collect 12 samples from the shallow decision unit.

4.31.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-47 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.32 100-F-48, 184-F COAL PIT DEBRIS

4.32.1 History

The 100-F-48 waste site is an area of debris disposal within the 184-F coal pit. The site was discovered in a 1973 photograph during a historical literature search of the 100-F Area. In the photograph, debris appears to be dumped in the western half of the coal pit. Building debris is visible on the surface at the site. No documentation has been found to indicate the source of this debris or the date it was placed in the coal pit.

4.32.2 Excavation Operations

Remediation of the 100-F-48 waste site was performed from September 21, 2010, to January 11, 2011. The coal scrape area was remediated to a depth of approximately 0.3 m (1 ft), while the main excavation area had a final depth that ranged from approximately 0.2 m (0.7 ft) to 3.5 m (11.4 ft). The 100-F-48 waste site excavation resulted in approximately 14,832 BCM (19,400 BCY) of material being removed for disposal at ERDF. Soil and debris from the main excavation area were direct loaded to ERDF, while material removed from the coal scrape area was staged at the east stockpile area before eventual removal to ERDF. Types of debris uncovered include: concrete, steel pipe, rebar, porcelain, clay pipe, bricks, wire, cable, suspect asbestos-containing material (ACM), and asphalt. No overburden soil stockpiles were associated with the waste site.

4.32.3 Verification Samples

Verification sampling was conducted at the 100-F-48 waste site in July and August 2011. Sampling was conducted to support a determination that residual contaminant concentrations in

the soil meet cleanup criteria. The statistical verification sampling design was divided into four decision units: excavation, coal scrape, east stockpile, and north stockpile.

4.32.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-48 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.33 100-F-49, 1716-F MAINTENANCE GARAGE LUBRICATION PIT

4.33.1 History

The 100-F-49 waste site consisted of the remaining components of the former 1716-F Maintenance Garage including the foundation, the lubrication pit, and the contaminated drain(s). The foundation of the former garage building was T-shaped with overall dimensions of approximately 15 by 17 m (50 by 55 ft). The 1716-F Maintenance Garage was built in 1945 and was similar in construction to the 1716 Buildings in the 100-B/C and 100-D Areas, except the 1716-F garage contained a small office. The garage provided automotive repair, light vehicle maintenance, and lubrication service for 100-F Area vehicles. It was a single-story, T-shaped building consisting of one large rectangular room (high bay with two stalls) and two smaller adjoining rooms (one stall and one office).

4.33.2 Excavation Operations

The 100-F-49 waste site was remediated between January 11 and April 12, 2011. During the 100-F-49 remedial activities, a steel tank was discovered. The tank was not expected to be present at this location, and therefore the excavator had slightly broken into the tank, causing some of the liquid from the tank to spill into the surrounding soils. The spilled liquid from the tank and soil was sampled and determined that the tank was used for oil storage purposes. The tank and its location were carefully observed and determined to be the same oil tank that 2008 confirmatory sampling expected to find. The liquid and sludge contents were pumped from the tank prior to its disposal. The steel tank structure, oil-saturated soils, and additional underlying soil were removed from the 100-F-49 excavation and disposed at ERDF.

Remediation included removal of the 1-in.-diameter steel pipe, 20 m^3 (21.3 yd^3) of concrete, a 1,325-L (350-gal) steel storage tank and approximately 1,325 L (350 gal) of fuel, oil, and sludge. Miscellaneous debris such as concrete and rebar were removed from the excavation and

stockpiled adjacent to the site for disposal at ERDF. The deepest part of the 100-F-49 excavation extended to approximately 2.7 m (8.9 ft). Approximately 2,727 BCM (3,567 BCY) of soil and debris was excavated from the 100-F-49 waste site. Roughly half of the materials were stockpiled adjacent to the excavation prior to disposal at ERDF. The other half of the excavated materials was directly loaded for disposal at ERDF.

Following the load out of stockpile materials, the staging pile area was scraped to a depth of 0.3 m (1 ft). A very small green/yellow stain was observed, and it was determined that the stain was not caused by the stockpile; rather, the stain was present at this location prior to any 100-F-49 stockpiling activities.

4.33.3 Verification Samples

Verification sampling for the 100-F-49 waste site was performed on July 20, 2011, to support a determination that residual contaminant concentrations at this site meet the cleanup criteria. The sample design was divided into two decision units: shallow zone and staging pile. Twelve samples were collected within the excavation footprint. Due to the small size of the staging pile, only four composite samples were collected.

4.33.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-49 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.34 100-F-51, 146-F FISH LABORATORY SOIL; AND 100-F-63, ANIMAL FARM RADIOACTIVE EFFLUENT LINES

4.34.1 History

The 100-F-51 waste site consists of the soil under and around the former 146-F Fish Laboratory, which was constructed in March 1945 to study the effects of reactor process water on fish and other river inhabitants. The laboratory and underlying concrete pad may have been removed sometime during the decontamination and decommissioning activities of nearby facilities in June 1975. The 146-F Fish Laboratory received process liquids from several sources including raw water from the 181-F River Pump House; chemically treated, pre-reactor process water from the 190-F Main Process Pump House; and reactor effluent process water from the 107-F retention basin. Activities at the 146-F Fish Laboratory included studies of aquatic

species that were exposed to varying amounts of process waters from 100-F Area operations. These liquids were contained in large, open-topped fish troughs and head tanks within the laboratory.

The 100-F-63 waste site comprised the radioactive effluent piping and process sewers at the north end of the EAF. The 100-F-63 waste site contained an assembly of pipes (ranging from 5-cm [2-in.] to 20-cm [8-in.] diameter) of varying lengths. Beginning in 1945, radioactive effluent was supplied to the fish laboratory from the 147-F Pump House. The effluent was used to perform studies by exposing fish to varying concentrations of reactor cooling water effluent. Portions of the effluent pipelines and process sewer were likely removed with remediation of the nearby 100-F-33 waste site in 2005.

4.34.2 Excavation Operations

Remedial action at the 100-F-51 and 100-F-63 waste sites began on December 20, 2010, and continued through January 20, 2011. Excavation depth ranged from 0.5 to 1.5 m (1.6 to 4.9 ft) bgs) and resulted in approximately 253 BCM (331 BCY) of soil and debris being removed and disposed at ERDF. Approximately 330 BCM (432 BCY) of overburden soil was stockpiled to be used as backfill. The waste site debris included concrete, clay pipe, steel pipe, and asphalt.

4.34.3 Verification Sampling

Verification sampling was conducted at the 100-F-51 and 100-F-63 waste sites on May 18, 2011. The area was divided into to two decision units: shallow zone and overburden stockpile. Twelve statistical samples were collected from the excavation footprint. Four focused samples were collected from the overburden stockpile.

4.34.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-51 and 100-F-63 waste sites achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.35 100-F-52, 146-FR RADIOECOLOGY AND AQUATIC BIOLOGY LABORATORY SOIL

4.35.1 History

The 100-F-52 waste site consists of the soil under and around the former 146-FR Radioecology and Aquatic Biology Laboratory. Constructed in 1952, the 146-FR Radioecology and Aquatic Biology Laboratory was a single-story, concrete-block building with a concrete foundation used for studies of the effects of pre-reactor and post-reactor process water on fish eggs, young fish, and other small river creatures of interest. It contained offices, laboratories, hatcheries, rearing troughs, and 12 large rectangular operating ponds. A drainage trench and walkway were located in the operating pond area of the facility.

4.35.2 Investigation

Several different remediation efforts have partially overlapped the 100-F-52 waste site. A small area along the northern edge of the 146-FR laboratory footprint was removed along with pipelines associated with the 100-F-33 and 100-F-19 waste sites. Soils that were adjacent to the eastern edge of the 146-FR laboratory footprint were excavated when pipelines associated with the 1607-F6 waste site were removed. When pipelines associated with the 100-F-19 waste site were removed, the entire southern edge of the 146-FR laboratory footprint was removed. Excavation associated with the 100-F-26:12 Main Process Sewer Pipeline removed soils underlying the entire southern edge of the 146-FR laboratory footprint.

Confirmatory sampling was performed at the 100-F-52 waste site on November 28, 2007, and February 20, 2008. Evaluation of the results indicates that residual concentrations of all detected site COPCs are below soil shallow zone RAGS, except for cadmium, chromium (total), copper, manganese, molybdenum, nickel, silver, zinc, and benzo(a)pyrene, which exceed RAGs for groundwater and/or river protection. RESRAD modeling predicts that these contaminants will not migrate more than 2 m (6.6 ft) vertically in 1,000 years. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

4.35.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 100-F-52 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. This site does not have residual contaminant concentrations that would require any deep zone institutional controls.

4.36 100-F-53, 108-F SEPTIC SYSTEM

4.36.1 History

The 100-F-53 waste site was identified through historical research. Pre-construction drawings showed what appeared to be an undocumented septic system and drain field. The waste site includes the septic drain field, a potential septic tank, and septic pipelines. The septic system was suspected to be associated with the 108-F Biology Laboratory based on proximity.

4.36.2 Investigation

Confirmatory sampling at the 100-F-53 waste site was performed December 4, 2007, and February 19 and December 10, 2008, according to an observational and focused sampling approach. Samples were collected from the contents of the septic drain field pipelines, and the underlying soil and soil from the footprint of the former septic tank location. Evaluation of the data indicates that residual concentrations of all detected site COPCs are below soil shallow zone RAGs, except for lead, mercury, and zinc. RESRAD modeling predicts that residual concentrations will not migrate more than 2 m (6.6 ft) vertically in 1,000 years. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

4.36.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 100-F-53 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. This site does not have residual contaminant concentrations that would require any deep zone institutional controls

4.37 100-F-54, 100-F ANIMAL FARM PASTURE

4.37.1 History

The 100-F-54 waste site is the soil associated with the former pastures for holding domestic farm animals used in experimental toxicology studies at the animal farm. The pastures were in use from 1952 to 1967. Three general pasture areas were associated with the EAF complex:

- Area 1: A large, contiguous pasture from the 141-G Building north to the perimeter road
- Area 2: Two smaller pastures: "2a" west of the 141-H Building and "2b" north of the 141-T Building

- Area 3: Two larger pastures (one for hogs, one for goats) south of the 141-C and 145-F Buildings.

4.37.2 Investigation

Confirmatory sampling at the 100-F-54 waste site was performed on November 19, 2007. A statistical sample design was selected for confirmatory sampling because the distribution of potential residual soil contamination was uncertain.

4.37.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 100-F-54 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. This site does not have residual contaminant concentrations that would require any deep zone institutional controls.

4.38 100-F-55, 1607-F7 CONTAMINATED ASH LAYER

4.38.1 History

The 100-F-55, 1607-F7 Contaminated Ash Layer waste site is located within the former 100-F EAF complex. The 100-F-55 waste site was a black layer of ash less than 0.3 m (1 ft) thick, which was uncovered approximately 0.3 m (1 ft) bgs near the 1607-F7 septic system.

4.38.2 Excavation Operations

Remedial action at the 100-F-55 waste site was performed from September 16 to October 7, 2010. The 100-F-55 waste site was excavated to a depth of 0.7 m (2.3 ft), which resulted in 15 BCM (19.62 BCY) of contaminated soil being removed.

4.38.3 Verification Sampling

The 100-F-55 and 100-F-62 waste sites were combined for verification sampling, which was conducted between June 2011 and September 2011. The waste sites have been divided into four decision units: the north and south excavation footprints, the south excavation expansion, and the footprints of the two waste staging pile areas.

4.38.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-55 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.39 100-F-56, 100-F SURFACE DEBRIS/STAINS

The 100-F-56 waste site consisted of areas of miscellaneous discarded and abandoned materials that were scattered across the 100-F Area. This site is subdivided into two subsites to facilitate closeout: 100-F-56:1, 100-F Garnet Sand Areas and 100-F-56:2, 100-F Surface Debris Areas. There is no process history associated with the 100-F-56 waste site.

4.39.1 History

The 100-F-56:1 subsite consists of two areas of garnet sand. The first area is described as red garnet sand (sand blasting) with some scattered miscellaneous debris, wood, metal, glass, and vitrified clay chunks. The second area is described as stained soil within a garnet sandblasting area. One location is approximately 200 m (656 ft) north of the 105-F Reactor Building, and the other is 300 m (984 ft) south of the reactor.

The 100-F-56:2, 100-F Surface Debris Areas subsite included 20 locations of stained soil and debris. Seventeen locations contained miscellaneous wood debris, two locations are described as oil/filter areas, and one site is described as a lead debris area (i.e., coil-type battery).

4.39.2 Excavation Operations

The remediation of both northern and southern locations of the 100-F-56:1 subsite occurred on March 1 and 2, 2011. The soil within the 100-F-56:1 northern and southern subsite footprints was excavated to a depth of approximately 0.2 m (9 in.) bgs, and the combined excavations resulted in the removal of 440 BCM (575 BCY) of soil and debris, which were disposed at ERDF. The garnet sand was mixed with soil; therefore, no clean soil in the immediate vicinity was available for backfill.

Remedial action and housekeeping activities were performed at the 100-F Area from July 2005 to March 2008. During these activities many of the previously identified 100-F-56:2 subsite components were found to have been at other sites that were remediated after the initial evaluation. Only seven locations were identified where debris remained.

A total of seven locations containing wood debris (i.e., railroad ties and a wooden utility pole) at the 100-F-56:2 subsite were remediated on March 1 and 2, 2011. Remedial action activities included only surface pick up of material and debris. Less than 20 BCM (26.16 BCY) of wood debris was directly loaded for disposal at ERDF.

4.39.3 Verification Sampling

Verification sampling was conducted at the 100-F-56:1 subsite on July 13, 2011. At the northern location, one of the focus samples failed groundwater and river protection cleanup criteria for hexavalent chromium. The single location was further remediated to a depth of 1 m (3 ft) bgs. The location was resampled on August 22, 2011, after additional remediation was performed.

Cleanup of the 100-F-56:2 subsite was demonstrated through visual evaluation. The collection and removal of surface debris demonstrated the achievement of cleanup goals.

4.39.4 Statement of Protectiveness

The verification sampling and visual evaluation demonstrate that remedial actions at the 100-F-56 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.40 100-F-57, 190-F PROCESS WATER PUMP HOUSE DEBRIS (RECHECK)

4.40.1 History

The 100-F-57 waste site consisted of the remaining below-grade pump room facilities and foundation of the 190-F Process Water Pump House. This waste site is subdivided into two subsites to facilitate closeout. The two subsites are the 100-F-57:1, 190-F Process Water Pump House Debris (Eastern Half) and 100-F-57:2, 190-F Process Water Pump House Debris (Western Half). The pump house operated during the entire life of the 105-F Reactor, from 1945 to 1965. It was where the sodium dichromate was added to inhibit corrosion of the 105-F Reactor process tubes. The pump house and annex were directly north of the 105-F Reactor.

4.40.2 Excavation Operations

Remediation of the 100-F-57:1 subsite occurred between December 2010 and January 2012. The remediation resulted in approximately 3,002 BCM (3,926 BCY) of material being removed and

disposed at ERDF to a depth of approximately 2 m (6.6 ft). The debris included concrete, rebar, steel pipe, miscellaneous steel, wire, steel cable, and nonfriable mastic. During the excavation of the waste site, an underground injection control well was discovered. The underground injection control well was also removed and disposed at ERDF.

Remediation of the 100-F-57:2 subsite occurred between December 2010 and April 2012. The subsite was excavated to groundwater in two locations and reached a maximum depth of 12.8 m (42 ft). The remediation resulted in approximately 55,701 BCM (72,854 BCY) of sodium dichromate contaminated soil and debris being removed and disposed at ERDF. The debris included concrete, rebar, steel pipe, transite pipe, miscellaneous steel, wire, steel cable, and nonfriable asbestos.

4.40.3 Verification Sampling

Cleanup verification sampling was performed at 100-F-57:1 in January and May 2012. The sample design consisted of two decision units: the excavation footprint and the overburden stockpile. Twelve statistical samples were collected from the shallow zone. A single composite sample was collected consisting of 25 aliquots from the stockpile.

Cleanup verification sampling was performed at the 100-F-57:2 subsite in May 2012. The 100-F-57:2 subsite was divided into seven decision units for verification sampling. Forty-eight statistical samples and 11 focused were collected from the various decision units.

4.40.4 Statement of Protectiveness

The verification sampling and assessment demonstrate that remedial actions at the 100-F-57 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

4.41 100-F-58, 100-F SURFACE DEBRIS POTENTIALLY CONTAINING ASBESTOS

4.41.1 History

The 100-F-58, 100-F Surface Debris Potentially Containing Asbestos waste site includes areas that are scattered across the 100-F Area. The waste site consisted of 22 locations of miscellaneous potentially asbestos-containing waste. Asbestos-containing material was identified in eight of these areas.

4.41.2 Excavation Operations

The 100-F-58 waste site was remediated on March 2, 2011. Remediation consisted of removal (hand pick up) and disposal of all ACM. The remediation resulted in approximately 1 BCM (1.3 BCY) of material being removed and disposed at ERDF. Post-remediation photographs are attached to the WSRF for the 100-F-58 waste site.

4.41.3 Verification Sampling

Verification sampling was not performed at the 100-F-58 waste site.

4.41.4 Statement of Protectiveness

The evaluation of information from the 100-F-58 waste site demonstrates that the site does not contain waste materials or associated CERCLA hazardous waste and has achieved the RAOs and corresponding RAGs established in the interim action ROD. The site does not pose a risk to human health or the environment and will support future unrestricted land uses that can be represented (or bounded) by a rural-residential scenario. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, remedial action supports a reclassification of this site of "Interim Closed Out."

4.42 100-F-60, 100F CAST IRON PIPE

4.42.1 History

The 100-F-60, 100-F Cast Iron Pipe waste site was discovered in December 2004 while excavating a test pit during the 100-F-26:9 confirmatory sampling activities. The discovered pipe was a 10-cm (4-in.)-diameter cast iron pipe, buried approximately 1.2 m (4 ft) bgs.

4.42.2 Investigation

Confirmatory sampling at the 100-F-60 waste site was performed in September 2010.

4.42.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 100-F-60 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. This site does not have residual contaminant concentrations that would require any deep zone institutional controls. In accordance with this evaluation, the confirmatory data support a reclassification of this site to "No Action."

4.43 100-F-61, STAINED SOIL NEAR 100-F-12

4.43.1 History

The 100-F-61, Stained Soil Near 100-F-12 waste site is located at the northeast corner of the 105-F Reactor complex. The 100-F-61 waste site consisted of dark stained soil discovered during confirmatory sampling activities to investigate the 100-F-12 french drain.

4.43.2 Excavation Operations

Remediation of the 100-F-61 waste site began February 7, 2011, to remove the stained soil contamination. Remedial action was completed on August 11, 2011. The stained soil associated with the confirmatory sampling description was located and removed. A layer of coal ash beneath the surface was removed with the excavation. Debris removed from the excavation consisted of asphalt, steel cable, steel conduit, and parts of steel pipe. All waste material was directly loaded for disposal at ERDF. No overburden was associated with the waste site. The excavation area encompassed the entire 100-F-12 waste site and resulted in the removal of any remaining structures and material associated with it. Approximately 670 BCM (876 BCY) of waste material was removed from the site. Less than 10 BCM (13 BCY) consisted of contaminated asphalt and debris. The maximum depth of remedial action is an estimated 3 m (10 ft).

4.43.3 Verification Sampling

Verification sampling for the 100-F-61 waste site was performed on September 14, 2011. Twelve statistical samples were collected from the shallow zone excavation to support this determination.

4.43.4 Statement of Protectiveness

The verification sampling and visual evaluation demonstrate that remedial actions at the 100-F-61 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.44 100-F-62, ANIMAL FARM SEPTIC LINES

4.44.1 History

The 100-F-62 waste site was in use from 1949 to 1976. The site included suspected pipelines from the 141-M and 144-F Buildings to the 1607-F7 and 100-F-31 septic systems. The 100-F-55 waste site is located near the 100-F-62 north pipeline that connected to the 1607-F7 septic system.

4.44.2 Excavation Operations

Remedial action at the 100-F-62 waste site was performed from December 2010 to March 2011 to remove 594 BCM (777 BCY) of soil. An additional 1,018 BCM (1,301 BCY) was removed from the site between July and August 2011. Five waste staging pile areas were used during the excavation for stockpiling the excavated material prior to disposal at ERDF. The 100-F-62 north pipeline excavation included the removal of the pipelines to the former 1607-F7 septic tank and contained the 100-F-55 waste site excavation. From the north excavation, approximately 2 m (7 ft) of the 10-cm (4-in.)-diameter VCP were removed, and approximately 5 m (16 ft) of the 10-cm (4-in.)-diameter steel pipe with lead bells were removed. A 15-cm (6-in.)-diameter cast-iron pipe believed to run from the 144-F Inhalation Toxicology Laboratory facility to the 100-F-31 septic system could not be located, but the area of the suspected pipeline location was remediated. The depth of remedial action ranged from 2.3 m (7.6 ft) at the north pipeline to 4.4 m (14.5 ft) at the south pipeline.

4.44.3 Verification Sampling

The 100-F-62 and 100-F-55 waste sites were combined for verification sampling, which was conducted between June 2011 and September 2011. The waste sites have been divided into four decision units: the north and south excavation footprints, the south excavation expansion, and the footprint of the waste staging pile areas.

4.44.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-62 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.45 100-F-64, YELLOW AND RED STAINED AREA ALONG RAILROAD TRACKS NEAR THE 1713-FA

4.45.1 History

The 100-F-64 waste site was discovered during a 100-F Area orphan sites walkdown on May 4, 2005. The site consisted of red and yellow stained soil that straddled railroad tracks located on the west side of the demolished 1713-FA Essential Materials Storehouse. This stained soil may have been associated with spills from historical railroad unloading activities at the site.

4.45.2 Excavation Operations

Remediation of the 100-F-64 waste site occurred from August 3 through 22, 2011. Approximately 312 BCM (408 BCY) of stained soil was removed from the site and direct loaded into trucks for disposal at ERDF. The excavation was located in two distinct areas, and all soil was directly loaded out for disposal. The deepest part of the 100-F-64 excavation extended to a depth of approximately 1.5 m (4.9 ft).

4.45.3 Verification Sampling

Verification sampling was conducted November 29, 2011. Twelve statistical soil samples were collected on the grid within the excavation footprint.

4.45.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-64 waste site achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.46 100-F-65, GREEN STAINED AREA ALONG RAILROAD TRACKS IMMEDIATELY WEST OF 190-F

4.46.1 History

The 100-F-65 waste site consisted of 7.3 m^2 (78.6 ft^2) of green-stained soil that was discovered during remediation of the 100-F-57, 190-F Process Water Pump House Debris waste site.

4.46.2 Excavation Operations

Remediation of the 100-F-65 waste site was performed on July 25, 2011. Contamination existed on the surface of the 100-F-65 waste site; therefore, no overburden material was stockpiled. The remediation resulted in approximately 84 BCM (109.9 BCY) of material being removed and disposed at ERDF. The maximum depth of remedial action was 1 m (3 ft). Additional material surrounding the 100-F-65 waste site was subsequently removed in the excavation layback for the 100-F-57:2 remediation.

4.46.3 Verification Sampling

Cleanup verification sampling at the 100-F-65 waste site was performed on May 22, 2012, to determine if the waste site meets RAOs and RAGs. A single focused sample was collected from the site.

4.46.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 100-F-65 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.47 116-F-1, LEWIS CANAL

4.47.1 History

The 116-F-1 Lewis Canal was a 1,744-m (5,722-ft)-long unlined canal. The canal was used to dispose of 105-F Reactor cooling water effluent and transport effluent to the Columbia River during the 1953 Ball 3X Project and during process tube cleaning activities. Effluent from the reactor entered the canal by two 122-cm (48-in.)-diameter pipelines. The pipelines are identified as 100-F-19:3.

4.47.2 Excavation Operations

Remedial action at the 116-F-1 waste site began in June 2002. Excavation of the site involved removing the overburden materials, buried sludge and debris, the contaminated structure, and underlying contaminated soil. In December 2002, excavation was completed for the main excavation. Initial sampling results indicated small areas of contamination in the shallow zone and overburden soils, and additional remediation of a small portion of the site was completed in January 2003. The general average elevation of the bottom of the excavation was at about 121 m

(396 ft) upon completion. The excavation was approximately 24,820 m^2 (267,000 ft^2) in area with a maximum depth of approximately 4.5 m (14.8 ft). Approximately 77,696 metric tons (76,469 US tons) of material from the site were disposed at ERDF.

4.47.3 Verification Sampling

Cleanup verification sampling began in December 2002 and finished in February 2002. The site consisted of shallow and overburden decision units. The shallow zone decision unit contained seven decision subunits that were divided into eight sampling areas. One composite cleanup verification sample was collected from each sample area.

4.47.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-1 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.48 116-F-2, 107-F LIQUID WASTE DISPOSAL TRENCH

4.48.1 History

The 116-F-2 waste site is located approximately 120 m (394 ft) from the Columbia River. The site received cooling water effluent from the 116-F-14 Retention Basin during reactor outages due to ruptures of fuel elements. The site was an open liquid trench that operated from 1950 to 1965. The site was fed by two emergency bypass ditches. One ditch was fed by a valve on the 100-F-19 pipeline, which originated at the 105-F Reactor, and then ran to the south end of the 116-F-14 Retention Basin. The second ditch connected the 116-F-2 trench to another valve on the 107-cm (42-in.) 105-F effluent pipeline (100-F-19). During deactivation of the 105-F Reactor, the 116-F-2 trench received overflow water from the 105-F FSB via the 116-F-14 Retention Basin.

4.48.2 Excavation Operations

Remedial action at the 116-F-2 waste site began on November 22, 2000. Excavation of the site involved removing the overburden materials and underlying contaminated soil. On April 17, 2002, the excavation was completed. The elevation of the bottom of the excavation was at 121.4 m (413.4 ft) upon completion. The excavation was approximately 15,352 m^2 (50,367 ft^2) in area with a depth of approximately 4.6 m (15 ft). Approximately 113,007 metric tons (124,534 US tons) of material from the site were disposed at ERDF.

4.48.3 Verification Sampling

Cleanup verification sampling began on May 21, 2002, and was finished on May 29, 2002. The 116-F-2 waste site consisted of shallow zone, deep zone, and overburden decision units. Each verification sample was a composite formed by combining soil collected at four randomly selected nodes within each sampling area.

4.48.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-2 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.49 116-F-3, 105-F STORAGE BASIN TRENCH

4.49.1 History

The 116-F-3 waste site is located south of the 105-F Reactor Building inside the 105-F Exclusion Area fence. In 1947, the site received reactor effluent from the 105-F Reactor Building during a fuel-failure outage. In 1951, the site was used for disposal of sludge from the 105-F FSB. During the 1970s, the site was surface stabilized and the remaining open trench filled in with 2.4 m (8 ft) of soil. During test pit activities in 1993, a buried pipe measuring 15 cm (6 in.) in diameter was found buried in the trench approximately 1.8 m (6 ft) below surface grade. The pipe was removed from the trench.

4.49.2 Excavation Operations

Remedial action at the 116-F-3 waste site began in October 2002. Excavation of the site involved removing the overburden materials and underlying contaminated soil. In January 2003, the majority of excavation was completed. Additional remedial excavation occurred in February 2003. At the conclusion of excavation activities, the elevation of the bottom of the excavation was at 121.7 m (399.3 ft). The excavation was approximately 843 m^2 (9,070 ft^2) in area with a depth of approximately 4.7 m (15.4 ft). Approximately 5,205 metric tons (5,738 US tons) of material from the site were disposed at ERDF.

4.49.3 Verification Sampling

Cleanup verification sampling began on January 6, 2003. Initial analytical results indicated areas of contamination, and additional remediation was completed. Following additional remedial excavation, resampling occurred on February 26, 2003. Verification sample data were replaced with resampling data and used in calculations for this site.

Each verification sample was a composite formed by combining soil collected at four randomly selected nodes within each sampling area. The 116-F-3 waste site consisted of only one shallow zone decision unit, which was divided into four sampling areas. One composite cleanup verification sample was collected from each sample area.

4.49.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-3 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.50 116-F-4, 105-F PLUTO CRIB

4.50.1 History

The 116-F-4 waste site is located southwest of the 105-F Reactor Building. The 116-F-4 Pluto Crib was used from 1950 to 1952 to dispose of water from individual reactor process tubes contaminated as a result of fuel element cladding failures. Water contaminated with fission products was diverted from the affected process tube within the reactor to the crib via an aboveground hose. The crib was covered with soil after its use was discontinued.

4.50.2 Excavation Operations

Excavation at the 116-F-4 waste site began on September 20, 1993, as part of a treatability study. The elevation of the excavation floor was 123.2 m (404.2 ft) upon completion, with a maximum depth of approximately 5.5 m (18 ft). To ensure excavation sidewall stability, the throat of the crib excavation was expanded from the initial 6- by 6-m (20- by 20-ft) dimension to approximately 29 by 29 m (95 by 95 ft). The resulting final excavation yielded 2,980 BCM (3,900 BCY) of uncontaminated overburden soil and 410 BCM (540 BCY) of contaminated soil. Approximately 700 metric tons (772 US tons) of material from the site were disposed at ERDF.

4.50.3 Verification Sampling

Cleanup verification sampling was conducted on November 10, 1993. The number and location of verification samples were chosen to ensure bias in order to indicate any potential remaining contamination. Two verification samples were taken at 4.3 m (14 ft), three at 5.5 m (18 ft), and one sample was collected for laboratory analysis from the bottom of test pit 1. Soil sampling was also conducted in the clean spoil pile, or overburden soil, to ensure that the soil set aside as potentially uncontaminated met the applicable requirements for use as clean fill.

4.50.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-4 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.51 116-F-5, BALL WASHER CRIB

4.51.1 History

The 116-F-5 waste site is located south of the 105-F Reactor Building. The 116-F-5 waste site was a liquid waste site that operated from 1954 to 1964 and received approximately 3,028 L (800 gal) of liquid decontamination wastes from the F Reactor ball washer assembly. The crib was used to dispose of spent wash fluids used to clean and decontaminate small steel-jacketed boron balls used in the Ball 3X safety system. Ground-penetrating radar data and subsequent field observations determined that the crib is constructed of a circular excavation, 2.7 m (9 ft) deep, approximately 6 m (20 ft) in diameter at the top, tapering down to a 3-m (10-ft) diameter at the bottom. The crib was fed by a 10-cm (4-in.)-diameter VCP that ran from the 105-F Building to the edge of the excavation, from which point a 10-cm (4-in.) schedule-40 steel pipe was used. The lines were approximately 1.2 m (4 ft) below grade.

4.51.2 Excavation Operations

A large test pit was excavated at the 116-F-5 waste site on July 30, 1997. The test pit excavation was an ellipse approximately 6 by 7.3 m (20 by 24 ft) by 3.7 m (12 ft) in depth. During test pit excavation, the entire 3- by 3-m (10- by 10-ft) by 2.7-m (9-ft)-deep crib structure (gravels) was excavated, field screened, and sampled. The test pit was backfilled to grade level with the excavated material. During the excavation contaminated material was not encountered. No material from the site was disposed at ERDF.

4.51.3 Verification Sampling

Cleanup verification sampling was performed on July 30, 1997, and consisted of a shallow decision unit. Five discrete samples from each depth interval were composited together for a total of four composite samples.

4.51.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-5 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.52 116-F-6, 1608-F LIQUID WASTE DISPOSAL TRENCH, 105-F COOLING WATER TRENCH

4.52.1 History

The 116-F-6 waste site is located southeast of the southeastern corner of the 105-F Reactor Building. The site was an unlined trench 91 m (300 ft) long, 30 m (100 ft) wide, and 3 m (10 ft) deep. The trench was used intermittently to dispose of cooling water from the 105-F Reactor via the 1608-F Pumping Station while maintenance and repairs were being performed on the effluent system. This practice was used during several reactor upgrades from 1952 through 1965. In the spring of 1956, effluent water overflowed the trench, flooding an area south of the site. The overflow was not treated as an unplanned release, but the trench area was expanded to include the area of the overflow.

4.52.2 Excavation Operations

Remedial action at the 116-F-6 waste site began in October 2002. Excavation of the site involved removing the overburden materials and underlying contaminated soil. In November 2002, the majority of excavation was completed. At the conclusion of excavation activities, the elevation of the bottom of the excavation was at 123 m (402 ft). The excavation was approximately 843 m^2 (9,070 ft^2) in area with a depth of approximately 5.2 m (17 ft). Approximately 32,156 metric tons (35,446 US tons) of material from the site were disposed at ERDF. No pipe was encountered at the southeast corner of the site. A pipe to the north-central part of the site was encountered, removed, and disposed at ERDF. This pipe was excavated to north of the site.

4.52.3 Verification Sampling

Cleanup verification sampling began on November 20, 2002. Each verification sample was a composite formed by combining soil collected at four randomly selected nodes within each sampling area. The site was consisted of shallow, deep, and overburden decision units.

4.52.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-6 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.53 116-F-7, 117-F CRIB AND PIPELINE, 116-F-7 SEAL PIT WATER CRIB AND PIPELINE

4.53.1 History

The 116-F-7 Seal Pit Water Crib and Pipeline is located 137 m (450 ft) south of the southwestern corner of the 105-F Building. The crib's 6-m (20-ft) square bottom is at a depth of 5.8 m (19 ft) and received radioactive process effluent. The crib was filled with gravel and covered with approximately 1.5 m (4.9 ft) of clean soil. The crib was marked by a 122-cm (48-in.)-diameter steel vent pipe. A distribution piping system of 15-cm (6-in.) perforated asbestos cement pipe, forming a cross, lies just beneath a polyethylene vapor barrier about 0.6 m (2 ft) below grade. The site includes the pipeline that originated at the 117-F Building and terminated at the crib site.

4.53.2 Investigation

Confirmatory sampling at the 116-F-7 waste site was performed on October 12, 2004, according to a stratified focused sampling approach and was developed based on historical information. Pipe scale was collected from the distribution pipes for analysis, and a sample of the soil at the interface of the crib bottom and native soil was also collected. Fifteen aliquots of soil, distributed across the excavated pit bottom, were collected and combined into one composite sample.

4.53.3 Statement of Protectiveness

The confirmatory sampling results demonstrate that remedial actions at the 116-F-7 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD and the site has been reclassified as "Interim Closed Out." These results show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils. The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. This site does not have residual contaminant concentrations that would require any deep zone institutional controls. In accordance with this evaluation, the confirmatory data support a reclassification of this site to "No Action."

4.54 116-F-8, 1904-F OUTFALL; AND 100-F-42, 1904-F SPILLWAY

4.54.1 History

The 116-F-8 waste site consisted of the former 1904-F outfall structure, an open-topped concrete weir box measuring 8.2 m (27 ft) by 4.3 m (14 ft) by 7.9 m (26 ft) deep, with all but the upper 0.3 m (1 ft) existing below grade. The structure was in use from 1945 to 1965.

The outfall structure was designed to channel reactor cooling water effluent from the 107-F Retention Basin (116-F-14 waste site) into two 1.07-m (42-in.) river outfall pipelines (100-F-39 waste site) exiting the northeastern side of the outfall structure. Waste effluent from the 100-F Area EAF, which was typically discharged to the adjacent 116-F-16 outfall structure, could also be diverted to the 116-F-8 outfall via a distribution box.

The outfall structure was also connected to an emergency overflow spillway (100-F-42), designed to control overflow in the event that flow could not be completely discharged via the outfall pipelines. The overflow spillway consisted of a reinforced concrete flume approximately 4 m (13 ft) wide and 0.6 m (2 ft) deep, and extended from the outfall structure into the Columbia River. The 100-F-42 waste site encompasses the portion of the overflow spillway and associated contaminated soils above the Columbia River ordinary high water mark.

Designed use of the outfall structure coincided with historic operations in the 100-F Area from 1945 to 1965. The above-grade portion of the structure was demolished into the cavity in 1979, and the site was backfilled and covered with clean soil.

4.54.2 Excavation Operations

Remedial action activities at the 116-F-8 and 100-F-42 waste sites were conducted from August 31, 2004, to September 22, 2005. Remediation involved excavation and staging of clean overburden material and removal of the demolished concrete outfall structure, the concrete spillway structure above the Columbia River ordinary high water mark, and contaminated soil to the extent required to satisfy the RAOs and corresponding RAGs. The residual

100-F-39 effluent pipelines was sealed with concrete prior to backfill of the remediation footprint. Contaminated materials were disposed at ERDF. Approximately 1,325 m^2 (14,260 ft^2) of plan area was excavated, including excavation within the deep zone (greater than 4.6 m [15 ft] bgs) up to 8 m (26 ft) bgs. Approximately 4,900 metric tons (5,400 US tons) of material from the sites was removed and disposed at ERDF.

4.54.3 Verification Sampling

Cleanup verification sampling was conducted from February 9 to 26, 2006. Each verification sample was composed of a composite sample formed by combining soil collected at the required number of randomly selected locations within each sampling area. Due to their immediate proximity and historic functional relationship, the 116-F-8 and 100-F-42 waste sites were combined into one unit for the purposes of decision unit stratification. The sites were divided into three decision units: shallow zone, deep zone, and overburden. The shallow zone consisted of the excavation sidewalls and floors that were less than 4.6 m (15 ft) bgs. The deep zone consisted of the portions of the excavation sidewalls and excavation floor that were more than 4.6 m (15 ft) bgs. The shallow zone decision unit contained one decision subunit, divided into four sampling areas. The deep zone decision unit contained one decision subunit, divided into three sampling areas. The overburden decision unit contained one subunit, divided into four sampling areas.

4.54.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-8 and 100-F-42 waste sites have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.55 116-F-9, ANIMAL WASTE LEACHING TRENCH

4.55.1 History

The 116-F-9 waste site is located approximately 120 m (394 ft) from the Columbia River. During the operative years of the 100-F Area EAF, animal pens housed animals used for experimental purposes. When the pens were cleaned, water containing animal wastes was flushed to the 116-F-9 trench. The site was therefore commonly known as the animal waste leaching trench. The site was associated with the 141-C Animal Barn and the 141-N Animal Waste Collection Facility. The trench operated from 1963 to 1976.

Historical documents describe the site as two trenches connected together, forming an irregular "Y" shape. The site was described as having dimensions of approximately 122 by 3 by 3 m (400 by 10 by 10 ft) in the longer leg, and approximately 30 by 3 by 3 m (100 by 10 by 10 ft) in the shorter leg. The site was backfilled after operation of the trench ceased, and although its boundary was not marked, it was within a larger area identified by concrete markers with underground radioactive material warning signs. During excavation, the northernmost portion of the trench contamination was found to extend farther northwest than expected, and extend farther west of its documented location at the southern end as well. The western boundary of the 116-F-9 excavation is adjacent to the excavation for the 116-F-14 (107-F) retention basin site.

4.55.2 Excavation Operations

Remedial action at the 116-F-9 waste site began on September 4, 2001. Excavation of the site involved removing the overburden materials and underlying contaminated soil. Contaminated materials were disposed at ERDF. A discolored area of soil smelling strongly of "rotten eggs" was encountered during excavation. The smell was most likely due to hydrogen sulfide, a byproduct of animal waste decomposition under aerobic conditions.

On March 25, 2002, the excavation was completed. The elevation of the bottom of the excavation was 120.3 m (394.7 ft) upon completion. The excavation was approximately 5,484 m^2 (59,029 ft^2) in area with a depth of approximately 5.8 m (19 ft). Approximately 49,405 metric tons (54,460 US tons) of material from the site were disposed at ERDF.

4.55.3 Verification Sampling

Cleanup verification sampling began on April 1, 2002, and was completed on April 10, 2002. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area. The site excavation was divided into shallow and deep zone decision units.

4.55.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-9 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.56 116-F-10, 105-F DUMMY DECONTAMINATION FRENCH DRAIN

4.56.1 History

The 116-F-10 waste site is located south of the 105-F Reactor Building. The 116-F-10 waste site was used to dispose of waste fluids derived from the decontamination of dummy fuel element spacers and other reactor hardware. The french drain was made of vitrified tile pipe 0.9 m (3 ft) in diameter by 3 m (10 ft) deep, resting on a bed of sand and gravel. The drain was used from 1948 until 1965 and received approximately 400,041 L (105,680 gal) of radioactive liquid rinses and spent nitric acid.

The site also included a 10-cm (4-in.)-diameter steel pipeline that discharged into the french drain about 1.2 m (4 ft) below grade. This pipeline originated at the "wash pad" located in the southeast corner of the 105-F Building FSB. The pipe ran to the northwest 9 m (30 ft) and then entered the 116-F-3 excavation. The 10-cm (4-in.)-diameter steel pipeline was removed without excavation during remediation of the FSB and the 116-F-10 french drain and 116-F-3 Storage Basin Trench waste sites. Field screening indicated there was no contamination in the pipeline, and the area was not included in the final cleanup verification sampling design. Because the two associated waste sites (116-F-3 and 116-F-10) were verified clean as shallow zone sites and the ends of the pipes originally terminated within the boundaries of these excavations, it can be concluded that the short distance between was also clean.

4.56.2 Excavation Operations

Remedial action at the 116-F-10 waste site began and was completed on October 22, 2002. Excavation of the site involved removing the french drain, the underlying contaminated soil, and the pipeline. The elevation of the bottom of the excavation was at 120.3 m (394.6 ft) upon completion. The excavation was approximately 195 m^2 (2,100 ft^2) in area with a maximum depth of approximately 4.4 m (14.4 ft). Approximately 848 metric tons (935 US tons) of material from the site were disposed at ERDF.

4.56.3 Verification Sampling

Cleanup verification sampling was conducted in December 2002. The 116-F-10 waste site consisted of only a shallow zone decision unit because the site only required excavation to a depth of 4.4 m (14.4 ft). Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area. The shallow zone decision unit contained one decision subunit, which was divided into four sampling areas

4.56.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-10 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations

support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.57 116-F-11, 105-F CUSHION CORRIDOR FRENCH DRAIN

4.57.1 History

The 116-F-11 french drain was located adjacent to the 105-F Reactor on the southeast side of the building. The french drain, constructed of 0.9-m (3-ft)-diameter tile pipe, buried vertically, received liquid decontamination waste from the cushion corridor area of the reactor. Several portions of the reactor building walls were removed during 105-F interim safe storage activities, prior to remediation of the 100-F-19:2 and 116-F-11 waste sites. During the remediation of the waste sites, there was little evidence of the 116-F-11 french drain. Reactor interim safe storage activities most likely removed the majority of the waste site during demolition of the reactor walls. The location of the 116-F-11 waste site was within the 100-F-19:2 excavation footprint and is therefore included here.

4.57.2 Excavation Operations

Remedial action at the 116-F-11 waste site was performed during excavation of the 100-F-19:2 pipeline. See Section 4.11.4 for details.

4.57.3 Verification Sampling

Cleanup verification sampling for the 116-F-11 waste site was conducted as part of the 100-F-19:2 pipeline verification sampling. See Section 4.11.5 for details.

4.57.4 Statement of Protectiveness

The verification sample results confirm that remedial action at the 116-F-11 waste site achieved RAOs and corresponding RAGs established in the interim action ROD. The remaining soils at these sites have been sampled, analyzed, and evaluated. These results also indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. The acceptability of unrestricted direct exposure to deep zone soils has not been demonstrated; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.58 116-F-12, 148-F FRENCH DRAIN

4.58.1 History

The 116-F-12 french drain is located northeast of the 105-F Reactor building and due north of the northwest corner of the 116-F-14 Retention Basin. The 116-F-12 french drain was used to dispose of effluent pump prime recovered from the 148-F Pumphouse from 1944 to 1964.

4.58.2 Excavation Operations

The 116-F-12 waste site remedial action was conducted during the excavation of 100-F-19:1 pipeline. See Section 4.11.2 for details.

4.58.3 Verification Sampling

Cleanup verification sampling for the 116-F-12 waste site was conducted as part of the 100-F-19:1 pipeline verification sampling. See Section 4.11.3 for details.

4.58.4 Statement of Protectiveness

The verification sample results confirm that remedial action at the 116-F-12 waste site achieved RAOs and corresponding RAGs established in the approved interim action ROD. The remaining soils at these sites have been sampled, analyzed, and evaluated. These results also indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. The acceptability of unrestricted direct exposure to deep zone soils has not been demonstrated; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.59 116-F-13, 1705-F EXPERIMENTAL GARDEN FRENCH DRAIN

The site has been described as a french drain. A review of documents and drawings has found no indication that a french drain ever existed at the 1705-F Experimental Garden. Therefore, the 116-F-13 french drain is not accepted as a waste site.

4.60 116-F-14, 107-F RETENTION BASIN

4.60.1 History

The 116-F-14 waste site is located east-northeast of the 105-F Reactor Building. The basin was used to hold discharged reactor water for a brief period of time, allowing radioactive decay and thermal cooling to occur before the water was discharged to the Columbia River. Shortly after

the reactor was shut down in 1965, water inside the basin was pumped to the 116-F-2 overflow trench. One and a half meters (5 ft) of clean fill material was placed over the sludge in the bottom of the basin, and the basin walls were spray coated with asphalt. The steel aboveground effluent pipeline that ran from the reactor building to the basin was cut into sections that were placed on top of the fill in the east section of the basin. Additional decommissioning tasks were completed in 1978 to 1979 during which the upper 3 m (10 ft) of the basin's vertical walls were knocked down and the effluent pipe sections were moved to the west basin section. The basin decommissioning continued in stages through 1999.

4.60.2 Excavation Operations

Remedial action at the 116-F-14 waste site began on July 27, 2000. Excavation of the site involved removing the overburden materials, debris, and underlying contaminated soil. On September 4, 2001, the majority of the site excavation was completed. The elevation of the bottom of the excavation was at 121.4 m (398.3 ft) upon completion. Additional remedial excavation in the shallow zone occurred on October 16, 2001; December 10, 11, and 13, 2001; and January 16, 2002. The excavation was approximately 20,039 m^2 (215,698 ft^2) in area with a depth greater than 4.6 m (15 ft). Approximately 212,015 metric tons (233,707 US tons) of material from the site were disposed at ERDF.

4.60.3 Verification Sampling

Cleanup verification sampling began in the shallow zone on October 29, 2001, and deep zone sampling occurred on September 17, 2001. Initial results indicated areas of contamination, and additional remediation was completed. Following additional remedial excavation re-sampling events occurred on December 17, 2001, and January 16, 2002, in the shallow zone.

One composite cleanup verification sample was collected from each sample area. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area.

4.60.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-14 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.61 116-F-15, 108-F RADIATION CRIB

4.61.1 History

The 116-F-15 waste site is located east of the 105-F Reactor Building. The 116-F-15, 108-F Radiation Crib was a 0.9- by 0.9-m (3- by 3-ft) concrete sump near the center of the former 108-F Building first floor. The sump system connected to a subgrade pipe trench that ran north and south along the first floor. The trench was approximately 0.9 m (3 ft) tall, 0.3 m (1 ft) wide, and 61 m (200 ft) long, and drained from both ends into the sump. Many laboratory floor and hood drains were connected to the trench and sump. A 15-cm (6-in.) earthenware pipeline exited the sump and the building to the south.

4.61.2 Excavation Operations

Remediation of the 116-F-15 waste site was performed on September 26, 2005, to locate and remove the piece of contaminated pipe that was found during the 2002 excavation activities (and to verify that the sump was removed during the 1999 demolition of the 108-F Biological Laboratory. Remediation consisted of the removal of approximately 86 metric tons (95 US tons) of material, including concrete debris, piping, and soil, which was disposed at ERDF. The soil was excavated and field surveyed to a depth of approximately 2.6 m (8.5 ft). The contaminated cast-iron pipe found during the February 2002 excavation was not located during this remedial action. Therefore, an additional test pit was excavated on November 29, 2005, in an attempt to locate the contaminated 15-cm (6-in.)-diameter cast-iron pipe. The additional excavation was unsuccessful, and the excavated material was placed back in the pit. Additional efforts in July 2006 to locate the contaminated pipe using a metal detector were also unsuccessful. However, the contaminated 15-cm (6-in.)-diameter cast-iron pipe (100-F-26:4) was found during test pitting activities in December 2006. The contaminated pipe is associated with the 100-F-26:4 pipeline site and is not a part of the 116-F-15 sump as previously indicated.

4.61.3 Verification Sampling

Verification sampling at the 116-F-15 waste site was performed on December 12, 2006, using a statistical design. The 116-F-15 waste site consisted of only a shallow zone decision unit because the site only required excavation to a depth of 2.6 m (8.5 ft).

4.61.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-15 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent

uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.62 116-F-16, PNL OUTFALL; AND 100-F-43, SPILLWAY FOR PNL OUTFALL

4.62.1 History

The 116-F-16 waste site consisted of the former outfall for the EAF process sewer (100-F-29 waste site). The outfall was a direct discharge the 100-F-43 spillway. No other effluent discharge mechanisms were associated with the 116-F-16 outfall.

The 100-F-43 waste site was a 4.6-m (15-ft)-wide concrete structure spillway extended from the 116-F-16 outfall to the Columbia River shoreline and into the river. The spillway was in use from 1956 to 1976. An engineered erosion barrier composed of heavy riprap was constructed at the discharge end of the concrete structure.

4.62.2 Excavation Operations

Remedial action activities at the 116-F-16 and 100-F-43 waste sites were conducted from August 31, 2004, to September 8, 2005. Remediation involved excavation and staging of clean overburden material and removal of the outfall, the concrete spillway structure above the ordinary high water mark, and contaminated soil. Contaminated materials were disposed at ERDF. Approximately 384 m^2 (4,130 ft^2) of plan area was excavated, with all remedial activities restricted to the shallow zone (less than 4.6 m [15 ft] bgs). Approximately 2,090 metric tons (2,300 US tons) of material from the site was removed and disposed at ERDF.

4.62.3 Verification Sampling

Verification sampling was conducted on February 13 and 15, 2006. Each verification sample was composed of a composite sample framed by combining soil collected at the required number of randomly selected locations within each sampling area. Due to their immediate proximity and historic functional relationship, the 116-F-16 and 100-F-43 waste sites were combined into one unit for the purposes of decision unit stratification. The combined site included shallow zone and overburden decision units. The shallow zone decision unit contained one decision subunit, divided into four sampling areas. The overburden decision unit for the site contained one subunit, divided into four sampling areas.

4.62.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 116-F-16 and 100-F-43 waste sites have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that

contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.63 118-F-8:1, 105-F REACTOR BELOW STRUCTURE AND UNDERLYING SOILS, 118-F-8:3, 105-F FUEL STORAGE BASIN, AND 118-F-8:4 FUEL STORAGE BASIN WEST SIDE ADJACENT AND SIDE SLOPE SOILS

4.63.1 History

The 105-F Reactor was a graphite-moderated, water-cooled reactor that was used to produce weapons-grade plutonium. Construction of the 105-F Reactor began December 1943, with operations commencing in February 1945. The 105-F Reactor was retired in June 1965. The primary source of contamination to the concrete structures and soils was sodium dichromate-treated reactor cooling water and fuel storage basin (FSB) water that became contaminated through contact with fuel elements and components from the reactor cooling system. The 118-F-8:1, 118-F-8:3, and 118-F-8:4 subsites represent the 105-F below-grade structure/underlying soils, FSB, and FSB adjacent/side slope soils, respectively. Soil directly beneath the 105-F Reactor (i.e., accepted 118-F-8:2 subsite) has not been remediated.

4.63.2 Excavation Operations (118-F-8:1, 118-F-8:3)

Removal and disposal activities at the 105-F site began in 1999 and concluded in December 2003. Excavation of the site involved removing the building structures, debris, and underlying contaminated soil. The 105-F D&D activities resulted in removal of above- and below-grade structures outside of the 105-F Reactor core shield walls, to a minimum of 0.9 m (3 ft) below surrounding grade. Approximately 22,132 metric tons (24,345 US tons) of contaminated materials were disposed at ERDF. Specific areas are discussed below.

Zone 2 – Valve Pit (Included in the 118-F-8:1 Subsite). The valve pit walls were removed to a minimum of 0.9 m (3 ft) below the surrounding surface grade. Because of elevated levels of hexavalent chromium and PCBs in the valve pit floor, the concrete floor was removed and disposed at ERDF. The former floor of the zone 2 valve pit was located 4.8 m (15.8 ft) below surrounding grade. The soils underlying the former floor were sampled and analyzed for hexavalent chromium and PCBs.

Zone 3 – Shallow Structures (Included in the 118-F-8:1 Subsite). The zone 3 structures are within the shallow zone (i.e., 4.6 m [15 ft] or less bgs). Zone 3 includes the solids feed area, the gas recirculation tunnel, the trench under the accumulator room, the east water tunnel, and the flow laboratory basement. The gas recirculation tunnel was removed in its entirety so that the underlying pipe tunnel (zone 4) could be accessed. All of the other below-grade walls, including ceilings, associated with the zone 3 structures were removed to a minimum of 0.9 m (3 ft) below the surrounding grade. In addition, because of elevated levels of hexavalent chromium, the

solids feed area concrete floor was removed and disposed at ERDF. The former floors of the solids feed area and the gas recirculation tunnel were located at respective depths of 3.4 m (11 ft) and 4.4 m (14.5 ft). The floors of the trench under the accumulator room, the east water tunnel, and the flow laboratory are located at the respective depths of 4.4 m (14.5 ft), 3.8 m (12.5 ft), and 3 m (10 ft) below surrounding grade. The soils underlying the former solids feed area floor were sampled and analyzed for hexavalent chromium.

Zone 4 – Deep Zone Structures (Included in the 118-F-8:1 Subsite). The concrete floors of the zone 4 structures are within the deep zone (i.e., greater than 4.6 m [15 ft] bgs). Zone 4 includes the east and west inlet water tunnels, the pipe tunnel, the 315 and 316 exhaust plenums, and the southeast tunnel. All of the concrete ceilings associated with zone 4 structures were removed. In addition, all zone 4 walls were removed to a minimum of 0.9 m (3 ft) below the surrounding surface grade. None of the zone 4 concrete floors required removal and were therefore left in place. The floors of the east and west inlet water tunnels, the pipe tunnel, the 315 plenum, the 316 plenum, and the southeast tunnel are located at the respective depths of 4.6 m (15 ft), 5 m (16.5 ft), 4.9 m (16 ft), 5 m (16.5 ft), and 6 m (20 ft) below surrounding grade.

Equipment Decontamination Areas (Included in the 118-F-8:1 Subsite). Approximately 1 m (3 ft) of contaminated soil from equipment decontamination activities was removed from the equipment decontamination areas and disposed at ERDF. Excavation and disposal were conducted in December 2003.

Zone 1 – Fuel Storage Basin (Included in the 118-F-8:1 Subsite). The 105-F FSB was excavated and removed in its entirety. The portion of the FSB excavation included in the cleanup verification package (CVP) consists of the soils directly underlying the former FSB. The south and east side slope portions of the FSB excavation were included with an adjacent pipeline. Cleanup verification of the east and south side slope areas of the FSB excavation are included in the CVP for the 100-F-19:2 pipelines.

4.63.3 Excavation Operations (118-F-8:4)

Remedial action of the 118-F-8:4 subsite began on March 14, 2007, and was completed on June 22, 2007. Excavation of the site involved removing the uncontaminated overburden and the underlying contaminated soil. Approximately 2,950 BCM (3,859 BCY) of uncontaminated overburden soil was removed and stockpiled near the excavation for subsequent use as backfill. Approximately 1,650 BCM (2,158 BCY) of contaminated soil was disposed at ERDF. At the conclusion of remediation activities, the elevation of the deepest part of the excavation was approximately 118.5 m (389 ft) above mean sea level with a maximum depth of approximately 8 m (26 ft) bgs. The excavation was approximately 1,634 m^2 (17,580 ft^2).

4.63.4 Verification Sampling (118-F-8:1 and 118-F-8:3)

Zone 2 – Valve Pit (Included in the 118-F-8:1 Subsite). Zone 2 contains both shallow and deep zone decision units. Concrete verification samples were collected from the shallow zone valve pit floor and walls in 11 floor and 14 wall locations. Floor samples were collected on

January 3 and 4, 2000. Wall samples were collected on July 24 and 25, 2000. The wall samples were analyzed for the nonradionuclide constituents (PCBs, lead, mercury, and hexavalent chromium). The wall samples were not analyzed for radionuclide constituents because the conceptual site model for concrete structures confirmed the floor was the primary radiologically contaminated area of the valve pit as supported by field screening data.

Since hexavalent chromium was detected in the concrete floor at elevated concentrations, the floor was demolished and disposed at ERDF. Samples were collected from the deep zone underlying soils on August 24, 2000. The samples obtained from the soil underneath the valve pit floor were analyzed for hexavalent chromium and PCBs. The mercury and lead data obtained from the concrete floor were used in conjunction with the mercury and lead data from the valve pit walls to verify cleanup of the valve pit for lead and mercury. The radionuclide data obtained from the concrete floor were used to represent the remaining concrete walls as well as surrounding and underlying deep zone soil.

Zone 3 – Shallow Zone Structures (Included in the 118-F-8:1 Subsite). Zone 3 is a shallow zone decision unit and includes the solids feed area, the flow laboratory basement, the east water tunnel, the trench beneath the accumulator room, and the 103 gas recirculation tunnel.

Solids Feed Area. Concrete verification samples were collected from 35 floor and 14 wall locations in the solids feed area. The floor samples were collected between January 4 and 12, 2000. The wall samples were collected on August 1 and 2, 2000. The wall samples were analyzed for the nonradionuclide constituents (lead and hexavalent chromium). The wall samples were not analyzed for radionuclide constituents because based on the conceptual site model for concrete structures and confirmed by field screening results, the floor was the primary radiologically contaminated area in the solids feed area. The radionuclide results from the floor were used to represent the radionuclide concentration of the solids feed area walls.

Since hexavalent chromium was detected in the concrete floor at elevated concentrations, the floor was demolished and disposed at ERDF. Samples from 14 locations were then obtained from the soil underlying the solids feed area on August 22, 2000. Because of elevated concentrations of hexavalent chromium in two soil sample locations, soil from those areas was removed and two additional samples collected on October 11, 2000. The samples obtained from the soil underneath the solids feed area floor were analyzed for hexavalent chromium. The lead data from the concrete floor were used in conjunction with the lead data from the walls to verify cleanup for lead. The radionuclide data obtained from the concrete floor were used to represent the remaining concrete walls as well as surrounding and underlying soil.

Flow Laboratory Basement. Concrete floor samples were collected from three locations in the flow laboratory basement on January 3, 2000. Of the areas within zone 3, hexavalent chromium was identified as a COC for the solids feed area only; therefore, samples collected from the other zone 3 areas or rooms were not analyzed for hexavalent chromium.

East Water Tunnel. Concrete floor samples were collected from two locations in the east water tunnel on February 22, 2000.

Accumulator Room Trench. Concrete floor samples were collected from five locations in the accumulator room trench on February 1, 2000.

Gas Recirculation Tunnel. Verification samples were not collected from the gas recirculation tunnel because the structure was removed in its entirety. The structure required removal for accessing the underlying pipe tunnel.

Zone 4 – Deep Zone Structures (Included in the 118-F-8:1 Subsite). Zone 4 is a deep zone decision unit that includes the east and west inlet tunnels, the southeast tunnel, the 315 and 316 exhaust plenums, and the pipe tunnel. Verification samples were collected from the concrete floors of the zone 4 structures in accordance with the conceptual site model. The conceptual site model specified, and confirmed through field screening, that the floors of the structures provide a worst-case representation of the residual contaminant concentrations.

East and West Inlet Tunnels. Concrete floor samples were collected from four locations in the inlet tunnels on December 29, 1999.

Southeast Tunnel. Concrete floor samples were collected from five locations in the southeast tunnel on February 1, 2000.

315 and 316 Exhaust Plenum. Concrete floor samples were collected from 14 locations in the two exhaust plenums on February 29, 2000.

Pipe Tunnel. Concrete floor samples were collected from 14 locations in the pipe tunnel on February 22, 2000.

Equipment Decontamination Areas (Included in the 118-F-8:1 Subsite). The equipment decontamination areas are a shallow zone decision unit and include two areas in the vicinity of the 105-F Building that were used during equipment D&D activities. The sample results from the two equipment decontamination areas were combined into one unit for cleanup verification. Four verification samples were collected in December 2003.

Zone 1 – Fuel Storage Basin Underlying Soil (Included in the 118-F-8:3 Subsite). Zone 1 is a deep zone decision unit that includes soils underlying the former 118-F-8:3 FSB. Soil verification samples were collected from 13 locations beneath the former FSB on December 4 and 5, 2002. The verification sampling of the south and east portions of the FSB excavation were included with an adjacent pipeline.

4.63.5 Verification Sampling (118-F-8:4)

Cleanup verification sampling began on May 31, 2007, and concluded on June 22, 2007. The site was divided into three decision units: shallow zone excavation, deep zone excavation, and overburden stockpiles. Four composite samples were collected from the shallow zone, 4 composite samples were collected from the deep zone, and 16 composite samples were collected from overburden stockpiles.

4.63.6 Statement of Protectiveness

The verification sample results confirm that remedial actions at the 118-F-8:1, 118-F-8:3, and 118-F-8:4 subsites have achieved the RAOs and corresponding RAGs established in the approved interim action ROD and EPA (et al. 1998). These results also indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. The acceptability of unrestricted direct exposure to deep zone soils has not been demonstrated; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.64 126-F-2, 183-F CLEARWELL

4.64.1 History

The 126-F-2 waste site consisted of the clearwells and collocated pumphouse that were formerly part of the 183-F water treatment facility. Located north of the 105-F Reactor Building and south of the former 182-F reservoir these units were used as part of the cooling water treatment train for the 105-F Reactor from 1944 to 1965. Chemical addition to this point in the treatment train was limited to coagulants (alum and hydrated calcium oxide), pH adjustment (sulfuric acid), and chlorination.

The clearwells were composed of two separate, covered, predominantly below-grade structures with a combined capacity of approximately 34 million L (9 million gal). In the late 1970s, the cover for the eastern clearwell structure was demolished and the basin partially filled with demolition debris that has since been removed as part of remedial activities. The cover for the western clearwell structure remains intact, and the facility is believed to be a bat-roosting site. The pumphouse was partially demolished and buried in place. The site presently appears as an open, empty basin (eastern clearwell) and a structure covered with a near-grade roof (western clearwell).

4.64.2 Excavation Operations

Remediation of the 126-F-2 waste site was performed from July to September 2005 and consisted of the removal of debris within the eastern clearwell structure down to the concrete floor. No staining or other visual evidence of residual contamination was observed at the floor. Approximately 28,986 metric tons (31,952 US tons) of material was removed and staged at an area adjacent to the clearwells before disposal at ERDF. No remedial activities were performed at the western clearwells, because the roof is intact and the facility is not known to have been used for the disposal of any demolition debris or other potentially hazardous substances.

4.64.3 Verification Sampling

Verification sampling at the 126-F-2 waste site was performed on December 14, 2005. Sampling consisted of the collection of 25 aliquots from across the staging area that were used to generate a primary sample.

4.64.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 126-F-2 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The deep zone portion of the eastern clearwell structure has been shown to meet direct exposure criteria; therefore, no deep zone institutional controls are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.65 128-F-2, 100-F BURNING PIT

4.65.1 History

The 128-F-2 waste site is located adjacent to the Columbia River and includes the former 100-F Burning Pit. The waste site was an irregularly shaped depression that was used for incinerating nonradioactive, combustible materials (e.g., vegetation, office waste, paint waste, and chemical solvents) from 1945 to 1965. During Hanford Site cleanup operations in the late 1970s, unknown quantities of debris were removed from the burn pit and the site.

The 100-F-59, Riparian Area Contamination originating from 128-F-2 waste site was originally part of the 128-F-2 waste site. This area, below the ordinary high water mark adjacent to the river, contains metals and organic contaminants above the soil RAGs. According to WIDS, the 100-F-59 waste site was created to address contamination below the ordinary high water mark.

4.65.2 Excavation Operations

Remediation of the waste site was performed from August 2005 through March 2008 in phases. A total of 34,540 metric tons (38,000 US tons) of material were removed and disposed. The maximum depth of remedial action was 6 m (19 ft). Debris unearthed in the waste site included brick, wood, fiberglass, wire, sheet metal, rebar, burned paper, plastic, concrete, cement blocks, pipe, burned tires, steel, electrical conduit, lead weights, nails, bolts, and other unspecified building materials.

4.65.3 Verification Sampling

Verification sampling in the 128-F-2 waste site occurred on various dates in 2007 and 2008. In two cases, a second round of verification sampling was required because elevated levels of contaminants necessitated additional remediation. In the first case, a second sample design was created after initial verification sampling showed the soils contained elevated hexavalent chromium concentrations. The area underwent additional excavation and was then sampled for this constituent only using the second design. In the second case, results from a single sample location showed detectable levels of some organics. Although none of the results exceed direct exposure RAGs, this area underwent additional remediation due to its proximity to the Columbia River. This single location was then re-sampled for all COCs/COPCs to verify site cleanup.

4.65.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 128-F-2 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.66 132-F-1, 132-F-1 CHRONIC FEEDING BARN, 141-F SHEEP BARN

4.66.1 History

The 132-F-1 waste site is the former location of the 141-F Chronic Feeding Sheep Barn that was part of the EAF at the 100-F Area. When in use, the site was an L-shaped concrete block building with a concrete floor and concrete animal pens located both inside and outside the building. The 141-F Building was connected to a special sewer system designed for handling radioactive waste. Contaminated manure and sawdust that could not be shoveled out of the animal pens was washed into the sewer, which went to the 141-N sump. When the sump became full, the wastewater was pumped through a screen to the Columbia River via the process sewer system (100-F-29). The solids trapped by the screen were dried and sent to the 118-F-5 sawdust pit. In 1963, the 116-F-9 Animal Leach Trench was constructed 46 m (150 ft) from the northeast corner of the 116-F-14 Retention Basin, and the liquid portion of the contaminated pen washdown wastewater from the 141-N sump was diverted to this trench.

4.66.2 Excavation Operations

Excavation began August 9, 2005, and extended through August 12, 2005. Approximately 3,400 BCM (4,400 BCY) of soil and debris was excavated and staged onsite before disposal at ERDF. Remediation of the 132-F-1 waste site consisted of the removal of all material within the building footprint to a depth of approximately 1 m (3 ft) bgs. Removed material included concrete building foundation debris and piping debris. Sections of 4-in.-diameter cast iron piping appeared to have been animal stall drain piping. The greatest levels of radiological contamination, predominantly Sr-90, were found inside the cast iron piping. Excavation began August 9, 2005, and extended through August 12, 2005.

4.66.3 Verification Sampling

Verification sampling was conducted January 25, 2006. Statistical sampling was required for this site because the spatial distribution of potential residual soil contamination over the study area (site) was uncertain. Therefore, sampling locations were distributed over the entire site on a grid basis in an effort to determine the residual presence of contamination. The site was divided into two decision units for verification sampling. The first decision unit was delineated based on the surveyed limits of excavation, and the second decision unit was composed of the staging pile footprint.

4.66.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 132-F-1 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.67 132-F-2, INHALATION LABORATORY, 144-F, 144-F

The site was a laboratory that was part of the EAF. The building has been demolished. It was a rectangular one-story, 302-m^2 (3,250-ft^2) concrete block building. The building contained an office, laboratories, and indoor and outdoor animal runs. During the April 1999 visit, a survey-grade global positioning system was used to locate the site using its mapped coordinates. A wooden stake was found in the ground at those coordinates. No evidence of the site was found. However, the area had been disturbed by heavy equipment, concrete chunks were visible, and vegetation was sparse. Much of the former building site was excavated during the remediation of waste site 132-F-1 in 2005. For these reasons, the site was "Not Accepted" as a waste site.

4.68 132-F-3, 115-F GAS RECIRCULATING FACILITY

4.68.1 History

The 115-F Gas Recirculation Facility was in operation between 1943 and 1965, concurrent with startup and shutdown of the 105-F Reactor. The 115-F Gas Recirculation Facility was a single-story, reinforced-concrete structure 51 m (168 ft) long (including the fan room) and up to 30 m (98 ft) wide. Approximately 6 m (20 ft) of the structure was above grade, with perimeter walls extending 4 m (13 ft) below grade. A 6-m- (18-ft)-wide operating gallery extended through the center of the building, flanked on either side by cells that contained the gas processing equipment. The reinforced-concrete cell walls, ceiling, and floors were 1 m (3 ft) thick. The service section (containing the ventilation fan, air compressor, office, and locker room) was located at right angles to the operating gallery, extending across the full width of the building at the west end. The ventilation fan supplied fresh air to the operating gallery, office, and locker room. The main gas lines to and from the 105-F Building entered the recirculation facility through an 11-m (36-ft)-wide by 2.5-m (8-ft)-high pipe tunnel that ran beneath the full length of the facility. Processing consisted of cooling the gas and condensing the moisture that was picked up from the reactor, passing the gas through a drying tower containing silica gel, and then filtering the gas before feeding it back into the reactor inlet gas header. The 115-F Gas Recirculation Facility decommissioning activities included radiological characterization, removal of tunnel piping, equipment/waste disposal, and demolition/site grading.

4.68.2 Investigation

Based on the characterization results, a calculation methodology known as "allowable residual contamination level" (ARCL) was used to evaluate the potential radiological dose to a hypothetical, maximally exposed site resident if the site was released for unrestricted use after the demolition and burial in situ of the facility. The ARCL calculation results indicated that the facility was ready for demolition activities, which began in July 1984 and were completed in October 1984. The below-grade perimeter walls were demolished to at least 1 m (3 ft) below grade. Remaining walls were left intact to provide containment for the rubble. The entire area was covered with clean backfill at least 1.2 m (4 ft) deep. Final grading to approximate the surrounding terrain added another 1 m (3 ft) of clean backfill material over the demolition site.

Using the greatest activities from the characterization data to represent residual contamination levels over 100% of the inner surface area of the former facility, RESRAD modeling was performed in 2003 to support the previous decision to demolish and bury the facility in place. The RESRAD modeling accounts for radioactive decay from 1984 (the year of demolition) to 2003, and predicts that the site achieves the dose limits and risk objectives for rural-residential land use, groundwater protection, and river protection.

4.68.3 Statement of Protectiveness

Based on the characterization of concrete samples, ARCL calculation, and RESRAD modeling, the RAOs and the corresponding RAGs established in the interim action ROD (EPA 1999) have been achieved at the 132-F-3 waste site . Any residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that based on RESRAD modeling, pose no threat to groundwater or the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "No Action."

4.69 132-F-4:1, 116-F REACTOR STACK DEMOLITION SITE AND 132-F-4:2, 116-F REACTOR EXHAUST STACK BURIAL

4.69.1 History

The 132-F-4:1 stack was used to dispose of exhaust air that originated from work areas within the 105-F Reactor Building beginning in 1945. The stack originally discharged unfiltered air into the atmosphere until operation of the 117-F Filter Building began in 1960. Clean air entered uncontaminated portions of the reactor building, passed through zones with increasing levels of contamination, was directed through particulate and activated charcoal filters in the 117-F Filter Building, and then discharged into the atmosphere through the exhaust stack. Operation of the stack was shut down in 1965. The stack consisted of a reinforced concrete structure 61 m (200 ft) high, with a base diameter of 5.05 m (16.6 ft) and a maximum wall thickness of 0.46 m (1.5 ft) at its base. A double octagon base that extended 5.3 m (17.5 ft) below grade provided the stack foundation. A 0.15-m (0.5-ft) drain pipe was installed in the bottom of the stack, and an inlet duct was attached approximately 3 m (10 ft) above the base.

Before demolition, the inlet duct was disconnected from the stack and disposed of separately. A thin layer of contaminated sand-like material that had accumulated on the stack floor over the years from deterioration of the inner stack surface was removed using vacuum cleaners and disposed of separately as waste. Interior surfaces of the stack base were coated with an as-low-as-reasonably-achievable coat to render any contamination nonsmearable and inhibit contamination spread during blasting. A trench 6 m (20 ft) wide, 5.5 m (18 ft) deep, and 61 m (200 ft) long was excavated between the 115-F and 117-F Building sites. The 116-F stack and foundation were demolished by explosives on September 14, 1983. Rubble from the stack foundation was pushed into the trench using heavy equipment. The trench containing the stack rubble was covered with clean fill to a depth at least 1 m (3.3 ft).

The 132-F-4:2 Reactor Stack Base was a monolithic concrete stack base and foundation and included an imbedded stack condensate drain line. The stack base was buried in place about 0.5 m (1.5 ft) east of the 132-F-4 Reactor Stack Burial Trench. The 5.6-m (18.5-ft)-diameter octagonal stack base was removed to about 1 m (3 ft) below grade and extends to 7.2 m (23.5 ft) below grade. The vertical 15-cm (6-in.) cast iron condensate drain pipe in the center of stack base exited the side of the concrete monolith about 1.6 m (5 ft) below grade. The condensate

drain line from the stack base to the 105-F Building process sewer was removed during the demolition activities for the 105-F Reactor below-grade structures.

4.69.2 Investigation

Using ARCL calculation methodology in 1985 it was determined that no further decontamination or remedial action was needed prior to demolition and in situ burial. The radionuclide inventories for the exhaust stack were determined from radiological characterization results from concrete samples collected in 1980 and 1983. The ARCL calculations for rubble from the 116-F exhaust stack determined that the residual radionuclide dose would be less than the acceptable dose criteria for a residential scenario. Consequently, the 116-F exhaust stack was demolished and the burial site was considered to meet the release criteria for unrestricted use.

Using the greatest activities from the characterization data to represent residual contamination levels over 100% of the inner surface area of the former stack, RESRAD modeling was performed in 2003 to support the previous decision to demolish and bury the stack in place. The RESRAD modeling accounts for radioactive decay from 1980 (the year of the characterization data) to 2003 and predicts that the site achieves the dose limits and risk objectives for rural-residential land use, groundwater protection, and river protection.

4.69.3 Statement of Protectiveness

Based on the characterization of concrete samples, ARCL calculation, and RESRAD modeling, the RAOs and the corresponding RAGs established in the interim action ROD (EPA 1999) have been achieved at the 132-F-4:1 and 132-F-4:2 waste sites. Any residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that, based on RESRAD modeling, pose no threat to groundwater or the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "No Action."

4.70 132-F-5, 117-F FILTER BUILDING

4.70.1 History

The 117-F Filter Building began operation in 1960 (approximately 15 years after startup of the 105-F Reactor) to filter reactor exhaust air before its routing to the 116-F Exhaust Stack. The building is essentially identical to the other 100 Area 117 filter buildings. Reactor exhaust air was routed to the filter building via an underground concrete inlet duct, filtered through high-efficiency particulate air and activated charcoal filters, and then routed to the stack via an underground exhaust duct. The building was a reinforced-concrete structure that was approximately 18 m (59 ft) long, 11.9 m (39 ft) wide, and 10.7 m (35 ft) high. About 2.4 m (8 ft) of the building was above grade. The concrete walls and floors were typically 0.3 m (1 ft) thick, with a maximum thickness of 0.6 m (2 ft). The building was connected to the 105-F Building

exhaust air system by a 12-m (40-ft)-long underground inlet duct. An 18.3-m (60-ft) discharge duct conveyed the filtered air to the exhaust stack opening. The ducts were made of reinforced concrete, with a maximum wall thickness of 0.3 m (1 ft). Inner surfaces of the building that were exposed to airflow through the facility were coated with a 0.1-cm (0.04-in.)-thick layer of vinyl-based paint that provided a hard, smooth barrier over the concrete. The 117-F Filter Building operated for a 5-year period.

The 117-F Filter Building and associated below-grade ductwork were decommissioned and demolished in 1983. Dust was vacuumed from the walls and floors to prevent spread of loose contamination. Filter equipment was removed and bagged. Decontamination activities consisted of using Masslin cloth, wire brushes, and other techniques on the equipment and on the vinyl-based coating of the exposed surfaces. Contaminated equipment was packaged and shipped to the Hanford Site 200 West Area burial grounds for disposal. As part of decommissioning activities, extensive radiological surveys were performed and samples were collected to evaluate the potential radiological dose to a hypothetical, maximally exposed site resident if the site was released for unrestricted use after the demolition and burial in situ of the facility. The characterization results indicated that the facility was ready for demolition. Demolition and site grading were performed in November 1983, using conventional heavy equipment. The rubble was buried under at least 1 m (3 ft) of clean fill and the site was graded to blend with the natural terrain.

4.70.2 Investigation

Extensive radiological surveys were performed and samples were collected to evaluate the potential radiological dose to a hypothetical, maximally exposed site resident if the site was released for unrestricted use after the demolition and burial in situ of the facility. All surfaces, components, and pipe penetrations were 100% surveyed for alpha and beta-gamma contamination. Final survey results for fixed contamination were less than 200 counts per minute/probe area for beta-gamma and less than 500 disintegrations per minute/100cm^2 for alpha. Paint and concrete sample results also supported release for unrestricted use. The rubble was buried under at least 1 m (3 ft) of clean fill. The site was graded to blend with the natural terrain. A RESRAD evaluation was performed in 2003 to support the No Action decision. RESRAD showed that none of the contaminants detected in the paint would reach groundwater within 1,000 years. Consequently, the groundwater and river protection objectives are met for the site. The evaluation predicts that the dose limits for the rural residential (15 mrem/yr) and groundwater (4 mrem/yr) pathways will not be exceeded.

4.70.3 Statement of Protectiveness

Based on the characterization results and RESRAD modeling, 132- the RAOs and the corresponding RAGs established in the 1interim action ROD (EPA 1999) have been achieved at the 132-F-5 waste site. Any residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that based on RESRAD modeling, pose no threat to groundwater or the Columbia River. Institutional controls to prevent

uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "No Action."

4.71 132-F-6, 1608-F WASTE WATER PUMPING STATION, 1608-F EFFLUENT PUMPING STATION, 132-F LIFT STATION

4.71.1 History

The 1608-F facility was a lift station to pump effluents collected from various drain systems to the 107-F Retention Basin. It was a reinforced-concrete structure approximately 4 m (13 ft) above grade and 10.4 m (34 ft) below grade. Maximum thickness of the concrete was 0.6 m (2 ft). The facility consisted of a main equipment room measuring approximately 11.6 by 10.7 m (38 by 35 ft), a below grade valve room, four distribution sumps, and three pump sumps. Two of the pump sumps originally contained electric motor-driven pumps and the third sump contained a steam-driven sump. Steel gates were used to distribute liquid in the center distribution sump to the other distribution sumps/pump sumps. All three pumps discharged via a 0.4-m (16-in.)-diameter pipe to the effluent line leading to the 107-F Retention Basin or to the 116-F crib.

The 1608-F facility decommissioning activities included removal of equipment and sump water, equipment/waste disposal, characterization, and demolition/site grading. A total of 1.6 m^3 (56 ft^3) of asbestos material was removed from the facility, bagged, and transported to the Hanford Site central landfill for disposal. Work areas were then cleaned with high-efficiency particulate air vacuums and the facility was released from asbestos restriction by the Hanford Environmental Health Foundation. Pumps and associated piping were removed and shipped to the 200 Area burial grounds for disposal. Approximately 104,166 L (27,500 gal) of residual water in the sumps was pumped into liquid tank trailers and transported to the 1325-N Liquid Waste Disposal Facility. During the process of removing water from the pumps, approximately 151 L (40 gal) of oil from four transformers on the main operating level was drained into plastic carboys, sampled, determined to be nonradioactive and contain less than 50 parts per million PCBs, and transported to the 100-N Area for disposal. Sump sediment was removed using a high-pressure water jet, shoveled into 92 208-L (55-gal) drums, sampled, designated as nonhazardous low-level waste, and shipped to the 200 Area burial grounds for disposal.

4.71.2 Investigation

Based on characterization results from surveys and samples, ARCL was used to evaluate the potential radiological dose to a hypothetical, maximally exposed site resident if the site was released for unrestricted use after the demolition and burial in situ of the facility. The ARCL calculation results indicated that the facility was ready for demolition activities. All pipe openings were sealed to prevent water draining into the facility after demolition. Demolition operations were performed in August 1987, using standard heavy equipment. The sumps and rubble from demolition of the walls, ceilings, and floors of the equipment rooms were 5 m (16 ft)

or more below grade. The entire area was covered with clean backfill at least 5 m (16 ft) deep and the area was graded to approximate the surrounding terrain.

4.71.3 Statement of Protectiveness

Based on the characterization of concrete samples, ARCL calculation and RESRAD modeling, the RAOs and the corresponding RAGs established in the interim action ROD (EPA 1999) are achieved at 132-F-6. Any residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that based on RESRAD modeling, pose no threat to groundwater or the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "No Action."

4.72 141-C, 141-C ANIMAL BARN, LARGE ANIMAL BARN & BIOLOGY LABORATORY, HOG BARN

4.72.1 History

The 141-C waste site is the location of the large animal barn and biology laboratory. The site was used to house animals during radiobiological studies. Radiological studies involving milk cows, pigs, chickens, ducks, goats, fish, and beagle dogs were conducted at the EAF from 1945 until 1976, when experimental facilities were relocated to the 300 Area. Studies on pigs were conducted at the 141-C Building from 1952 to 1976, using similar isotopes to those used for sheep testing at the 132-F-1 Building, including iodine-131, strontium-90, cesium-137, ruthenium-106, and plutonium-239.

The 141-C Building was an "L"-shaped, single-story pre-engineered steel structure on a concrete pad, with each wing measuring 35.4 m (116 ft) long by 6 m (20 ft) wide by 2.4 m (8 ft) high. A common concrete drainage trench served steel stalls equipped with feeding and watering facilities. The facility also contained a biology laboratory and two small appended feed and supply sheds. An addition constructed on the southwest side of the facility in 1959 was used to provide additional housing for large animals exposed to long half-life radioisotopes over extended periods of time.

Contaminated manure and sawdust was removed from the 141-C facility in plastic-lined cardboard radiation boxes and disposed in a trench behind the 105-F Reactor Building. Contaminated manure and sawdust that could not be shoveled out of the animal pens was washed into the sewer, which went to the 141-N sump via a special sewer system designed for handling animal farm waste. When the sump became full, the wastewater was pumped through a screen to the Columbia River via the process sewer system (100-F-29). The solids trapped by the screen were dried and sent to the 118-F-5 sawdust pit. In 1963, the 116-F-9 Animal Leach Trench was completed, and the liquid portion of the contaminated pen wash wastewater from the 141-N sump was diverted there.

4.72.2 Excavation Operations

Remediation of the 141-C waste site consisted of the removal of soil and debris within the building footprint to a depth of approximately 1 m (3 ft). Approximately 900 BCM (1,200 BCY) of soil and debris was excavated and staged onsite before disposal at ERDF.

4.72.3 Verification Sampling

Verification sampling at the 141-C waste site and staging pile was performed on January 30, 2006, to collect data to make a decision as to whether the RAOs had been reached. Ten soil samples were collected from the remediation footprint using a random sampling approach. Each sample consisted of 25 aliquots. One sample consisting of 30 aliquots was collected from the staging pile.

4.72.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 141-C waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.73 1607-F2, 1607-F2 SEPTIC TANK, 124-F-2, 1607-F-2 SANITARY SEWER SYSTEM

4.73.1 History

The 1607-F2 waste site is located southwest of the 107-F Retention Basin and was in use from 1944 to 1988. The septic system consisted of a septic tank, tile field, and, associated pipeline. The septic system had a 522-person capacity and serviced the 184-F, 190-F, 105-F, 108-F, and the 1700 Administration Service Buildings. The tile field was constructed of 4-in.-diameter VCP, concrete pipe, and drain tile. The feed pipeline identified as part of 1607-F2 extends from its connection with the 100-F-26 pipeline to the septic tank.

4.73.2 Excavation Operation

Remedial action at the 1607-F2 waste site began on March 21, 2002. Excavation of the site involved removing the septic tank, tile field, associated piping, underlying contaminated soil, and the feed pipeline to its junction with the 100-F-26 pipeline. On June 10, 2002, the excavation was completed. The elevation of the bottom of the excavation was at 118.3 m (388.1 ft) upon completion. The excavation was approximately 6,679 m^2 (7,988 ft^2) in area with a maximum

depth of approximately 4.6 m (15 ft). Approximately 35,099 metric tons (38,690 US tons) of material from the site was disposed at ERDF.

4.73.3 Verification Sampling

Cleanup verification sampling was conducted on August 13, 2002. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area. The shallow zone decision unit contained one decision subunit, which was divided into eight sampling areas. One composite cleanup verification sample was collected from each sample area.

4.73.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 1607-F2 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. The cleanup verification package does not demonstrate the acceptability of unrestricted access to deep zone soils (i.e., below 4.6 m [15 ft]); therefore, institutional controls to prevent uncontrolled drilling or excavation into deep zone soils are required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.74 1607-F3, 1607-F2 SEPTIC TANK, 124-F-3, 1607-F-3 SANITARY SEWER SYSTEM

4.74.1 History

The 1607-F3 waste site is a septic tank, drain field, and associated pipeline that were used from 1944 to 1965. The sewer system was located approximately 183 m (600 ft) west of the 183-F Water Treatment Plant. The septic system serviced the 182-F Pump Station, 183-F Water Treatment Plant, and 151-F Substation. The tank was constructed of reinforced concrete, and the walls and floor were 25 cm (10 in.) thick. The tank dimensions were 1.8 by 4.6 by 4 m (6 by 15 by 13 ft) deep, and the top roughly at grade. The septic tank had a capacity of 5,432 L (1,435 gal) and could support 41 people assuming an input of 132 L (35 gal) per capita per day and a 1-day retention period.

4.74.2 Excavation Operations

Remediation of the 1607-F3 sanitary sewer system waste site was performed in September 2005 and December 2006 and consisted of the removal of the septic tank, drain field, associated piping, and overburden material. Approximately 3,791 metric tons (4,179 US tons) of material was excavated, staged onsite, and subsequently disposed at ERDF. The depth of the excavation

was approximately 4 m (13 ft) bgs for the septic tank and approximately 2 m (7 ft) bgs for the drain field and pipe corridor.

4.74.3 Verification Sampling

Verification sampling of the 1607-F3 waste site was performed in March and December 2006. The site was divided into two decision units: excavation footprint and staging pile. Twenty soil samples were collected from the remediation footprint. Each sample consisted of 25 aliquots. One sample consisting of 30 aliquots was collected from the staging pile.

4.74.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 1607-F3 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.75 1607-F4, 1607-F2 SEPTIC TANK, 124-F-4, 1607-F-4 SANITARY SEWER SYSTEM

4.75.1 History

The 1607-F4 waste site is a septic tank, drain field, and associated pipeline in use from 1944 to 1965. The septic tank was constructed of reinforced concrete with a capacity of 795 L (210 gal). The dimensions of the tank were 1.6 m (5.3 ft) long by 1 m (3.3 ft) wide by 2.7 m (9 ft) deep. The drain field was constructed of 10-cm (4-in.)-diameter VCP, concrete pipe, or drain tile with a total of 15 linear m (48 linear ft) of piping. The 1607-F4 Sanitary Sewer System serviced the 115-F Gas Recirculation Building.

4.75.2 Excavation Operations

Remediation of the 1607-F4 waste site was performed from April 3 through 5, 2007, and included removal of the septic tank, the drain field, and the associated piping. Overburden material and other soils presumed to contain no residual contamination above cleanup levels were stockpiled south of the excavation for post-remediation verification sampling. Approximately 707 BCM (925 BCY) of piping, concrete material, and suspect contaminated adjacent soils were removed and disposed of to ERDF. Excavation depths at the 1607-F4 waste site ranged from 2.6 to 3.2 m (8.5 to 10.5 ft) bgs.

4.75.3 Verification Sampling

Verification sampling for the 1607-F4 waste site was performed in April and August 2007 to collect data to determine if the RAGs had been met. The site was divided into three decision units: excavation footprint, stockpile, and the area between the septic tank and drain field (road crossing). Ten soil samples were collected from the remediation footprint. Each sample consisted of 25 aliquots. One sample consisting of 25 aliquots was collected from the stockpile. Two samples were collected from the area of the road crossing.

Because a segment of this waste site (the discharge pipeline from the septic tank to the drain field) was beneath a heavily used haul road, verification sampling of the soil below this portion of the removed pipeline was conducted immediately following remediation to allow for expedited backfill of the roadway.

4.75.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 1607-F4 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.76 1607-F5, 1607-F5 SEPTIC TANK, 124-F-5, 1607-F-5 SANITARY SEWER SYSTEM

4.76.1 History

The 1607-F5 waste site is a septic tank, drain field, and the interconnecting pipeline. The septic tank was constructed of reinforced concrete, the walls were 20 cm (8 in.) thick, and the floor was 15 cm (6 in.) thick. The septic tank had a capacity of 795 L (210 gal). The tank dimensions were 1.62 m (5.33 ft) long and 1.01 m (3.33 ft) wide, with a maximum depth of 2.7 m (9 ft). Exiting the southeast side of the septic tank was a 15.2-cm (6-in.)-diameter by 20-m (66-ft)-long VCP or drain tile that branched into two 9-m (30-ft) sections of 10-cm (4-in.) vitrified clay piping.

4.76.2 Excavation Operations

Remediation of the 1607-F5 waste site began on August 30, 2005, and was completed on August 31, 2005. The remediation consisted of the removal of approximately 2,250 metric tons (2,480 US tons) of material to a depth of approximately 2.8 m (9.2 ft) bgs. The soil and debris

(including the septic tank and drain field contents) were excavated and staged on site before disposal at ERDF.

4.76.3 Verification Sampling

Verification sampling for the 1607-F5 waste site was performed March 13 through 20, 2006. The site was divided into two decision units for the purpose of verification sampling. The first decision unit was delineated based on the surveyed limits of material removal (shallow), and the second decision unit is composed of the remediation waste staging pile area. Ten soil samples were collected from the remediation footprint. One sample consisting of 30 aliquots was collected from the staging pile.

4.76.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 1607-F5 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.77 1607-F6, 1607-F6 SEPTIC TANK, 124-F-6, 1607-F-6 SANITARY SEWER SYSTEM

4.77.1 History

The 1607-F6 waste site was documented to be the location of three septic tanks, drain field, and interconnecting pipelines. During excavation only one tank was encountered and removed. The other two older septic tanks were likely removed and replaced with the newer septic tank during construction of the 1705-F Building. The two older tanks were formerly located under what was the east side of the former 1705-F Building. The tile drain field was located east of the septic tank and partially over one of the 100-F-19 reactor cooling water effluent pipelines.

4.77.2 Excavation Operations

Remedial action at the 1607-F6 waste site began on July 28, 2000. Excavation of the site involved removing the overburden materials, septic system structure (tank and associated influent and drain field piping), and underlying contaminated soil. Based on field screening overburden materials identified as potentially clean were placed in stockpiles for potential use as backfill. On April 25, 2001, the excavation was completed. The general average elevation of the bottom of the overall site excavation was at 123.5 m (405.2 ft) upon completion. The excavation was approximately 582 m^2 (1,908 ft^2) in area with a maximum depth of

approximately 3.5 m (11.5 ft). Approximately 1,726 metric tons (1,898 US tons) of material from the site were disposed at ERDF.

4.77.3 Verification Sampling

Cleanup verification sampling was complete on May 14, 2001. The 1607-F6 waste site consisted of shallow zone and overburden layback decision units. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area. The site was excavated to a general average depth of 3.5 m (11.5 ft) with the shallow zone consisting of the entire site excavation. The north-south pipeline was included with this site after the initial cleanup verification sampling had been conducted for the septic system excavation. Based on statistical evaluation of the resulting data, the residual contaminant concentrations meet the cleanup criteria specified in the RDR/RAWP (DOE/RL-96-17) and the Remaining Sites ROD (EPA 1999).

4.77.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 1607-F6 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.78 1607-F7, 141-M BUILDING SEPTIC TANK, 124-F-7

4.78.1 History

The 1607-F7 waste site was a septic tank, drain field, and the interconnecting pipeline. The drain field was located under an area that was historically used for animal grazing (i.e., pasture). The septic tank received sanitary sewage from the former 141-M Building from 1945 to 1975. The septic tank had a volume of 3,800 L (1,000 gal).

4.78.2 Excavation Operations

The 1607-F7 waste site was excavated on August 8 and November 30, 2005. Remediation of the 1607-F7 waste site involved layback of overburden and removal of the septic tank, drain field, the interconnecting pipeline, and associated soils around and below those structures. Some of these materials were staged just south of the site before disposal; however, most of the waste was excavated using direct loadout and shipment to ERDF. The overall depth of the excavation for the septic tank was approximately 3 m (10 ft) bgs and approximately 1.5 m (5 ft) bgs for the drain field. The excavation depths included removal of 0.6 m (2 ft) of soil below these structures

for disposal at ERDF. Approximately 1,088 metric tons (1,200 US tons) of material was disposed at ERDF.

4.78.3 Verification Sampling

Verification sampling for the 1607-F7 waste site was performed on April 4, 2006, to collect data to determine if the RAGs had been met. The site was divided into two decision units for the purpose of verification sampling. The first decision unit was delineated based on the surveyed limits of material removal (shallow), and the second decision unit is composed of the remediation waste staging pile area.

4.78.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 1607-F7 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.79 182-F, 182-F RESERVOIR

4.79.1 History

The 182-F reservoir was in use from 1944 to 1977. The reservoir was used to provide reserve water from the Columbia River for reactor cooling water and raw water for the 100 Area and had a storage capacity of 94.6 million L (25 million gal). The reservoir was later used as a landfill for disposal of decontaminated rubble from buildings that were decommissioned in the 100-F Area. In 1997, the site was covered with clean fill.

4.79.2 Excavation Operations

Excavation of the 182-F reservoir began on March 29, 2005, with removal and stockpiling of debris and soil. Visual observations of soil and debris removed from the southern and eastern portions of the reservoir indicated the presence of inert demolition debris (e.g., concrete, wood, rebar). No hazardous materials other than a limited amount of lead, asbestos, and some batteries were found. Excavation of the western portion of the reservoir revealed essentially soil with no debris. Based on the results of the excavation and discussion with RL and EPA, it was determined that excavation would stop and sampling would be performed to evaluate the stockpiled material and to determine if further excavation of the soil remaining in the reservoir would be required.

4.79.3 Verification Sampling

Verification samples of stockpiled material removed from the reservoir and residual soil remaining in the reservoir were collected on April 29, 2005, and analyzed for asbestos, radionuclides, metals, and PCBs. One soil sample from each of 2 large stockpiles of soil and debris (i.e., east stockpile and west stockpile) removed from the southern and eastern portions of the reservoir was collected by taking 30 aliquots of soil distributed across the surface of the pile to a height of approximately 1.5 m (5 ft) and combining into 1 sample for laboratory analysis. The soil removed from the western portion of the reservoir did not require sampling because it was agreed to be clean fill. One soil sample was collected from the soil exposed in the sidewalls of the excavation within the reservoir. The sample consisted of 30 aliquots of soil distributed across the sidewalls of the excavation and combined into 1 sample for laboratory analysis. A field radiological survey of the exposed concrete floor in the reservoir was performed to verify that radiological contamination was not present.

Additional sampling of soil within the reservoir for PCB analysis was performed on May 26, 2005. For this sampling event the exposed side slopes within the reservoir were divided into four sample areas. Within each sample area, four soil aliquots were randomly located and collected on the side slopes and then combined into one sample for each area resulting in a total of four soil samples.

4.79.4 Statement of Protectiveness

The verification sampling results demonstrate that remedial actions at the 182-F waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

4.80 600-351, STAINED AREA OUTSIDE 100-F AREA

4.80.1 History

The 600-351, Stained Areas Outside of 100-F Area consisted of two stained soil areas. The first area (north location) consisted of stained, crusted soil, and vegetation measuring 4 m (13.2 ft) in diameter. The second area (south location) consisted of petroleum-based material released to the ground surface and the underlying soils. The soil appeared crusted and no vegetation was growing in the affected area. There were oil cans lying at the site and the surrounding area.

The 600-351 waste site was identified during an orphan sites evaluation walkdown on October 1, 2008. These areas are not associated with any particular process. Prior to use by the

Hanford Site Manhattan Project, the 600-351 waste site location was part of an historic agricultural site occupying some 202,000 m^2 (50 ac) consisting of five tracts of land used circa 1938 to 1943.

4.80.2 Excavation Operations

Remedial action at the 600-351 waste site was initiated on March 10, 2011. Subsequently, additional remediation was performed on July 12 and August 4, 2011. The initial excavation resulted in the removal of approximately 27.6 BCM (36.1 BCY) of contaminated soil. The excavation activities included removal of less than 1 BCM (1.308 BCY) of debris that consisted of miscellaneous steel cans and wire. All material was direct loaded for disposal at ERDF. Accounting for all additional remediation performed at the 600-351 waste site, the excavation resulted in the total removal of approximately 60.4 BCM (79.0 BCY) of contaminated soil.

4.80.3 Verification Sampling

Verification sampling was conducted at the 600-351 waste site June 6 through August 8, 2011. Due to the small size of the 600-351 excavation footprint, a composite sampling approach was applied for verification sampling. One sample was collected from one-half of each excavated area of the 600-351 (north and south areas) for a total of four verification samples. Each sample consisted of 25 aliquots of soil collected from across the surface of the sample area and combined into 1 sample. Although the deepest portion of the excavation extended up to 1.8 m (6 ft), the majority of the aliquots of soil were collected from within the depth of 1 m (3.3 ft).

4.80.4 Statement of Protectiveness

With exception of lead and arsenic, the verification sampling results demonstrate that remedial actions at the 600-351 waste site have achieved the RAOs and corresponding RAGs established in the interim action ROD. The residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil, and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out." Lead and arsenic contamination in this historical orchard area will be addressed through other site characterization efforts (e.g., RI/FS process). Administrative institutional control will be required until a final decision concerning historic orchard pesticide use is made.

4.81 UPR-100-F-2, BASIN LEAK DITCH, 107-F BASIN LEAK DITCH, 100-F-3

4.81.1 History

The UPR-100-F-2 Basin Leak Ditch was formed in 1955 following an overflow of the 107-F Retention Basin. The ditch was enlarged by repeated overflows from an effluent manhole located near the north end of the 107-F Retention Basin. Prior to remediation, the ditch appeared as an open cobble field leading to the edge of the Columbia River. In 1975, soil samples were taken from four soil-boring locations along the path of the ditch and along the riverbank. Elevated concentrations of europium-152, cobalt-60, and cesium-137 were identified.

4.81.2 Excavation Operations

Remedial action at the UPR-100-F-2 waste site began on February 6, 2001. Excavation of the site involved removing the overburden materials and underlying contaminated soil. Based on field screening, overburden materials identified as potentially clean were placed in stockpiles for potential use as backfill. On July 28, 2001, the excavation was completed. The maximum excavation depth of 4.2 m (13.8 ft) occurs in the western portion of the waste site, with a surface elevation of 124.5 m (408.5 ft), and a bottom-of excavation elevation of 120.3 m (394.7 ft). The actual excavation depth throughout the remainder of the site varies, as does the surface elevation, but generally both decrease as the site approaches the river. At its lowest point, near the river, the excavation depth is near groundwater, which is 114 m (374 ft). The excavation was approximately 2,388 m^2 (25,704 ft^2) in area, and approximately 670 metric tons (739 US tons) of material from the site were disposed at ERDF.

4.81.3 Verification Sampling

Cleanup verification sampling at UPR-100-F-2 began on August 16, 2001, and was finished on August 16, 2001. The site consisted of a single shallow zone decision unit, composed of the excavation floor and sidewalls. The shallow zone decision unit was divided into 12 sampling areas. Each verification sample was a composite formed by combining samples collected at four randomly selected nodes within each sampling area.

4.81.4 Statement of Protectiveness

The verification sample results confirm that remedial action at the UPR-100-F-2 waste site achieved RAOs and corresponding RAGs established in the approved interim action ROD. The remaining soils at these sites have been sampled, analyzed, and evaluated. These results also indicate that residual concentrations in the shallow zone will support future land uses that can be represented (or bounded) by a rural-residential scenario, and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. In accordance with this evaluation, the sample data support a reclassification of this site to "Interim Closed Out."

5.0 PERFORMANCE STANDARDS AND CONSTRUCTION QUALITY CONTROL

This section addresses the process for demonstrating achievement of performance standards including attainment of RAGs and maintaining the required quality controls during remedial activities.

5.1 ATTAINMENT OF PERFORMANCE STANDARDS

The remedial actions described in Sections 4.1 through 4.81 of this report were performed to identify and reduce potential threats to human health and the environment from 100-FR-1 OU waste site contamination. Following remediation activities at a waste site, an evaluation against identified performance standards (the RAOs in the interim action RODs) is conducted in order to verify that the residual contamination does not pose an unacceptable health risk to future users of the site.

5.1.1 Performance Standard Documentation

Attainment of the specific RAO performance standards in the interim action RODs and interim closure of individual 100-FR-1 OU waste sites are documented in the CVPs, or remaining sites verification packages (RSVPs). These documents provide remediation information as described in Section 2.3 to support the formal reclassification in the WSRFs. Table 5-1 identifies waste sites in the 100-FR-1 OU where remedial action was not required based on evaluation of process history and/or confirmatory sampling data. Table 5-2 provides information to support the "Interim Closed Out" reclassification for sites where contamination was present above RAGs and remediation by RTD was required.

Table 5-1. No Action Waste Sites in the 100-FR-1 Operable Unit. (4 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a, b]
100-F-7	100-F-7, Underground Fuel Tank – 1705-F Building	2004-124	2/15/05	No Action	RSVP-2004-124, *Remaining Sites Verification Package for the 100-F-7 Underground Fuel Tank for the 1705-F Building*
100-F-9	100-F-9, French Drain at East End of 105-F Storage Room (Northeast Corner)	2004-125	2/15/05	No Action	RSVP-2004-125, *Remaining Sites Verification Package for the 100-F-9 French Drain at the East End of the 105-F Storage Room*
100-F-12	100-F-12, 36-inch French Drain at 105-F Building	2004-126	2/15/05	No Action	RSVP-2004-126, *Remaining Sites Verification Package for the 100-F-12 French Drain*

Table 5-1. No Action Waste Sites in the 100-FR-1 Operable Unit. (4 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a, b]
100-F-18	100-F-18, 105-F Condensate Drain Field, Underground Tank at 105-F Building, Undocumented	2004-137	2/15/05	No Action	RSVP-2004-137, *Remaining Sites Verification Package for the 100-F-18 Condensate Drain Field and Underground Tank*
100-F-26:1	100-F-26:1, North Process Sewer Collection Pipelines	2005-008	07/21/05	No Action	RSVP-2005-008, *Remaining Sites Verification Package for the 100-F-26:1 North Process Sewer Collection Pipelines*
100-F-26:2	100-F-26:2, Process Water Pipelines to the Aquatic Biology and Strontium Gardens	2005-005	05/26/05	No Action	RSVP-2005-005, *Remaining Sites Verification Package for the 100-F-26:2 Process Water Pipelines to the Aquatic Biology Fish Ponds and Strontium Gardens*
100-F-26:3	100-F-26:3, 184-F Powerhouse Pipelines	2004-118	12/03/04	No Action	--
100-F-26:5	100-F-26:5, 190-F Bypass Pipelines	2005-007	07/21/05	No Action	RSVP-2005-007, *Remaining Sites Verification Package for the 100-F-26:5 Bypass Process Sewer Pipeline to the Lewis Canal (190-F and 185-F Process Sewer Lines)*
100-F-26:6	100-F-26:6, 190-F Reservoir Pipelines	2004-119	12/03/04	No Action	--
100-F-26:11	100-F-26:11, 1607-F4 Sanitary Sewer Pipelines	2005-003	05/26/05	No Action	RSVP-2005-003, *Remaining Sites Verification Package for the 100-F-26:11, 1607-F4 Sanitary Sewer Pipelines*
100-F-26:16	100-F-26:16, Reactor Cooling Water Pipelines	2004-120	01/11/05	No Action	--
100-F-36	100-F-36, 108-F Chemical Pump House, 108-F Biological Laboratory	2007-002	05/24/07	No Action	RSVP-2007-002, *Remaining Sites Verification Package for the 100-F-36, 108-F Biological Laboratory, and for the 116-F-15, 108-F Radiation Crib*
100-F-37	100-F-37, French Drain Discovered Near Hydrant F-2	2004-095	08/11/04	No Action	RSVP-2004-095, *Remaining Sites Verification Package for 100-F-37 French Drain Discovered Near Hydrant F-2*

Table 5-1. No Action Waste Sites in the 100-FR-1 Operable Unit. (4 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a, b]
100-F-44:1	100-F-44:1, Discovery Pipeline Near 182-F Reservoir	2007-005	04/26/07	No Action	WSRF-2007-005, *Description of 100-F-44:1 Subsite*
100-F-44:2	100-F-44:2, Discovery Pipeline Near 108-F Building	2007-006	05/30/08	No Action	RSVP-2007-006, *Remaining Sites Verification Package for the 100-F-44:2, Discovery Pipeline Near 108-F Building*
100-F-44:4	100-F-44:4, Discovery Pipeline in Silica Gel Pit	2008-030	09/23/08	No Action	RSVP-2008-030, *Remaining Sites Verification Package for the 100-F-44:4, Discovery Pipeline in Silica Gel Pit*
100-F-44:5	100-F-44:5, Process Sewer Pipelines	2008-016	04/22/09	No Action	RSVP-2008-016, *Remaining Sites Verification Package for the 100-F-44:5 Process Sewer Pipelines*
100-F-46	100-F-46, 119-F Stack Sampling French Drain	2008-021	08/08/08	No Action	RSVP-2008-021, *Remaining Sites Verification Package for the 100-F-46, 119-F Stack Sample French Drain*
100-F-52	100-F-52, 146-FR Radioecology and Aquatic Biology Laboratory Soil	2008-022	06/27/08	No Action	RSVP-2008-022, *Remaining Sites Verification Package for the 100-F-52, 146-FR Radioecology and Aquatic Biology Soil*
100-F-53	100-F-53, 108-F Septic System	2008-019	06/26/09	No Action	RSVP-2008-019, *Remaining Sites Verification Package for the 100-F-53, 108-F Septic System*
100-F-54	100-F-54, 100-F Animal Farm Pastures	2008-015	04/17/08	No Action	RSVP-2008-015, *Remaining Sites Verification Package for the 100-F-54 Animal Farm Pastures*
100-F-60	100-F-60, 100F Cast Iron Pipe	2010-034	03/02/11	No Action	RSVP-2010-034, *Remaining Sites Verification Package for the 100-F-60, Cast Iron Pipe*
116-F-7:1	116-F-7:1, 116-F-7 Crib, 117-F Crib, 116-F-7 Seal Pit Water Crib	2004-128	2/15/05	No Action	RSVP-2004-128, *Remaining Sites Verification Package for the 116-F-7 Seal Pit Water Crib*
116-F-7:2	116-F-7:2, 116-F-7 Crib Pipeline, 117-F Crib Pipeline, 116-F-7 Seal Pit Water Crib Pipeline	2005-044	10/24/05	No Action	WSRF-2005-044, *116-F-7:2, 117-F Crib Pipeline*
132-F-3	132-F-3, 115-F Gas Recirculating Facility	2003-25	12/09/03	No Action	*Waste Site Evaluation for 132-F-3, 115-F Gas Recirculation Facility*

Table 5-1. No Action Waste Sites in the 100-FR-1 Operable Unit. (4 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a, b]
132-F-4:1	116-F Reactor Stack Demolition Site	2003-23	03/17/04	No Action	*Waste Site Evaluation for 132-F-4, 116-F Reactor Exhaust Stack*
132-F-4:2	116-F Reactor Stack Base Burial	2005-043	11/14/2005	No Action	*Waste Site Evaluation for 132-F-4:2, 116-F Reactor Exhaust Stack*
132-F-5	132-F-5, 117-F Filter Building	2003-29	12/08/03	No Action	*Waste Site Evaluation for 132-F-5, 117-F Filter Building*
132-F-6	132-F-6, 1608-F Waste Water Pumping Station, 1608-F Effluent Pumping Station, 132-F-6 Lift Station	2003-32	12/08/03	No Action	*Waste Site Evaluation for 132-F-6, 1608-F Waste Water Pumping Station*

[a] The remaining sites verification package is attached to the waste site reclassification form.
[b] The waste site evaluation is attached to the waste site reclassification form.

-- = not applicable
WIDS = Waste Information Data System

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
100-F-4	100-F-4, 108-F Building 12-inch French Drain	2002-040	07/25/02	Interim Closed Out	CVP-2002-00001, *Cleanup Verification Package for the 100-F-4, 100-F-11, 100-F-15. and 100-F-16 French Drains*
100-F-10	100-F-10, French Drain at East End of 105-F Storage Room (Southeast Corner)	2003-051	05/06/04	Interim Closed Out	CVP-2003-00017, *Cleanup Verification Package for the 118-F-8:1, 105-F Reactor Below-Grade Structures and Underlying Soils; the 118-F-8:3, 105-F Fuel Storage Basins Underlying Soils; and the 100-F-10 French Drain*
100-F-11	100-F-11, 108-F Building 18 inch French Drain	2002-040	07/25/02	Interim Closed Out	CVP-2002-00001, *Cleanup Verification Package for the 100-F-4, 100-F-11, 100-F-15, and 100-F-16 French Drains*
100-F-15	100-F-15, 108-F Building Ventilation French Drain, Undocumented	2002-040	07/25/02	Interim Closed Out	CVP-2002-00001, *Cleanup Verification Package for the 100-F-4, 100-F-11, 100-F-15, and 100-F-16 French Drains*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
100-F-16	100-F-16, 108-F Building 30-inch French Drain, Undocumented	2002-040	07/25/02	Interim Closed Out	CVP-2002-00001, *Cleanup Verification Package for the 100-F-4, 100-F-11, 100-F-15, and 100-F-16 French Drains*
100-F-19:1	100-F-19, 105-F Reactor Cooling Water Effluent Underground Pipelines; 100-F-19:1 (North Group), and 100-F-19:3 (West Group)	2001-099	05/22/02	Interim Closed Out	CVP-2001-00002, *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*
100-F-19:2	100-F-19, 105-F Reactor Cooling Water Effluent Underground Pipelines; 100-F-19:2 (South Group)	2003-022	09/15/03	Interim Closed Out	CVP-2001-00003, *Cleanup Verification Package for the 100-F-19:2 Reactor Cooling Water Effluent Pipeline, 116-F-11 Cushion Corridor French Drain, UPR-100-F-1 Sewer Line Leak, and 100-F-29 Experimental Animal Farm Process Sewer Pipelines*
100-F-19:3	100-F-19, 105-F Reactor Cooling Water Effluent Underground Pipelines; 100-F-19:1 (North Group), and 100-F-19:3 (West Group)	2001-099	05/22/02	Interim Closed Out	CVP-2001-00002, *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*
100-F-23	100-F-23, 141-C Drywell	2003-019	08/14/03	Interim Closed Out	CVP-2003-00011, *Cleanup Verification Package for the 100-F-23, 141-C Drywell*
100-F-24	100-F-24, 145-F Drywell	2003-020	08/12/03	Interim Closed Out	CVP-2003-00012, *Cleanup Verification Package for the 100-F-24, 145-F Drywell*
100-F-25	100-F-25, 146-FR Drywells	2003-021	08/14/03	Interim Closed Out	CVP-2003-00010, *Cleanup Verification Package for the 100-F-25, 146-FR Drywells and the UPR-F-3 Mercury Spill*
100-F-26:4	100-F-26:4, South Process Pipelines	2007-035	09/29/11	Interim Closed Out	RSVP-2007-035, *Remaining Sites Verification Package for the 100-F-26:4, South Process Pipelines*
100-F-26:7	100-F-26:7, Sodium Dichromate and Sodium Silicate Pipelines	2011-088	10/08/11	Interim Closed Out	RSVP-2011-088, *Remaining Sites Verification Package for the 100-F-26:7, Sodium Dichromate and Sodium Silicate Pipelines*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
100-F-26:8	100-F-26:8, 1607-F1 Sanitary Sewer Pipelines	2004-130 and 2005-004	03/14/08	Interim Closed Out	RSVP-2004-130/2005-004, *Remaining Sites Verification Package for the 1607-F1 Sanitary Sewer System (124-F-1) and the 100-F-26:8 (1607-F1) Sanitary Sewer Pipelines Waste Sites*
100-F-26:9	100-F-26:9, 1607-F2 Sanitary Sewer Pipelines	2008-029	10/29/08	Interim Closed Out	RSVP-2008-029, *Remaining Sites Verification Package for the 100-F-26:9, 1607-F2 Sanitary Sewer Pipelines*
100-F-26:10	100-F-26:10, 1607-F3 Sanitary Sewer Pipelines	2007-028	12/03/07	Interim Closed Out	RSVP-2007-028, *Remaining Sites Verification Package for the 100-F-26:10, 1607-F3 Sanitary Sewer Pipelines (182-F, 183-F, and 151-F Sanitary Sewer Lines)*
100-F-26:12	100-F-26:12, 72-inch Main Process Sewer Pipeline	2007-034	04/29/08	Interim Closed Out	RSVP-2007-034, *Remaining Sites Verification Package for the 100-F-26:12, 1.8-m (72-in.) Main Process Sewer Pipeline*
100-F-26:13	100-F-26:13, 108-F Drain Pipelines	2005-011	03/03/08	Interim Closed Out	RSVP-2005-011, *Remaining Sites Verification Package for the 100-F-26:13, 108-F Drain Pipelines*
100-F-26:14	100-F-26:14, 116-F-5 Influent Pipelines, 116-F-5 Ball Washer Crib	2007-029	02/29/08	Interim Closed Out	RSVP-2007-029, *Remaining Sites Verification Package for the 100-F-26:14, 116-F-5 Influent Pipelines*
100-F-26:15	100-F-26:15, Miscellaneous Pipelines associated with 1608-F Sump	2007-031	03/08/08	Interim Closed Out	RSVP-2007-031, *Remaining Sites Verification Package for the 100-F-26:15 Miscellaneous Pipelines Associated with the 132-F-6, 1608-F Waste Water Pumping Station*
100-F-29	100-F-29, 100-F Experimental Animal Farm Process Sewer Pipelines	2003-022	09/15/03	Interim Closed Out	CVP-2001-00003, *Cleanup Verification Package for the 100-F-19:2 Reactor Cooling Water Effluent Pipeline, 116-F-11 Cushion Corridor French Drain, UPR-100-F-1 Sewer Line Leak, and 100-F-29 Experimental Animal Farm Process Sewer Pipelines*
100-F-31	100-F-31, 144-F Sanitary Sewer System	2006-033	08/24/06	Interim Closed Out	RSVP-2006-033, *Remaining Sites Verification Package for the 100-F-31, 144-F Sanitary Sewer System*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
100-F-33	100-F-33, 146-F Aquatic Biology Fish Ponds	2006-021	08/25/06	Interim Closed Out	RSVP-2006-021, *Remaining Sites Verification Package for the 100-F-33, 146-F Aquatic Biology Fish Ponds*
100-F-34	100-F-34, Biology Facility French Drain	2001-099	05/22/02	Interim Closed Out	CVP-2001-00002, *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*
100-F-38	100-F-38, Yellow Stained Soil Near Hydrant F-2	2004-093	03/13/06	Interim Closed Out	RSVP-2004-093, *Remaining Sites Verification Package for the 100-F-38 Stained Soil Site*
100-F-42	100-F-42, 1904-F Spillway, 100-F-39:1 Flume	2006-045	09/25/06	Interim Closed Out	RSVP-2006-038, *Remaining Sites Verification Package for the 116-F-8, 1904-F Outfall Structure and the 100-F-42, 1904-F Spillway*
100-F-43	100-F-43, Spillway for PNL Outfall, 116-F-16 Spillway, 100-F-39:2	2006-046	09/14/06	Interim Closed Out	RSVP-2006-039, *Remaining Sites Verification Package for the 116-F-16, PNL Outfall and the 100-F-43, PNL Outfall Spillway*
100-F-44:8	100-F-44:8, 1717-F Fuel Oil Supply and Return Pipelines	2011-043	09/27/11	Interim Closed Out	RSVP-2011-043, *Remaining Sites Verification Package for the 100-F-44:8, 1717-F Fuel Oil Supply and Return Lines*
100-F-44:9	100-F-44:9, 105-F Process Sewer Pipeline	2011-061	08/25/11	Interim Closed Out	RSVP-2011-061, *Remaining Sites Verification Package for the 100-F-44:9, 105-F Process Sewer Pipeline*
100-F-45	100-F-45, Buried River Effluent Pipelines	2011-084	08/23/11	Interim Closed Out	RSVP-2011-084, *Remaining Sites Verification Package for the 100-F-45, Buried River Effluent Pipelines*
100-F-47	100-F-47, 151-F Substation	2011-086	09/15/11	Interim Closed Out	RSVP-2011-086, *Remaining Sites Verification Package for the 100-F-47, 151-F Substation*
100-F-48	100-F-48, 184-F Coal Pit Debris	2011-093	12/11/11	Interim Closed Out	RSVP-2011-093, *Remaining Sites Verification Package for the 100-F-48, 184-F Coal Pit Debris*
100-F-49	100-F-49, 1716-F Maintenance Garage Lubrication Pit	2011-089	09/12/11	Interim Closed Out	RSVP-2011-089, *Remaining Sites Verification Package for the 100-F-49, 1716-F Maintenance Garage Lubrication Pit*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
100-F-51	100-F-51, 146-F Fish Laboratory Soil	2011-085	08/18/11	Interim Closed Out	RSVP-2011-085, *Remaining Sites Verification Package for the 100-F-51, 146-F Fish Laboratory Soil and 100-F-63, Animal Farm Radioactive Effluent Lines*
100-F-55	100-F-55, 1607-F7 Contaminated Ash Layer	2011-083	12/22/11	Interim Closed Out	RSVP-2011-083, *Remaining Sites Verification Package for the 100-F-55, 1607-F7 Contaminated Ash Layer and 100-F-62, Animal Farm Septic Lines*
100-F-56:1	100-F-56:1, 100-F Garnet Sand Areas	2011-094	12/11/11	Interim Closed Out	RSVP-2011-094, *Remaining Sites Verification Package for the 100-F-56:1, 100-F Garnet Sand Areas*
100-F-56:2	100-F-56:2, Other 100-F Surface Debris Areas	2011-040	06/21/11	Interim Closed Out	*Supporting Information for Reclassification of the 100-F56:2, 100-F Surface Debris Areas*
100-F-57:1	100-F-57:1, 190-F Process Water Pump House Debris (Eastern Half)	2012-010	04/06/12	Interim Closed Out	RSVP-2012-010, *Remaining Sites Verification Package for the 100-F-57:1, Eastern 190-F Process Water Pump House Debris and Overburden Stockpile*
100-F-57:2	100-F-57:2, 190-F Process Water Pump House Debris (Western Half)	2012-058	08/20/12	Interim Closed Out	RSVP-2012-058, *Remaining Sites Verification Package for the 100-F-57:2, 190-F Process Water Pump House Debris (Western Half) and 100-F-65, Green Stained Area Along Railroad Tracks Immediately West of 190-F*
100-F-58	100-F-58, 100-F Surface Debris Potentially Containing Asbestos	2011-033	05/25/11	Interim Closed Out	RSVP-2011-033, *Remaining Sites Verification Package for the 100-F-58, 100-F Surface Debris Potentially Containing Asbestos*
100-F-61	100-F-61, Stained Soil near 100-F-12	2011-103	12/22/11	Interim Closed Out	RSVP-2011-103, *Remaining Sites Verification Package for the 100-F-61, Stained Soil Near 100-F-12 Waste Site*
100-F-62	100-F-62, Animal Farm Septic Lines	2011-104	12/22/11	Interim Closed Out	RSVP-2011-083, *Remaining Sites Verification Package for the 100-F-55, 1607-F7 Contaminated Ash Layer and 100-F-62, Animal Farm Septic Lines*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
100-F-63	100-F-63, Animal Farm Radioactive Effluent Lines	2011-097	08/18/11	Interim Closed Out	RSVP-2011-085, *Remaining Sites Verification Package for the 100-F-51, 146-F Fish Laboratory Soil and 100-F-63, Animal Farm Radioactive Effluent Lines*
100-F-64	100-F-64, Yellow and Red Stained Area Along Railroad Tracks Near the 1713-FA	2011-119	03/06/12	Interim Closed Out	RSVP-2011-119, *Remaining Sites Verification Package for the 100-F-64, Yellow and Red Stained Area Along Railroad Tracks Near the 1713-FA Building*
100-F-65	100-F-65, Green Stained Area Along Railroad Tracks Immediately West of 190-F	2012-059	08/20/12	Interim Closed Out	RSVP-2012-059, *Remaining Sites Verification Package for the 100-F-57:2, 190-F Process Water Pump House Debris (Western Half) and 100-F-65, Green Stained Area Along Railroad Tracks Immediately West of 190-F*
116-F-1	116-F-1, Lewis Canal	2003-007	11/03/03	Interim Closed Out	CVP-2002-00009, *Cleanup Verification Package for the 116-F-1 Lewis Canal*
116-F-2	116-F-2, 107-F Liquid Waste Disposal Trench	2002-057	03/12/03	Interim Closed Out	CVP-2001-00005, *Cleanup Verification Package for the 116-F-2, 107-F Liquid Waste Disposal Trench*
116-F-3	116-F-3, 105-F Storage Basin Trench	2003-005	06/16/03	Interim Closed Out	CVP-2002-00008, *Cleanup Verification Package for the 116-F-3 Fuel Storage Basin Trench*
116-F-4	116-F-4, 105-F Pluto Crib	2001-039	11/08/01	Interim Closed Out	CVP-2001-00006, *Cleanup Verification Package for the 116-F-4 Pluto Crib*
116-F-5	116-F-5, Ball Washer Crib	98-036	08/16/01	Interim Closed Out	CVP-2001-00007, *Cleanup Verification Package for the 116-F-5 Ball Washer Crib*
116-F-6	116-F-6, 1608-F Liquid Waste Disposal Trench, 105-F Cooling Water Trench	2003-006	11/03/03	Interim Closed Out	CVP-2002-00010, *Cleanup Verification Package for the 116-F-6 Liquid Waste Disposal Trench*
116-F-8	116-F-8, 1904-F Outfall Structure	2006-038	09/25/06	Interim Closed Out	RSVP-2006-038, *Remaining Sites Verification Package for the 116-F-8, 1904-F Outfall Structure and the 100-F-42, 1904-F Spillway*
116-F-9	116-F-9, Animal Waste Leaching Trench	2002-056	10/16/02	Interim Closed Out	CVP-2001-00008, *Cleanup Verification Package for the 116-F-9 Animal Waste Leaching Trench*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
116-F-10	116-F-10, 105-F Dummy Decontamination French Drain, 116-F-8, 105 Dummy/Perf Decontamination Crib, Perf Decontamination Drain	2003-003	06/14/03	Interim Closed Out	CVP-2003-00003, *Cleanup Verification Package for the 116-F-10, 105-F Dummy Decontamination French Drain*
116-F-11	116-F-11, 105-F Cushion Corridor French Drain	2003-022	09/15/03	Interim Closed Out	CVP-2001-00003, *Cleanup Verification Package for the 100-F-19:2 Reactor Cooling Water Effluent Pipeline, 116-F-11 Cushion Corridor French Drain, UPR-100-F-1 Sewer Line Leak, and 100-F-29 Experimental Animal Farm Process Sewer Pipelines*
116-F-12	116-F-12, 148-F French Drain	2001-099	05/22/02	Interim Closed Out	CVP-2001-00002, *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*
116-F-14	116-F-14, 107-F Retention Basin, 107-F	2002-050	07/12/02	Interim Closed Out	CVP-2001-00009, *Cleanup Verification Package for the 116-F-14 Retention Basin*
116-F-15	116-F-15, 108-F Radiation Crib	2007-003	05/24/07	Interim Closed Out	RSVP-2007-002, *Remaining Sites Verification Package for the 100-F-36, 108-F Biological Laboratory, and for the 116-F-15, 108-F Radiation Crib*
116-F-16	116-F-16, PNL Outfall	2006-039	09/14/06	Interim Closed Out	RSVP-2006-039, *Remaining Sites Verification Package for the 116-F-16, PNL Outfall and the 100-F-43, PNL Outfall Spillway*
118-F-8:1	118-F-8:1, 105-F Reactor Ancillary Support Areas, Below-Grade Structures and Underlying Soils	2003-051	05/06/04	Interim Closed Out	CVP-2003-00017, *Cleanup Verification Package for 118-F-8:1, 105-F Reactor Below-Grade Structures and Underlying Soils; the 118-F-8:3, 105-F Fuel Storage Basin Underlying Soils; and the 100-F-10 French Drain*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
118-F-8:3	118-F-8:3, 105-F Reactor Fuel Storage Basin Underlying Soils	2003-051	05/06/04	Interim Closed Out	CVP-2003-00017, *Cleanup Verification Package for 118-F-8:1, 105-F Reactor Below-Grade Structures and Underlying Soils; the 118-F-8:3, 105-F Fuel Storage Basin Underlying Soils; and the 100-F-10 French Drain*
118-F-8:4	118-F-8:4, 105-F Fuel Storage Basin West Side Adjacent and Side Slope Soils	2007-027	03/04/08	Interim Closed Out	CVP-2007-00004, *Cleanup Verification Package for the 118-F-8:4 Fuel Storage Basin West Side Adjacent and Side Slope Soils*
126-F-2	126-F-2, 183-F Clearwells	2006-017	05/04/06	Interim Closed Out	RSVP-2006-017, *Remaining Sites Verification Package for the 126-F-2, 183-F Clearwells*
128-F-2	128-F-2, 100-F Burning Pit	2008-031	12/01/08	Interim Closed Out	RSVP-2008-031, *Remaining Sites Verification Package for the 128-F-2, 100F Burning Pit Waste Site*
132-F-1	132-F-1, 132-F-1 Chronic Feeding Barn, 141-F, 141-F Sheep Barn	2006-029	08/17/06	Interim Closed Out	RSVP-2006-029, *Remaining Sites Verification Package for the 132-F-1, 141-F Chronic Feeding Sheep Barn*
141-C	141-C, 141-C Animal Barn, Large Animal Barn & Biology Laboratory, Hog Barn	2006-027	05/24/06	Interim Closed Out	RSVP-2006-027, *Remaining Sites Verification Package for the 141-C Large Animal Barn and Biology Laboratory (Hog Barn)*
1607-F2	1607-F2, 1607-F2 Septic Tank, 124-F-2, 1607-F2 Sanitary Sewer System	2002-059	03/11/03	Interim Closed Out	CVP-2002-00005, *Cleanup Verification Package for the 1607-F2 Septic System*
1607-F3	1607-F3, 1607-F3 Septic Tank, 124-F-3, 1607-F3 Sanitary Sewer System	2006-047	04/2607	Interim Closed Out	RSVP-2006-047, *Remaining Sites Verification Package for the 1607-F3 Sanitary Sewer System*
1607-F4	1607-F4, 1607-F4 Septic Tank, 124-F-4, 1607-F4 Sanitary Sewer System	2004-131	12/03/07	Interim Closed Out	RSVP-2004-131, *Remaining Sites Verification Package for the 1607-F4 Sanitary Sewer System*
1607-F5	1607-F5, 1607-F5 Septic Tank, 124-F-5, 1607-F5 Sanitary Sewer System	2006-043	09/14/06	Interim Closed Out	RSVP-2006-043, *Remaining Sites Verification Package for the 1607-F5 Sanitary Sewer System (124-F-5)*
1607-F6	1607-F6, 1607-F6 Septic Tank, 124-F-6, 1607-F6 Sanitary Sewer System	2001-085	11/08/01	Interim Closed Out	CVP-2001-00010, *Cleanup Verification Package for the 1607-F6 Septic System and Pipelines*

Table 5-2. Summary of 100-FR-1 Operable Unit Closure Documentation. (9 Pages)

WIDS Site Code	WIDS Site Name	Waste Site Reclassification Form	Reclassification Date	Reclassification Status	Closure Document [a]
1607-F7	1607-F7, 141-M Building Septic Tank, 124-F-7	2006-040	10/19/06	Interim Closed Out	RSVP-2006-040, *Remaining Sites Verification Package for the 1607-F7, 141-M Building Septic Tank*
182-F	182-F, 182-F Reservoir	2005-025	09/12/05	Interim Closed Out	RSVP-2005-025, *Remaining Sites Verification Package for the 182-F Reservoir Waste Site*
600-351	Stained Areas Outside of 100-F Area	2011-087	09/26/11	Interim Closed Out	RSVP-2011-087, *Remaining Sites Verification Package for the 600-351, Stained Areas Outside of 100-F Area*
UPR-100-F-1	UPR-100-F-1, 141 Building Sewer Line Spill, UN-100-F-1, 141-C to 141-M Sewer Line Leak	2003-022	09/15/03	Interim Closed Out	CVP-2001-00003, *Cleanup Verification Package for the 100-F-19:2 Reactor Cooling Water Effluent Pipeline, 116-F-11 Cushion Corridor French Drain, UPR-100-F-1 Sewer Line Leak, and 100-F-29 Experimental Animal Farm Process Sewer Pipelines*
UPR-100-F-2	UPR-100-F-2, Basin Leak Ditch, 107-F Basin Leak Ditch, 100-F-3	2001-094	04/23/02	Interim Closed Out	CVP-2001-00011, *Cleanup Verification Package for the UPR-100-F-2 Basin Leak Ditch*
UPR-100-F-3	UPR-100-F-3, Mercury Spill	2003-021	08/14/03	Interim Closed Out	CVP-2003-00010, *Cleanup Verification Package for the 100-F-25, 146-FR Drywells and the UPR-F-3 Mercury Spill*

[a] The remaining sites verification package is attached to the waste site reclassification form.

CVP = cleanup verification package
PNL = Pacific Northwest Laboratory
RSVP = remaining sites verification package
WIDS = Waste Information Data System

5.1.2 Remedial Action Objectives and Goals

Remedial action objective performance standard attainment involves comparisons of soil analytical data to RAGs (Table 5-3) and is evaluated using the following general steps:

- Identify the units within a site for cleanup verification and conduct sample collection and analysis for COCs and COPCs
- Calculate the summary statistics for the identified units or maximum values
- Identify the appropriate RAGs to be applied to the units

- Evaluate the summary statistics or maximum values, as appropriate, for the identified units against the decision rules for achieving the appropriate RAGs.

Remedial action goals are specific numeric targets developed to ensure achievement of the RAOs identified in the interim action RODs. The RAGs applicable to the 100-BC-1 waste sites, along with the process for verifying attainment of the RAGS, are described in detail in the 100 Area RDR/RAWP (DOE/RL-96-17) and are summarized in Table 5-3.

Table 5-3. Summary of Achieved Performance Standards for Unrestricted Land Use.

Regulatory Requirement	Remedial Action Goals	Evaluation Method
Direct Exposure – Radionuclides	Attained <15 mrem/yr dose rate above background over 1,000 years. Attained the CERCLA risk range of 10^{-4} to 10^{-6}.	Compared dose and risk goals to RESRAD model outputs based on unrestricted land use assumptions and verification data set values.
Direct Exposure – Nonradionuclides	Attained individual COC RAGs (MTCA Method B cleanup levels for unrestricted land use). Passed the WAC 173-340-740(7)(e) three-part test.	Compared goals with verification data set values.
Risk – Nonradionuclides	Achieved hazard quotient of <1 for noncarcinogens.	Compared goal with individual hazard quotients calculated from verification data set values.
	Achieved cumulative hazard quotient of <1 for noncarcinogens.	Compared goal with cumulative hazard quotients calculated from verification data set values.
	Achieved excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	Compared goal with individual carcinogen risks calculated from verification data set values.
	Attained a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	Compared goal with cumulative carcinogen risks calculated from verification data set values.
Groundwater/River Protection – Radionuclides	Attained individual radionuclide groundwater and river cleanup requirements. Attained National Primary Drinking Water Standards <4 mrem/yr (beta/gamma) dose rate.	Compared goals to RESRAD model outputs based on unrestricted land-use assumptions and verification data set values.
Groundwater/River Protection – Nonradionuclides	Attained individual nonradionuclide groundwater and river cleanup requirements.	Compared the RAGs of the 100 Area RDR/RAWP (DOE/RL-96-17, 2009) with verification data set values.

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
COC = contaminant of concern
MTCA = *Model Toxic Control Act*
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* DOE/RL-96-17, 2009
RESRAD = RESidual RADioactivity
WAC = *Washington Administrative Code*

5.1.3 Contaminant Identification

The COPCs and COCs for some waste sites were initially identified in the interim action RODs based on historical and field investigation information and were further refined during development of the 100 Area RDR/RAWP (DOE/RL-96-17), the 100 Area SAP (DOE/RL-96-22), and the 100 Area Burial Grounds SAP (DOE/RL-2001-35). The final lists of relevant COCs are documented in the CVP or RSVP for each waste site and may include additional constituents identified during the remediation and characterization process (Table 5-4), pursuant to the interim action ROD "observational approach." Following the process described in this section, residual soil concentrations at all of the sites addressed in this report were shown to meet the RAO performance standards established for unrestricted surface use. The waste sites individually meet the cleanup objectives for eventual unrestricted surface use summarized in Table 5-3. Closeout of individual waste sites was based on the evaluation of analytical laboratory results from verification or confirmatory soil samples that were analyzed by contract laboratories using approved EPA methods. The resulting data for each waste site were subjected to a data quality assessment and determined to be suitable for their intended use to support closure decisions.

5.2 FUTURE ATTAINMENT OF FINAL REMEDIAL ACTION PERFORMANCE STANDARDS

Cleanup of waste sites in accordance with the interim action RODs is expected to continue in the River Corridor until interim remedial action decisions are replaced by final RODs. Final RODs are required (40 *Code of Federal Regulations* 300) for the 100-F Area in order to identify the final remedy decision, including any adjustments to the remedy identified in the interim action RODs, if necessary, to ensure protection of human health and the environment.

In addition to the information and data that originally established the basis for remedial actions under the interim action RODs, final remedial action decisions will incorporate new information acquired through characterization of interim closed waste sites. Development of the final remedy RODs will also incorporate data and information collected during the final source and groundwater remedial investigation and feasibility study.

The final ROD development process will also incorporate evaluation of emerging ecological protection requirements, although the interim action RODs included general objectives for protection of ecological receptors based on meeting the unrestricted land-use cleanup levels.

The final RODs will integrate historical and current characterization information, as well as current applicable or relevant and appropriate requirements. Waste sites remediated under interim action RODs will ultimately be evaluated by the lead agency and lead regulatory agency against the decisions and requirements documented in the final RODs. Upon satisfactory completion of the final remedial actions for the 100-F/IU-2/IU-6 Area, EPA will issue a certificate of completion to DOE.

Table 5-4. Summary of Waste Site Contaminants of Concern and Contaminants of Potential Concern. (3 Pages)

COC/COPCs	*Radionuclides*	Americium-241	Barium-133	Carbon-14	Cesium-137	Cobalt-60	Europium-152	Europium-154	Europium-155	Gross alpha/beta	Helium-3	Nickel-63	Plutonium-238	Plutonium-239/240	Strontium-90	Technicium-99	Thorium-230	Tritium	Uranium-233/234	Uranium-235	Uranium-238	*Inorganics*	All ICP metals	Antimony	Asbestos	Arsenic	Barium	Beryllium	Boron	Cadmium	Cobalt	Copper	Hexavalent chromium	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Total Chromium	Vanadium	Zinc	*Organics*	Herbicides	PAH	Pesticides	PCBs	SVOCs	TPH	VOCs
Waste Site																																																		
100-F-4													X	X																		X								X										
100-F-10		X		X	X	X	X	X	X			X	X		X			X									X					X	X		X														
100-F-11													X	X																		X								X										
100-F-15													X	X																		X								X										
100-F-16													X	X																		X								X										
100-F-19:1				X	X	X	X	X	X			X			X																	X																		
100-F-19:2		X		X	X	X	X	X	X			X	X		X			X									X					X	X		X														
100-F-19:3				X	X	X	X	X	X			X			X																																			
100-F-23				X	X	X	X								X																	X																		
100-F-24				X	X	X	X								X																	X																		
100-F-25				X	X	X	X	X				X			X																	X			X														
100-F-26:4		X			X	X	X	X		X			X	X	X										X	X	X			X		X	X		X			X		X	X	X					X	X	X	
100-F-26:7																							X									X																		
100-F-26:8		X			X	X	X	X	X	X									X	X	X		X									X			X											X	X	X	X	
100-F-26:9					X	X	X	X	X	X			X	X	X				X	X	X		X									X			X											X	X	X	
100-F-26:10		X	X		X	X	X	X	X	X		X			X				X	X	X					X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	
100-F-26:12				X	X	X	X	X	X			X			X			X								X	X			X			X		X			X	X	X								
100-F-26:13		X			X	X	X	X					X	X	X				X	X	X		X									X			X											X				
100-F-26:14		X			X	X	X	X	X			X			X					X	X		X									X			X															
100-F-26:15		X		X	X	X	X	X	X	X		X			X			X					X									X			X															
100-F-29		X		X	X	X	X	X	X			X	X		X			X								X						X	X		X															
100-F-31		X			X		X																	X			X			X		X	X	X		X	X	X	X	X	X		X			X	X		
100-F-33				X	X	X	X	X	X			X	X	X	X				X	X				X				X	X				X			X										X			X	X	
100-F-34				X	X	X	X	X	X			X			X																	X																		
100-F-38		X			X	X	X	X	X											X	X						X							X					X								X	X		
100-F-42					X	X	X	X	X																		X						X							X										
100-F-43					X									X	X																		X	X																	
100-F-44:8																									X	X	X			X					X			X	X	X				X		X	X	
100-F-44:9		X		X	X	X	X	X	X			X	X		X			X								X			X				X	X		X										X				
100-F-45					X		X																								X	X	X		X				X		X								
100-F-47																							X		X										X												X	X	X	
100-F-48																		X			X	X	X												X													X	X	X	X	X
100-F-49																							X												X													X	X	X	X	
100-F-51				X	X	X	X	X	X			X	X	X	X					X	X						X	X			X		X	X	X		X		X	X	X	X		X			X	X	X	
100-F-55		X			X		X																X										X			X											X	X	X	X	

Table 5-4. Summary of Waste Site Contaminants of Concern and Contaminants of Potential Concern. (3 Pages)

COC/COPCs	*Radionuclides*	Americium-241	Barium-133	Carbon-14	Cesium-137	Cobalt-60	Europium-152	Europium-154	Europium-155	Gross alpha/beta	Helium-3	Nickel-63	Plutonium-238	Plutonium-239/240	Strontium-90	Technicium-99	Thorium-230	Tritium	Uranium-233/234	Uranium-235	Uranium-238	*Inorganics*	All ICP metals	Antimony	Asbestos	Arsenic	Barium	Beryllium	Boron	Cadmium	Cobalt	Copper	Hexavalent chromium	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Total Chromium	Vanadium	Zinc	*Organics*	Herbicides	PAH	Pesticides	PCBs	SVOCs	TPH	VOCs
Waste Site																																																			
100-F-56:1																										X	X			X			X	X		X			X	X	X						X			
100-F-56:2																																																		
100-F-57:1																									X		X					X	X	X		X				X		X			X		X		
100-F-57:2																							X		X								X			X									X		X		
100-F-58																									X																									
100-F-61																							X												X										X		X	X	X	
100-F-62		X			X		X																X									X			X									X	X	X	X	
100-F-63				X	X	X	X	X	X			X	X	X	X				X	X						X	X			X		X			X		X	X	X	X		X			X	X	X	
100-F-64																																X	X	X		X			X	X					X		X		X	
100-F-65																							X										X			X										X				
116-F-1				X	X	X	X	X																		X							X																
116-F-2				X	X	X	X	X																									X																
116-F-3							X	X																									X																
116-F-4		X			X	X	X	X						X	X				X		X											X																
116-F-5					X	X																																											
116-F-6					X	X	X	X							X																		X																
116-F-8					X	X	X	X	X																								X																
116-F-9				X	X	X	X								X																		X																
116-F-10					X	X	X														X												X								X								
116-F-11		X		X	X	X	X	X	X			X	X		X				X								X						X	X		X													
116-F-12				X	X	X	X	X	X			X			X																																			
116-F-14				X	X	X	X	X	X			X			X															X		X								X									
116-F-15					X	X	X	X	X				X	X	X							X		X		X							X			X														
116-F-16					X									X	X																		X	X															
118-F-8:1		X	X	X	X	X	X	X	X			X	X	X	X	X		X	X	X	X					X						X	X		X										X				
118-F-8:3		X	X	X	X	X	X	X	X			X	X	X	X	X		X	X	X	X					X						X	X		X										X				
118-F-8:4		X	X	X	X	X	X	X	X		X	X	X	X	X				X	X	X					X						X	X		X										X				
132-F-1															X																															X				
141-C				X															X							X	X			X		X	X	X	X	X	X	X		X		X		X					
1607-F2				X	X	X	X	X																																										
1607-F3				X		X																		X		X	X		X	X		X		X				X	X		X			X	X	X		X
1607-F4		X		X	X	X	X	X	X	X				X	X				X	X	X		X						X				X		X								X	X	X		
1607-F5																													X	X		X		X	X									X	X	X		
1607-F6				X	X	X	X	X	X			X			X																			X												X	X		
1607-F7																							X				X						X			X										X	X	X		X

Table 5-4. Summary of Waste Site Contaminants of Concern and Contaminants of Potential Concern. (3 Pages)

COC/COPCs	*Radionuclides*	Americium-241	Barium-133	Carbon-14	Cesium-137	Cobalt-60	Europium-152	Europium-154	Europium-155	Gross alpha/beta	Helium-3	Nickel-63	Plutonium-238	Plutonium-239/240	Strontium-90	Technicium-99	Thorium-230	Tritium	Uranium-233/234	Uranium-235	Uranium-238	*Inorganics*	All ICP metals	Antimony	Asbestos	Arsenic	Barium	Beryllium	Boron	Cadmium	Cobalt	Copper	Hexavalent chromium	Lead	Manganese	Mercury	Molybdenum	Nickel	Selenium	Silver	Total Chromium	Vanadium	Zinc	*Organics*	Herbicides	PAH	Pesticides	PCBs	SVOCs	TPH	VOCs
Waste Site																																																			
182-F		X		X	X	X	X	X	X	X		X	X	X	X			X		X	X				X																										
600-351																							X											X										X		X	X		X	
UPR-100-F-1		X		X	X	X	X	X	X			X	X		X			X								X						X	X		X														
UPR-100-F-2					X	X	X	X																																										
UPR-100-F-3				X	X	X	X	X				X			X																	X			X																

COC = contaminant of concern
COPC = contaminant of potential concern
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
VOC = volatile organic compound

5.3 QUALITY CONTROL

The quality assurance and quality control programs used throughout the remediation activities are identified in the 100 Area RDR/RAWP (DOE/RL-96-17), the 100 Area SAP (DOE/RL-96-22), and the 100 Area Burial Grounds SAP (DOE/RL-2001-35). Samples that were used to demonstrate achieving the cleanup objectives for individual waste sites were collected and analyzed in accordance with these documents, which were approved by the Tri-Party agencies. The sampling and analysis plan documents contained a quality assurance project plan to establish the objectives, functional activities, methods, and quality assurance/quality control measures associated with the sampling and analysis activities. Verification data sets that were used to support waste site closure underwent a data quality assessment to ensure suitability for their intended use. Results of the data quality assessment are documented in the CVPs and RSVPs for individual waste sites.

6.0 FINAL INSPECTION AND CERTIFICATIONS

Based on evaluation of the approved closeout documentation referenced in Table 5-1 and final inspection of the 100-FR-1 OU waste sites, interim remedial actions have been completed and RAOs have been achieved. Pursuant to the scope of the 100 Area interim action ROD and RAOs, this means that contaminated soil was excavated and disposed at ERDF and waste sites were backfilled (as needed) and revegetated.

The results of confirmatory and verification sampling at interim closed out and no-action 100-FR-1 OU waste sites show that residual contaminant concentrations do not preclude future uses (as bounded by the rural-residential scenario) and allow for unrestricted surface use (i.e., ground surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. If deemed necessary, final inspections of the interim remedial actions will be conducted in the future and include the DOE-RL, EPA, and Washington Closure Hanford representatives. The inspections would include only the waste sites where remedial actions occurred to verify that the sites had been backfilled with clean materials and revegetated as required by the applicable interim action RODs. The waste sites have been reclassified in WIDS as "Interim Closed Out," "No Action," or "Rejected" (RL-TPA-90-0001).

DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions*, describes institutional controls for the Hanford Site. Institutional controls are required at 16 of the remediated 100-FR-1 OU waste sites. Table 6-1 identifies each individual waste site and its associated institutional control. The primary institutional control associated with the waste sites is acceptability of unrestricted direct exposure to deep zone soils. Analyses of deep zone soils at these waste sites have been demonstrated not to meet cleanup levels for unrestricted direct exposure. Hence, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are required.

The remaining remediated waste sites in the 100-FR-1 OU area are available for unrestricted land use.

Table 6-1. 100-FR-1 Waste Site Specific Institutional Controls. (2 Pages)

WIDS Site Code	WIDS Site Name and Aliases	Institutional Control
100-F-10	100-F-10, French Drain at East End of 105-F Storage Room (Southeast Corner)	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
100-F-19	100-F-19, 105-F Reactor Cooling Water Effluent Underground Pipelines; 100-F-19:1 (North Group), 100-F-19:2 (South Group) and 100-F-19:3 (West Group)	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).

Table 6-1. 100-FR-1 Waste Site Specific Institutional Controls. (2 Pages)

WIDS Site Code	WIDS Site Name and Aliases	Institutional Control
100-F-26:5	100-F-26:5, 190-F Bypass Pipelines	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
100-F-29	100-F-29, 100-F Experimental Animal Farm Process Sewer Pipelines	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
100-F-34	100-F-34, Biology Facility French Drain	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
116-F-6	116-F-6, 1608-F Liquid Waste Disposal Trench, 105-F Cooling Water Trench	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
116-F-9	116-F-9, Animal Waste Leaching Trench	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
116-F-10	116-F-10, 105-F Dummy Decontamination French Drain, 116-F-8, 105 Dummy/Perf Decontamination Crib, Perf Decontamination Drain	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
116-F-11	116-F-11, 105-F Cushion Corridor French Drain	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
116-F-12	116-F-12, 148-F French Drain	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
116-F-14	116-F-14, 107-F Retention Basin, 107-F	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
118-F-8:1	118-F-8:1, 105-F Reactor Ancillary Support Areas, Below-Grade Structures and Underlying Soils	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
118-F-8:3	118-F-8:3, 105-F Reactor Fuel Storage Basin Underlying Soils	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
118-F-8:4	118-F-8:4, 105-F Fuel Storage Basin West Side Adjacent and Side Slope Soils	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
1607-F2	1607-F2, 1607-F2 Septic Tank, 124-F-2, 1607-F2 Sanitary Sewer System	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).
UPR-100-F-1	UPR-100-F-1, 141 Building Sewer Line Spill, UN-100-F-1, 141-C to 141-M Sewer Line Leak	Institutional controls are required to prevent uncontrolled drilling or excavation into the deep zone (i.e., below 4.6 m [15 ft]).

WIDS = Waste Information Data System

7.0 OPERATIONS AND MAINTENANCE ACTIVITIES

There is no CERCLA site-specific surveillance and maintenance associated with the 100-FR-1 OU waste sites that have institutional controls. The DOE will retain responsibility for operations and maintenance functions of the 100-FR-1 OU area. These functions and associated landlord responsibilities cover all of the general infrastructure and include such things as access roads, facilities, and services. Monitoring at the Hanford Site is conducted in order to evaluate the performance of the remedies and to identify changes in conditions. In remediated areas, monitoring activities help to verify that the remedies remain effective, resources are protected, and that contaminant migration is prevented. Monitoring also helps to facilitate the maintenance of remedy systems in working condition and to keep controls in working order. These activities are often defined in an operations and maintenance plan for a site, such as maintaining signs, fences, and restrictions on excavations or land use. For the 100-FR-1 OU waste sites, there are no waste-site specific operations and maintenance activities.

The DOE will continue to be responsible for the following general activities:

- Responding to emergency situations or off-normal conditions such as the deterioration of a physical control beyond predicted levels, an error that results in a "near-miss," or the discovery of previously unidentified sources of contamination.

- Notification of the appropriate regulatory agencies of regulatory threshold exceedances, releases of hazardous substances in excess of quantities reportable under CERCLA, and spills or discharges of hazardous substances or dangerous wastes to the environment.

- Long-term monitoring will be required for source sites where residual contaminants preclude unrestricted use.

Multiple resource management plans have been developed at the Hanford Site to protect and provide the policies, goals, and objectives for the management of the site's biological, natural, and cultural resources. These plans address the ongoing surveillance, protection, and controlled use of the resources and guide the management of resources.

CERCLA 5-year reviews will be required to assess the protectiveness of remedial actions where hazardous substances, pollutants, or contaminants are left onsite above levels that allow for unlimited use and unrestricted exposure. In addition to CERCLA, the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) allows 5-year reviews to address regulated *Resource Conservation and Recovery Act of 1976* (RCRA) units and past-practice units that are regulated under RCRA and/or CERCLA. The third CERCLA 5-year review report for the Hanford Site was completed in November 2011.

7.1 ENVIRONMENTAL MONITORING

The 100 Area of the Hanford Site includes significant natural resources including habitat for numerous endangered, protected, and listed species. In addition to the cleanup conducted under CERCLA, environmental monitoring and reporting on the 100-FR-1 OU is conducted annually in accordance with DOE O 231.1A, *Environment, Safety, and Health Reporting*. DOE/RL-2011-119, *Hanford Site Environmental Report for Calendar Year 2011,* includes a summary of cleanup performance and compliance relative to applicable federal, state, and local environmental laws and regulations; DOE orders; Secretary of Energy Notices; and DOE Headquarters and site operations office directives, policies, and guidance. It summarizes specific requirements, actions, plans, and schedules identified in the Tri-Party Agreement (Ecology et al. 1989) and other compliance or consent agreements. Although the report is written each year primarily to meet DOE reporting requirements and guidelines, it is also intended to provide a broad spectrum of environmental information to DOE managers, the public, the Tribes, public officials, regulatory agencies, Hanford Site contractors, and elected representatives.

Each annual report provides an overview of activities at the site; demonstrates the status of the site's compliance with applicable federal, state, and local environmental laws and regulations, executive orders, and DOE policies and directives; and summarizes environmental data that characterize Hanford Site environmental management performance. The report also highlights significant environmental and public protection programs and efforts.

The monitoring includes many Hanford Site activities including decommissioning, demolition, remediation, restoration, waste management, closure activities, environmental occurrences, pollution prevention, waste minimization, and monitoring activities for environmental resources. Media included in the monitoring activities are air emissions, facility effluents, surface water, river sediment, drinking water, groundwater, food/farm products, vegetation, fish and wildlife (including threatened and endangered species), radiation, and cultural resources.

There are no site-specific CERCLA monitoring requirements associated with the 100-FR-1 OU waste sites.

7.2 GROUNDWATER MONITORING

Groundwater monitoring at the Hanford Site is guided by DOE/RL-2002-59, *Hanford Site Groundwater Strategy: Protection, Monitoring, and Remediation*, and fulfills requirements for monitoring according to the *Atomic Energy Act of 1954*, RCRA, CERCLA, and WAC 173-303. The strategy focuses on protecting groundwater, groundwater monitoring and groundwater remediation.

The 100-FR-3 groundwater OU lies beneath and adjacent the 100-FR-1 source OU. Sampling and analysis in the 100-FR-3 OU is performed according to DOE/RL-2003-49, *100-FR-3 Operable Unit Sampling and Analysis Plan*, as modified by TPA-CN-241, *Change Notice for*

Modifying Approved Documents/Workplans in Accordance with the Tri-Party Agreement Action Plan, Section 9.0 Documentation and Records, 100-FR-3 Operation Unit Sampling and Analysis Plan, DOE/RL-2003-29, Rev.1 and TPA-CN-228 (July 14,2008), and PNNL-14287, *Data Quality Objectives Summary Report - Designing a Groundwater Monitoring and Assessment Network for the 100-BC-5 and 100-FR-3 Operable Units.* Monitoring results (i.e., groundwater flow and contaminant distribution) are presented in annual Hanford Site groundwater monitoring reports.

DOE/RL-2011-118, *Hanford Site Groundwater Report for 2011*, describes groundwater monitoring results for the 100-FR-3 groundwater OU. This annual report indicates that groundwater flow direction varies within the 100-FR-3 OU because of the Columbia River. During moderate river stage, flow direction is to the east-northeast (toward the river) in the western portion of 100-FR-3 and towards the southeast (approximately parallel to the river) in the eastern portion of the OU.

Contaminant distribution in groundwater is evaluated in the 100-FR-3 OU by collecting samples from groundwater monitoring wells, and aquifer tubes and shoreline springs adjacent to the Columbia River samples. Contaminants routinely monitored are strontium-90, tritium, hexavalent chromium, trichloroethene, and nitrate. Elevated levels of strontium-90, chromium, trichloroethene, and nitrate are detected in the 100-FR-3 groundwater OU; elevated levels of hexavalent chromium and nitrate are also detected in aquifer tubes adjacent to the Columbia River (DOE/RL-2011-118). Tritium concentrations in groundwater have not exceeded the drinking water standard since 2001. Groundwater remediation is not currently being performed in the 100-FR-3 OU.

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