DOE/RL-2014-44-ADD1
Draft A

Remedial Design Report/ Remedial Action Work Plan Addendum for 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 Soils

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

U.S. DEPARTMENT OF ENERGY | Richland Operations Office

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Title: Remedial Design Report/Remedial Action Work Plan Addendum for 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 Soils

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Contents

Appendices

Figures

Tables

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Terms

ACM	asbestos-containing material
AOC	area of contamination
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BMP	best management practice
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
CTA	container transfer area
CVP	cleanup verification package
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
FS	feasibility study
IC	institutional control
IH	industrial hygiene
LDR	land disposal restricted
MTCA	“Model Toxics Control Act – Cleanup”
NCP	“National Oil and Hazardous Substances Contingency Plan”
NESHAP	“National Emission Standards for Hazardous Air Pollutants”
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PPE	personal protective equipment

RAO	remedial action objective
RAWP	remedial action work plan
RCBRA	river corridor baseline risk assessment
RCRA	*Resource Conservation and Recovery Act of 1976*
RDR	remedial design report
RESRAD	RESidual RADioactivity
RI	remedial investigation
ROD	record of decision
RTD	remove, treat, and dispose
SAP	sampling and analysis plan
SNF	spent nuclear fuel
SPA	staging pile area
STOMP	Subsurface Transport Over Multiple Phases
TRU	transuranic
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
USC	*United States Code*
WAC	*Washington Administrative Code*

1 Introduction

The *Record of Decision for the Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (hereafter referred to as the 100-F/IU Area ROD) (EPA 2014) defines selected remedies for the listed operable units (OUs) of the Hanford Site (referred to collectively as the 100-F/IU Area). In general, these selected remedies consist of three categories:

- Remove, treat, and dispose (RTD) remediation for waste sites in the 100-IU-2 and 100-IU-6 OUs.
- Monitored natural attenuation for contaminated groundwater in the 100-FR-3 OU.
- Institutional controls (ICs) to protect the integrity of response actions and minimize exposure to contamination in soil and groundwater until such contamination is at levels that allow for unlimited use and unrestricted exposure (as defined in the *Integrated Remedial Design/Remedial Action Work Plan for 100-F/IU*, hereafter referred to as the Integrated RDR/RAWP [DOE/RL-2014-44]) . This includes general ICs as well as specific ICs for individual waste sites in the 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 OUs.

The Integrated RDR/RAWP (DOE/RL-2014-44) addresses overarching common elements and integration considerations for these three categories. This addendum supplements the Integrated RDR/RAWP in addressing implementation requirements specific to the soil remedy of RTD for waste sites in the 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 OUs, as well as certain IC components.

The OUs that comprise the 100-F/IU Area are depicted in Figure 1-1. The 100-FR-1 and 100-FR-2 OUs are associated with past activities at the 100-F Reactor Area. Waste sites in these OUs are generally related to the operational and waste management processes for former reactor operations and the associated experimental animal farm. These waste sites were primarily remediated under interim actions, and the associated area has been restored. The 100-IU-2 and 100-IU-6 OUs include the waste sites within the areas between and outside the reactor areas within the River Corridor. Waste sites in these OUs are predominantly related to nonradiological operations such as construction activities and general purpose disposal. Many of the waste sites in these OUs have been previously remediated under interim actions, but several waste sites remain to be remediated.

Remedial actions have been ongoing in the 100-F/IU Area since 1996 under three interim action RODs:

- *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) and the associated *Amendment to the Interim Action Record of Decision for the 100-BC-1, 100-DR-1, and 100-HR-1 Operable Units* (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* (EPA 1999); and
- *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington* (EPA 2000).

These previous and ongoing remediation activities have been performed in accordance with the applicable revision of DOE/RL-96-17, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (hereafter referred to as the interim action RDR/RAWP). The interim actions have established much of the document and process framework needed to successfully implement the scope of the 100-F/IU ROD. Upon approval, this addendum and the Integrated RDR/RAWP supersede the interim action RDR/RAWP

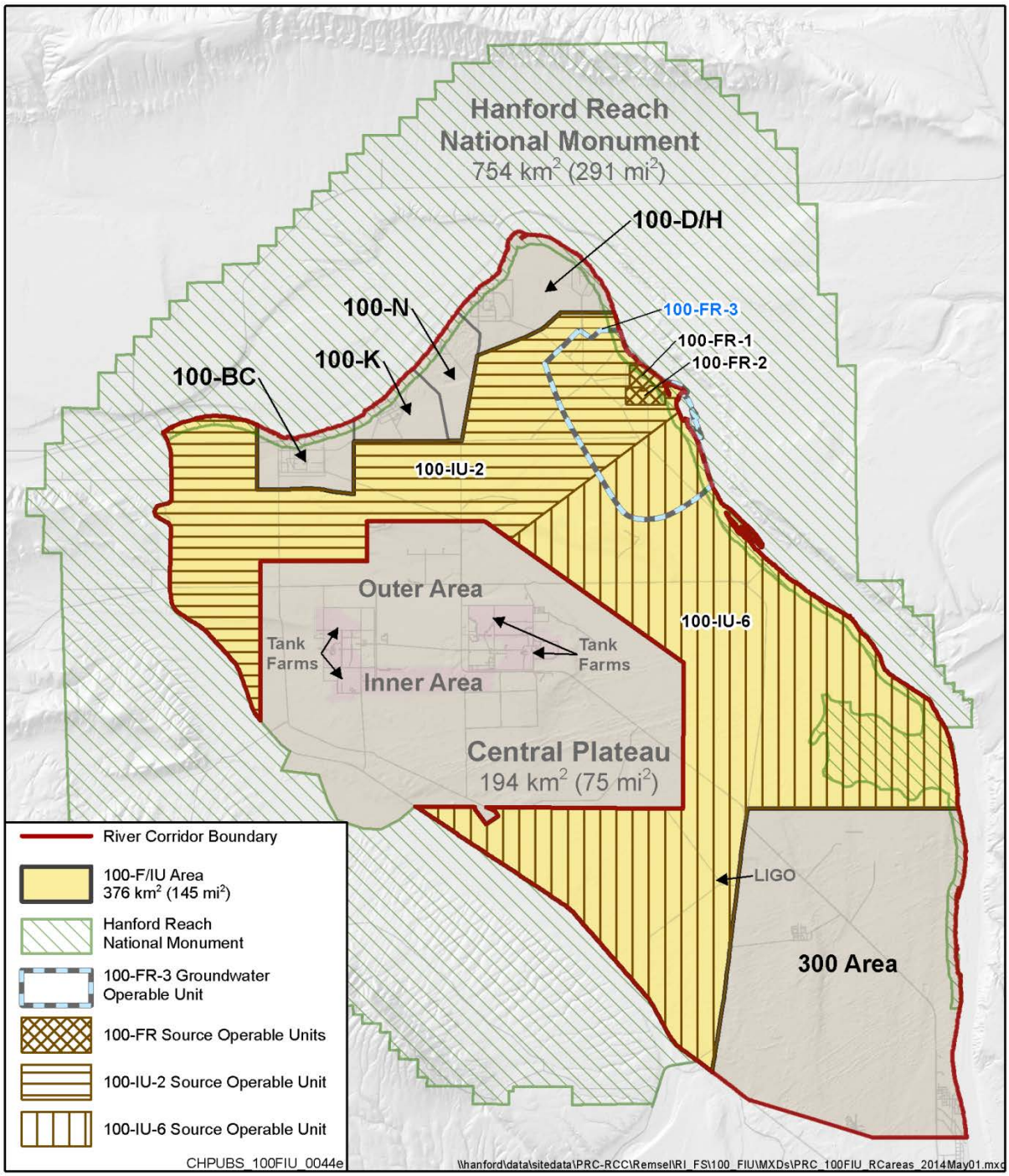

Figure 1-1. 100-F/IU Area Operable Units within the River Corridor

for the 100-F/IU Area, but remedial designs, plans, and other regulatory agreements approved under interim actions shall remain in effect except where this addendum explicitly describes otherwise. Existing lower tier documents that reference the interim action RDR/RAWP may continue to be used with the understanding that these references are superseded by this approved addendum and the associated

Integrated RDR/RAWP (DOE/RL-2014-44). The interim action RDR/RAWP will continue to be applicable for other source OUs in the 100 Area for which a final action ROD has not yet been issued.

1.1 Purpose

The primary purpose of this addendum is to provide the RDR/RAWP to describe the design and implementation of the remedial action process required for RTD of 100-F/IU Area waste sites by the 100-F/IU Area ROD. In addition, this document addresses the requirements for completion of the remedial action process and the closeout/verification process for these waste sites in accordance with the 100-F/IU ROD. The contents of this document will be reviewed and revised as appropriate to reflect changes to the design and work plans for remedial action. In the meantime, any adjustments will be documented in the unit manager's meeting minutes and/or via change notices, as necessary.

1.2 Scope

This addendum supplements the Integrated RDR/RAWP to provide the RDR and RAWP for RTD of 100-F/IU Area waste sites. The *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) lists the RDR and the RAWP as two separate documents. However, this document streamlines the requirements; the RDR and RAWP are combined to cover both the remedial designs and remedial actions.

1.2.1 Remedy Components and Waste Sites

This addendum addresses the following components of the 100-F/IU ROD:

- Removal of contaminated soil and associated debris from waste sites
- Treatment, as necessary, to meet waste acceptance criteria at an acceptable disposal facility
- Disposal of contaminated materials at the Hanford Site's Environmental Restoration Disposal Facility (ERDF) or other disposal facilities approved in advance by the U.S. Environmental Protection Agency (EPA)
- Backfilling and recontouring of excavated areas followed by planting with native vegetation
- ICs associated with access for active remediation areas.

The waste sites with a selected RTD remedy in the 100-F/IU Area ROD are identified in Table 1-1. If additional waste sites that may require remediation are identified beyond those listed in the table, they will be discussed with the U.S. Department of Energy, Richland Operations Office (DOE-RL) and EPA for appropriate disposition. Summary information for all 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 waste sites is provided in Appendix A. Some of the waste sites identified in Table 1-1 have already been addressed and reclassified under interim actions. Activities for these waste sites may be limited to verification that the interim actions taken remain protective under the 100-F/IU ROD requirements without further remedial action, and associated documentation that these sites meet the 100-F/IU ROD requirements.

Table 1-1. Waste Sites Addressed by this Remedial Design Report/ Remedial Action Work Plan

Selected Remedy	Waste Site
RTD to residential cleanup levels	600-20, 600-279, 600-293, 600-294, 600-298:1, 600-298:2, 600-298:3, 600-298:4, 600-298:5, 600-298:6, 600-298:7, 600-298:8, 600-299:1, 600-299:2, 600-299:3, 600-299:4, 600-299:5, 600-299:6, 600-300:1, 600-300:2, 600-300:3, 600-300:4, 600-300:5, 600-300:6, 600-300:7, 600-300:8, 600-300:9, 600-300:10, 600-300:11, 600-300:12, 600-301, 600-303, 600-316:1, 600-316:2, 600-316:3, 600-316:4, 600-316:5, 600-316:6, 600-318:1, 600-318:2, 600-318:3, 600-318:4, 600-318:5, 600-320:1, 600-320:2, 600-320:3, 600-320:4, 600-320:5, 600-320:6, 600-320:7, 600-320:8, 600-320:9, 600-321:1, 600-321:2, 600-321:3, 600-321:4, 600-326:1, 600-326:2, 600-328, 600-329, 600-331, 600-332, 600-334:2, 600-349, 600-356, 600-358, 600-368, 600-369:1, 600-369:2, 600-369:3, 600-369:4, 600-369:5, 600-369:6, 600-369:7, 600-369:8, 600-370, 600-371, 600-372:1, 600-372:2, 600-373, 600-374, 600-375:1, 600-375:2, 600-375:3, 600-375:4, 600-375:5, 600-376:1, 600-376:2, 600-377, 600-378, 600-379

ROD = Record of Decision
RTD = remove, treat, dispose

Buildings (including the 105-F Reactor Safe Storage Enclosure) are not part of the 100-F/IU ROD. Contaminated buildings have been demolished and removed in accordance with *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) action memoranda (EPA and DOE 1997 and Ecology et al. 1998). Potential releases from those buildings may have resulted in waste sites that have been previously addressed or are within the scope of this document.

1.2.2 Waste Sites Containing Principal Threat Waste

Principal threat wastes are those source materials considered to be highly toxic and/or highly mobile that generally cannot be reliably contained and/or would present a significant risk to human health and/or the environment should exposure occur. Principal threat wastes associated with the 100-F/IU Area have already been removed through previous cleanup actions, and no further specific consideration is given in this document.

1.3 Report Organization

The essential elements of this RDR/RAWP are present in Sections 1.0 through 5.0, which comprise the main body of the report. The appendices present additional information and guidance. The contents of each section are briefly described below:

- Section 1.0, “Introduction,” presents the purpose, scope, and this overview of the report’s organization. Additional introductory and background information can be found in the integrated RDR/RAWP.
- Section 2.0, “Basis for Remedial Action,” presents the objectives, cleanup levels, cleanup verification approach, and applicable or relevant and appropriate requirements (ARARs).

- Section 3.0, “Remedial Action Design and Planning,” presents the design and remediation planning components and process.
- Section 4.0, “Remedial Action Management and Approach” presents the details for field-implementation of the selected remedy and ICs specific to waste site remediation.
- Section 5.0, “Waste Management Plan,” describes waste storage, transportation, packaging, handling, labeling, and disposal as applicable to waste streams for each waste site.
- Section 6.0, “References,” contains all reference information used for the main body of the report.
- Appendix A, “Waste Site Information,” presents a general description and status of all 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 waste sites.
- Appendix B, “Guidance for Cleanup Verification Packages,” presents a detailed description of the cleanup verification process to aid in development and review of cleanup verification packages (CVPs).
- Appendix C, “Cleanup Levels,” presents a summary of the development of the contaminant-specific numerical cleanup values.

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2 Basis for Remedial Action

The 100-F/IU Area ROD (EPA 2014) selected remedial action for specific waste sites based on a determination that remaining unremediated sites present an unacceptable risk to human health and the environment. The Integrated RDR/RAWP (DOE/RL-2014-44) provides the associated remedial action objectives (RAOs), which provide a narrative statement of the extent to which cleanup is necessary under the ROD. This chapter then provides the associated analyte-specific soil cleanup levels and requirements for their application, as well as the ARARs for 100-F/IU Area remedial action.

2.1 Cleanup Levels

DOE's reasonably anticipated future use for the 100-F/IU Area is conservation and preservation. The U.S. Environmental Protection Agency and the Washington State Department of Ecology believe that other uses, including residential use, are reasonably anticipated future land use. To achieve RAOs, numerical cleanup levels for residential land use were calculated during the 100-F/IU Area remedial investigation/feasibility study (RI/FS) (DOE/RL-2010-98, *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*) and promulgated by the 100-F/IU Area ROD (EPA 2014). These cleanup levels also allow for conservation and preservation uses.

Soil cleanup levels for direct contact human health receptors were developed using standard approaches, consistent with state and federal guidance. Direct contact cleanup levels for nonradionuclides are based on risk calculations provided in the Washington State's "Model Toxics Control Act – Cleanup" (MTCA) procedures. Direct contact cleanup levels for radionuclides are calculated based on an excess lifetime cancer risk of $1x10^{-4}$ or a radiological dose of 15 mrem/yr. For each radionuclide, the lower of the risk or dose-based calculations is used as the cleanup level.

Soil cleanup levels for groundwater and surface water protection were also developed based on current state and federal guidance and, consistent with guidance, incorporate site-specific data from the 100-F/IU Area. Soil cleanup levels are described below based on a residential scenario with irrigation. Irrigation provides an increased amount of water to the soil, and a relatively high 72 mm/yr of water is assumed to reach groundwater. The irrigated residential scenario is used to identify the potential for groundwater and surface water contamination to occur from waste sites due to higher groundwater recharge rates associated with the irrigation of crops and was used to develop the residential cleanup levels.

Cleanup levels are calculated for single contaminants. For sites with multiple residual contaminants, risks from individual contaminants will be added and evaluated (as described in Section 2.2.2) to ensure that the waste site meets total risk limits as specified in CERCLA and the "National Oil and Hazardous Substances Contingency Plan" (NCP) (40 *Code of Federal Regulations* [CFR] 300). When a groundwater protection cleanup level is exceeded, site-specific information will be evaluated to determine if remediation has achieved the RAOs.

The river corridor baseline risk assessment (RCBRA) (DOE/RL-2007-21) and the RI/FS report (DOE/RL-2010-98) evaluated ecological risks at interim remediated waste sites with upland habitats for potential ecological risks. The RI/FS used information from the RCBRA and from other sources to evaluate the risk to populations and communities of ecological receptors, and determined that interim remedial actions that achieved interim action ROD cleanup levels for protection of human health were also protective of ecological receptors and there was no ecological risk at remediated waste sites within the 100-F/IU Area. Further, the 100-F/IU Area RI/FS report (DOE/RL-2010-98) concluded that there were no contaminants of ecological concern or ecological risk to populations and communities due to the

100-F/IU Area waste sites in riparian, near-shore, and river environments. These conclusions considered the size of waste sites relative to ecological receptor home ranges. The 100-F/IU Area ROD (EPA 2014) then determined that, for 100-F/IU Area waste sites that have not been remediated under interim actions, residual contamination will not be sufficient to adversely impact populations and communities of ecological receptors once human health cleanup levels are achieved. As such, no further evaluation of ecological risks will be performed for individual waste sites addressed under this RDR/RAWP.

The cleanup levels for a residential land-use scenario are included in Appendix C, Table C-1 for radiological and nonradiological constituents. The methodology used to arrive at these values is summarized in Appendix C of this document and in the 100-F/IU Area ROD (EPA 2014). For the purpose of using the RESidual RADioactivity (RESRAD) dose model, unrestricted future use in the 100-F/IU Area is represented by an individual resident in a rural-residential setting. This resident is assumed to consume and irrigate crops raised in a backyard garden, consume animal products (e.g., meat and milk) from locally raised livestock or meat from game animals (including fish), and live in a residence on the waste site. The exposure pathways considered in estimating dose from radionuclides in soil are inhalation; soil ingestion; ingestion of crops, meat, fish, drinking water, and milk; and external gamma exposure. Based on EPA guidance, this individual is conservatively assumed to spend 60% of his/her lifetime (15 hr/day, 350 days/yr) indoors on site and 12% of their time (3 hr/day, 350 days/yr) outdoors on site. The assumptions used for the unrestricted land-use scenario are also described in Appendix C of this document.

Soil cleanup levels for nonradionuclides were calculated using the MTCA Method B equations provided by *Washington Administrative Code* (WAC) 173-340-740(3) for carcinogens and noncarcinogens. For both carcinogens and noncarcinogens, the calculations assume that a resident with an average body weight of 16 kg (35 lb) over the period of exposure ingests soil at a rate of 200 mg/day (73 g/yr), with a frequency of contact of 100% and a gastrointestinal absorption rate of 100%. For individual nonradionuclide carcinogenic chemicals, the calculation is based on achieving an excess lifetime cancer risk goal of $1x10^{-6}$ for an exposure duration of 6 years and a lifetime of 75 years. For noncarcinogens, the calculation is based on achieving a hazard quotient of 1.

Soil cleanup levels for the protection of groundwater and surface water are based on site-specific data for the 100-F/IU Area and current federal drinking water standards and state water quality standards (EPA 2014). Contaminant-specific soil cleanup levels for the protection of groundwater and surface water were calculated based on site-specific data and specific parameters using the Subsurface Transport Over Multiple Phases (STOMP) code with a one-dimensional model. For highly mobile contaminants (retardation coefficient < 2), the model assumes the entire vadose zone from ground surface to groundwater is contaminated. For less mobile contaminants (retardation coefficient ≥ 2), the model assumes the top 70% is contaminated and the bottom 30% is not contaminated. Based on this model, no soil cleanup level for groundwater or river protection is calculated for some contaminants because they are calculated to not reach the groundwater within 1,000 years at levels that contaminate groundwater above drinking water standards (or would contaminate the river above surface water standards).

For the residential land-use scenario, it is assumed that the period of analysis for evaluation of site risks and groundwater protection is 1,000 years, and direct exposure of onsite residents to residual contamination to a depth of 4.6 m (15 ft) may occur (this represents a reasonable estimate of the soil depth that could be excavated and distributed at the soil surface as a result of site development activities).

2.2 Application of Cleanup Levels

2.2.1 Cleanup Levels Based on Vadose Zone Depth

For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to 4.6 m (15 ft) below the ground surface per WAC 173-340-740(6)(d). This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities. Soils and materials 4.6 m (15 ft) or more below ground surface are referred to as being in the deep zone whereas the materials above 4.6 m (15 ft) below ground surface (bgs) are referred to as being in the shallow zone. The direct exposure cleanup levels are applicable to the ground surface and soils or materials within the shallow zone. Groundwater protection and river protection cleanup levels are applicable to soils in both the shallow and the deep zones. However, if a site will meet the direct exposure cleanup criteria throughout the site excavation, it is appropriate to handle the entire site as a shallow zone decision unit regardless of the depth of the excavation. This may be advantageous for site closeout because a site that meets the more restrictive shallow zone criteria will not have a requirement for deep zone ICs.

The RAOs call for prevention of human exposure to the upper 4.6 m (15 ft) of soil, structures, or debris with contaminants of concern (COCs) at concentrations above cleanup levels and management of contaminated soils below 4.6 m (15 ft). Generally, this would entail RTD of soils below 4.6 m (15 ft) exceeding cleanup levels in Table C-1 for groundwater and river protection for waste sites in the scope of this addendum. It is anticipated that (under limited circumstances) factors such as nature and form of contaminated material, implementability, cost, volume, and impacts to ecological and cultural resources may be used to evaluate the extent of excavation at depths greater than 4.6 m (15 ft). Appropriate remedy selection change documentation (e.g., a memorandum-to-file, explanation of significant differences, or ROD amendment, based on the nature of the exception) will be prepared and public involvement will be provided for, if necessary. Regardless of these factors, protection of groundwater and the Columbia River must be achieved for any contamination left below 4.6 m (15 ft) (i.e., alternative remedial measures must be evaluated).

The soil cleanup levels apply to soil and structures (including pipelines and debris). Cleanup levels do not apply to constituents that are an integral part of manufactured structures. Application of soil cleanup levels to sediment and scale within pipelines and similar structures may be over-conservative, depending on site-specific conditions. Where there are exceedances of cleanup levels in sediment/scale data, but not in corresponding underlying soil, alternative demonstrations of RAO attainment may be used with EPA approval. For example, the EPA may approve use of a matrix-correction approach to adjust contaminant concentrations to consider a combined scale and pipeline wall matrix. The EPA may also approve qualitative demonstrations of protectiveness based on site-specific considerations.

2.2.2 Multiple Contaminant Concentrations

Cumulative effects associated with the presence of multiple radionuclide or nonradionuclide contaminants at waste sites must be evaluated to ensure that the waste site meets total risk limits as specified in CERCLA, the NCP, and MTCA. The following standards must be met for cumulative effects of multiple contaminants:

- Total excess cancer risk from all nonradionuclide constituents must not exceed $1x10^{-5}$.
- Total of all toxicity hazard quotients for nonradionuclide constituents must be a hazard index of less than 1.

- Cumulative risk of all radionuclides must not exceed the CERCLA risk range of 10^{-4} to 10^{-6} or a radiological dose of 15 mrem/yr, where that limitation is more conservative.
- Summation of the predicted groundwater dose from all beta- and photon-emitting radionuclides must be less than 4 mrem/yr.

The 2007 MTCA cleanup regulation, WAC 173-340-708(8)(e), provides a method to determine compliance with cleanup levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (PAHs). Mixtures of carcinogenic PAHs are considered as a single hazardous substance, and the cleanup levels established for benzo(a)pyrene are used as the cleanup levels for mixtures of carcinogenic PAHs. Cleanup verification samples are analyzed to determine the concentration of each carcinogenic PAH listed in Table 2-1 (from Table 708-2 of the 2007 MTCA cleanup regulation). Following the criteria of Appendix B, statistical values representing the PAH COC concentrations for each decision unit are calculated or the maximum detected value is selected when the COC is detected in fewer than 50% of the samples (and for focused samples). The selected value for each PAH is multiplied by the corresponding toxicity equivalency factor in Table 2-1 to obtain the toxic equivalent concentration of benzo(a)pyrene for that carcinogenic PAH. The toxic equivalent concentrations of all the carcinogenic PAHs are added to obtain the total toxic equivalent concentration of benzo(a)pyrene for the decision unit. This value is compared against the cleanup level for benzo(a)pyrene from Table C-1 to determine compliance. The results of this determination are included in the waste site CVP as described in Appendix B.

2.2.3 Discovery of Additional Contaminants

Contaminants of concern were selected in the 100-F/IU Area ROD (EPA 2014) based on review of available characterization data, waste site history and processes, and characterization of analogous waste sites, and are listed in Appendix C (Table C-1). In the event that contaminants are discovered during remediation for which cleanup levels were not established in the ROD, the information will be presented to the DOE and EPA project managers for determination of a path forward.

Table 2-1. Toxic Equivalency Factors for Carcinogenic Polyaromatic Hydrocarbons [a]

CAS Number	Carcinogenic Polyaromatic Hydrocarbons	Toxic Equivalency Factors
50-32-08	Benzo(a)pyrene	1
56-55-3	Benzo(a)anthracene	0.1
205-99-2	Benzo(b)fluoranthene	0.1
207-08-9	Benzo(k)fluoranthene	0.1
218-01-9	Chrysene	0.01
53-70-3	Dibenz(a,h)anthracene	0.1
193-39-5	Indeno(1,2,3-cd)pyrene	0.1

a. From WAC 173-340-708(8)(e), Table 708-2.

CAS = Chemical Abstract Services

2.3 Verification of Waste Site Cleanup

Appendix B provides guidance for the process by which CVPs are prepared and reviewed. The purpose of the CVP is to document that the relevant waste site has been remediated in accordance with the applicable ROD and that the RAOs under the applicable land-use scenario have been achieved. Site-specific data evaluations are presented in the CVP to demonstrate that the waste site, following remediation, does not pose an unacceptable risk to human health and is protective of groundwater and the river.

The primary determination of the successful completion of remediation is the comparison of analysis of residual COC concentrations against cleanup levels in appropriate tables. In addition, site-specific factors such as the concentration of the contaminants at depth, the type of waste site (solid or liquid), and calculations of residual site risks are used to verify that remaining concentrations of contaminants are protective of direct exposure and groundwater and the Columbia River (see Appendix B). Development of a site-specific contaminant distribution model may be necessary to more accurately describe actual site conditions and show that contaminant concentrations decrease with soil depth. Use of analogous sites and process knowledge, or a test pit or borehole, may be needed to establish the distribution of contaminants with respect to soil depth. A site-specific contaminant distribution model, using actual field data, will more accurately predict potential impacts of vadose zone soil contaminants on groundwater and the river. The model information will be used to determine if the residual concentrations of contaminants in the unsaturated vadose zone are protective of groundwater and the river, or if further excavation of remaining contamination in the unsaturated vadose zone is required. Results will be documented in the CVP.

2.4 Applicable or Relevant and Appropriate Requirements

The NCP (40 CFR 300) and the 100-F/IU Area ROD require that the remedial actions comply with ARARs established in the ROD. The purpose of this section is to summarize how each of the ARARs identified in the ROD will be met during remedial action.

Activities associated with the remedial action for the source area waste sites covered under the ROD are expected to occur on-site, as that term is defined under the NCP. As a result, the remedial actions described in this document must meet the substantive, but not administrative, requirements of the ARARs established in the ROD. In the event that any portion of the remediation work occurs at an offsite location (e.g., waste treatment at an offsite facility), the work is required to comply with all applicable requirements. The sites addressed by the 100-F/IU Area ROD and ERDF are reasonably close to one another, and the wastes meeting the ERDF waste acceptance criteria (WCH-191) are compatible for the selected disposal approach. Therefore, the waste sites and ERDF are considered to be a single site for response purposes.

If any requirement that might be an ARAR for the remedial action is promulgated subsequent to issuance of the 100-F/IU Area ROD, the DOE and EPA will review the requirement and determine if compliance with the new requirement is necessary to ensure that the remedy is protective of human health and the environment, in accordance with 40 CFR 300.430(f). If necessary to ensure protection of human health and the environment, the selected remedy will be revised to incorporate the newly promulgated ARAR.

2.4.1 Chemical-Specific ARARs

Chemical-specific ARARs are typically health- or risk-based regulatory values or methodologies that are applied to site-specific media and used to establish cleanup criteria. Chemical-specific ARARs for source waste site remedial action selected in the ROD are as follows:

- **WAC 173-340-740, "Unrestricted Land Use Soil Cleanup Standards":** Establishes methodology for calculating soil cleanup levels based on unrestricted land use (WAC 173-340-740(3)); adjustments to calculated cleanup levels to take into account cumulative effects of multiple contaminants and exposure pathways, adjustments based on state and federal law, and adjustments in consideration of natural background levels and practical quantitation limits (WAC 173-340-740(5)); points of compliance where cleanup levels must be attained (WAC 173-340-740(6)); and monitoring protocols for sampling, analysis, and statistical methods used to determine compliance (WAC 173-340-740(7)). Soil cleanup levels for unrestricted land use have been selected in the ROD. Sampling and analysis requirements and locations will be addressed in accordance with a sampling and analysis plan (SAP) for waste sites undergoing remediation; considerations for cumulative effects of multiple contaminants will be documented in closeout documentation as described in Appendix B.
- **WAC 173-340-747, "Deriving Soil Concentrations for Groundwater Protection":** Establishes methodology for determining soil concentrations that will not cause contamination of groundwater at levels that exceed groundwater cleanup levels under WAC 173-340-720. Soil cleanup levels to ensure protection of groundwater have been selected in the ROD, using alternative fate and transport modeling as allowed in WAC 173-340-747(8).
- **WAC 246-247-035(1)(a)(ii), "National Standards Adopted by Reference for Sources of Radionuclide Emissions" (adopting by reference 40 CFR 61.92):** Requires that airborne emissions from all combined operations at the Hanford Site not exceed 10 mrem/yr effective dose equivalent to any member of the public. For source waste site remedial actions, standard construction techniques such as use of water spray to control fugitive emissions of radioactively contaminated dust and particles will be used to meet this ARAR.

2.4.2 Action-Specific ARARs

Action-specific ARARs typically are technology- or activity-based requirements or limitations triggered by a particular type of action such as excavation, transport, and/or disposal of hazardous waste. Action-specific ARARs for source waste site remedial action selected in the ROD are as follows:

- **WAC 173-400-040, "General Standards for Maximum Emissions":** All sources and emission units are required to meet the general emission standards unless a specific source standard is available. General standards apply to visible emissions, particulate fallout, fugitive emissions, odors, emissions detrimental to health and property, sulfur dioxide, and fugitive dust. Remedial actions will be conducted in a manner to ensure compliance with substantive provisions of these standards. In particular, compliance with these requirements will be achieved by the use of fixatives and water sprays to control emissions of contaminated dust and particulates.
- **WAC 173-400-075, "Emission Standards for Sources Emitting Hazardous Air Pollutants":** This section identifies emission standards for hazardous air pollutants from various sources and adopts, by reference, "National Emission Standards for Hazardous Air Pollutants" (NESHAP), 40 CFR 61. These sources are, for the most part, industry specific and not expected to be encountered or implemented as part of 100-F/IU Area source waste site remediation, with the exception of standards

for asbestos emissions (discussed under the ARAR entry for 40 CFR 61 Subpart M) and radionuclide emissions (discussed under the ARAR entry for WAC 246-247).

- **WAC 173-460, "Controls for New Sources of Toxic Air Pollutants":** These requirements are considered applicable if a treatment technology that involves toxic air pollutant emissions is necessary during implementation of the source waste site remedial action. No treatment requirements have been identified at this time for 100-F/IU Area source unit waste sites that would be required to meet the substantive requirements of WAC 173-460. Treatment of some waste encountered during the remedial action may be required to meet the ERDF waste acceptance criteria. In most cases, the type of treatment anticipated would consist of solidification/stabilization techniques, and the provisions of WAC 173-460 would not be an ARAR. If the need for any treatment technology with toxic air pollutant emissions potentially subject to WAC 173-460 is identified, DOE will notify the EPA and an evaluation of WAC 173-460 requirements will be conducted.

- **WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides"; WAC 246-247, "Radiation Protection – Air Emissions":** These standards specify that airborne radionuclide may not exceed 10 mrem/yr to the whole body of any member of the public (WAC 173-480-040/WAC 246-247-035). The radionuclide emission standard applies to fugitive, diffuse, and point-source air emissions generated during excavation or treatment of source waste site contaminated soil within the 100-IU-2 and 100-IU-6 OUs. Compliance with the standard is determined on a Hanford Site-wide basis and is documented in the annual radionuclide air emissions report for the Hanford Site. WAC 173-480-050 requires that all emission units make every reasonable effort to maintain radioactive materials in effluents to unrestricted areas to levels that are as low as reasonably achievable (ALARA). WAC 173-480-060 and WAC 246-247-040(3) require the application of best available radionuclide control technology to control radioactive air emissions for new emission units; WAC 246-247-040(4) requires use of ALARA-based control technology for existing emission units. WAC 246-247-075 and WAC 173-480-070 establish monitoring, testing, and quality assurance requirements for emissions of radioactive material; WAC 246-247-035(1)(a)(i) and (ii) require determination of compliance with numerical limits in accordance with NESHAP emission tests. 100-F/IU Area remediation activities associated with radionuclides are required to meet all these standards, including associated design, work practices, and/or air emissions controls. Monitoring, testing, and quality assurance requirements will be defined in an air monitoring plan to be approved by the lead regulatory agency. Standard construction techniques such as using water spray to control fugitive emissions of contaminated dust and particulates will be used to meet emission standards of WAC 173-480 and WAC 246-247 when excavating source waste sites.

- **40 CFR 61 Subpart M, "National Emission Standard for Asbestos":** 40 CFR 61.140 and 61.145 define regulated asbestos-containing material (ACM) and regulated removal and handling requirements, and specify sampling, inspection, handling, and disposal requirements for regulated sources having the potential to emit asbestos. No visible emissions are allowing during handling, packaging, and transport of ACM. 40 CFR 61.150 identifies requirements for the removal and disposal of asbestos from demolition and renovation activities, and also specifies no visible emissions. Buried ACM may be encountered during excavation of source waste sites and on pipelines or other structures excavated as part of remedial action within the 100-IU-2 and 100-IU-6 OUs. ACM associated with remedial actions will be handled consistent with the applicable or relevant requirements of 40 CFR 61.140, 40 CFR 61.145, and 40 CFR 61.150.

- **40 CFR 761, "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions":** 40 CFR 761.50(b)(1), (2), (3), (4), and (7) and (c) establish general requirements for the storage and disposal of polychlorinated biphenyl (PCB) wastes including liquid PCB wastes, PCB items, PCB remediation waste, PCB bulk product wastes, and PCB/radioactive wastes at concentrations exceeding 50 ppm PCBs. Specific handling and disposal requirements are established for PCB liquids, articles, and PCB containers in 40 CFR 761.60(a), (b), and (c), respectively. PCB remediation waste requirements are established in 40 CFR 761.61. Substantive requirements of these provisions would generally be applicable to PCB wastes encountered during remedial action for source waste sites. Remedial action will comply with these requirements through adherence to waste management procedures (see Chapter 5) and receiving facility waste acceptance criteria (e.g., WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*).

- **40 CFR 265.554, "Staging Piles":** Establishes substantive standards for temporary storage of solid, nonflowing hazardous remediation waste in staging piles. Hazardous remediation waste from the 100-IU-2 or 100-IU-6 OUs stored in staging piles shall be managed in accordance with Section 5.4.3.

- **WAC 173-303, "Dangerous Waste Regulations":** WAC 173-303 establishes a variety of substantive requirements applicable to generation, storage, treatment, and disposal of materials designated as dangerous waste. Dangerous waste associated with remedial actions in the 100-F/IU Area will comply with substantive provisions of the identified requirements through adherence to waste management procedures (see Chapter 5) and, for disposal, the receiving facility's waste acceptance criteria (e.g., WCH-191, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*.) Specific provisions of WAC 173-303 identified in the ROD as ARARs are as follows:

  - **WAC 173-303-016, "Identifying Solid Waste," and WAC 173-303–017, "Recycling Processes Involving Solid Waste":** These sections establish criteria for identifying materials that are and are not solid wastes, including materials that are or are not solid wastes when recycled in certain ways.

  - **WAC 173-303-070, "Designation of Dangerous Waste":** Establishes the method for determining if a solid waste is regulated as a dangerous waste.

  - **WAC 173-303-077, "Requirements for Universal Waste":** This section exempts universal waste (i.e., certain batteries, mercury-containing equipment, and lamps) from most of the requirements of WAC 173-303 in lieu of alternative, less stringent management requirements.

  - **WAC 173-303-120, "Recycled, Reclaimed, and Recovered Wastes":** Describes requirements for persons who recycle materials that are solid and dangerous wastes. Certain recyclable materials, including scrap metal, spent refrigerants, spent antifreeze, and lead acid batteries, are subject to less stringent standards under WAC 173-303-120 when being recycled. WAC 173-303-120(5) provides for the recycling of used oil.

  - **WAC 173-303-140, "Land Disposal Restrictions":** Establishes treatment requirements and prohibitions for land disposal of dangerous waste. Provisions incorporate treatment standards for federal *Resource Conservation and Recovery Act of 1976* (RCRA) hazardous or mixed (hazardous and radioactive) wastes, in addition to establishing requirements for land disposal of certain state-only (nonfederally regulated) dangerous waste.

  - **WAC 173-303-170, "Requirements for Generators of Dangerous Waste":** Establishes requirements for generators of solid waste, including requirements to determine if the waste is regulated as a dangerous waste; requirements for generators who accumulate dangerous waste on site in tanks, containers, or containment buildings for a period of 90 days or less; and requirements for generators who treat waste in onsite containers, tanks, or containment buildings within 90 days of waste generation.

  - **WAC 173-303-200, "Accumulating Dangerous Waste On-Site":** Establishes requirements for accumulating dangerous waste on site in containers, tank systems, or containment buildings. Invokes various substantive standards for management of dangerous waste in containers and tanks. Container waste storage exceeding 90 days would be subject to the substantive requirements of WAC 173-303-630.

  - **WAC 173-303-630, "Use and Management of Containers":** Establishes substantive requirements for management of containers holding dangerous waste, including requirements for maintaining containers in good condition, identifying container contents, using containers that are compatible with stored waste, keeping containers closed when not adding or removing waste, maintaining adequate aisle space, providing secondary containment for containers of liquid dangerous waste, and standards for storage of containers holding ignitable or reactive waste and incompatible wastes.

  - **WAC 173-303-64620(4), "Requirements" (corrective action):** Requires corrective action for releases of dangerous waste and dangerous constituents and establishes minimum standards for implementing actions. Corrective action performed under CERCLA authority must be consistent with these standards. The process, selected action, and implementation of the remedial action for the 100-IU-2 and 100-IU-6 OUs satisfy this requirement.

- **WAC 173-350, "Solid Waste Handling Standards":** These regulations establish minimum standards for the proper handling and disposal of nondangerous, nonradioactive solid waste. Performance standards of WAC 173-350-040 require that solid waste facilities be designed, constructed, operated, and closed in a manner that does not pose a threat to human health or the environment, and that comply with other applicable environmental laws. WAC 173-350-300 establishes requirements for onsite storage of solid waste in containers and for collection and transportation in a manner that avoids littering or releases. Remedial action will comply with these requirements through adherence to the waste management procedures in Chapter 5.

2.4.3 Location-Specific ARARs

Location-specific ARARs are restrictions or requirements placed on hazardous substance concentrations or remedial actions based on the specific location of the substance or action. The location-specific ARARs established in the ROD are discussed below.

- **36 CFR 65, "National Historic Landmarks Program," 36 CFR 800, "Protection of Historic Properties,":** These provisions require that federal agencies consider the impacts of their actions on cultural properties through identification and evaluation. Potential adverse effects are to be avoided or mitigated. Historical and cultural reviews have been performed to identify cultural and historic sites within the 100-IU-2 and 100-IU-6 OUs. Additional reviews will be done, if necessary, at remedial action areas. Remedial actions will be performed in a manner to avoid or mitigate impacts on identified cultural properties, and to minimize harm to any National Historic Landmarks.

- **43 CFR 10, "Native American Graves Protection and Repatriation Regulations":** These provide requirements for federal agency responsibilities for discovery, protection, and appropriate disposition of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony. Remedial activities in the 100-IU-2 and 100-IU-6 OUs will be conducted in a manner to identify, protect, and provide for appropriate disposition of covered human remains, objects, and items. In the event of a discovery of covered items, Native American Tribal consultation will be conducted.

- **"Archaeological and Historic Preservation Act of 1974," 16 USC §469a-1 through 469a-2d:** Requires that Federal projects do not cause the loss of archaeological or historic data through preservation; it does not require protection of the actual waste site or facility. Remediation activities in the 100-IU-2 and 100-IU-6 OUs will prevent irreparable loss of significant scientific, prehistoric, or archeological data through preservation.

- ***Migratory Bird Treaty Act of 1918*:** These requirements are applicable to the protection of migratory bird species associated with the 100-F/IU Area, including upland species and waterfowl. "Taking" of protected migratory birds, their young, or their eggs is prohibited. Federal agencies are required to avoid or minimize impacts to migratory bird resources, restore or enhance their habitat, and prevent or abate detrimental alteration. 100-F/IU Areas remedial actions will require mitigation measures to deter nesting by migratory birds on, around, or within remedial action sites, and methods to identify and protect occupied bird nests.

- **"Bald and Golden Eagle Protection Act," 16 USC §668, and 50 CFR 22:** Requires protection of eagle habitat to maintain eagle populations so the species is not classified as threatened, endangered, or sensitive. Bald eagles nest, feed, and overwinter along the shores of the Columbia River. Remedial actions in the 100-IU-2 and 100-IU-6 OUs will be performed in a way to protect bald eagle habitat.

3 Remedial Action Design and Planning

This chapter describes the framework for remedial action designs and other associated planning documents. Due to interim actions in the 100 Areas, many of the components described in this chapter have already been completed and implemented in ongoing waste site remediation.

3.1 Remedial Action Planning

The remedial action schedules for cleanup of the Hanford Site are driven by a set of milestones that have been established as part of the Tri-Party Agreement (Ecology et al. 1989), and which may be renegotiated as remediation proceeds. Scheduled future milestones associated with cleanup of the OUs associated with the 100-F/IU Area under the interim action ROD are summarized in Table 3-1, and may be renegotiated to align with the 100-F/IU Area ROD in accordance with the Tri-Party Agreement. Milestones presented are based on previous Tri-Party agreements for the interim action ROD and do not reflect schedule changes associated with the 100-F/IU Area ROD.

Cost estimates for remediation of remaining waste sites were prepared as part of the 100-F/IU Area RI/FS (DOE/RL-2010-98) and were subsequently carried forward into the 100-F/IU Area ROD (EPA 2014). The estimates were prepared with an accuracy of -30% to +50% to support evaluation of remedial alternatives and selection of a remedy. Cost estimates are updated based on design work. In accordance with CERCLA requirements, an explanation of significant differences will be pursued by the Tri-Parties if remediation costs change significantly from those identified in the ROD (generally more than -30% to +50%).

3.1.1 Detailed Remediation Planning

Project schedules are developed in accordance with the procedures of the performing contractor at several different levels consistent with the project work breakdown structure. The work breakdown structure-based schedules promote complete and consistent compliance with DOE O 413.3, *Program and Project Management for the Acquisition of Capital Assets*, and cost and schedule control systems criteria. Large-scale (multi-year) projects encompassing multiple smaller projects (e.g., each waste site remediation can be considered a single project, while the entire project is to remediate all waste sites) are generally planned and scheduled using a phased approach. Near-term (less than 1 year) work is usually planned and scheduled at a detail activity level using logic ties to establish and maintain a true critical-path schedule. Logic-driven, critical-path schedules, commonly referred to as the critical-path method, are used to manage and control the daily progress of the work and provide early warning of problem areas. Forecast planning and scheduling (1 to 2 years) can be performed at the task-package level, and long-range planning and scheduling (greater than 2 years) is performed at the work package or cost account levels. Planning elements at the work package level include, but are not limited to or bound by, remedial design, procurement, remedial actions, and site closures.

Some of the tiered planning documentation (e.g., remedial designs) may require approval by the lead regulatory agency, if requested. When reviews are required, DOE shall provide the documentation to the lead regulatory agency for review and approval. Summary briefings and discussions may be held at unit manager's meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules, including those for procurement. Specific processes for remedial design reviews and approvals are provided in Section 3.2.

Table 3-1. Summary of Tri-Party Agreement Milestones for 100-IU-2 and 100-IU-6 Waste Site Remediation[a]

Milestone	Description	Due Date/ Complete Date
M-016-149	Complete 100-IU-2/6 interim response actions for the following waste sites: 600-293, 600-294, 600-298, 600-299, 600-300, 600-301, 600-303, 600-305, 600-309, 600-310, 600-313, 600-316, 600-318, 600-319, 600-320, 600-321, 600-328, 600-329, 600-331, 600-332, 600-334, 600-326, 600-349, 600-358, 600-368, 600-369, 600-370, 600-371, 600-372, 600-373, 600-374, 600-375, 600-376, 600-377, 600-378, and 600-379.	March 31, 2016
M-016-00A	Complete all response actions for the 100 Area units (except groundwater actions that are covered under Major Milestone M-016-00 and 100-K Area response actions addressed in M-016-00C) by the specified due date as approved in a RDR/RAWP. Completion of response actions is defined as the completion of the ROD or action memorandum requirements in accordance with an approved RDR/RAWP or removal action work plan and EPA and/or Ecology approval of waste site reclassification forms.	March 31, 2017

a. The Tri-Party Agreement milestones presented in Table 3-1 address the selected remedy and schedule previously established in consideration of the interim action RODs for the 100 Area. These milestones may be renegotiated in accordance with the Tri-Party Agreement to align with the requirements of the 100-F/IU Area ROD.

Ecology = Washington Department of Ecology

EPA = U.S. Environmental Protection Agency

RDR/RAWP = remedial design report/remedial action work plan

ROD = Record of Decision

3.1.1.1 Remedial Action Design

Remedial designs are prepared by the remediation contractor and include all design work, project plans, project procedures, remediation cost estimating, drawings, and specifications required to perform the remediation. Project plans, procedures, and work packages will define the data-gathering requirements to ensure worker health and safety and to eventually prove the waste sites meet remediation goals and standards. Project procedures will define the "how to" of obtaining data and controlling the site activities. Planning documentation is discussed further in Section 3.3. Scope of work, design drawings, and specifications will also provide the necessary technical tools to procure subcontractors, as needed.

3.1.1.2 Remedial Actions

Remedial action includes implementing the remedial design and project plans. The implementation will include, but not limited to, subcontractor oversight, excavation, material handling, waste treatment,

analytical system operations, worker health and safety, radiological controls, data gathering, and overall daily conduct of operations. Subcontractor oversight occurs through administration of subcontract documents. Project specifications and procedures define the "how to" of excavation, material handling, analytical system operation, data gathering, and overall daily conduct of operations. Appropriate worker health and safety and radiological control requirements are included in site health and safety plans, permits, and job hazard analyses included in work packages.

3.1.1.3 Site Verification and Closeout

Site verification and closeout includes, but is not limited to, data collection (including samples and photographs), data evaluation, data interpretation, preparation of documentation, and EPA approval that the RAOs have been met via waste site reclassification or other documentation.

3.2 Remedial Action Design

Remedial action design includes all design work, project plans, project procedures, remediation cost estimates, drawings, and specifications required to perform the remedial action. Project plans will define the data-gathering requirements to ensure worker health and safety and to eventually prove that the waste sites meet remediation goals and standards. Project procedures and work packages define the "how to" of obtaining data and controlling the site activities. DOE shall provide the remedial action designs to the lead regulatory agency for review and approval, if requested. Summary briefings and discussions may be held at unit manager's meetings or other forums, as agreed. Issues will be identified and resolved in a timely manner to prevent or minimize impacts to schedules for issuing requests for proposals. Remedial action designs that were prepared and initiated or approved under the interim action ROD, and where the remedy selected in the 100-F/IU Area ROD has not significantly changed the designed work, will not require new review and approval.

The following process will be followed to implement the remedial action design review and approval process and may be modified at the 100 Area unit manager's meeting or via other documentation (e.g., Tri-Party Agreement change notice):

- When requested, DOE shall provide the draft remedial design package and design schedule to the lead regulatory agency at the unit manager's meetings, or deliver to the local field office.
- The lead regulatory agency shall provide notice to DOE in a timely manner, if approval is warranted, usually within 3 to 5 days.
- The lead regulatory agency review period is generally 2 weeks. If additional review time is necessary, the review period can be increased up to 4 weeks. If more than 4 weeks is required due to the complexity of the project, DOE and the lead regulatory agency shall agree to the review period, as necessary. To minimize impacts to the schedule, additional review time should be communicated early in the process.
- Review comments and issues shall be identified and resolved in a timely manner. Review comments and issues, including responses or resolutions, shall be documented in the unit manager's meetings, letters, or other forums, as agreed.
- DOE shall provide a copy of the final remedial design package, with comments incorporated, to the lead regulatory agency at the unit manager's meetings, deliver to the local field office, or otherwise transmit.

- A documented approval should be communicated to DOE by the lead regulatory agency within a reasonable time frame. The approval should reference the specific design and indicate that approval by the lead regulatory agency is warranted.

3.3 Other Remedial Action Planning Documents

Additional planning documentation for remedial action includes work packages and procedures, the SAP, health and safety plan(s), ecological and cultural resource reviews, air monitoring plans, technical performance specifications, and safety analysis/hazard classifications. Many of these planning documents have previously been prepared and issued under the interim action RDR/RAWP. As described in the following subsections, the existing documents may continue to be used under this RDR/RAWP, with the understanding that references to the interim action RDR/RAWP are superseded by this approved addendum and the associated Integrated RDR/RAWP (DOE/RL-2014-44).

3.3.1 Work Packages and Procedures

Work packages and procedures are used to provide guidance to site workers during field work execution. They define the scope, operations, progression of field work, personnel control requirements, radiological posting requirements, and analytical system guidance. Work packages and procedures are developed by multi-disciplinary involvement following a graded approach. The personnel responsible for compliance with this RDR/RAWP are included in the development process for work packages to ensure that applicable requirements are incorporated or addressed. The site superintendent (or other site contractor responsible party) must then execute field operations in compliance with these work packages.

3.3.2 Sampling and Analysis Plan

The SAP provides direction for sampling efforts to support excavation guidance, waste characterization, worker health and safety, and site closure for 100-F/IU Area waste site remediation. The SAP includes quality assurance project plans that define the strategy to control the quality and reliability of the analytical data and establish associated protocols for data management. The field analytical team must perform all sampling and analysis efforts in compliance with the applicable SAP and any site-specific sampling instructions or agreements developed in accordance with that SAP. The *100 Area Remedial Action Sampling and Analysis Plan* (DOE/RL-96-22) remains in effect for 100-F/IU Area remedial actions until approval of the *Final Action Sampling and Analysis Plan for 100 Area Waste Sites* (DOE/RL-2014-49). New or revised SAPs are provided by DOE to the EPA for review and approval.

3.3.3 Health and Safety Plan

Health and safety plans for waste site remediation within the 100 Area have been developed to provide direction for general site health and safety measures associated with the remedial action scope. All remedial action contractor project personnel will be trained on the applicable health and safety plan. Job hazard analyses are developed for task-specific controls and are included in work packages.

3.3.4 Ecological and Cultural Resource Reviews

Prior to remedial action or the construction of support areas, cultural and ecological resource reviews are conducted to determine if the proposed activities in these areas will impact natural or cultural resources. The first line of action is to avoid or minimize impacts by siting activities in areas with the least potential for impact to significant resources. When impacts to natural or cultural resources are unavoidable, the project is given recommendations to minimize impacts. Additional mitigation may be required if criterion for a threshold area of disturbance or habitat quality is met.

3.3.5 Air Monitoring Plan

The substantive requirements applicable to radioactive air emissions resulting from remediation activities are to quantify potential emissions, monitor the emissions, and identify and employ best available radionuclide control technology. Exemption from these requirements may be requested if the potential-to-emit for the activity or emission unit would result in a total effective dose equivalent of less than 0.1 mrem/yr. Implementation of these elements fulfills the ARARs identified in Section 2.4. The use of best available radionuclide control technology includes, but is not limited to, dust suppression (e.g., water, water sprays, fixatives) and the use of other standard engineering controls (e.g., high-efficiency particulate air filter vacuum cleaners). Air monitoring plans incorporating these components are provided to the lead regulatory agency for approval.

3.4 Technical Performance Specifications

Technical performance specifications are prepared as needed to support remedial actions. Remediation of these sites requires soil removal, segregation, storage, transportation, disposal, and backfilling. Technical performance specifications may include the following areas:

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

Each technical specification establishes quality and workmanship requirements and defines how quality is measured.

3.5 Safety Analysis/Emergency Preparedness

Hazards associated with the proposed remedial actions addressed in this document are examined based on anticipated inventories of radioactive and/or hazardous materials and appropriate controls identified, and the hazard categorization is documented as warranted. Hazard categorization documentation, as well as analysis of radioisotopes and hazardous material for emergency response planning for waste sites requiring remediation, will be prepared before initiating excavation operations.

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4 Remedial Action Management and Approach

The Integrated RDR/RAWP (DOE/RL-2014-44) identifies the overall remedial action management and approach for implementation of the 100-F/IU Area ROD (EPA 2014). This chapter describes the components of the project team, change management approach, remedial action operations, and waste site closure processes specific to RTD at 100-IU-2 and 100-IU-6 waste sites.

4.1 Project Team

The project team for soil remediation consists of the lead agency (DOE), the lead regulatory agency (EPA), and DOE-RL's selected contractor(s). The contractor project managers are responsible for leading project teams in remedial action implementation. The project teams contain the personnel necessary to perform the remedial actions in a safe, efficient, and compliant manner.

4.2 Remedial Action Change Management

Change management will be performed as described in the Integrated RDR/RAWP (DOE/RL-2014-44). The contractor project manager is responsible for tracking all changes and obtaining appropriate reviews by staff for changes affecting 100-F/IU Area waste site remediation. The project manager will discuss the proposed change with DOE-RL, and DOE-RL will then discuss the type of change that is necessary with EPA. As the lead regulatory agency, EPA is responsible to determine the significance of the change.

4.3 Remedial Action Operations

The components of the selected remedy addressed by this addendum are identified in Section 1.2.1. This section describes general mobilization and RTD operations for waste sites. This section also identifies ICs associated with remedial action operations.

4.3.1 Mobilization and Site Preparation

Mobilization and site preparation include the following activities that are necessary to prepare the site for excavation:

- Establishing site utility services as required.
- Constructing necessary roads, field support facilities, container survey stations, and decontamination stations. Hanford Site roadways are constructed of existing site materials, except the surface course, which is imported. Field support facilities may include restrooms, changing facilities, lunchrooms, and construction offices; multiple facility support areas may be used for remediation of 100-IU-2 and 100-IU-6 waste sites.
- Stripping the existing vegetation and debris. Stripping removes surface and near-surface materials (including vegetation and roots, cobbles, and boulders) that may be stockpiled (where practicable) and used later as a top dressing and planting medium for revegetation. For sites where topsoils contain hazardous debris material or do not meet cleanup levels, the material is not stockpiled for reuse. In these cases, stripping may still be performed, with resulting material managed for disposal as waste, or surface material may be removed as part of general excavation activities without a discrete surface-stripping effort.
- Removing overburden material. Clean overburden and layback soils may be segregated and stockpiled on site for later use as backfill material.

- Removing slabs and foundations of demolished buildings, when necessary for access to underlying soil.

4.3.2 Remove, Treat, and Dispose

This subsection addresses activities specific to RTD remediation of waste sites. During all aspects of RTD, dust control will be maintained on the haul roads, at the excavation site, on overburden stockpiles, and in the staging pile areas (SPAs). Use of water for dust control at the excavation site will be minimized. Soil fixatives (e.g., soil cement) will be applied during periods of extended inactivity and/or when potential concerns arise about health issues or the spread of contamination.

Under the RTD process, contaminated soils and engineered structures containing contamination (e.g., pipelines) with COCs exceeding cleanup levels will be remediated up to 4.6 m (15 ft) bgs to meet cleanup levels for direct exposure, groundwater, and surface water protection as identified in Chapter 2. Remediation will continue below 4.6 m (15 ft) bgs where site COC concentrations exceed cleanup levels for groundwater and surface water protection. Site-specific modeling and consideration may be used to demonstrate protectiveness for COC concentrations at greater than 4.6 m (15 ft) bgs nominally above cleanup levels.

Engineered structures at waste sites identified for RTD, including pipelines, may be left in place if it can be demonstrated that residual contamination is not present or is present at residual concentrations that achieve RAOs. The cleanup levels do not apply to chemicals that are an integral part of manufactured structures, and site-specific consideration may be given for applying cleanup levels to sediment/scales within pipelines or other structures. When asbestos in nonfriable form (e.g., asbestos in the pipe matrix, asbestos impregnated in tar paper-wrapped water pipes) is encountered in the shallow zone, as in pipelines, and no other CERCLA hazardous waste is associated with the pipelines other than asbestos in nonfriable form, remediation of such pipelines is not required (DOE-RL et al. 2005c).

4.3.2.1 Excavation

Excavation involves removing clean and contaminated soil, debris, and anomalous waste present within the site boundaries. For dump sites with subsurface debris, materials will be excavated with standard construction equipment, sorting as necessary to remove anomalous material and large debris. Excavated materials may be stockpiled and staged in an approved SPA for subsequent load-out or may be loaded directly into waste transportation containers/vehicles at the excavation site.

In excavation areas where there are large quantities of observed lead-containing materials (e.g., lead bricks, lead slag) intermixed with the soil, observation, sorting, and radiological surveys (as necessary) for removal of the large materials and non-lead anomalous materials will be performed. The remaining materials may then be identified as meeting the RCRA definition of “soil” per 40 CFR 268.2 and considered hazardous/dangerous due to lead contamination. In such cases, the soil will be sampled in accordance with the SAP and transported to the ERDF or other approved facility for treatment (stabilization) and subsequent disposal.

Material from waste site areas that are not subsurface dump sites or burial grounds (e.g., pipelines or soil-staining sites) where anomalous material is not encountered does not require mechanical sorting. This material may be directly loaded into containers after enough information is gathered to characterize the waste.

Sluicing (use of water) is not an acceptable excavation method. Selection of the excavation/sorting method will be made by remedial action project management, and the method may be changed to another approved method based on the type of material being excavated. Alternate excavation/sorting methods

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

Material that has been excavated will be directed in one of the following ways.

- Radiologically contaminated material that is above cleanup levels and within the ERDF waste acceptance criteria (WCH-191) will be loaded into plastic-lined roll-off containers on project haul trucks at the excavation site. ACM will be double-bagged or put into roll-off containers that are double-lined. The loaded containers will be covered (i.e., by folding and securing the liner over the load) and surveyed prior to being transported to a container transfer area (CTA) using the project haul trucks. If radiological contamination is found on a container exterior, the container will be decontaminated using standard equipment and techniques. In the unlikely event that a container cannot be decontaminated using standard methods, advanced techniques, such as those described in Section 4.3.2.6, will be implemented as necessary. Released containers will be offloaded and staged in the CTA until applicable shipping papers (e.g., a waste tracking form) are completed. When the shipping papers have been completed, ERDF transport vehicles will enter the CTA, pick up the full containers, and haul them to the ERDF.

- Nonradiologically contaminated material above cleanup levels and within ERDF waste acceptance criteria (WCH-191) may be loaded into plastic-lined or unlined roll-off containers as described above or may be direct-loaded into material handling vehicles (e.g., dump trucks) for transportation to ERDF. ACM will be double-bagged or put into roll-off containers that are double-lined.

- Anomalous waste (e.g., drums, intact containers, or unknown materials) and/or above-cleanup-level material that is not within ERDF waste acceptance criteria (WCH-191) will be set aside within the area of contamination (AOC) or within a designated SPA for further characterization and final dispositioning. Waste that is subsequently identified for ERDF disposal or staging will be directed as described previously, with the exception that drummed waste may be transported in standard ERDF containers or by other means such as flatbed trailers or cargo vans. Excavated material that must be sent to facilities other than ERDF for treatment and/or disposal will be stockpiled or drummed and staged within the AOC, within designated SPAs, or within a container storage area until loaded for offsite shipment. Identification of an appropriate treatment and/or disposal facility and arrangements for loading and transporting excavated material to facilities other than ERDF will be made on a case-by-case basis by project waste management personnel. Prior to shipment, an offsite acceptability determination in accordance with 40 CFR 300.440 must be obtained from the EPA for receipt, storage, treatment, and disposal of CERCLA waste at the identified treatment/disposal facility.

- Land disposal restricted (LDR) waste or containers of LDR waste that are not within the ERDF waste acceptance criteria may need repackaging or treatment to comply with the ERDF waste acceptance criteria (WCH-191). LDR waste that has been placed into a container will not be placed back into the AOC (i.e., on the land), except by EPA approval. Land disposal restricted waste may be removed from a container and placed directly into another container, even within the designated AOC boundary, as long as no land placement occurs. Containerized LDR waste that needs to be placed on the ground for treatment or repackaging will be done within an SPA or as otherwise approved by EPA.

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

- In certain situations, soil may be placed over material excavated within a waste site or discovered within a staging pile as a temporary measure. Such action may be undertaken to minimize an imminent threat to workers (e.g., a high-dose item is uncovered, and a temporary soil cover is appropriate to control worker exposure). Temporary covering with soil may also be undertaken to prevent windborne dispersal of excavated material or highly contaminated soil and to maintain segregation from other waste site materials. These temporary measures may be undertaken while plans are developed for safe re-excavation and removal of waste site materials. In these instances lead regulator notification will be made.

- Non-LDR material that has been packaged may be returned to an excavation area or SPA in situations where the dose rates, contamination levels, free liquids, or other abnormalities have subsequently been determined to exceed normal transport requirements. In these situations, when repackaging is necessary, the previously excavated material will be reloaded into the transportation container. Notification to the lead regulatory agency is generally not required for these actions. The exception is LDR waste, which shall be managed in accordance with the fourth bullet above.

- An approved LDR treatment method for radioactively contaminated cadmium-, silver-, and mercury-containing batteries allows for macroencapsulation prior to disposal. However, lead-acid batteries are not covered by this standard and require initial treatment (draining corrosive liquids, treating separately prior to disposal) (DOE-RL et al. 2005b).

- While not anticipated for 100-IU-2 and 100-IU-6 waste sites, if suspect spent nuclear fuel (SNF) is discovered, it must be managed as SNF and is not eligible for disposal in ERDF. Shielded bunkers will be used for interim storage of the SNF with minimum specifications of (1) a 1.8-m (6-ft)-tall security fence, and (2) a bunker constructed of concrete shielding blocks including a heavy metal lid or concrete shielding block cover. Spent nuclear fuel will be characterized for shipment to the Canister Storage Building facility until an offsite storage or disposal facility authorized to manage SNF becomes available (DOE-RL et al. 2005b).

- While not anticipated for 100-IU-2 and 100-IU-6 waste sites, if transuranic (TRU) waste material is discovered, it must be identified as either contact-handled TRU waste or remote-handled TRU waste and managed in accordance with the waste acceptance criteria of the receiving facility (WCH-126, *600 Area Remediation Design Solution Waste Packaging, Transportation, and Disposal Requirements*).

All material being transported from the excavation site is covered, contained, or has moisture content adequate for inhibiting dust without being covered or contained during transport and disposal. The moisture content of bulk contaminated material destined for ERDF disposal will be in accordance with ERDF waste acceptance criteria (WCH-191).

Excavated material will be surveyed and characterized as necessary for appropriate disposition prior to undertaking disposal of materials. When excavation of a waste site is complete, exposed dig faces will be evaluated to verify that remedial action goals have been met. When cleanup levels have been met and backfill concurrence is obtained from the lead regulatory agency, site backfill will be authorized. Approval of a waste site reclassification form constitutes approval for backfill, or the lead regulatory agency may approve backfill in advance. (Note: Unless specified otherwise, the term “backfill” as used in this document refers to filling in and/or recontouring the excavation once post-waste site remediation sampling has demonstrated that cleanup levels have been met.) Clean backfill material is obtained from clean material storage areas, approved/clean rubble, and local borrow sites. Excavations are backfilled as described in Section 4.4.4.

4.3.2.2 Material Handling and Transportation

All contaminated materials (including excavated soils, debris, disposable protective clothing, air filters, and trash) require proper packaging, handling, and transportation in accordance with the waste management plan provided in Chapter 5. Contaminated bulk materials will be transported to disposal using approved vehicles/containers. Drummed waste may either be loaded into standard ERDF containers or be transported by other means such as flatbed tractor-trailer units or cargo vans.

Containers will be transported from the remediation site to the ERDF over existing Hanford Site roadways. Each shipment of soil/debris transported to the ERDF will be referenced to a waste profile that is intended to provide an upper bound on the concentrations of contaminant materials found at the site. The waste profile is in effect until the characteristics of the excavation site have changed significantly. Empty containers returning from the ERDF will be removed from the ERDF tractor trailers in the CTA and rolled onto project haul trucks for refilling. The CTA helps to maintain a continuous flow of materials through the transportation system by allowing excavation to continue for a limited time if the trucks running to the ERDF are not operating, or it allows ERDF trucks to continue to run for a limited time if the excavators are not operating.

The containers are inspected for the presence of water prior to placing a liner or waste into the container. When water is found in a container with an estimated volume of 151 L (40 gal) or less (less than a depth of 1.27 cm [0.5 in.] in the bottom of the container), the water may be used as an aid for dust suppression in an adjacent excavation or staging pile, or absorbent materials may be used in the container. When water is found in the container with an estimated volume greater than 151 L (40 gal), lead regulatory agency approval is necessary to use the water as an aid for dust suppression.

An alternative to transporting loaded containers from the excavation area to the CTA, then from the CTA to ERDF, is to load excavated material directly into material handling vehicles. These vehicles then proceed directly to ERDF and the CTA is not used. The advantages of this method are that material handling vehicles can transport larger quantities and duplicate handling of excavated material is eliminated. Excavated material must not be radiologically contaminated and must meet the conditions of the applicable waste shipping and receiving plan.

Transportation and handling for offsite treatment and/or disposal of contaminated material will be coordinated on a case-by-case basis. All offsite shipments will be conducted using equipment and methods that are compliant with applicable U.S. Department of Transportation (DOT) regulations and DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*.

4.3.2.3 Soil and Debris Characterization

Soil and debris characterization will be based on the observational approach and performed in accordance with the SAP. This approach relies on available historical information and limited field investigations combined with a “characterize-and-remediate-in-one-step” methodology. The latter methodology consists of the use of field screening instrumentation (e.g., radiological survey instruments), visual evaluation of waste forms encountered during remediation, and in-process analytical sampling. These elements are used together and in consideration of waste site-specific information to characterize waste as remediation proceeds. Remediation continues until a combination of field screening results, sampling results, and/or observed absence of waste debris provides initial indication that cleanup goals have been achieved. Site-specific verification is performed as described in Section 4.4.

4.3.2.4 Decontamination

Radiological decontamination, when necessary to support excavation activities, will generally be performed using dry methods (e.g., wiping and high-efficiency particulate air-filtered vacuum cleaners) to the extent possible. When the use of wet methods (e.g., pressure washers and steam cleaners) is required to achieve decontamination objectives and the associated water or cleaning solutions are not collected, work will be conducted by trained site workers in accordance with the best management practices (BMPs) described below. Other decontamination, when necessary, will generally be performed using wet methods in accordance with the following BMPs.

General BMPs. These apply to all equipment cleaning/decontamination activities within a waste site:

- Decontamination activities are typically performed within active excavation areas of the AOC.
- The amount of water used to clean equipment will be minimized.
- Only raw or potable water will be used.
- Soaps, detergents, or other cleaning agents that would be regulated as a hazardous waste will not be added to wash water.
- Pressure washing will normally use cold water (hot water may be used to avoid icing).
- Steam cleaning will be used only after other methods prove to be ineffective.
- Decontamination practices will be documented in the daily log.
- Personnel responsible for equipment decontamination will be trained to this best management practice.

BMPs for Sites where remediation is ongoing. These apply to equipment being washed and/or decontaminated within sites that have ongoing remediation, or at a decontamination area established outside of the waste sites.

- Equipment washing/decontamination will be located in areas with ongoing waste removal or in a centralized area that supports multiple remedial actions.
- Spent wash water and associated contamination will be kept within active areas of the AOC or within the decontamination area if located outside of the AOC.
- Pre- and post-washing/decontamination contaminant surveys are not required.
- The project may opt to collect wash water for reuse in the excavation or to be sent for treatment.

BMPs for sites where remediation is complete. These apply to equipment being washed and/or decontaminated where cleanup levels are anticipated to have been achieved and further active remediation is not expected.

- At the “completion” of excavation activities at a site, the project may opt to transport the equipment to a nearby site that is being remediated (by excavation) to perform equipment washing/decontamination (as described above), or to utilize a defined decontamination area.
- A pre- and post-survey will be performed on the washing/decontamination area to assess and remediate (if required) areas affected by the activity. When the washing/decontamination is set up in

an area of a site that has apparently attained the cleanup levels, sampling of the area may be performed in accordance with the SAP, at the discretion of the lead regulatory agency.

- The project may also opt to perform other methods of equipment washing and/or decontamination for a completed site (e.g., wrap the equipment for transfer to a decontamination pad, provide for a temporary facility at the site to collect wash water, fix the contamination to the equipment).

4.3.3 Implementation of Institutional Controls for Waste Site Remediation

ICs are required before, during, and after the active phase of remedial action implementation where ICs are necessary to protect human health and the environment. ICs are used to control access to residual contamination in soil above standards for unlimited use and unrestricted exposure. ICs are required during remedial action and after cleanup is complete, or until the site meets the requirements for unlimited use and unrestricted exposure (as defined in the Integrated RDR/RAWP (DOE-RL-2014-44)).

The Integrated RDR/RAWP (DOE/RL-2014-44) provides general description of the ICs specified under the 100-F/IU Area ROD (EPA 2014). Details for implementation are described in DOE/RL-2001-41, *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions* (as revised). Under the 100-F/IU Area ROD, 15 previously remediated 100-FR-1 and 100-FR-2 sites were identified that require ICs to prevent inadvertent exposure to residual contamination in the deep zone. While not anticipated, additional 100-IU-2 and 100-IU-6 sites requiring similar post-remediation ICs may be identified through the course of remediation. Such ICs may be conservatively applied where deep zone areas cannot be demonstrated to be protective of shallow zone criteria, as described in Chapter 2. The 100-F/IU Area ROD also identifies one 100-FR-1 waste site where ICs are required to prohibit irrigation. This type of IC is not anticipated for any remaining 100-IU-2 or 100-IU-6 waste sites under the scope of this addendum. Implementation of ICs for the 16 waste sites identified in the ROD and any additional sites that may be identified is addressed under the *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions*, and is not addressed further in this addendum. Implementation of the ROD requirement to provide signage and access control for waste sites with contamination above cleanup levels is described below.

- Signage is posted and will be maintained at various locations around the perimeter of the Hanford Site, and one additional sign is located along the Columbia River at the 100-F Reactor Area. The sign set consists of one each in English and Spanish. The sign posted along the river is located so that the distance for viewing from the river is approximately 150 m (500 ft). The English language sign reads as follows:

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

  The Spanish language sign reads as follows:

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

General site access to the Hanford Site is restricted, and security badges must be worn by employees, contractors, and visitors. Before receiving a badge, personnel must receive the level of training required to access the site or perform work or be appropriately escorted.

4.4 Site Verification and Closeout

Site verification and closeout includes sample collection, demonstration of attainment of RAOs, cleanup documentation, site closure, and site release, as summarized in the following subsections.

4.4.1 Verification Sample Collection

Verification samples of the residual soil from within the excavated site, any clean soil stockpiles intended for use as backfill material, and residual soil from SPAs (if applicable) will be collected in accordance with the applicable SAP, as described in Section 3.3.2, including site-specific work instructions or other documented agreements for verification sample collection. Results from the verification samples will be used to demonstrate attainment of the RAOs.

4.4.2 Attainment of Remedial Action Objectives

The general approach for verifying attainment of RAOs involves the following steps:

- Performing data verification and validation
- Calculating summary statistics appropriate to the verification data set
- Evaluating summary statistics against the appropriate cleanup levels
- If needed, modeling exposure and risk to future site inhabitants
- If needed, modeling future impacts to groundwater and the Columbia River.

A detailed description of the process for verifying attainment of the RAOs is provided in Appendix B of this document.

4.4.3 Attainment of Remedial Action Objectives in Orchard Areas

Some 100-F/IU Area waste sites are collocated within the estimated seven square miles of pre-Manhattan era orchard lands at the Hanford Site. The soils within these orchard lands are expected to contain residual lead and arsenic as a result of past pesticide use for the orchards. Such pesticide contamination is being addressed as the separate 100-OL-1 OU that is not within the scope of the 100-F/IU Area ROD, the Integrated RDR/RAWP, and this soil addendum. Collocated lead and arsenic contaminated soils will be addressed per the following protocol for the purposes of 100-F/IU waste site remediation and reclassification:

- If lead and/or arsenic concentrations in the top 1 m (3.3 ft) of a waste site exceed background, and evidence such as review of historical photographs and maps indicates that the site could be affected by former orchard pesticide use, it will be assumed that the lead and arsenic concentrations are the result of pesticide use. Such lead and arsenic concentrations may be remediated incidentally where present with other COCs above cleanup levels, but will not be considered in evaluations for waste site reclassification.

- If lead and/or arsenic concentrations exceed background, but not cleanup levels, below 1 m (3.3 ft) depth, and evidence indicates that the site could be affected by former orchard pesticide use, it will be assumed that the lead and arsenic concentrations are the result of pesticide use. Such lead and arsenic concentrations may be remediated incidentally where present with other COCs above cleanup levels, but will not be considered in evaluations for waste site reclassification.

- If lead and/or arsenic concentrations exceed cleanup levels below 1 m (3.3 ft) depth, and other COCs are not present above CULs, a path forward will be developed with the lead regulatory agency. This may include further evaluation and/or remediation. For waste sites where fill material was placed over the surface following historic pesticide applications, the depth of the fill will be considered additively with the 1 m (3.3 ft) depth in evaluating lead and arsenic concentrations.

4.4.4 CERCLA Cleanup Documentation

Subsequent to determining that the RAOs have been attained, waste site reclassification documentation will be prepared, typically including a supporting CVP or other closeout documentation. The waste site reclassification documentation will document the remedial action process, verification sampling results (if applicable), and attainment of the RAOs under the appropriate land use at a site; and will support the eventual removal of the OU from the National Priorities List. Waste site reclassification documentation may be prepared for groups of sites or individual sites, as needed, in accordance with the guidance provided in Appendix B. Closeout documentation may also be used to support other CERCLA closeout documentation (e.g., remedial action reports, construction completion reports, and National Priorities List deletion packages).

4.4.5 Backfill, Recontour, and Revegetation

Once attainment of the RAOs under the appropriate land use has been verified, the site will be recontoured and/or backfilled and revegetated. A general recontour/backfill design will be developed based on the final excavated site and surrounding area topography, as well as the amount of stockpiled overburden/below-cleanup-level material that has been released for use as backfill material. As needed, additional backfill material may be transported to the excavated site from approved Hanford Site borrow areas.

Revegetation is performed after backfill to minimize runoff and erosion effects, as well as to restrict the spread of noxious weeds. Revegetation is generally performed between November and January, as the local shrub-steppe ecosystem receives its primary precipitation during this season, maximizing the potential for reestablishing vegetation. Restoration planning and scheduling also considers other project activities in the area.

The methods used for revegetation will reflect what is feasible and appropriate on a site-by-site basis. Native plant species will be selected based on availability and appropriateness for the structure of the soils to be revegetated. In some areas, shrubs such as sagebrush, bitterbrush, and hopsage may be planted as tubelings to provide habitat and structure for nesting wildlife. Native grasses that are adapted to the site conditions will be planted to provide an understory. Dry seed should be incorporated into the soil by mechanical means.

Any areas that have been excessively compacted may be loosened by ripping the soil with heavy equipment. Linear rip lines should be smoothed prior to revegetation. Based on site-specific conditions, fertilizer and/or straw mulch may be applied to support revegetation. Where used, straw applications should be mechanically crimped into the soil to prevent wind loss.

Representative revegetated areas will be monitored for 5 years following planting. Monitoring will be conducted using methods such as those from *Steppe Vegetation of Washington* (Daubenmire 1970) to estimate percent canopy cover and frequency of occurrence for each species. Additional plantings, fertilization, and/or soil amendment may be performed, as appropriate. The vegetative cover and composition at each site following a revegetation effort will be site specific, and different locations may

not be comparable. Several factors, including seedbed, moisture regime, and topographic features, influence native plant community establishment and success.

4.4.6 Site Release

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

Where deed notices or other ICs are used in accordance with the 100-F/IU Area ROD (EPA 2014), DOE will not allow activities that would interfere with the remedial action prior to EPA approval. In addition, DOE will take necessary measures, such as filing deed notices in appropriate county offices and enforcing such land-use limitations through contractual mechanisms, to ensure the continuation of these restrictions prior to any transfer or lease of the property to any private party in accordance with the statutory requirements of Section 120(h) of CERCLA and the regulatory requirements of 40 CFR 373. A copy of any restriction notification will be given to any prospective purchaser/transferee before any transfer or lease by DOE. The DOE will provide the EPA with written verification that these restrictions are in place. In addition, unless and until cleanup levels that would support unlimited use and unrestricted exposure are attained (as defined in the Integrated RDR/RAWP (DOE/RL-2014-44)), a reevaluation of the remedial action will occur as part of the CERCLA 5-year review. For more information on requirements applicable to ICs, refer to the Integrated RDR/RAWP (DOE/RL-2014-44) and the 100-F/IU Area ROD (EPA 2014).

5 Waste Management Plan

This waste management plan describes the activities for the management and disposal of waste associated with remedial action for 100-IU-2 and 100-IU-6 waste sites. Waste management activities will be performed in accordance with the applicable ARARs identified in Section 2.4. The requirements specified by the ARARs and other applicable guidance and procedures will address waste storage, transportation, packaging, handling, labeling, and disposal as they specifically apply to waste streams from each waste site.

5.1 Projected Waste Streams

Various waste streams are anticipated during waste site remediation. Each waste stream will require specific processing and disposal. Similar types of waste will be managed uniformly. Assignment of waste to the appropriate waste stream depends on knowing the designation of the waste and appropriate disposal facility. Waste streams may include, but are not limited to, the following:

- Nonhazardous, nondangerous miscellaneous solid waste
  - Filter paper, wipes, personal protective equipment (PPE), cloth, plastic, equipment, tools, pumps, wire, metal and plastic piping, and materials from cleanup of unplanned releases
  - "Demolition waste" consisting of solid, largely inert waste resulting from the demolition or razing of buildings, roads, or other man-made structures
- Mixed waste (i.e., waste that is both low-level radioactive waste and hazardous waste)
- Liquids, including liquids from unplanned releases (i.e., spills), decontamination/cleaning fluids, and unknown liquid encountered in pipelines or other waste site features
- Used oil and hydraulic fluids
- Returned sample waste associated with these waste sites
- Nonradioactive waste (e.g., asbestos, and chemically contaminated soils)
- Hazardous or dangerous waste.

Spent nuclear fuel has previously been encountered in the 100-FR-2 OU, but is not anticipated to be encountered during 100-IU-2 and 100-IU-6 waste site remediation.

5.1.1 Waste Characterization, Designation, and Disposal

Miscellaneous solid waste and demolition debris that has contacted contaminated media, and/or is designated as contaminated by process knowledge or other information, may be disposed of at ERDF as described below. Waste will be characterized and designated in accordance with requirements of the receiving facility and in accordance with the applicable SAP. The sorting process is observational and is performed to identify nonconforming waste forms. Waste will be designated using process knowledge, historical analytical data, engineering calculations, and/or analyses of samples identified in the referenced documents or SAPs, as appropriate. Anomalous wastes are defined as waste materials that must be separated from other waste streams because they may require special handling and/or treatment prior to disposal. This anomalous material may or may not require additional characterization prior to disposal. Every effort will be made to minimize waste volume for disposal at ERDF through recycling and reuse, as appropriate.

ERDF is the preferred disposal location, provided that the waste acceptance criteria (WCH-191) are met. As necessary, waste will be stored within the AOC, in an on-site container storage area, in staging piles, or at ERDF as described in the following subsections.

Miscellaneous solid waste or demolition debris that is nondangerous and has been radiologically released may be disposed of at an offsite permitted disposal facility or a limited purpose inert landfill, or recycled, as appropriate. On a case-by-case basis, and as allowed by the lead regulatory agency, such waste forms may be used as waste site backfill provided that general size and/or placement requirements are met. These case-by-case agreements will be documented in Unit Manager Meetings or other forums agreed to by the lead regulatory agency. Uncontaminated soils will be placed on the ground near the point of origin. Waste handling and disposal options are further described in in Section 5.2.

Small volumes of liquid that have been solidified may also be disposed of at ERDF if the waste meets ERDF waste acceptance criteria. Liquid waste that does not meet the ERDF acceptance criteria will be shipped to the Effluent Treatment Facility (ETF) or an appropriate offsite facility. Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440. The ETF is an approved noncontiguous onsite facility pursuant to CERCLA Section 104(d)(4) used to store and treat liquid waste generated from removal actions, provided the waste acceptance criteria are met.

Used nonradioactive oil will be sent offsite for recycling or disposal. Spent or unusable chemicals/reagents may also be generated during field sampling and analysis and would require disposal based on the designation.

Three categories of waste exist from a designation standpoint:

1. Wastes that do not require additional characterization or special handling include untreated wastes and/or process soil that may be designated without characterization, and do not require special handling for human exposure or waste acceptance.

2. Wastes that do not require additional characterization, but do require special handling are untreated wastes that may be designated without characterization, but do require special handling for human exposure or waste acceptance. Waste types in this category include, but are not limited to, lead bricks, friable ACM, and high-dose components that do not contain dangerous/hazardous materials.

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

Wastes will be designated for disposition based on historical data, process knowledge, engineering calculations, sampling and analysis, or combinations thereof. Each of these methods and their applications are described summarily below. This is presented for information purposes only, and the generator is responsible for proper waste designation.

- Historical data (e.g., analytical results) may be used to designate waste forms that have previously been characterized. Previous and current remediation projects have designated significant quantities of buried solid waste. The waste forms in this category are readily identified and are known for their hazardous material content.

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

Elemental lead debris, paint debris, and lead acid batteries are other examples where designation will be based on process knowledge.

- Engineering calculations may be performed to estimate the weight or volume of a hazardous waste in a certain matrix (e.g., calculating lead-based paint content on pump housings).
- Field screening and/or analytical sampling will be used for designation of wastes when the above-mentioned methods are not appropriate or available. Sampling and analysis is required for liquids and most of the anomalous waste forms. Where sampling is needed, historical data, process knowledge, and/or engineering calculations may be used to reduce the suite of analyses required. All sampling activities supporting waste designation will be performed in accordance with the SAP.

Figures 5-1 and 5-2 provide logic flow diagrams for disposition of soil and anomalous waste forms, respectively.

5.2 Waste Stream-Specific Management

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

5.2.1 Miscellaneous Solid Wastes

This is nonhazardous, nonradioactive waste that is expected to consist of paper, PPE, materials from cleanup of unplanned releases, debris, and other solid waste that will be collected during the remediation activities. Miscellaneous solid waste that has contacted potentially contaminated materials will be segregated from other materials and will generally be transported to the ERDF for disposal. Miscellaneous solid waste that has not contacted contaminated media and that has been radiologically released may be disposed offsite at a permitted disposal facility, disposed in an onsite limited purpose or inert landfill, or recycled, as appropriate. Miscellaneous solid waste will be placed in containers that are appropriate for the material and the disposal facility. Only waste meeting the inert waste criteria of WAC 173-350-990 may be disposed in an inert waste landfill.

5.2.2 Low-Level Radioactive Waste

Low-level radioactive waste, including soil, concrete, debris, and structures, will be removed during excavation. Plastic, paper, and other compactible waste will also be generated as part of the remediation activities. Debris that has contacted contaminated media may be disposed at the ERDF if the waste acceptance criteria (WCH-191) can be met. If the waste acceptance criteria cannot be met, the waste will be shipped to an appropriate offsite facility, depending on the waste designation. Offsite facilities that receive contaminated waste must be deemed acceptable by the EPA in accordance with 40 CFR 300.440. Material that can be radiologically released may be disposed in an onsite inert landfill if the waste meets the criteria for being “inert,” or recycled, as appropriate.

5.2.3 Hazardous/Dangerous and/or Mixed Waste (Both Radioactive and Hazardous/Dangerous)

Hazardous/dangerous and/or mixed waste that meets the LDR treatment standards and the ERDF waste acceptance criteria may be disposed in the ERDF. Wastes that do not meet the ERDF acceptance criteria may be temporarily staged until treated to meet the criteria and will be handled on a case-by-case basis. Depending on the waste designation, the waste may be shipped to an appropriate offsite facility deemed acceptable by EPA in accordance with 40 CFR 300.440.

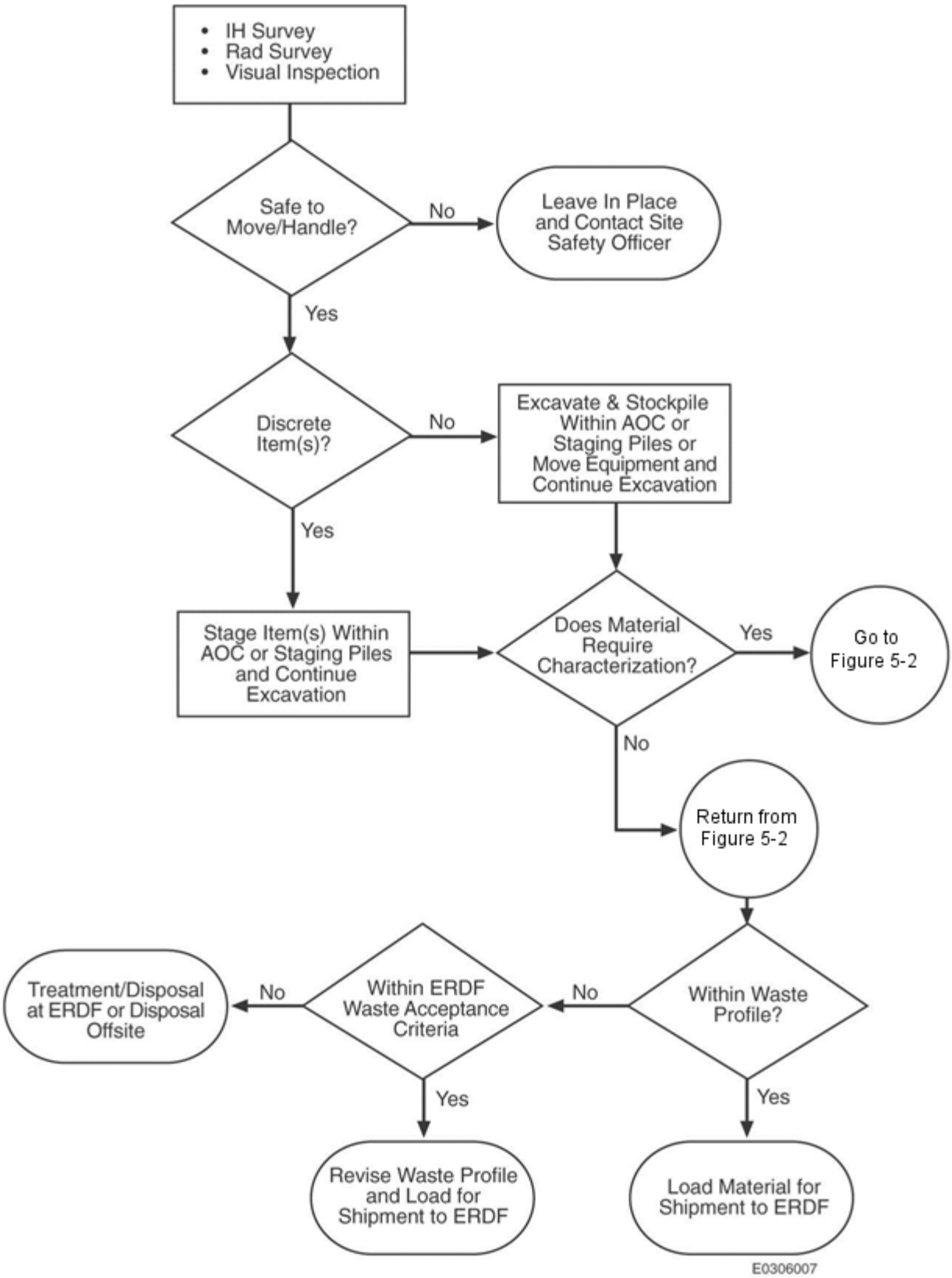

Figure 5-1. Logic Flow Diagram for Disposition of Buried Waste and Co-Mingled Soil

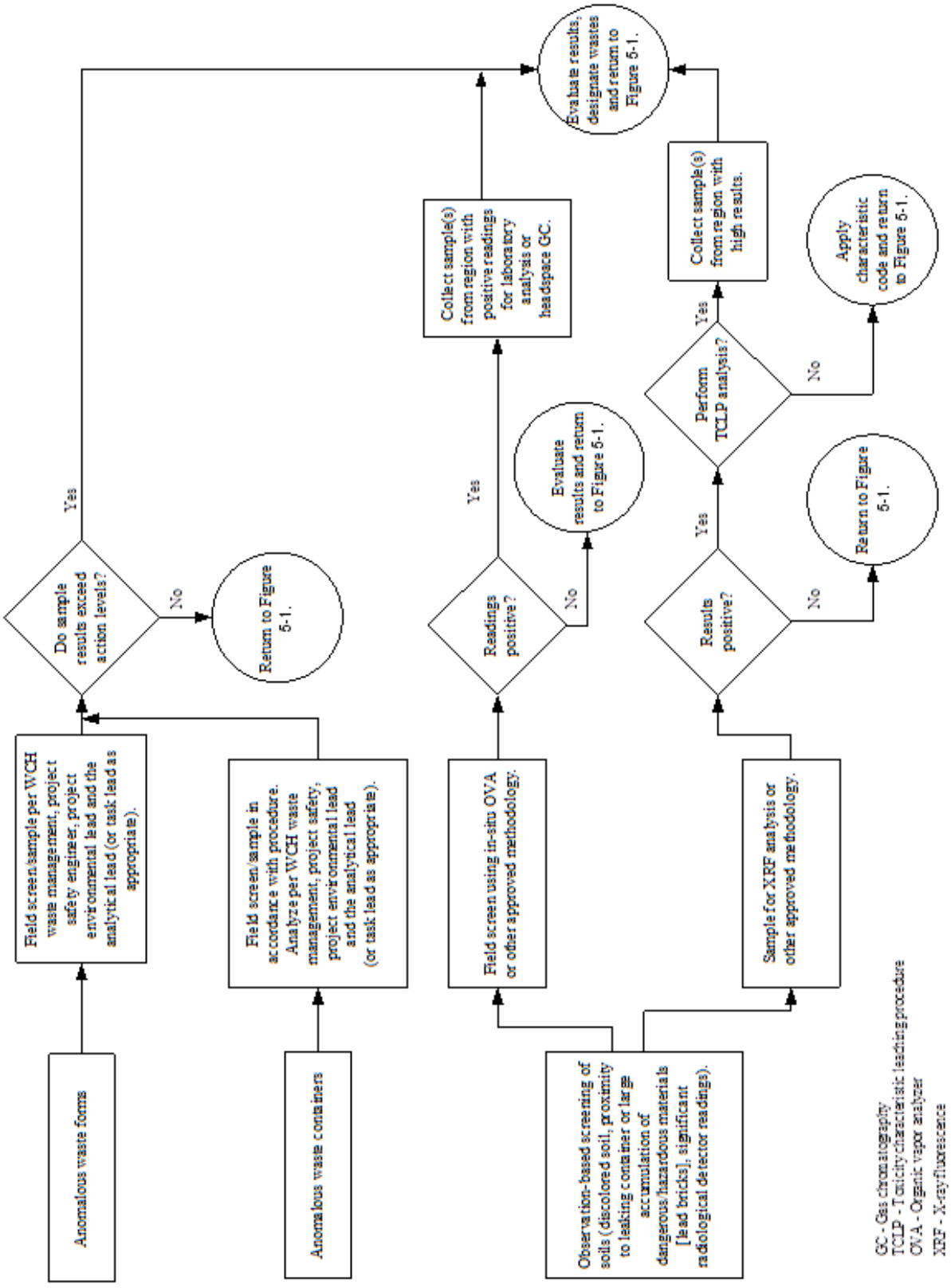

Figure 5-2. Logic Flow Diagram for Disposition of Anomalous Waste Forms

5.2.4 Liquid

5.2.4.1 Liquids from Unplanned Releases

If a release occurs, the notification of contractor spill release support is required. The reporting requirements will be met as prescribed by DOE O 232.1A, *Occurrence Reporting and Processing Operations*. The contractor point of contact will determine the actions required to address the spill and determine if the lead regulatory agency needs to be notified.

Spills (unplanned releases) that occur in clean areas that are being used in support of a CERCLA remediation are appropriate for disposal at the ERDF, when the following conditions exist:

1. The spill occurred from equipment supporting the CERCLA activity.
2. The waste meets the ERDF waste acceptance criteria (WCH-191).
3. The spill occurred within the CERCLA OU boundary or onsite area.

A “clean area” is defined as an area supporting a CERCLA remediation activity that is not contaminated with the contaminants of concern found in the active remediation areas (DOE-RL et al. 2007).

Liquid that is not treated to meet the ERDF acceptance criteria will be shipped to the ETF or an appropriate offsite facility. The ETF is an approved noncontiguous onsite facility pursuant to CERCLA Section 104(d)(4) used to store and treat liquid waste generated from remedial actions, provided the waste acceptance criteria can be met.

5.2.4.2 Decontamination Fluids

Decontamination fluids (i.e., water and/or nonhazardous cleaning solutions) from cleaning equipment and tools used in the OU may be discharged to the ground in accordance with Section 4.3.2. If decontamination fluids are collected and contain contaminant levels above those listed in WAC 173-200 or groundwater cleanup standards in WAC 173-340-720, they may be designated and transported to the ETF or other facility authorized by the lead regulatory agency, or may be used as dust suppressant following approval by the lead regulatory agency. Small volumes of nondangerous decontamination fluids may be stabilized to eliminate free liquids and then disposed to the ERDF if the waste acceptance criteria can be met.

5.2.4.3 Liquid Remaining in Pipes

Liquids that may remain in pipelines to be remediated will be collected to the extent reasonably practicable, designated, and transported to the ETF or other facility as authorized by the lead regulatory agency. If the liquid is water and contains contaminants in levels below those listed in WAC 173-200 or groundwater cleanup standards in WAC 173-340-720, it may be used as dust suppressant. Water above the WAC 173-200 or WAC 173-340-720 limits may be used as dust suppressant following approval by the lead regulatory agency.

Pipeline removal may be a planned remedial action or an activity made necessary by an unplanned discovery. Projects perform historical research to locate buried pipelines and learn as much as possible about their past functions and what liquids they may currently hold. Based upon that research, and observations and data gathered during remedial action, a graded approach will be used for spill control practices implemented during pipeline removal. The most stringent efforts will be used for pipes containing or expected to contain dangerous waste liquids. To the extent practicable, those pipelines will be tapped and liquids drained, containerized, and properly disposed.

Mitigative measures required in most cases will lie somewhere below those extremes. Spill control practices (spill kits, absorbents, liners, catch basins, etc.) will be used to minimize the quantities of nondangerous waste liquids that may be released to the soil. Pipelines will not be deliberately breached unless their contents are known or measures are in place to positively contain any liquids that may be discharged. Proposed pipeline remediation will be discussed with the regulators so they understand the approach to be used, spill controls that will be employed, and uncertainties or risks of unknown liquids or inadvertent discharges.

5.2.5 Used Oil and Hydraulic Fluids

Used oil and hydraulic fluids generated during operation of machinery at the waste sites will be radiologically released and sent offsite for recycling or disposal, as appropriate, or may be stabilized in accordance with ERDF waste acceptance criteria (WCH-191) and disposed to ERDF if the fluid contacted contaminated media associated with the waste site.

5.2.6 Returned Sample Waste

Screening and analysis of both solid and liquid samples may be conducted at the waste sites, offsite or onsite laboratories, and/or an onsite radiological counting facility. These samples are authorized to be returned to the OU. Unused samples and associated laboratory waste from offsite analyses will be managed by the applicable laboratory in accordance with contract specifications. Waste from field screening and onsite laboratories will be managed depending on whether it has been altered by analysis. Altered samples will be contained and disposed at the ETF, ERDF, or other appropriate facilities as authorized by the lead regulatory agency, depending on waste designation. Unaltered liquid waste generated during sample screening and analysis may be discharged to the ground near the point of generation, if contaminant concentrations are below levels listed in WAC 173-200, or below groundwater cleanup standards in WAC 173-340-720, or be disposed at the ETF, ERDF, or other appropriate facilities if it is above these criteria. Some liquids may be neutralized and/or stabilized to meet the disposal facility's waste acceptance criteria. Pursuant 40 CFR 300.440, remedial project manager approval is required before returning unused samples or waste from onsite or offsite laboratories. Approval of this RDR/RAWP constitutes remedial project manager approval for shipment of offsite and onsite laboratory sample waste back to the waste site of origin.

5.2.7 Radiological Counting Facility Sample Wastes

Samples from CERCLA activities may be analyzed in a radiological counting facility (currently located in the 300 Area). Counting capabilities include, but are not limited to, liquid scintillation, gross alpha/beta gamma, gamma ray spectroscopy, and alpha spectroscopy. This facility will be operated as a CERCLA facility to support counting of CERCLA samples from the Hanford Site. Various types of sample media will be prepared and counted such as smears, swipes, air filters, soil, liquids, and miscellaneous waste streams (e.g., concrete, cloth). Sample preparation activities prior to sample counting will typically involve physical processes (e.g., mounting of air filters and smears on planchets) prior to counting rather than radiochemistry.

The primary waste material generated from radiological counting includes samples, sample residues, and secondary waste (e.g., personnel protective equipment such as gloves and wipes). Laboratory calibration standard wastes or inter-laboratory comparison waste may be generated. Some waste may be generated from maintenance or calibration of sample equipment.

Sample counting wastes, including any associated secondary waste, may routinely be sent back to the operable unit of origin for disposition. Alternatively, sample counting waste may be sent directly to

ERDF for disposal if the waste meets the ERDF waste acceptance criteria. Other sample-related waste, such as inter-laboratory comparison samples and maintenance/calibration waste, may also be sent to ERDF for disposal if it contains CERCLA hazardous substances (including potentially radiologically contaminated wastes) and meets the waste acceptance criteria. Otherwise, the waste will be handled as solid waste that may be sent offsite for disposal at a municipal/industrial landfill or recycled as appropriate (e.g., used oils, batteries, or aerosol containers).

Disposal of CERCLA waste at any disposal facility other than ERDF requires EPA approval in accordance with 40 CFR 330.440. Disposal of material containing no or de minimis levels of CERCLA hazardous substances would not require an offsite acceptability determination per 40 CFR 300.440 and may be disposed at a non-CERCLA disposal facility.

Materials requiring collection will be placed in containers appropriate for the material and the receiving facility, and will be appropriately marked, labeled, stored, and transported. Containerized hazardous/dangerous waste, if any, will meet the substantive requirements of WAC 173-303.

The radiological counting facility currently located in the 300 Area is authorized as an noncontiguous onsite facility pursuant to CERCLA Section 104(d)(4) to receive and analyze CERCLA samples associated with 100 Area, 300 Area, and ERDF CERCLA actions. This radiological counting facility may be relocated with prior notification of the regulatory agencies.

5.3 Waste Handling, Packaging, and Labeling

Materials requiring collection will be placed in containers appropriate for the material and the receiving facility. Although ERDF containers will be used for most wastes, an alternative “truck and pup” style of container may be used for nonradionuclide-contaminated waste.

Waste moved outside of the AOC must meet all substantive requirements of WAC 173-303 and DOT requirements, as appropriate. In addition, PCB wastes will be managed in accordance with substantive provisions of 40 CFR 761, and asbestos waste will be managed in accordance with 40 CFR 61. Waste will be packaged, marked, and labeled in accordance with ARARs. If waste is determined to be SNF or TRU waste, it will be packaged in accordance with the appropriate criteria as determined at the time of shipment to an approved facility.

5.4 Storage

In general, waste unearthed in support of this RDR/RAWP will be disposed at the ERDF or other approved onsite or offsite facility. As necessary, waste will be stored within the AOC, in onsite container storage areas, in staging piles, or at the ERDF as described in the following subsections.

5.4.1 Area of Contamination

Waste that is excavated and held (i.e., not immediately transported to the ERDF) for further analysis, treatment, or any other reason will be typically managed within the AOC. The AOC approach was discussed in the NCP (55 FR 8666) with regard to remedial actions under CERCLA. The guidance states that the AOC can be equated to a RCRA landfill where movement within the area would not be considered land disposal and would not trigger the requirements of Subtitle C, such as 90-day storage or LDRs. Any movement of soil outside of the AOC but within the CERCLA onsite area will trigger compliance with all ARARs, such as RCRA provisions for management of dangerous waste. The AOC for each waste site will be delineated in the project drawings and are considered part of this RDR/RAWP. These drawings may be provided to the lead regulatory agency upon request.

5.4.2 Container Storage Areas

Items that are not amenable to storage within the AOC and that can readily and safely be removed (e.g., bagged PPE and sample returns) may be managed outside of the AOC within container storage areas. Container storage will also be used for ancillary waste generated in support of the remedial action (e.g., spill cleanup material). Substantive requirements of 40 CFR 264 Subpart I and WAC 173-303-630 must be met for container storage areas storing regulated dangerous waste. Upon completion of use, all dangerous waste and residues will be removed or decontaminated, including any contaminated soil.

5.4.3 Staging Piles

As an alternative to storage within the AOC or in containers, waste that is not immediately transported to the ERDF or other EPA-approved disposal facility may be stored in staging piles. The staging piles must be operated in accordance with the standards and design criteria prescribed in 40 CFR 264.554, paragraphs (d) through (k). General requirements for the staging piles include the following.

- Staging piles are used only during remedial operations for temporary storage at a facility and must be located within the contiguous property where the wastes to be managed in the staging piles originated.
- Staging piles cannot be used for flowing (i.e., liquid) waste storage.
- The SPA must be designed to prevent or minimize releases of hazardous wastes and hazardous constituents into the environment and minimize or adequately control cross-media transfer. To protect human health and the environment, this can include installation of berms, dust control practices, or using plastic liners/covers, as appropriate. A release of a hazardous substance outside the SPA confines and into the underlying soil or ambient air will be considered a release into the environment, and immediate notification under CERCLA will be pursued in accordance with 40 CFR 302, if the quantity involved exceeds a reportable quantity over a 24-hour period, and/or in accordance with other regulation(s), as applicable. However, if hazardous substances are discovered within the confines of an approved staging pile, it is not considered a release (DOE-RL et al. 2005a).
- The staging pile must not operate for more than 2 years (measured from the first time remediation waste is placed into the pile), except when the EPA grants an operating term extension. A record of the date when remediation waste was first placed in the staging pile must be maintained until final closeout of the site is achieved.
- Ignitable or reactive waste must not be placed in a staging pile unless it has been treated or mixed before being placed in the pile so that the waste no longer meets the definition of ignitable or reactive waste, or the waste is managed in order to protect it from exposure to any material or condition that may cause it to ignite or react.
- Incompatible wastes may not be placed in the same staging pile, unless the requirements in 40 CFR 264.17(b) have been met. The incompatible materials must be separated or they must be protected from each other with a dike, berm, wall, or other device. Remediation waste may not be piled on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 CFR 264.17(b).
- Within 180 days after the operating term of the SPA located in a previously uncontaminated area expires, the SPA must be closed in accordance with 40 CFR 264.258(a) and 40 CFR 264.111, or 40 CFR 265.258(a) and 40 CFR 265.111. This includes removing all remediation waste, contaminated containment system components, contaminated structures and equipment, and leachate.

Approval of this RDR/RAWP by the EPA constitutes general authorization to operate staging piles during remediation of the 100-F/IU Area. Specific SPA locations will be identified on project drawings and approved by the EPA in unit manager's meetings or other documented means of communication. A map outlining the AOC and any SPAs will be posted at the field construction offices and will be updated in the field, as needed. Field operation of staging piles within the referenced regulatory provisions will be accomplished through the following controls:

- The SPA will be surrounded with a minimum of a 15-cm (6-in.) berm to control run-on/runoff prior to use.
- Dust control practices will be deployed consistent with soil piles managed in the AOC, including the use of crusting agents, as necessary, to minimize migration/leaching or contaminants into underlying soil.
- Surveys of the SPA will be performed prior to waste placement to ensure no cross-media transfer or staging of waste on previously contaminated areas. A staging pile shall be remediated within 180 days after the operating period per 40 CFR 264.554(j) and (k).
- Gross sorting of waste will be performed within the AOC to identify and remove drums or other containers from the bulk soil prior to moving the soil to the staging piles. Additional sorting may be required on bulk soil prior to moving the soil to the SPA. Any dangerous or unknown waste identified will be packaged and managed appropriately (drums) within the SPA and within close proximity to the specific staging pile. Drums will be properly labeled, managed, and inspected weekly, or as described in project waste management procedures.

Once characterization and designation of the material is completed, the waste will be loaded into containers for transport to the ERDF or shipped on site or off site for treatment and/or disposal, as appropriate. To close out the SPAs after the waste has been removed, samples of the residual soil will be collected in accordance with the applicable SAP; specific sampling details may be presented in a site-specific sampling instruction prepared in accordance with the SAP. The sample results will be evaluated against cleanup levels as described in Chapter 2 to demonstrate closeout.

5.4.4 Environmental Restoration Disposal Facility Drummed Waste Staging Area

On a case-by-case basis, a staging area may be available at the ERDF for wastes from the 100 Area remedial action sites that require special handling and/or treatment not currently available, such as thermal treatment of a mixed radioactive/dangerous waste. Waste will be characterized at the site prior to transport to the ERDF staging area. All waste sent to the ERDF staging area will be stored in accordance with requirements prescribed by the ERDF ROD amendment (EPA 2002) and implementing documents.

5.5 Waste Transportation

Packaging, marking, and labeling for transportation will be in accordance with DOT 49 CFR requirements, ARARs, and procedures, as appropriate. With appropriate documentation (e.g., safety analysis report for packaging or risk-based exemption), packaging exceptions to DOT requirements that provide an equivalent degree of safety during transportation may be used for waste shipments. Coordination and preparation of these documents will be approved by the DOE-RL. ERDF roll-off-type containers will be used for most bulk wastes. Drummed waste may either be loaded into standard ERDF containers or be transported by other means such as flatbed tractor-trailer units or cargo vans. Containers will be sealed and shipped to the identified disposal facility as quickly as economically feasible. Waste

will be transported in accordance with WAC 173-303, DOT regulations, and DOE/RL-2001-36, *Hanford Sitewide Transportation Safety Document*, as appropriate.

5.6 Waste Treatment

When necessary, treatment is one of the selected remedy elements for the 100-F/IU Area waste sites. Treatment may be conducted at the site, at ERDF (in special cases), or at an EPA-approved offsite facility. If LDR wastes are encountered, the requirements of 40 CFR 268 will be applied, unless a treatability variance is approved by the EPA. Offsite treatment must be performed at a facility approved by the EPA in accordance with 40 CFR 300.440. Return of treated waste from offsite treatment facilities for disposal at ERDF will require additional authorization from DOE-RL.

Treatment will be required for LDR material unless a treatability variance or ARAR waiver is requested by DOE-RL and approved by the lead regulatory agency. If LDR wastes are encountered, the requirements of 40 CFR 268 and WAC 173-303-140 will be applied. Should LDR material be encountered, it will be temporarily stored within the AOC, in a container storage area, or in staging piles and disposed in accordance with applicable regulations. If treatment is required to address LDR wastes, DOE-RL will obtain regulatory agency approval. An approved LDR treatment method for radioactively contaminated cadmium-, silver-, and mercury-containing batteries allows for macroencapsulation prior to disposal. However, lead-acid batteries are not covered by this standard and require initial treatment (draining corrosive liquids, treating separately prior to disposal) (DOE-RL et al. 2005b).

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6 References

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36 CFR 65, "National Historic Landmarks Program," *Code of Federal Regulations*, as amended.

36 CFR 800, "Protection of Historic Properties," *Code of Federal Regulations*, as amended.

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

40 CFR 264.554, "Staging Piles," *Code of Federal Regulations*, as amended.

40 CFR 265, "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, *Code of Federal Regulations*, as amended.

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

40 CFR 300, "National Oil and Hazardous Substances Contingency Plan," *Code of Federal Regulations*, as amended.

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DOE/RL-96-22, 2013, *100 Area Remedial Action Sampling and Analysis Plan*, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2001-36, 2011, *Hanford Sitewide Transportation Safety Document*, Rev. 1E, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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WCH-191, 2014, *Environmental Restoration Disposal Facility Waste Acceptance Criteria*, Rev. 3, Washington Closure Hanford, Richland, Washington.

Appendix A

100-F/IU Area Waste Site Information

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A1. 100-F/IU Area Waste Site Summary

Summary information for all waste sites associated with the 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 Operable Units as of September 1, 2014, is presented in this appendix as Tables A-1 and A-2. This information includes the decision identified for applicable sites under the *Record of Decision for the Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU Area ROD) (EPA 2014), as well as their dispositioning under earlier RODs (EPA 1997, 1999, and 2000b). If a site was not previously included in a ROD, that status is also noted.

The 100-F/IU Area ROD was developed concurrently with ongoing remedial actions; as a result, multiple 100-IU-2 and 100-IU-6 waste sites and/or subsites remediated or evaluated under the *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* (Remaining Sites ROD) (EPA 1999) were not quantitatively evaluated in development of the 100-F/IU Area ROD. These sites therefore require a remediation decision under the 100-F/IU Area ROD, which is reflected in Table A-2. However, further activities for these waste sites may be limited to verification and associated documentation that interim actions taken remain protective under the 100-F/IU Area ROD requirements.

Many 100-F/IU waste sites were remediated using a “plug-in” approach under the Remaining Sites ROD (EPA 1999) and were documented in Explanations of Significant Difference (ESDs) (EPA 2000a, 2004, and 2009). The 2009 ESD (EPA 2009) also included a change in the way plug-in waste sites were reported. The new provision authorized that future plug-in sites would be documented in annual “Fact Sheets” included in the Tri-Party Agreement Administrative Record. Fact sheets were published annually in 2011, 2012, and 2013 by the U.S. Department of Energy to identify such sites. Waste sites that were added in this manner are documented in the following references:

- *Fact Sheet: 100 Area "Plug-In" and Candidate 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)
- *Fact Sheet: 100 Area "Plug-In" and Candidate Sites for Calendar Year 2012 - 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 2013).

Information related to current site knowledge and status was also compiled from the following summary resources:

- Waste Information Data System (WIDS)
- Stewardship Information System (SIS)
- DOE/RL-2010-98, *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units*
- OSR-2009-002, *100-F/IU-2/IU-6 Area – Segment 1 Orphan Sites Evaluation Report*
- OSR-2010-0001, *100-F/IU-2/IU-6 Area - Segment 2 Orphan Sites Evaluation Report*
- OSR-2010-0004, *100-F/IU-2/IU-6 Area - Segment 3 Orphan Sites Evaluation Report*

- OSR-2011-0001, *100-F/IU-2/IU-6 Area - Segment 4 Orphan Sites Evaluation Report*
- OSR-2011-0002, *100-F/IU-2/IU-6 Area - Segment 5 Orphan Sites Evaluation Report*.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-2, Strontium Garden	This site is a former ecological study garden used for growing cereal grains, alfalfa, and other crops in soils containing strontium-90 and cesium-137.	RTD Waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2001-00001. 100-F/IU ROD (EPA 2014), no additional action.
100-F-4, 108-F Building 12-Inch French Drain	This site was a 0.3-m (12-in.)-diameter vertical vitrified clay pipe adjacent to the former 108-F Building that was removed during D&D of the building.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2002-00001. 100-F/IU ROD (EPA 2014), no additional action.
100-F-7, Underground Fuel Tank	This site contained an underground 3,785-L (1,000-gal) fuel oil tank that supplied oil to the 1705-F Laboratory Building Heater Room. The laboratory was decommissioned and demolished in 1975. The former location of the fuel oil tank was excavated with the 100-F-33 fish ponds in 2005 and nothing was found.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-124. 100-F/IU ROD (EPA 2014), no additional action.
100-F-9, French Drain	This site was a 91-cm (36-in.)-diameter vertical concrete pipe at the east end of the 105-F Reactor Building storage room that was believed to have been removed during D&D activities for interim safe storage of the building from 1998 to 2003. A test pit at the former location of the french drain found no residual contamination.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-125. 100-F/IU ROD (EPA 2014), no additional action.
100-F-10, French Drain	This site was a 91-cm (36-in.)-diameter concrete pipe buried to unknown depth at the east end of the 105-F storage room. The french drain was removed during excavation of the 100-F-19:2 pipelines and its institutional controls status is included with the pipelines.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2003-00017. 100-F/IU ROD (EPA 2014), excavation restrictions.
100-F-11, 108-F Building 18-Inch French Drain	This site was a 0.5-m (18-in.)-diameter vertical concrete pipe (length unknown) adjacent to the northwest corner of the electrical substation on the west wall of 108-F Building. Removed during D&D of the 108-F Building.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2002-00001. 100-F/IU ROD (EPA 2014), no additional action.
100-F-12, 36-Inch French Drain at 105-F Building	This site was a 91-cm (36-in.)-diameter vertical concrete pipe of unknown length with a steel lid. Located at northeast corner of the 105-F Reactor.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-126. 100-F/IU ROD (EPA 2014), no additional action.
100-F-14, Vent Pipe	This site was a steel vent pipe extending above grade. The above-grade portion was 10 cm (4 in.) in diameter with a 90-degree bend at the top.	Candidate waste site; Remaining Sites ROD (EPA 1999). Site was reclassified to no action per WSRF 2004-127. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-15, 108-F Building French Drain	This site was a 1.2-m (36-in.)-diameter gravel-filled vertical concrete pipe extending to an unknown depth located adjacent to the east wall of the 108-F Building. This french drain was removed during D&D of the 108-F Building.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2002-00001. 100-F/IU ROD (EPA 2014), no additional action.
100-F-16, 108-F Building French Drain	This site was a 0.8-m (30-in.)-diameter vertical steel pipe of unknown length adjacent to the 108-F Building, which was removed during D&D of the 108-F Building.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2002-00001. 100-F/IU ROD (EPA 2014), no additional action.
100-F-18, Condensate Drain	This site was a 91-cm (36-in.)-diameter vertical steel pipe located near the northwest corner of the 105-F Reactor Building adjacent to the north wall of the fan house. It was removed during D&D activities for interim safe storage of the building from 1998 to 2003.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-137. 100-F/IU ROD (EPA 2014), no additional action.
100-F-19, Process Effluent Pipelines. Subsites 1-3.	Numerous underground pipelines radioactively and/or chemically contaminated. These include process sewer lines, process effluent pipelines to and from the retention basins, and numerous others left in place upon D&D activities. Consists of three subsites: (1) north group, (2) south group, and (3) west group.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00002 and CVP-2001-00003. 100-F/IU ROD (EPA 2014), excavation restrictions.
100-F-20, PNNL Parallel Pits	This site was two earthen pits or trenches, believed to have been used to dispose of both radioactive and nonradioactive material from the experimental animal farm.	RTD Waste site; Burial Grounds ROD (EPA 2000). Remediated and interim closed out per CVP-2006-00009 and WSRF 2006-060. 100-F/IU ROD (EPA 2014), no additional action.
100-F-23, 141-C Drywell	This site was a french drain that received liquid waste from animal pens and 141-C Building research laboratories.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2003-00011. 100-F/IU ROD (EPA 2014), no additional action.
100-F-24, 145-F Drywell	This site was a french drain that received waste from the 145-F Animal Monitoring Laboratory.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2003-00012. 100-F/IU ROD (EPA 2014), no additional action.
100-F-25, 146-F Drywells	This site was french drains that received waste from the 146-F and 146-FR Buildings.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2003-00010. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-26, Underground Pipelines. Subsites 1-16.	100-F Water treatment facility underground pipelines; process sewer. Consists of 16 subsites as follows: 100-F-26:1, North Process Sewer Collection Pipelines. Reclassified to no action per WSRF 2005-008. 100-F-26:2, Water Pipelines to Aquatic Biology & Strontium Gardens; no action. WSRF 2005-005. 100-F-26:3, 184-F Powerhouse Pipelines; reclassified to no action per WSRF 2004-118. 100-F-26:4, South Process Pipelines. remediated and interim closed out per WSRF 2007-035. 100-F-26:5, 190-F Bypass Process Sewer Pipelines. Reclassified to no action per WSRF 2005-007. 100-F-26:6, 190-F Reservoir Pipelines. Reclassified to no action per WSRF 2004-119. 100-F-26:7, Sodium Dichromate and Sodium Silicate Pipelines; interim closed out after additional remediation per WSRF 2011-088. 100-F-26:8, 1607-F1 Sanitary Sewer Pipelines; remediated and interim closed out per WSRF 2005-004. 100-F-26:9, 1607-F2 Sanitary Sewer Pipelines; remediated and interim closed out per WSRF 2008-029. 100-F-26:10, 1607-F3 Sanitary Sewer Pipelines; remediated and interim closed out per WSRF 2007-028. 100-F-26:11, 1607-F4 Sanitary Sewer Pipelines. Reclassified to no action per WSRF 2005-003. 100-F-26:12, Main Process Sewer; remediated and interim closed out per WSRF 2007-034. 100-F-26:13, 108-F Drain Pipelines; remediated and interim closed out per WSRF 2005-011. 100-F-26:14, 116-F-5 Influent Pipelines; remediated and interim closed out per WSRF 2007-029. 100-F-26:15, Miscellaneous Pipelines associated with 1608-F Sump; remediated and interim closed out per WSRF 2007-031. 100-F-26:16, Reactor Cooling Water Pipelines. Reclassified to no action per WSRF 2004-120.	Candidate waste site; Remaining Sites ESD (EPA 2004). See subsite details. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-29, Process Sewer Pipeline	This site consisted of contaminated pipelines that existed at the 100-F Experimental Animal Farm.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2001-00003. 100-F/IU ROD (EPA 2014), Excavation restrictions.
100-F-31, 144-F Sanitary Sewer System	This site consisted of a septic tank and drain field that supported the 144-F Building.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-033. 100-F/IU ROD (EPA 2014), no additional action.
100-F-33, 146-F Aquatic Biology Fish Ponds	The fish ponds were constructed of unlined reinforced concrete and used to support testing on fish using varying mixtures of river and reactor effluent water.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-021. 100-F/IU ROD (EPA 2014), no additional action.
100-F-34, Biology Facility French Drain	This site was a french drain that supported the 1705-F Experimental Gardens. Co-located with the 100-F-19:1 pipeline subsite.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2001-00002. 100-F/IU ROD (EPA 2014), Excavation restrictions.
100-F-35, Soil Contamination Area	Soil contamination area inside the 105-F Reactor exclusion area identified in 1997 when survey instruments detected elevated readings over an area measuring approximately 3 by 3 m (10 by 10 ft). The contamination was believed to have been spillage from a container storing soil excavated from the 116-F-4 Pluto Crib.	RTD Waste site; Remaining Sites ESD (EPA 2009). Remediated and interim closed out per CVP-2002-00007. 100-F/IU ROD (EPA 2014), no additional action.
100-F-36, 108-F Chemical Pumphouse	This site was the 108-F Chemical Pumphouse, but was remodeled to be the Biological Laboratory for plant and animal experiments, then decontaminated and demolished.	Candidate waste site; Remaining Sites ESD (EPA 2004). Reclassified to no action per WSFR 2007-002. 100-F/IU ROD (EPA 2014), no additional action.
100-F-37, French Drain	This site consisted of an abandoned french drain near hydrant F-2.	Candidate waste site; Remaining Sites ESD (EPA 2004). Reclassified to no action per WSFR 2004-095. 100-F/IU ROD (EPA 2014), no additional action.
100-F-38, Yellow-Stained Soil	This site consisted of yellow-stained soil near hydrant F-2 and the 100-F-37 waste site.	Candidate waste site; Remaining Sites ESD (EPA 2004). Remediated and interim closed out per WSFR 2004-093. 100-F/IU ROD (EPA 2014), no additional action.
100-F-39, 100-F River Effluent Pipelines	This site consisted of two 108-cm (42-in.)-diameter pipelines that discharged reactor cooling water effluent from the 105-F Reactor into the main channel of the Columbia River via the 116-F-8 Outfall.	. No prior ROD. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-42, 1904-F Spillway	This site consisted of a reinforced concrete flume that extended from the 116-F-8 Outfall to the Columbia River shoreline.	RTD Waste site; Remaining Sites ESD (EPA 2009). Remediated and interim closed out per WSRF 2006-045. 100-F/IU ROD (EPA 2014), no additional action.
100-F-43, PNL Outfall Spillway	This site consisted of a reinforced concrete flume that extended from the 116-F-16 Outfall to the Columbia River shoreline.	RTD Waste site; Remaining Sites ESD (EPA 2009). Remediated and interim closed out per WSRF 2006-046. 100-F/IU ROD (EPA 2014), no additional action.
100-F-44, 100-F Miscellaneous Pipelines. Subsites 1-10.	This site consisted of a compilation of pipeline segments not previously addressed in any closure documents. Subsites are 100-F-44:1, Pipeline Near 182-F Reservoir; no action per WSRF 2007-005. 100-F-44:2, Pipeline Near 108-F Building; no action per WSRF 2007-006. 100-F-44:3, 1607-F3 Sewer System Pipeline; rejected per WSRF 2007-010. 100-F-44:4, Pipeline in Silica Gel Pit; no action per WSRF 2008-030. 100-F-44:5, Process Sewer Pipeline; no action per WSRF 2008-016. 100-F-44:6, 189-F Refrigeration Pipeline; rejected per WSRF 2007-007. 100-F-44:7, 1717-F Blowdown Pipeline; rejected per WSRF 2007-012. 100-F-44:8, 1717-F Fuel Oil Supply and Return Pipelines. Interim closed out, WSRF 2011-043. 100-F-44:9, 105-F Process Sewer Pipelines. Interim closed out, WSRF 2011-061. 100-F-44:10, 141-C Sewer Pipeline; rejected per WSRF 2007-011.	Candidate waste site; Remaining Sites ESD (EPA 2009). See subsite details. 100-F/IU ROD (EPA 2014), no additional action.
100-F-45, Buried Effluent Pipelines	The site consisted of a piece of pipeline that was buried in the river bank after it floated loose from the river effluent pipeline.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-084. 100-F/IU ROD (EPA 2014), no additional action.
100-F-46, French Drain	This site consisted of the 119-F french drain, a gravel-filled vertical pipe, and the pipeline from the 119-F Stack Sampling Building to the french drain.	No prior ROD. Reclassified to no action per WSRF 2008-021. 100-F/IU ROD (EPA 2014), no additional action.
100-F-47, 151-F Substation	The substation consisted of a fenced, gravel-bed yard measuring 92.4 m (303 ft) by 137.2 m (450 ft), with the 151-F Switch House along the eastern fence line. A railroad spur entered the yard from the south and paralleled the east fence line.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-086. 100-F/IU ROD (EPA 2014), no additional action. 12/15/2011.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-48, 184-F Coal Pit Debris	The site consisted of an area of debris that was identified in an aerial photograph and a historical literature search.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-093. 100-F/IU ROD (EPA 2014), no additional action.
100-F-49, 1716-F Maintenance Garage Lubrication Pit	The site consists of components of the 1716-F Maintenance Garage, including the foundation, the lubrication pit, and the contaminated drain(s).	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-089. 100-F/IU ROD (EPA 2014), no additional action.
100-F-50, 100-F Railroad French Drain	The site consists of a french drain between two sets of railroad tracks at the first junction in the south center of the 100-F Area.	No prior ROD. Reclassified to no action per WSRF 2007-001. 100-F/IU ROD (EPA 2014), no additional action.
100-F-51, 146-F Fish Laboratory Soil	The site is the soil under and around the former 146-F Fish Laboratory. WSRF 2011-085, 9/26/2011.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-085. 100-F/IU ROD (EPA 2014), no additional action.
100-F-52, 146-FR Radioecology/Aquatic Laboratory Soil	The site consists of the soil under and around the former 146-FR Radioecology and Aquatic Biology Laboratory.	No prior ROD. Reclassified to no action per WSRF 2008-022. 100-F/IU ROD (EPA 2014), no additional action.
100-F-53, 108-F Septic System	The site potentially consists of pipelines, a septic tank, the drain field, and any contaminated soil around them.	Candidate waste site; Remaining Sites ESD (EPA 2009). Reclassified to no action per WSRF 2008-019. 100-F/IU ROD (EPA 2014), no additional action.
100-F-54, Animal Farm Pastures	This site consists of the remaining soil associated with the former pastures that were used to hold contaminated animals.	No prior ROD. Reclassified to no action per WSRF 2008-015. 100-F/IU ROD (EPA 2014), no additional action.
100-F-55, Contaminated Ash Layer at 1607-F7	The site consists of a contaminated layer of ash located in a trench near the 1607-F7 area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-083. 100-F/IU ROD (EPA 2014), no additional action.
100-F-56, 100-F Surface Debris/Stains. Subsites 1-2.	The site consists of scattered surface debris located throughout the 100-F Area. 100-F-56:1, 100-FGarnet Sand Areas; interim closed out, WSRF 2011-094, 12/15/2011. 100-F-56:2, Surface Debris Areas. Interim closed out. WSRF 2011-040. 6/2/2011.	RTD Waste site; Remaining Sites ESD (EPA 2009). See subsites. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-57, 190-F Process Water Pump House Debris. Subsites 1-2.	The site consists of the remaining foundation of the demolished 190-F Process Water Pump House. 100-F-57:1; Eastern portion of 190-F Bldg. Interim closed out per WSRF 2012-010 4/10/2012. 100-F-57:2; Western portion of 190-F Bldg. Interim closed out per WSRF 2012-058, 8/23/2012.	RTD Waste site; Remaining Sites ESD (EPA 2009). See subsites. 100-F/IU ROD (EPA 2014), no additional action.
100-F-58, 100-F Surface Debris Potentially Containing Asbestos.	This site contained potential asbestos-contaminated waste that was collected from several locations in the 100-F Area where it had been discarded or abandoned.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2011-033. 100-F/IU ROD (EPA 2014), no additional action.
100-F-59, Riparian Zone Contamination Originating from Waste Site 128-F-2.	This site is a nonradiological waste site created after the remediation of the 128-F-2 Burn Pit. It has two riparian areas known to contain contaminants above soil remedial action goals. The first riparian area, located adjacent to the Columbia River, was remediated, as part of 128-F-2, to an elevation below the ordinary high water mark of the river. The second riparian area, located east and southeast of the 128-F-2 waste site and below the ordinary high water mark, was not remediated.	No prior ROD. WIDS and SIS Accepted site. Deferred to 100 Area final ROD. 100-F/IU ROD (EPA 2014), no additional action.
100-F-60, 100F Cast Iron Pipe	This site was a piece of 10-cm (4-in.)-diameter cast iron pipe found during confirmatory sampling of test pit 19 for the 100-F-26:9 pipelines.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2010-034. 100-F/IU ROD (EPA 2014), no additional action.
100-F-61, Stained Soil near 100-F-12.	This site was an area of stained soil discovered in 2004 during confirmatory sampling of the 100-F-12 french drain. Analysis of a soil sample indicated several constituents with chemical concentrations above remedial action goals.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2011-103. 100-F/IU ROD (EPA 2014), no additional action.
100-F-62, Animal Farm Septic Pipelines.	This site was effluent piping from the 141-M Building to the 1607-F7 septic tank and drain field, and effluent piping from the 144-F Building to the 100-F-31 septic tank and drain field in the 100-F Experimental Animal Farm.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2011-104. 100-F/IU ROD (EPA 2014), no additional action.
100-F-63, Animal Farm Radioactive Effluent Pipelines.	This site included the radioactive effluent pipelines and process sewers at the north end of the 100-F Experimental Animal Farm.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2011-0977. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
100-F-64, Stained Soil Near 1713-FA.	This site consisted of red and yellow stained soil along railroad tracks near the 1713-FA Building with elevated concentrations of lead.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2011 119. 100-F/IU ROD (EPA 2014), no additional action.
100-F-65, Green Stained Soil Near RR Tracks.	This site consisted of green stained soil along the railroad tracks immediately west of the 190-F Building. Remediated as part of the 100-F-57:2 waste site.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2012-059. 100-F/IU ROD (EPA 2014), no additional action.
116-F-1, Lewis Canal, Process Effluent Disposal Trench.	This site was an unlined trench 914 m (3,000 ft) long by 12 m (40 ft) wide by 3 m (10 ft) deep that received reactor cooling water (process effluent) from the 105-F Reactor, 190-F Building, and 116-F-14 Retention Basin, plus decontamination wastes from the 189-F Building.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2002-00009. 100-F/IU ROD (EPA 2014), no additional action.
116-F-2, 107-F Liquid Waste Disposal Trench	This site was an open liquid waste trench used for intermittent disposal of reactor cooling water (process effluent) from 1950 to 1965.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00005. 100-F/IU ROD (EPA 2014), excavation restrictions.
116-F-3, 105-F Storage Basin Trench	This site was a trench that received reactor cooling water (process effluent) during a 1947 fuel element rupture occurrence. In 1951, the trench received sludge from the 105-F Fuel Storage Basin.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2002-00008. 100-F/IU ROD (EPA 2014), no additional action.
116-F-4, Pluto Crib	This site was a wooden crib that received liquid waste from the105-F Reactor during fuel ruptures between 1950 and 1952.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00006. 100-F/IU ROD (EPA 2014), no additional action.
116-F-5, Ball Washer Crib	This site was a wood structure located in the transfer basin area of the 105-F Reactor Building that received decontamination wastes from the 105-F Reactor ball washer assembly.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00007. 100-F/IU ROD (EPA 2014), no additional action.
116-F-6, Liquid Waste Disposal Trench	This site was an open excavation used to receive reactor cooling water (process effluent) during maintenance shutdowns of the 105-F Reactor.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2002-00010. 100-F/IU ROD (EPA 2014), excavation restrictions.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
116-F-7, 117-F Crib and Pipeline. Subsites 1-2.	This site consisted of a crib, and pipeline that have been filled with gravel and covered with clean soil. The pipeline originated at the 117-F Filter Building (132-F-5) and terminated at the crib site.	Candidate waste site; Remaining Sites ROD (EPA 1999). Subsites reclassified to no action per WSRFs 2004-128 and 2005-044. 100-F/IU ROD (EPA 2014), no additional action.
116-F-8, 1904-F Outfall Structure	Located on the bank of the Columbia River, this site served as a weir box for 105-F Reactor coolant water ducted to the river via the 100-F-42 Spillway to provide overflow capability in case the outfall lines became plugged.	RTD Waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-038. 100-F/IU ROD (EPA 2014), no additional action.
116-F-9, PNL Animal Waste Leach Trench	This site was a leaching trench that received waste water from the cleaning of animal pens in the experimental animal farms.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00008. 100-F/IU ROD (EPA 2014), excavation restrictions.
116-F-10, 105-F Dummy Decontamination French Drain	This site consisted of a vitrified clay pipe placed in the ground vertically and used to dispose of fluid from decontamination of dummy fuel element spacers and other reactor hardware.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2003-00003. 100-F/IU ROD (EPA 2014), no additional action.
116-F-11, Cushion Corridor French Drain	This site was a french drain that received liquid decontamination waste from the cushion corridor area of the reactor.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00003. 100-F/IU ROD (EPA 2014), no additional action.
116-F-12, 148-F French Drain	This site was a french drain that received effluent pump priming water from the 148-F Pumphouse during 1944-1964. Co-located with the 100-F-19:1 pipeline subsite.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2001-00002. 100-F/IU ROD (EPA 2014), excavation restrictions.
116-F-14, 107-F Retention Basins	This site was a concrete-lined, open-top reservoir designed to retain reactor cooling water prior to discharge to the Columbia River.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00009. 100-F/IU ROD (EPA 2014), excavation restrictions.
116-F-15, 108-F Radiation Crib	This site was a floor drain and sump that emptied into a trench beneath the floor of the 108-F Building.	RTD Waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2007-003. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
116-F-16, PNL Outfall Structure	Located on the bank of the Columbia River, this site served as a concrete weir box that carried experimental animal farm wastes to the river.	RTD Waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-039. 100-F/IU ROD (EPA 2014), no additional action.
118-F-1, Burial Ground	This site was a solid waste burial ground that received radioactive material and reactor components from the 100-F Reactor from 1954-1965. Site contained two north/south trenches.	RTD Waste site; Burial Grounds ROD (EPA 2000). Remediated and interim closed out per CVP-2007-00001. 100-F/IU ROD (EPA 2014), no additional action.
118-F-2, Burial Ground	This site received solid waste from the 100-F Reactor and biology facilities from 1945 to 1965.	RTD Waste site; Burial Grounds ROD (EPA 2000). Remediated and interim closed out per CVP-2007-00002. 100-F/IU ROD (EPA 2014), no additional action.
118-F-3, Minor Construction Burial Ground	This solid waste site received irradiated reactor parts from the 100-F Reactor during the 3X Project in 1952. Waste was primarily vertical safety rod thimbles and step plugs.	RTD Waste site; Burial Grounds ROD (EPA 2000). Remediated and interim closed out per CVP-2006-00008. 100-F/IU ROD (EPA 2014), no additional action.
118-F-4, 115-F Pit	This site was a small unlined disposal pit used to receive silica gel from the 115-F drying towers.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-129. 100-F/IU ROD (EPA 2014), no additional action.
118-F-5, PNL Sawdust Pit	This site received sawdust containing strontium-90 and plutonium-239 from the animal pens at the Experimental Animal Farm from 1954-1975. Materials were placed in paper boxes or 250-L (55-gal) metal drums for burial.	RTD Waste site; Burial Grounds ROD (EPA 2000). Remediated and interim closed out per CVP-2007-00003. 100-F/IU ROD (EPA 2014), no additional action.
118-F-6, PNL Solid Waste Burial Ground	This site received biological waste from animal research studies from 1965-1973. During remediation, a single railroad tank car containing burned animal carcasses was found buried in the easternmost trench, as predicted by geophysical investigations. Informational samples and strontium-90 assays were taken of groundwater in trench 4, which was excavated to 6.5 m (21 ft) below ground surface.	RTD Waste site; Burial Grounds ROD (EPA 2000). Remediated and interim closed out per CVP-2008-00001. 100-F/IU ROD (EPA 2014), excavation restrictions.
118-F-7 Misc. Hardware Storage Vault	This site was a below ground concrete vault south of the 105-F Reactor building that was used from 1945 to 1965 for temporary storage of contaminated reactor parts and mixed wastes.	RTD Waste site; Burial Grounds ROD (EPA 2000). Remediated and interim closed out per CVP-2006-00007. WSRF 2008-018. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
118-F-8, 105-F Reactor Building Subsites 1-4.	This site is an inactive plutonium production reactor that operated from 1944 to 1965 and was placed in Interim Safe Storage in 2003. The site includes: 118-F-8:1: 105-F Reactor Ancillary Support Areas, Below-Grade Structures, and Underlying Soils;	Action memorandum (EPA 1998). 118-F-8:1, Remediated and interim closed out per CVP-2003-00017. 100-F/IU ROD (EPA 2014), no additional action.
	118-F-8:3: 105-F Fuel Storage Basin and Underlying Soils; and	118-F-8:3, Remediated and interim closed out per CVP-2003-00017. 100-F/IU ROD (EPA 2014), excavation restrictions.
	118-F-8:4: 105-F Fuel Storage Basin West Side Adjacent and Side Slope Soils.	118-F-8:4, Remediated and interim closed out per CVP-2007-00004. 100-F/IU ROD (EPA 2014), excavation restrictions.
120-F-1, Glass Dump	This was a dump site containing surface litter consisting of numerous fluorescent tubes, light bulbs, vacuum tubes, broken tools, small batteries, chemical bottles, and laboratory apparatus.	RTD Waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2008-028. 100-F/IU ROD (EPA 2014), no additional action.
126-F-1, Ash Pit	This was a solid waste site that received coal ash from the 184-F coal-fired steam plant. The site became radioactively contaminated due to leakage from the 105-F Reactor process effluent disposal system.	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2002-00004. 100-F/IU ROD (EPA 2014), no additional action.
126-F-2, 183-F Clearwells	Reinforced concrete water storage basins designed to store river water being processed for reactor coolant. Operated from 1945 to 1965.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-017. 100-F/IU ROD (EPA 2014), no additional action.
128-F-1, Burning Pit	Burning pit that operated from 1945 to 1965. Waste included nonradioactive, combustible materials such as paint waste, office waste, and chemical solvents.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2003-035. 100-F/IU ROD (EPA 2014), no additional action.
128-F-2, Burning Pit	Site is an irregularly-shaped depression located on the river bank used for burning of nonhazardous office waste, vegetation, paint, solvents, and other combustibles.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2008-031. 100-F/IU ROD (EPA 2014), no additional action.
128-F-3, PNL Burn Pit	Shallow pit used for burning materials from the Experimental Animal Farm. Pit currently filled with coal ash.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-042. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
132-F-1, Chronic Feeding Barn	Site was a concrete block building with concrete animal pens that was used as the main housing facility for sheep and other livestock used in radiological dose studies.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-029. 100-F/IU ROD (EPA 2014), no additional action.
132-F-3, Gas Recirculation Facility	Single-story concrete building that housed the reactor inert gas processing and recirculation system.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2003-025. 100-F/IU ROD (EPA 2014), no additional action.
132-F-4, 116-F Reactor Stack. Subsites 1-2.	Site contains concrete rubble from demolition of the 105-F (116-F) Reactor Stack. The stack was used to exhaust confinement air from the work areas of the 105-F Reactor Building from 1944-1965 and was demolished in 1983. The stack and its foundation were demolished with explosives and buried in a trench. Site consists of two subsites: (1) 116-F Reactor Stack, and (2) Reactor Stack Base Burial Site.	Candidate waste site; Remaining Sites ROD (EPA 1999). 132-F-4:1, reclassified to no action per WSRF 2003-023. 100-F/IU ROD (EPA 2014), no additional action. 132-F-4:2, reclassified to no action per WSRF 2005-043. 100-F/IU ROD (EPA 2014), no additional action.
132-F-5, 117-F Filter Building	Building received exhaust fan discharge through an inlet duct from the 105-F Reactor and discharged filtered air through a duct and out the 116-F stack.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2003-029. 100-F/IU ROD (EPA 2014), no additional action.
132-F-6, 1608-F Waste Water Pumping Station	Former concrete building that housed a water pumping station that operated from 1944-1965 and was demolished in situ in 1987. Received waste water from reactor drains and sumps and combined these wastes with reactor effluent.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2003-032. 100-F/IU ROD (EPA 2014), no additional action.
141-C, Animal Barn	Site was the location of the large animal barn and biology laboratory, and also referred to as the hog barn.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-027. 100-F/IU ROD (EPA 2014), no additional action.
182-F, Reservoir	Received raw water from the Columbia River for input to the reactor cooling water system. Operated 1945-1965.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2005-025. 100-F/IU ROD (EPA 2014), no additional action.
600-351, Stained Soil Areas Outside of 100-F Area	This site contained two stained soil areas outside of 100-F Area hiving stained, crusted soil and no vegetation.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2011-087. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
1607-F1, 124-F-1 Septic Tank and Drainfield	Concrete septic tank with a 125-person capacity, a vitrified pipe tile field, and associated piping. Received sanitary sewage from the 1701-F badge house, 1709-F Fire Station, and 1720-F administrative office and change room.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2004-130. 100-F/IU ROD (EPA 2014), no additional action.
1607-F2, Septic System	Site included a septic tank, drainfield, and associated piping that received sanitary wastes from the 184-F, 185-F, 190-F, and 1700 Admin. Services Building. Site operated from 1944 to 1988.	RTD Waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2002-00005. 100-F/IU ROD (EPA 2014), no additional action.
1607-F3, 124-F-3 Septic System	Site included a 41-person capacity concrete tank with vitrified pipe tile field. It operated from 1944 to 1965. It received sanitary sewage from 182-F Pump Station, 183-F Water Treatment Plant, and 151-F Substation. Arsenic-lead site.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-047. 100-F/IU ROD (EPA 2014), no additional action.
1607-F4, Septic System	Site included a 6-person capacity concrete tank, vitrified pipe tile field, and associated piping. It operated from 1944 to 1965 and received sanitary sewage from the 115-F Gas Recirculation Building.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2004-131. 100-F/IU ROD (EPA 2014), no additional action.
1607-F5, Septic System	Site included a 6-person capacity concrete tank with vitrified pipe tile field. It operated from 1944 to 1965 and received sanitary sewage from the 181-F Pump house.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-043. 100-F/IU ROD (EPA 2014), no additional action.
1607-F6, Septic System	Site included three tanks, a tile field, and associated pipelines. It operated from 1945 to 1975 and received sanitary wastes from the 1705-F, 146-F, and 146-FR Animal Farm Buildings.	RTD Waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2001-00010. 100-F/IU ROD (EPA 2014), no additional action.
1607-F7, Septic System	Site included a septic tank, drainfield, and associated piping that received sanitary sewage from the 141-M Building.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2006-040. 100-F/IU ROD (EPA 2014), no additional action.
UPR-100-F-1, Sewer Line Leak	Spill of 64,352 L (17,000 gal) of animal pens wash water occurred when a process sewer line from the 141-C Hog Barn plugged and overflowed adjacent to the building in 1971.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2001-00003. 100-F/IU ROD (EPA 2014), no additional action.

Table A-1. 100-FR-1 and 100-FR-2 Waste Site Information

Site Name	Site Information	Site Status
UPR-100-F-2, Basin Leak Ditch (100-F-3)	Ditch formed by overflow of the north end of the 107-F Retention Basin during 1955 and enlarged by repeated overflows from an effluent line manhole north of the basin. Ditch ran northeast to the Columbia River	RTD Waste site; ROD Amendment (EPA 1997). Remediated and interim closed out per CVP-2001-00011. 100-F/IU ROD (EPA 2014), no additional action.
UPR-100-F-3, Mercury Spill	Mercury spilled on the floor of the former 146-FR Fish Lab. All material was "squeegeed" out the door of the building and was reported to have been cleaned up and removed.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per CVP-2003-00010. 100-F/IU ROD (EPA 2014), no additional action.

CVP = cleanup verification package
D&D = decontamination and decommissioning
ESD = explanation of significant differences
ROD = record of decision
RTD = remove-treat-dispose
SIS = Stewardship Information System
UPR = unplanned release
WIDS = Waste Information Data System
WSRF = waste site reclassification form

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-3, Hanford Townsite Dumping Area and Paint Pit 100-IU-6	Site consisted of a shallow trench that appeared to be an old borrow pit approximately 37 x 27 x 1.2 m (120 x 90 x 4 ft) and a dumping area spread over an area about 280 x 490 m (925 x 1,600 ft). Waste included dried paint and paint cans, roofing paper, possible asbestos-containing material, steel, aluminum, burnt wood, etc.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2011-072, CCN 161468. 100-F/IU ROD (EPA 2014), no additional action.
600-5, Waste Oil Dump, Asphalt Heliport 100-IU-2	Site consisted of a circular asphalt or heavy oil area 4.6 m (15 ft) in diameter and an asphalt or heavy oil ditch 7.6 m (25 ft) long, 38 cm (15 in.) wide, and 2.5 cm (1 in.) deep. Also located at this site was a metal flag and steel pipe.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2010-087. 100-F/IU ROD (EPA 2014), no additional action.
600-20, 100-IU-6, Tank Cleaning Site; 615 Hot Mix Plant. 100-IU-6	The site was the remaining components of a hot mix asphalt batch plant that included two large asphalt tanks, valve pits, piping, asphalt spills, and assorted debris. Waste asphalt, dumped in solid and liquid form, was prevalent at the site, as was other construction and equipment debris.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2013). (Remediation pending: 8/27/14) 100-F/IU ROD (EPA 2014), RTD to CULs.
600-23, Dumping Area Within Gravel Pit #11 100-IU-6	Site was an area of buried debris inside a large gravel pit.	RTD Waste site; Remaining Sites, 100-IU-6 ESD (EPA 2000a). Remediated and interim closed out per CVP-2001-00020. 100-F/IU ROD (EPA 2014), no additional action.
600-52, White Bluffs Surface Basin 100-IU-2	Site was a depression in the ground that may have received discharges from the 600-106 Pickling Acid Crib.	Candidate waste site; Remaining Sites ROD (EPA 1999). Site was reclassified to no action per WSRF 2003-028. 100-F/IU ROD (EPA 2014), no additional action.
600-98, East White Bluffs City Landfills 100-IU-2	Site consisted of two unlined pre-Hanford landfills.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-098. 100-F/IU ROD (EPA 2014), no additional action.
600-99, JA Jones #2 100-IU-2	Site contained minor construction equipment used by the J.A. Jones Construction Company and included wood scraps, concrete, and some metallic waste.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2003-037. 100-F/IU ROD (EPA 2014), no additional action.
600-100, White Bluffs Landfill 100-IU-2	Site is an unlined depression that received industrial, commercial, domestic, and farm waste.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2010-082. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-107, Cribs at 213-J&K Storage Facility 100-IU-6	Site consisted of two small cribs located in the 213-J and 213-K Storage Vault Facility.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2003-033. 100-F/IU ROD (EPA 2014), no additional action.
600-108, 213-K Vault (with 600-257, 213-J Vault) 100-IU-6	This waste site consisted of the 213-K Storage Vault only, which was one of two parallel, reinforced concrete, earth-covered storage facilities. Originally built to store containers of processed plutonium product; later used to store soil samples and contaminated equipment.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2011-051. 100-F/IU ROD (EPA 2014), no additional action.
600-109, HTCL, Hanford Trailer Camp Landfill 100-IU-6	This site was located within a gravel pit and consisted of scattered debris and typical domestic and construction waste that were used during construction of the Hanford Site facilities. This is an arsenic-lead contamination site.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2010-075. 100-F/IU ROD (EPA 2014), no additional action.
600-110, HTL, Hanford Townsite Landfill. 100-IU-6	This site consisted of an unlined excavated area used for pre-Hanford dumping of industrial and domestic waste. The site was backfilled for use in the Hanford Construction Camp.	Candidate waste site; Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-062. 100-F/IU ROD (EPA 2014), no additional action.
600-111, P-11 Critical Mass Laboratory Crib 100-IU-6	This site was the location of a demolished facility and crib with subsurface radiological contamination. Facilities were called the P-11 Critical Mass Laboratory and included the 120 and 123 Buildings.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2004-065. 100-F/IU ROD (EPA 2014), no additional action.
600-120, White Bluffs Spare Parts Burn Pit 100-IU-2	This site was a burn pit that was used for industrial and commercial wastes. The site appears to have been backfilled with coal ash.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2010-063. 100-F/IU ROD (EPA 2014), no additional action.
600-124, White Bluffs Burn Site and Paint Disposal Area 100-IU-2	The site was an area with evidence of burning and paint disposal. Possible asbestos-containing material was scattered about.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2010-094. 100-F/IU ROD (EPA 2014), no additional action.
600-125, White Bluffs Waste Disposal Trench 1 100-IU-2	This site was a sandy depression with wood, ceramic, and metal debris on the surface.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2010-088. 100-F/IU ROD (EPA 2014), no additional action.
600-127, White Bluffs Fuel Storage Area 100-IU-2	This site was two loading docks and a rectangular area surrounded by a low soil berm.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2004-064. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-128, White Bluffs Oil and Oil Filter Dump Site 100-IU-2	This site was a pre-Hanford, White Bluffs Community oil dump area that included canister-type oil filters.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-039. 100-F/IU ROD (EPA 2014), no additional action.
600-129, White Bluffs Community Dump Site 100-IU-2	This site was a pre-Hanford, White Bluffs Community dump site of miscellaneous debris and trash.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2004-136. 100-F/IU ROD (EPA 2014), no additional action.
600-131, White Bluffs Special Fabrication Shops 100-IU-2	This site included the remnants of the Special Fabrication Shop and Warehouse, boiler house, loading dock/well, and a water station.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-045. 100-F/IU ROD (EPA 2014), no additional action.
600-132, Construction Contractor Shop Landfill 100-IU-2	This site was a large, open borrow pit, with access ramps for trucks, ridges in the bottom where scraped, and piles of soil near the edges. Miscellaneous trash was scattered about the site.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-040. 100-F/IU ROD (EPA 2014), no additional action.
600-139, White Bluffs Automotive Repair Shop 100-IU-2	This site was an area thought to be associated with an automotive repair shop, due to type of surface debris: battery caps, engine gaskets, dumped waste oil, and fragments of tail lights.	Candidate waste site; Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-041. 100-F/IU ROD (EPA 2014), no additional action.
600-146, Steel Structure on Northwest Side of Gable Mountain 100-IU-6	The site included a steel structure constructed of steel "I" beams and "L" beams. The structure appeared to be lying in a horizontal position. Debris observed lying around the structure included stainless steel pipe, metal rings, metal boxes, empty cans, and wood.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2010-045. 100-F/IU ROD (EPA 2014), no additional action.
600-149, Small Arms Range. Subsites 1-2. 100-IU-6	The site was a practice range for rifles, shotguns, machine guns, hand grenades, smoke bombs, and other small arms. 600-149:1; range house building, well pumphouse, and four firing ranges. 600-149:2; berm located behind pistol/rifle range area.	RTD Waste site; 100 Area Remaining Sites ROD (EPA 1999). See Subsites. 600-149:1; Interim closed out per WSRF 2011-028. 600-149:2; Remediated and interim closed out per WSRF 2008-049. 100-F/IU ROD (EPA 2014), no additional action.
600-176, White Bluffs Paint Disposal Area 100-IU-2	The site was a dumping area where excess paint materials were disposed of by pouring them on the ground. The paint spills and chips were scattered over a large area.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2011-029. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-178, 213-J and 213-K Guard House Toilet Pit 100-IU-6	The site was a toilet pit opening within a concrete pad that was the remains of a guard house. No evidence of a sewage distribution system (septic tank) was found.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-057. 100-F/IU ROD (EPA 2014), no additional action.
600-181, White Bluffs Oil Dump 100-IU-2	This site was an oil dumping area with an asphalt-like surface.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-048. 100-F/IU ROD (EPA 2014), no additional action.
600-182, White Bluffs Asbestos Pipe Lagging and Excess Piping 100-IU-2	This site consisted of excess piping materials and an area of highly degraded piping insulation that appeared to be made of asbestos or a similar material.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2010-089. 100-F/IU ROD (EPA 2014), no additional action.
600-186, Hanford Construction Camp Septic Tanks and Sewage 100-IU-6	The waste site included all of the septic tanks as well as the sewage treatment plants at the Hanford Construction Camp.	Candidate waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-069, CCN 161467. 100-F/IU ROD (EPA 2014), no additional action.
600-188, White Bluffs Waste Disposal Trench 2 100-IU-2	This site was an open trench with industrial waste filling about one-third of it. There was evidence of chemical or oil dumping as well as empty 208-L (55-gal) drums.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2010-090. 100-F/IU ROD (EPA 2014), no additional action.
600-190, White Bluffs Tar/Paint Disposal Area 100-IU-2	This site was an area where tar and/or paints appeared to have been dumped.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-047. 100-F/IU ROD (EPA 2014), no additional action.
600-191, White Bluffs Community Dump Site 2 100-IU-2	This site was a pre-Hanford, White Bluffs Community dump site of miscellaneous debris and trash.	RTD Waste site; Remaining Sites ESD (EPA 2009). Remediated and interim closed out per WSRF 2004-136. 100-F/IU ROD (EPA 2014), no additional action.
600-201, White Bluffs Paint and Disposal Site 100-IU-2	This site contained miscellaneous trash and debris including paint, glass, metal shavings, metal parts, and army-green canvas material.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2003-038. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-202, Four Burn and Burial Pits at Hanford Townsite 100-IU-6	This site included four burn and burial pits located close together and arranged to form a triangle. The waste included miscellaneous trash such as glass, china, bottles, kitchen materials, and a broken toilet bowl.	Candidate waste site; Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2011-030. 100-F/IU ROD (EPA 2014), no additional action.
600-204, Hanford Townsite Burn and Burial Trench 100-IU-6	This site was a long, narrow trench that was used for dumping and burning trash.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-043. 100-F/IU ROD (EPA 2014), no additional action.
600-205, Hanford Townsite Landfill 2 100-IU-6	This site was a large area that appeared to have been used as a dumping area for domestic waste for the Hanford townsite community.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2011-031. 100-F/IU ROD (EPA 2014), no additional action.
600-208, Hanford Construction Camp Boiler House Ponds 100-IU-6	This site consisted of 18 liquid disposal ponds that supported the boiler houses used for heating in the Hanford construction camp.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Reclassified to no action per WSRF 2004-096. 100-F/IU ROD (EPA 2014), no additional action.
600-235, Lead-Sheathed Telephone Cables 100-IU-6	Lead-Sheathed Telephone Cables in all areas of the Hanford Site.	No prior ROD. No Action per WSRF 2001-091. 100-F/IU ROD (EPA 2014), no additional action.
600-239, Debris in Pit 16 100-IU-6	The site contained several large wooden beams, pallets, steel pipe, plates, and rubber tires. Miscellaneous Restoration was performed in 2012 to remove debris.	No prior ROD. No Action per WSRF 2001-017. 100-F/IU ROD (EPA 2014), no additional action.
600-257, 213-J Vault; with 600-108, 213-K Vault 100-IU-6	These waste sites consisted of the 213-K and 213-J vaults; two parallel, reinforced concrete, earth-covered storage facilities. Originally built to store containers of processed plutonium product; later used to store soil samples and contaminated equipment.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2011-051. 100-F/IU ROD (EPA 2014), no additional action.
600-279, Vegetation-Free Area Between White Bluffs and 100-F Area. 100-IU-2	The site was a large area with no vegetation covered with ash and bits of burned debris related to a pre-Manhattan Engineering District orchard. The area is located in the corner of a large orchard visible in 1941 and 1948 aerial photographs.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2013). Interim closed out per WSRF 2013-134. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-280, Hardened Tar Site 100-IU-6	The site is a 10- x 6-m area where tar was dumped.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-014. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-293, Service Station #1	This site was the former location of a service station that supported the White Bluffs Central Shops.	Candidate waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2013-120. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-294, Service Station #2	This site was the former location of a service station north of Federal Avenue and west of Gasoline Alley that was demolished and buried in place in 1975.	Candidate waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2013-132. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-295, Paint Shop 100-IU-2	This site was the location of a former paint shop building.	Candidate waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-007. 100-F/IU ROD (EPA 2014), no additional action.
600-296, Fire Department Septic System 100-IU-2	This site consisted of multiple locations of former fire station septic systems.	Candidate waste site; Remaining Sites ESD (EPA 2009). No action per WSRF 2011-015. 100-F/IU ROD (EPA 2014), no additional action.
600-297, Imhoff Tank 100-IU-2	This site consisted of an Imhoff tank located south of Federal Avenue, and west of the Chicago Milwaukee Railroad that supported former facilities in the vicinity and is associated with the 600-106 filter bed.	Candidate waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2011-006. 100-F/IU ROD (EPA 2014), no additional action.
600-298, Stained/Burned Soil Areas. Subsites 1-8. 100-IU-2	This site consisted of multiple surface-stained and burned soil areas containing debris.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-8 were interim closed out per WSRF 2013-040. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-299, Battery areas. Subsites 1-6 100-IU-2	This site consisted of multiple areas with batteries at the ground surface, surface debris, and stained soil. This is an arsenic-lead contamination site.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-6 were interim closed out per WSRF 2013-041. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-300, Miscellaneous Debris. Subsites 1-12. 100-IU-2	This site consisted of miscellaneous debris areas with containers of paint, tar, petroleum products, and unknown substances. This is an arsenic-lead contamination site.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-12 were interim closed out per WSRF 2013-042. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-301, White Bluffs Sanitary Sewer Pipelines 100-IU-2	This site consisted of miles of sanitary sewer pipelines associated with the White Bluffs townsite.	Candidate waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2013-129. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-302, French Drain and Vent Pipe 100-IU-2	This site was a 1-m-diameter drain with an associated vent pipe.	Candidate waste site; Remaining Sites ESD (EPA 2009). No Action per WSRF 2010-095. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-303, Vertical Pipes 100-IU-2	This site consisted of four vertical pipes sticking out of the ground in a 3- x 3-m area adjacent to a concrete foundation of a former building.	Candidate waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2013-046. 100-F/IU ROD (EPA 2014), RTD to CULs..
600-305, Areas with suspect asbestos-containing material Subsites 1-5 100-IU-2	This site consisted of suspect asbestos-containing material areas.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-5 were interim closed out per WSRF 2012-070. 100-F/IU ROD (EPA 2014), no additional action.
600-306, Burn site #1 100-IU-2	This site was a burned surface debris area, approximately 9 x 9 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-031. 100-F/IU ROD (EPA 2014), no additional action.
600-307, Burn site #2 100-IU-2	This site was a burned surface debris area, approximately 4 x 4 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-032. 100-F/IU ROD (EPA 2014), no additional action.
600-308, Garnet Sand 100-IU-2	This site was a surface garnet sand area, approximately 6 x 6 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-060. 100-F/IU ROD (EPA 2014), no additional action.
600-309, Burn Site #3 100-IU-2	This site was an area of burned and dumped debris from pre-Hanford and Hanford disposal activities. The site was approximately 30 x 20 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-040. 100-F/IU ROD (EPA 2014), no additional action.
600-310, Burn Site #4 100-IU-2	This site was a burned area of glass cinders and metal slag, approximately 7 x 17 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-041. 100-F/IU ROD (EPA 2014), no additional action.
600-311, Burn Site #5 100-IU-2	This site was a burned surface debris area, approximately 2 x 2 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-042. 100-F/IU ROD (EPA 2014), no additional action.
600-312, Burn Site #6 100-IU-2	This site was a burned surface debris area, approximately 2 x 2 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-043. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-313, Oil stained or Burn Area 100-IU-6	This site consisted of an oil-stained or burned area approximately 3 m in diameter.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-044. 100-F/IU ROD (EPA 2014), no additional action.
600-314, Telecommunication Components. Subsites 1-5 100-IU-6	This site consisted of multiple areas with single components of telecommunication equipment with dimensions of 41 x 23 cm. Also includes a single 3-m-diameter area with battery debris.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-5 were Interim closed out per WSRF 2012-045. 100-F/IU ROD (EPA 2014), no additional action.
600-315, Black Granular Stain 100-IU-6	This site was a 4-m-diameter black granular stain.	Candidate waste site; Remaining Sites ESD (EPA 2009). No Action per WSRF 2011-024. 100-F/IU ROD (EPA 2014), no additional action.
600-316, Dry cell Batteries. Subsites 1-6 100-IU-6	This site consisted of multiple areas with dry cell battery debris and mixed farmstead debris.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-6 were interim closed out per WSRF 2013-034. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-317, Batteries/burn Area 100-IU-6	This site consisted of scattered debris areas with battery debris and burned debris, approximately 15 x 7 m in area.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-046. 100-F/IU ROD (EPA 2014), no additional action.
600-318, Wet cell battery Areas. Subsites 1-5. 100-IU-6	This site consisted of multiple areas with battery and automotive shop debris.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-5 were Interim Closed Out per WSRF 2013-035. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-319, Miscellaneous Debris Areas. Subsites 1-3. 100-IU-6	This site consisted of multiple areas with debris, including areas with potential paint and solvent-related waste.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-3 were interim closed out per WSRF 2012-071. 100-F/IU ROD (EPA 2014), no additional action.
600-320, Oil Stain Areas. Subsites 1-9. 100-IU-6	This site consisted of multiple surface oil stains and oil dump areas with oil filters and tar. This is an arsenic-lead contamination site.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-9 were interim closed out per WSRF 2012-047. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-321, Suspect Asbestos Areas. Subsites 1-4. 100-IU-6	This site consisted of multiple areas with suspect asbestos-containing material on the ground surface.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-4 were interim closed out per WSRF 2013-047. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-322, Rail Spur Pipe 100-IU-6	This site was an 8-in.-diameter carbon steel drain pipe under a railroad spur.	Candidate waste site; Remaining Sites ESD (EPA 2009). No Action per WSRF 2011-011. 100-F/IU ROD (EPA 2014), no additional action.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-323, Bermed Area 100-IU-6	This site consisted of an area of bermed cinders with dimensions of approximately 30 x 30 m and 0.5 m high. EPA 2009. Candidate Site. No action per WSRF 2011-009, 4/26/11.	Candidate waste site; Remaining Sites ESD (EPA 2009). No Action per WSRF 2011-009. 100-F/IU ROD (EPA 2014), no additional action.
600-324, Burned Debris Area 100-IU-6	This site consisted of an area of burned debris on a 7- x 9-m concrete pad.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2012-048. 100-F/IU ROD (EPA 2014), no additional action.
600-325, Areas of Burned Roofing. Subsites 1-2. 100-IU-6	This site consisted of two areas with dimensions of approximately 5 m in diameter and 5 x 20 m with burned roofing material.	RTD Waste site; Remaining Sites ESD (EPA 2009). Subsites 1-2 were interim closed out per WSRF 2012-033. 100-F/IU ROD (EPA 2014), no additional action.
600-326, Odorous Black Material. Subsites 1-2. 100-IU-6	This site consisted of surface stained areas measuring 2 x 4 m with gray suspect insulation material. Also a 6-m-diameter area with black material.	Candidate waste site; Remaining Sites ESD (EPA 2009). 100-F/IU ROD (EPA 2014), RTD to CULs.
600-327, Suspect Dichromate Facility 100-IU-6	This site was a 6- x 10-m depression with water pipe stub at north end.	Candidate waste site; Remaining Sites ESD (EPA 2009). No Action per WSRF 2011-010. 100-F/IU ROD (EPA 2014), no additional action.
600-328, Lead slag area	This site was a 1- x 2-m area with suspect lead slag, stained soil, and stressed vegetation.	RTD Waste site; Remaining Sites ESD (EPA 2009). Interim closed out per WSRF 2013-054. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-329, Concrete Outfall Structure	This site is a concrete structure, possibly a waste water outfall to the Columbia River.	Candidate waste site; Remaining Sites ESD (EPA 2009). 100-F/IU ROD (EPA 2014), RTD to CULs.
600-331, Lime Sulfur Barrel Site	This site was an arsenic-lead contamination site approximately 3 m in diameter. This is the location of a pre-Hanford lime-sulfur barrel that deteriorated and collapsed, spilling its contents of arsenic-lead pesticide onto the soil.	Candidate waste site; Remaining Sites ESD (EPA 2009). (Pending interim closed out per WSRF 2013-114; 9/16/14) 100-F/IU ROD (EPA 2014), RTD to CULs.
600-332, Gable Mt. Firing Range Septic System	This site was the location of a septic system for the small arms firing range. The septic tank was approximately 1.2 x 2.1 x 0.9 m but had been previously removed.	Candidate waste site; Remaining Sites ESD (EPA 2009). 100-F/IU ROD (EPA 2014), RTD to CULs.
600-334, CMX Building. Subsites 1-2. 100-IU-6	This site was the former location of the 145 Building CMX/Process Water Development Semi-Works. Site dimensions are approximately 57 x 96 m. 600-334:1 CMX Building & Surface Anomalies. No action per WSRF 2011-002. 600-334:2 Burn Area Near CMX Bldg	Candidate waste site; Remaining Sites ESD (EPA 2009). See subsites. 600-334:1: 100-F/IU ROD (EPA 2014), no additional action. 600-334:2: 100-F/IU ROD (EPA 2014), RTD to CULs.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-341, Inter-Areas Battery Remnant Areas. Subsites 1-2. 100-IU-2	This site consisted of areas of soil with dry cell battery remnants and debris. 600-341:1; Inter Areas Battery Remnant Area #1A; interim closed out per WSRF 2010-053. 600-341:2; Inter Areas Battery Remnant Area #1B; interim closed out per WSRF 2010-066.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out (See subsites). 100-F/IU ROD (EPA 2014), no additional action.
600-342, Inter Areas Contaminated Clothing Area Near Susie Junction 100-IU-2	Disposal area of discarded radiological protective clothing near Susie Junction.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2010-008. 100-F/IU ROD (EPA 2014), no additional action.
600-343, Inter Areas Burn Site #1 100-IU-2	This site consisted of residual ash from burned material and discarded asphalt in an excavated trench.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2010-052. 100-F/IU ROD (EPA 2014), no additional action.
600-344, Inter Areas Stain Area #1 100-IU-2	This site consisted of a stained soil area with discarded pre-Hanford metal container lids.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2010-067. 100-F/IU ROD (EPA 2014), no additional action.
600-345, 100-BC Vicinity Oil Stain and Filter Area 100-IU-2	This site was a stained soil area with discarded oil filters.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2010-068. 100-F/IU ROD (EPA 2014), no additional action.
600-346, 100-BC Vicinity ash and Debris Area 100-IU-2	This site consisted of several small fly ash dump areas with metal debris.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Interim closed out per WSRF 2010-055. 100-F/IU ROD (EPA 2014), no additional action.
600-349, Unexploded Ordnance (UXO) outside of 600-149 100-IU-6	This site consisted of potential Unexploded Ordnance (UXO) in an area outside of the 600-149 small arms range.	Candidate waste site; 100 Area Fact Sheet (DOE-RL 2011). 100-F/IU ROD (EPA 2014), RTD to CULs.
600-350, PNL Dirt Mounds/Water Catchment Experiment. 100-IU-6	This site consisted of two separate fenced areas containing linear soil mounds.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2011). Remediated and Interim closed out per WSRF 2011-073. 100-F/IU ROD (EPA 2014), no additional action.
600-356, Tar Deposit West of Susie Junction 100-IU-6	This site consisted of two areas of pebbles and rocks northwest of Susie Junction with visible dark staining.	RTD Waste site; 100 Area Fact Sheet (DOE-RL 2013). Remediated and Interim closed out per WSRF 2014-053. 100-F/IU ROD (EPA 2014), RTD to CULs.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-358, Scattered Waste Areas in Vicinity of Gable Mtn Firing Range 100-IU-6	The site consisted of scattered CERCLA regulated debris identified during the UXO characterization and clearance of the 600-149 firing range.	Candidate waste site; 100 Area Fact Sheet (DOE-RL 2012). 100-F/IU ROD (EPA 2014), RTD to CULs.
600-368, Segment 4 Stained Soil #1 100-IU-6	This site consisted of a 15-m^2 (157-ft^2) area covered with green granules.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2013-083. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-369, Segment 4 Bare/Crusted Soil Areas. Subsites 1-8. 100-IU-6	This site consisted of eight debris and burn pit areas that were devoid of vegetation near the Leazer Spur. This is an arsenic-lead contamination site.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Subsites 1-8 were interim closed out per WSRF 2013-090. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-370, Segment 4 Bare Ground & Crusted Soil Areas. 100-IU-2	This site consisted of a large disturbed area with multiple burn sites, burn remnants, transite, insulators, wood, and concrete debris.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2013-084. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-371, Segment 4 Chalky Material Area 100-IU-2	This site consisted of multiple locations having a white chalky substance that resembled either grout or bentonite.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2013-085. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-372, Segment 4 Oil Stain and Filter Area #1. Subsites 1-2. 100-IU-2	This site consisted of two areas with a discarded oil filter that were devoid of vegetation.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Subsites 1-2 were Interim closed out per WSRF 2013-091. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-373, Segment 4 Bare Ground & White Stained Area 100-IU-2	This site consisted of a 28-m^2 (303-ft^2) area devoid of vegetation and covered by a white stain and crusted soil/glass debris.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2013-086. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-374, Segment 4 Drum Remnant Area 100-IU-2	This site consisted of an empty 208-L (55-gal) drum (crushed) surrounded by a small area devoid of vegetation.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2013-087. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-375, Segment 4 Dry Cell Battery Debris Areas Subsites 1-5. 100-IU-2	This site consisted of five locations that have dry cell battery debris and stained soil.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Subsites 1-5 were interim closed out per WSRF 2013-092. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-376, Segment 4 Stained Soil #2. Subsites 1-2. 100-IU-2	This site consisted of two stained soil areas with patches of bare ground and dried yellow material on the surface.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Subsites 1-2 were interim closed out per WSRF 2013-093. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-377, Segment 4 Oil Stain & Filer Area #2 100-IU-6	This site consisted of a 3-m^2 (32-ft^2) area devoid of vegetation and containing multiple filters.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2013-088. 100-F/IU ROD (EPA 2014), RTD to CULs.

Table A-2. 100-IU-2 and 100-IU-6 Waste Site Information

Site Name	Site Information	Site Status
600-378, Telephone Exchange Emergency Gen Bldg Underground Fuel Tank 100-IU-6	This site is the historical location of a 379-L (100-gal) underground storage tank used to store fuel for the 506 telephone exchange emergency generator building (508 Building).	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2014-051. 100-F/IU ROD (EPA 2014), RTD to CULs.
600-379, Segment 4 Burn Area #1 100-IU-6	This site consisted of a burn area with visible remnants.	Candidate waste site. 100 Area Fact Sheet (DOE-RL 2012). Interim closed out per WSRF 2013-089. 100-F/IU ROD (EPA 2014), RTD to CULs.
628-1, White Bluffs Burn Pit 100-IU-2	This site was a triangle-shaped area covered with sand and gravel and possibly used as a burn pit.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Remediated and interim closed out per WSRF 2003-046. 100-F/IU ROD (EPA 2014), no additional action.
JA Jones 1, J.A. Jones Co. Construction Dumping Pit #1 100-IU-6	This site was a trench used by the J.A. Jones Company for the disposal of miscellaneous debris, construction waste, and paint products.	RTD Waste site; Remaining Sites, 100-IU-6 ESD (EPA 2000a). Remediated and interim closed out per CVP-2001-00019. 100-F/IU ROD (EPA 2014), no additional action.
UPR-600-11, Contaminated Soil Dumped at J.A. Jones Pit #1 100-IU-6	This site was an area within the J.A. Jones Pit #1 where contaminated material was mistakenly disposed. The contaminated material was removed in 1980.	No prior ROD. Remediated and interim closed out per WSRF 98-215. 100-F/IU ROD (EPA 2014), no additional action.
UPR-600-16, Fire and Contamination Spread at P-11 (600-111) 100-IU-6	The area is currently a flat, featureless field that has been sown with rye grass. The results of an extensive radiological survey of the surface soil and confirmatory and verification sampling of the associated 600-111 waste site in 2008 showed that no residual contaminant concentrations are present at the site.	Candidate waste site. 100 Area Remaining Sites ROD (EPA 1999). Interim closed out per WSRF 2008-045. 100-F/IU ROD (EPA 2014), no additional action.

CUL = cleanup level
CVP = cleanup verification package
ESD = explanation of significant differences
ROD = record of decision
RTD = remove-treat-dispose
UPR = unplanned release
WSRF = waste site reclassification form

A2. References

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Appendix B

Guidance for Preparation of Cleanup Verification Packages

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Contents

Tables

B1. Purpose

The purpose of this appendix is to provide guidance to assist both authors and readers of documents for final closeout of waste sites in accordance with the *Record of Decision for the Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU Area ROD) (EPA 2014), and the TPA-MP-14 procedure in RL-TPA-90-0001, *Tri-Party Agreement Handbook Management Procedures*. The waste site reclassification form (WSRF) is the documentation of approval of the lead agencies for individual waste site reclassification. The WSRF may be incorporated within a larger document for format and presentation purposes, but the document is considered to be a supporting attachment. For previous interim and final waste site reclassifications in the 100 Areas, cleanup verification packages (CVPs) were written to reclassify radioactive liquid effluent sites and burial grounds while remaining sites verification packages were written to reclassify sites termed "candidate sites" or “remaining sites.” Under the 100-F/IU Area ROD, CVPs will be used as the primary supporting document for waste site reclassification. A CVP is not required if appropriate reclassification bases can be provided in a stand-alone WSRF or via supporting attachments other than a CVP. Projects will use this appendix as guidance for preparing final reclassification documentation.

B2. Objective

The overall objective of the CVPs under the 100-F/IU Area ROD (EPA 2014) is to demonstrate that the relevant waste sites have been remediated and may be reclassified to a final status. The 100-F/IU Area ROD provides the U.S. Department of Energy, Richland Operations Office, with the authority and guidelines to conduct continuing remedial actions at waste sites in the 100-F/IU Area and to propose waste sites for final reclassification. The 100-F/IU Area ROD specifies the remedial action objectives (RAOs), and associated cleanup levels (CULs) that define the extent to which the waste sites require cleanup to protect human health and the environment.

B3. Scope

The scope of this guidance is intended for the CVPs for the 100-F/IU Area waste sites addressed by this remedial design report/remedial action work plan (RDR/RAWP), but equivalent processes are expected to be used for waste sites throughout the 100 and 300 Areas. This is a guidance document, not a requirements document, and deviations from the guidance are acceptable.

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

- For multiple sites that were remediated or determined not to require remediation and received associated interim reclassification prior to issuance of the 100-F/IU Area ROD, but did not receive quantitative evaluation during development of the ROD. The remedy selected for these sites was remove, treat, and dispose to preserve the intent of the interim action remedy being implemented during ROD development. Because CVPs and remaining sites verification packages have already been written under interim actions for these sites, additional final reclassification supporting documentation may be limited to numerical demonstration that the interim action activities remain protective under the CULs of the 100-F/IU Area ROD.
- For sites that are identified for “no additional action” under the 100-F/IU Area ROD, final WSRFs may be prepared with no further explanation or supporting documentation.
- For small sites with limited analytical data sets, the lead agencies may agree to attach the analytic data and/or a simple comparison table to the TPA-MP-14 WSRF (RL-TPA-90-0001) with a location

map and a brief description of the action(s) performed. No other effort may be needed for reclassification or cleanup verification of such waste sites.

- Site-specific guidance from the lead agencies may specifically provide an alternate method for a portion of the CVP or for an entire CVP. This site-specific guidance should be documented and specifically noted in the CVP as approved by the lead agencies.
- Continuing process improvements may require deviation from this guidance in an effort to improve the closeout documents. These process changes will be incorporated into this appendix during future revisions of this document. Material process changes and decision-maker concurrence with material CVP changes will be documented in meeting minutes, in Tri-Party Agreement Change Notices, or by chronicling other correspondence.

The remainder of this guidance describes the typical steps involved in the preparation of the CVP closeout documents.

B4. Cleanup Verification Packages

B4.1 Executive Summary

The executive summary restates (at a higher level) the contents of the CVP. This includes a table documenting the achievement of CULs and RAOs for the given waste site. Table B-1 is provided as an example.

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain radionuclide total excess cancer risk of <1 x 10^{-4} over 1,000 years.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Maximum radionuclide excess cancer risk estimated using a sum of fractions evaluation is 1.22 x* 10^{-5}. **Or:** *Site-specific radionuclide excess cancer risk calculated by RESRAD is 1.1* x 10^{-6}*.*	*NA* *Yes* *Yes*
Direct Exposure – Nonradionuclides	Attain individual COC CULs.	**Example Language:** *All individual COC concentrations are below the CULs.*	*Yes*
Meet Nonradionuclide Risk Requirements	Attain a hazard quotient of <1 for all individual noncarcinogens.	**Example Language:** *The hazard quotients for individual nonradionuclide COCs in the shallow zone and overburden are less than 1.*	*Yes*
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	**Example Language:** *The cumulative hazard quotient (enter value) is less than 1 for the shallow zone and overburden.*	*Yes*
	Attain an excess cancer risk of <1 x 10^{-6} for individual carcinogens.	**Example Language:** *Excess cancer risk values for individual nonradionuclide COCs are less than 1 x* 10^{-6}*.*	*Yes*

Table B-1. Summary of Attainment of Remedial Action Objectives

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
	Attain a total excess cancer risk of <1 x 10^{-5} for carcinogens.	**Example Language:** *Total excess cancer risk (enter value) is less than 1 x 10^{-5}.*	*Yes*
Groundwater/ River Protection – Radionuclides	Attain single radionuclide COC groundwater and river protection CULs.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Residual concentrations of radionuclide COCs meet soil CULs for the protection of groundwater and the Columbia River* [c]*.*	*NA* *Yes*
	Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. [a]	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *Compliance is demonstrated by individual components meeting CULs. (If these are not attained, see Section C.5.2.)*	*NA* *Yes*
	Meet drinking water MCL for alpha emitters.	**Example Language:** *Radionuclides were not COCs for this waste site.* **Or:** *There are no alpha-emitting COCs for this site.* **Or:** *No alpha-emitting COCs are predicted to migrate to groundwater within 1,000 years.*	*NA* *NA* *Yes*
	Meet total uranium drinking water standard of 30 µg/L MCL (40 CFR 141.66). [a]	**Example Language:** *Uranium was not a COC for this waste site.*	*NA*
Groundwater/ River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river CULs.	**Example Language:** *Residual concentrations of COCs meet soil CULs for the protection of groundwater and the Columbia River.* [b]	*Yes*

Example Footnotes:

a "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141.66).

b Under the 100-F/IU ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

COC = contaminant of concern

CUL = cleanup level

MCL = maximum contaminant level

NA = not applicable

RESRAD = RESidual RADioactivity dose model

The WSRFs may be prepared for individual waste sites or for groups of sites, and are prepared in accordance with TPA-MP-14. The WSRF may be incorporated within the CVP document, or the CVP may be presented as an attachment to the WSRF, but the WSRF serves as the documentation of approval of the lead agencies for waste site reclassification. There is no further, separate approval of the CVP. A sample WSRF is provided below.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-6 **Control No.:** [Obtained from WIDS]

Waste Site Code(s)/Subsite Code(s): [WIDS Number and Site Name]

Reclassification Category: Interim ☐ Final ☒

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐
RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The [WIDS Number and Site Name] waste site is located within the 100-IU-6 Operable Unit and is identified as a waste site requiring remediation in the *Record of Decision for the Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU Area ROD). The [WIDS Number] waste site consisted of contaminated soils associated with [XXX].

Remediation of the [WIDS Number] waste site was conducted between [Dates]. Approximately [XXX] bank cubic meters (BCM) ([XXX] bank cubic yards [BCY]) of soil, rock, building debris, and piping were removed from the excavation and disposed to the Environmental Restoration Disposal Facility (ERDF).

The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at ERDF, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Final Closed Out.

Basis for reclassification:

Following remediation, verification sampling for the [WIDS Number] waste site was conducted on [Dates]. The sample results were evaluated in comparison to the cleanup levels (CULs) and remedial action objectives (RAOs) from the 100-F/IU Area ROD and DOE/RL-2014-44-ADD1, *Remedial Design Report/Remedial Action Work Plan Addendum for 100-FR-1, 100-FR-2, 100-IU-2, and 100-IU-6 Soils,* (100-F/IU Area RDR/RAWP Soils Addendum), Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington. In accordance with this evaluation, the verification sampling results support a reclassification of the [WIDS Number] waste site to Final Closed Out. The current site conditions achieve the CULs and RAOs established by the 100-F/IU Area ROD and the 100-F/IU Area RDR/RAWP Soils Addendum. Contamination did not extend into the deep zone; therefore, institutional controls to restrict uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the* [WIDS Number and Site Name] (attached).

Regulator comments:

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-6 **Control No.:** [Obtained from WIDS]

Waste Site Code(s)/Subsite Code(s): [WIDS Number and Site Name]

Waste Site Controls:

Engineered Controls: ☐ Yes ☒ No Institutional Controls: ☐ Yes ☒ No O&M Requirements: ☐ Yes ☒ No

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents:

No additional controls are required.

DOE Project Director (printed)	Signature	Date
N/A Ecology Project Manager (printed)	Signature	Date
EPA Project Manager (printed)	Signature	Date

B4.2 Statement of Protectiveness

This section is a paragraph stating that the waste site attains RAOs of the 100-F/IU ROD and discussing the pertinent future land use for the area. Whether or not institutional controls are necessary is explained. The discussion in this paragraph and the discussion in the Executive Summary should be essentially the same.

B4.3 Site Description and Background

The site history, waste disposal history, site physical dimensions, and location are summarized in this section of the CVP, and a figure(s) showing the vicinity map and/or site plan are provided.

B4.4 Characterization Sampling Activities (If Applicable)

Characterization sampling prior to remediation is appropriate if the location, nature, and potential contamination are not well known. The purpose of this section is to summarize results of such sampling

activities (if any) performed for waste sites. The type of information to be provided would include objectives and dates of site visits, dates of sampling, participation by the U.S. Department of Energy, Richland Operations Office or regulatory agencies, and any findings or determinations (e.g., nature and extent of contamination, visible description of staining, waste form) that resulted from the site visit.

B4.4.1 Geophysical Investigations

This section describes geophysical surveys performed at the site including figures showing possible nature and extent of below-ground features.

B4.4.2 Sample Design for Characterization Screening

The purpose of this section is to summarize the site-specific work instruction or other documentation/processes leading to sampling (e.g., a phased approach using focused sampling). This section typically includes a figure showing locations of samples and a sample summary table similar to Table B-2 with a discussion of the contaminants of concern (COCs), providing an explanation of how they were derived (e.g., based on professional judgment, process knowledge, waste characterization, analogous site information, visible inspection of waste forms).

B4.4.3 Characterization Sample Results

The purpose of this section is to describe the results of sampling activities. Analytical data from sampling are typically provided in an appendix to the CVP.

Table B-2. Sample Summary

Sample Location	Sample Media	Sample Number	WSP Coordinate Locations	Depth (m bgs)	Sample Analysis
Example Information					
Septic tank	*Septic tank contents*	*J01XN2*	*N 147917 E 580875*	*3*	*GEA, gross alpha, gross beta, ICP metals, PCB, pesticides, mercury, SVOA*
		J01XN6			*Hexavalent chromium*
Duplicate septic tank samples	*Septic tank contents*	*J01XN3*	*N 147917 E 580875*	*3*	*GEA, gross alpha, gross beta, ICP metals, PCB, pesticides, mercury, SVOA*
		J01XN7			*Hexavalent chromium*
Ash located east of septic tank	*Ash*	*J01XN1*	*N 147917 E 580882*	*0.5*	*ICP metals, PCB, pesticides, mercury, SVOA*
		J01XN5			*Hexavalent chromium*

Table B-2. Sample Summary

Sample Location	Sample Media	Sample Number	WSP Coordinate Locations	Depth (m bgs)	Sample Analysis
Equipment blank	*Silica sand*	*J01XN4*	*NA*	*NA*	*ICP metals, mercury, SVOA, PCB, pesticides*

Source: Field Sampling, Logbook [XXX]. Reference, [XXX]

bgs = below ground surface

GEA = gamma energy analysis

ICP = inductively coupled plasma

NA = not applicable

PCB = polychlorinated biphenyl

SVOA = semivolatile organic analysis

WSP = Washington State Plane

B4.5 Remedial Action Summary

A description of the excavation and disposal activities for remedial action is given in this section, which may include figures of pre- and post-remediation topographic contours. Appropriate information includes the dates of waste site excavation, description (and photographs if applicable) of materials excavated, disposal location of waste material, general excavation dimensions and elevations, locations of overburden and staging piles (if applicable), and amount of material disposed from the site. Pre- and post-remediation photographs and site maps showing pre-remediation Waste Information Data System boundaries compared to post-remediation site boundaries may be provided. Maps showing post-remediation site contours should be provided if available. Waste volumes provided are for a general sense of scale only.

Additionally, the CVP will discuss significant materials that may have been left at the site (if any) and what significant materials were removed. A summary of field screening or in-process sampling activities (if applicable) that guided remedial actions is also included.

B4.6 Verification Sampling Activities

This section describes the information used to develop the sampling designs for cleanup verification sampling, including reference to appropriate documents and dates of sampling.

B4.6.1 Contaminants of Concern for Verification Sampling

Waste site COCs identified for cleanup verification, typically via a site-specific verification sampling instruction, are listed in this section. The rationale or basis for the final site COC list is discussed in this section.

B4.6.2 Verification Sample Design

A brief explanation regarding the remedial excavation decision units and cleanup verification sampling is included in this section. Statistical sample designs for cleanup verification sampling of waste sites are

typically developed in a site-specific work instruction using Visual Sample Plan[1] (VSP) software. However, a statistical sample design may not be appropriate for all waste sites, and an exclusively focused sampling approach may be used with agreement from the lead agency and lead regulatory agency. Focused sampling may also be used in combination with statistical sampling approaches.

The description of the verification sample design typically includes information pertaining to the location, individual Hanford Environmental Information System (HEIS) sample numbers, Washington State Plane coordinates, and analytical methods requested for all samples collected. This information is typically presented in a table with an accompanying figure showing the sample locations overlain on a map of the area including the remediation footprint of the waste site(s).

For soil cleanup levels based on human exposure via direct contact or other exposure pathways where contact with the soil is required to complete the pathway, the point of compliance shall be established in the soils throughout the site from the ground surface to 4.6 m (15 ft) below ground surface (bgs) per *Washington Administrative Code* (WAC) 173-340-740(6)(d) (Ecology 2007). This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities. Soils and materials 4.6 m (15 ft) bgs or more, within the unsaturated zone, are referred to as being in the deep zone, whereas the materials above 4.6 m (15 ft) bgs are referred to as being in the shallow zone. The direct exposure CULs are applicable to the ground surface and soils or materials within the shallow zone. Groundwater protection and river protection CULs are applicable to soils in both the shallow and the deep zones. However, if a site will meet the direct exposure cleanup criteria throughout the site excavation, it is acceptable to handle the entire site as a shallow zone decision unit regardless of the depth of the excavation. This may be advantageous for site closeout because a site that meets the more restrictive shallow zone criteria will not have a requirement for deep zone ICs. A discussion regarding the rationale for decision unit selection is given as part of development of a site-specific sampling approach in accordance with the *100 Area Final Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE/RL-2014-49). Decision units may be identified based on depth, spatial, and/or process history considerations.

Sampling dates and the number of samples collected per decision unit are also discussed in this section. If any focused sampling was conducted, a summary of this activity and its rationale is also included.

B4.7 Verification Sampling Results

The verification samples collected are submitted to offsite laboratories certified to perform the requisite analyses using U.S. Environmental Protection Agency (EPA)-approved analytical methods. The laboratory-reported analysis data from the sampling are verified and validated for use in the statistical calculations (as appropriate) and are included in appendices to the CVP.

The primary statistical calculation to support cleanup verification is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. All UCL calculations are performed with EPA's ProUCL software[2]. The 95% UCL values for detected COCs in statistical data sets are calculated for each decision unit according to the following:

[1] Visual Sample Plan is a site map-based user-interface statistical sample design program. **Reference:** PNNL-19915, 2010, *Visual Sample Plan 6.0 User's Guide*, available at http://vsp.pnnl.gov/documentation.stm, Pacific Northwest National Laboratory, Richland, Washington.

[2] ProUCL may be downloaded at http://www.epa.gov/osp/hstl/tsc/software.htm.

- If there are five or more detections of a given COC within a data set, and the COC is detected in 25% or more of the total samples, a UCL is calculated. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If there are less than five detections of a given COC within a data set, a UCL is not calculated and the maximum concentration is used. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If a given COC within a data set is detected in five or more samples, but is detected in 25% or less of the total samples, a UCL is not calculated and the maximum concentration is used. A detection in either or both of the primary/duplicate sample pair is considered a single detection.
- If there are no detections of a COC within a data set, then there is no calculation or further evaluation performed for the COC.

For the statistical evaluation of primary/duplicate sample pairs, the following is applied to determine the value to be used in the UCL calculation:

- If detections are reported for both the primary and duplicate, the maximum concentration is used.
- If one detection and one nondetection are reported, the detected concentration is used.
- If both the primary and duplicate are reported as nondetects, the higher detection limit is used (as a nondetect within ProUCL).

The statistical values represent the COC concentrations for each decision unit (e.g., overburden, shallow zone, or deep zone soils). All UCL calculations are performed with EPA's ProUCL software. For sample results that are nondetects (i.e., a "U" is included with the data flags), the full reported minimum detectable activity (radionuclides) or practical quantitation limit (nonradionuclides) value is used as the concentration. Data are then identified as detected (1) or nondetected (0) in the ProUCL data input. In cases that ProUCL output identifies more than one potential UCL for a given data set, the UCL with the highest value is chosen. ProUCL cannot compute UCLs for data sets with less than five results; therefore, analysis of any statistical data sets with less than five results will be determined in consultation with the lead regulatory agency. The 95% UCL calculation brief is included in an appendix to the CVP.

For focused sampling, no statistical evaluation is performed and the maximum detected value is used for comparison with the CULs.

Comparisons of quantified COC results against the CULs for the waste site are summarized in appropriate tables. Comparison to statistical contaminant concentrations and comparisons to focused sampling results are presented in separate tables. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Ecology Cleanup Levels and Risk Calculations database or other reference databases for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered COCs and are not included in tables for comparison to CULs even though results for these constituents are routinely provided by the laboratories. Where asbestos is identified as a site COC, verification of cleanup completion may be based on visual identification of no residual asbestos-containing material by a certified asbestos inspector and should be described in the CVP.

Contaminants of concern were selected in the 100-F/IU Area ROD based upon the *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (DOE/RL-2010-98), which included a risk assessment. In the event that contaminants are discovered during remediation for which cleanup levels were not established in the ROD, the information will be presented to the U.S. Department of Energy and EPA project managers for determination of a path forward.

Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 may be detected in waste site samples, but are excluded from evaluation in these tables because these isotopes are not related to the operational history of the Hanford Site. The thorium and radium detected in environmental samples are associated with background quantities of uranium naturally present in soil.

The laboratory-reported data results for all constituents are stored in a project-specific database prior to archival in HEIS and are included as an attachment to the 95% UCL calculation.

B4.8 Verification Sample Data Evaluation

This section describes the evaluation of the sampling data in terms of comparison to the CULs, the radionuclide risk requirements, and the nonradionuclide risk requirements. Ideally, evaluation of the results listed in the tables reporting the sample results indicates that all COCs were quantified below CULs. In this case, residual concentrations of site COCs are protective in relation to the requirements for direct exposure and groundwater and river protection.

B4.8.1 Comparison of Sample Data to the CULs

Typically, evaluation of the results from verification sampling at a waste site against the CULs in Appendix C, Table C-1 will indicate that all COCs are quantified below the CULs. Exceedance of cleanup levels for direct exposure or groundwater and river protection would trigger additional cleanup, a site-specific risk analysis, or other evaluation based on the likelihood of a threat to human health. Soil CULs selected to be protective of groundwater and the river were calculated as described in Section 8.2 of the 100-F/IU Area ROD (EPA 2014). This included an assumed groundwater recharge rate of 72 mm/yr, representing an irrigated condition.

Per the Model Toxics Control Act (MTCA) Cleanup Regulation (Ecology 2007), WAC 173-340-708(8), compliance with cleanup levels for mixtures of carcinogenic polycyclic aromatic hydrocarbons (carcinogenic PAHs) is determined by considering mixtures of carcinogenic PAHs as a single hazardous substance and using the cleanup levels established for benzo(a)pyrene as the cleanup level for mixtures of carcinogenic PAHs. Statistical values representing the PAH COC concentrations for each decision unit are determined per the guidelines in Section B.4.6, or the maximum result is used for focused samples. The selected value for each PAH is multiplied by the corresponding toxicity equivalency factor as shown in Table B-3b to obtain the toxic equivalent concentration of benzo(a)pyrene for that carcinogenic PAH. The toxic equivalent concentrations of all the carcinogenic PAHs are added to obtain the total toxic equivalent concentration of benzo(a)pyrene for the decision unit. This value is compared against the cleanup level for benzo(a)pyrene from Table C-1 to determine compliance. The result of the determination of the total toxic equivalent concentration of benzo(a)pyrene is shown in Table B-3a and is included in Table B-3b.

Table B-3a. Toxic Equivalent Concentrations of Benzo(a)Pyrene [a]

Carcinogenic Polyaromatic Hydrocarbons	Maximum or Statistical Result (mg/kg)	Toxic Equivalency Factors (Unitless)	Toxic Equivalency BAP Concentration mg/kg
Benzo[a]pyrene	*0.005*	1	*0.005*
Benzo[a]anthracene	*0.005*	0.1	*0.0005*
Benzo[b]fluoranthene	*0.004*	0.1	*0.0004*
Benzo[k]fluoranthene	*0.0076*	0.1	*0.00076*
Chrysene	*0.06*	0.01	*0.0006*
Dibenz[a,h]anthracene	*0.024*	0.1	*0.0024*
Indeno[1,2,3-cd]pyrene	*0.04*	0.1	*0.004*
Total Toxic Equivalency Concentration of Benzo(a)pyrene			*0.01366*

a From WAC 173-340-708(8)(e), Table 708-2 (Ecology 2007)

BAP = benzo(a)pyrene

An example table showing the comparison of the statistical or maximum results as determined in the 95% UCL calculation to the direct exposure cleanup levels and groundwater and river protection cleanup levels is shown in Table B-3b. Ecological risk evaluations have concluded that remedial actions that achieve CULs to protect human health are also protective of ecological receptors, as described in Section 2.4.4 of the RDR/RAWP. No further evaluation or screening of potential ecological risk is performed in CVPs.

Table B-3b. Example Comparison of Statistical Contaminant of Concern Concentrations to Cleanup Levels[a]

COC	Maximum or Statistical Result [b] (pCi/g)	Radionuclide Shallow Zone CULs (pCi/g)	Radionuclide Groundwater and River Protection CULs (pCi/g)	Does the Statistical Result Exceed CULs? [c]
Example Residential Results:				
Cesium-137	*0.036*	*4.4*	*NA*	*No*
Strontium-90	*0.49*	*2.3*	*NA*	*No*
COC	**Maximum or Statistical Result[b] (mg/kg)**	**Nonradionuclide Direct Exposure CULs (mg/kg)**	**Nonradionuclide Groundwater and River Protection CULs (mg/kg)**	**Does the Statistical Result Exceed CULs?[c]**
Example Residential Results:				
Arsenic	*3.5 (<BG)*	*20*	*20*	*No*
Chromium (hexavalent)	*0.6*	*240*	*2.0*	*No*
Mercury	*0.03*	*24*	*NA*	*No*

Table B-3b. Example Comparison of Statistical Contaminant of Concern Concentrations to Cleanup Levels[a]

COC	Maximum or Statistical Result[b] (mg/kg)	Nonradionuclide Direct Exposure CULs (mg/kg)	Nonradionuclide Groundwater and River Protection CULs (mg/kg)	Does the Statistical Result Exceed CULs?[c]
Benzo(a)pyrene TEC	*0.01366*[d]	*0.14*	*NA*	*No*

Example Footnotes:

a CULs obtained from Appendix C, Table C-1 of this document.

b Background (BG) values are available from ECF-HANFORD-11-0038, *Soil Background for Interim Use at the Hanford Site*.

c Under the 100-F/IU Area ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

d Evaluation of the compliance of benzo(a)pyrene with cleanup levels includes the toxic equivalency concentrations of the carcinogenic PAHs in Tables 2-1 and B-3a.

BG = background
CUL = cleanup level
COC = contaminant of concern
NA = not available; no cleanup level calculated
RDL = required detection limit
TEC = toxic equivalency concentration
WAC = *Washington Administrative Code*

While not identified as COCs, the analytes in Table B-3c were detected above background levels in the example cleanup verification samples. These detections were below risk-based cleanup levels calculated during development of the 100-F/IU Area ROD. Therefore, these constituents do not warrant consideration as COCs. Data for all analytes are included in the appendices.

Table B-3c. Example Detected Waste Site Analytes Not Identified as COCs

Anthracene	Dibenz(a,h)anthracene	Nickel
Benzo(a)anthracene	Phenanthrene	Zinc
Benzo(b)fluoranthene	Copper	

B4.8.2 Evaluation of Attainment of Radionuclide and Nonradionuclide Risk Requirements

This section discusses how the verification sampling data are used in demonstrating attainment of radionuclide and nonradionuclide risk requirements.

B4.8.2.1 Radionuclide Evaluation of Risk and Dose

In addition to meeting the radionuclide CULs of Table C-1, the residual soil radionuclide activities must also meet the risk and radiological dose standards of 40 CFR 300 for direct exposure and 40 *Code of Federal Regulations* (CFR) 141 for protection of groundwater. The individual radionuclide cleanup verification statistical or focused data values may be entered into the RESidual RADioactivity (RESRAD) computer code (current version 6.5 [ANL 2009]) to predict the direct exposure cancer risk and the impact on groundwater and the river from residual radionuclide activities. General RESRAD input parameters for evaluation of carcinogenic risk per the 100-F/IU ROD are presented in Appendix C. Separate RESRAD runs are performed for separate decision units of a waste site area (e.g., the excavation footprint, overburden, and staging pile areas). Per Section 7.1.2 of the 100-F/IU Area ROD, the cancer risk limit for

soil radionuclide CULs was set at a $1x10^{-4}$ risk limit or 15 mrem/yr for isotopes where the latter is more conservative. Soil radionuclide CULs must also meet the multi-contaminant total cancer risk limit of $1x10^{-4}$.

The "National Oil and Hazardous Substances Pollution Contingency Plan" (40 CFR 300.430) establishes that CERCLA cleanups should generally achieve a level of residual risk of 10^{-4} to 10^{-6}. However, EPA guidance states that the upper boundary of the risk range is not a discrete line at 10^{-4} and a specific risk estimate around 10^{-4} may be considered acceptable, if justified based on site-specific conditions. If this circumstance occurs appropriate discussion shall be presented in the CVP. The results of the RESRAD radionuclide cancer risk predictions for the all-pathways scenarios for the units of the waste site area are typically presented as excess lifetime cancer risk (ELCR) versus time (years). These ELCR determinations represent the cancer risk contributions from soils at relevant time periods. Because of radioactive decay, the risk usually decreases over time and the maximum predicted ELCR occurs at the present time. However, there may be instances where radionuclides decay to more radioactive daughter products causing risk to increase over time. All ELCR predictions must be less than the individual and total cancer risk limit of $1x10^{-4}$ to meet the CULs. The RESRAD computations are shown in detail in calculation briefs presented in an appendix to the CVP. A figure may be provided to illustrate excess lifetime cancer risk as predicted using the RESRAD model.

Alternatively, for waste sites with few radionuclide COCs at concentrations well below the individual radionuclide CULs, Table B-4 provides a typical comparison of the shallow zone (including overburden) radionuclide cleanup verification statistically quantified values to direct exposure single radionuclide $1x10^{-4}$ cancer risk values using a sum of fractions evaluation. The columns on the left side of Table B-4 are the COCs and the statistical values, corrected for background, as appropriate. Uranium background is subtracted from the analyses for all soil samples but background for other radionuclides is only subtracted from the overburden soil analysis. This accounts for anthropogenic and naturally occurring radionuclide background in surface soils. Only uranium background concentrations are accounted for in shallow and deep zone soils by subtracting uranium isotope concentrations from the statistical values or maximum values. The fourth column presents the single radionuclide $1x10^{-4}$ cancer risk equivalence activity, and the last two columns present the statistical values divided by the cancer risk equivalence activity. In the Table B-4 example, the total predicted radionuclide cancer risk based on sum-of-fractions determination is less than $1x10^{-4}$ so no further evaluation is necessary. However, if the sum-of-fractions determination is greater than $1x10^{-4}$, further evaluation using RESRAD with site-specific input parameters or further cleanup is necessary.

Table B-4. Example Sum-of-Fractions Evaluation of Radionuclide Direct Exposure Risk

COCs	Statistical Values (pCi/g)		Activity Equivalent to $1x10^{-4}$ cancer risk [a] (pCi/g)	Fraction	
	Shallow Zone	Overburden		Shallow Zone	Overburden
Example Results:					
Cesium-137	0.044 (ND)	0 (<BG) (ND)	4.4	0.010	0
Cobalt-60	0.047 (ND)	0.049 (ND)	1.4	0.034	0.035
Europium-152	0.100 (ND)	0.15 (ND)	3.3	0.030	0.045
Europium-154	0.14 (ND)	0.14 (ND)	3	0.047	0.047
Sum of Fractions				0.121	0.127

Table B-4. Example Sum-of-Fractions Evaluation of Radionuclide Direct Exposure Risk

COCs	Statistical Values (pCi/g)		Activity Equivalent to $1x10^{-4}$ cancer risk [a] (pCi/g)	Fraction	
	Shallow Zone	Overburden		Shallow Zone	Overburden
Cancer Risk				$1.21 x10^{-5}$	$1.27 x10^{-5}$

Example Footnotes:

a Single radionuclide $1x10^{-4}$ cancer risk equivalence values are presented in Table C-1 of Appendix C and in Table 5 of the 100-F/IU Area ROD (EPA 2014).

COC = contaminant of concern

ND = not detected (in all samples in the data set)

B4.8.2.2 Nonradionuclides Evaluation of Risk Standards

The comparison tables, using Table B-3b as an example, provide a comparison of the nonradionuclide cleanup verification maximum or statistical values to the direct exposure, groundwater protection, and river protection CULs.

Attainment of Nonradionuclide Noncarcinogenic and Carcinogenic Risk Standards

For COCs with noncarcinogenic effects, WAC 173-340 specifies the evaluation of the hazard quotient, which is given as daily intake divided by a reference dose (WAC 173-340-200). Hazard quotients for individual noncarcinogenic nonradionuclides for residential land use are calculated by rearranging Equation 740-1 of WAC 173-340 (2007) as shown in Table C-2a. Similarly, the cancer risks for individual carcinogenic nonradionuclides for residential land use are calculated by rearranging Equation 740-2 of WAC 173-340 (2007), as shown in Table C-2b.

Calculation and application of hazard quotient and cancer risk under WAC 173-340 (2007) is discussed further in Table C-2 of Appendix C. Values for the reference doses (RfDs) and cancer potency factors (CPFs) for use in calculating the hazard quotient and cancer risk are provided in Table C-3.

Individual hazard quotients and the sum of individual hazard quotients for a waste site must be less than 1.0. For cumulative carcinogenic COCs, the cumulative excess cancer risk must be less than $1x10^{-5}$. For multiple carcinogenic COCs, the risks of the individual COCs (described above) are summed. If no risk associated with a single COC exceeds $1x10^{-6}$ for residential land use, and if the sum of the individual COC risk values do not exceed $1x10^{-5}$, then the carcinogenic risk requirements have been met.

Typically, the results of evaluation of the attainment of noncarcinogenic and carcinogenic individual and cumulative risk standards are presented in a calculation brief that is included in an appendix to the CVP.

Site-Specific Evaluation of Attainment of Nonradionuclide Noncarcinogenic and Carcinogenic Risk Standards

For instances where the conservative approach does not result in a determination that the sum of individual noncarcinogenic hazard quotients is less than 1.0 or that the individual or cumulative carcinogenic risks are less than $1x10^{-6}$ and $1x10^{-5}$, respectively, site-specific risk evaluations may be performed. The noncarcinogenic hazard quotient calculation may use an occupancy factor in Equations 740-1 and 740-2 from WAC 173-340-740(3) to account for the amount of time individuals may

actually spend on a waste site. For small waste sites (less than 1,000 m^2), a site-specific calculation may be performed utilizing an area factor to account for the size of the waste site and, hence, the daily intake.

B4.8.3 Groundwater Cleanup Levels Attained

The groundwater CULs are applicable to all decision units (e.g., shallow zone, deep zone, and overburden). Soil CULs for radionuclides and nonradionuclides for the protection of groundwater and the river are summarized in Table C-1 of Appendix C. These were calculated during development of the 100-F/IU Area ROD (EPA 2014) based on site-specific data and specific parameters using the STOMP (Subsurface Transport Over Multiple Phases) code. Exceedance of cleanup levels for groundwater and river protection is expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

B4.8.3.1 Radionuclide Groundwater Cleanup Levels Attained

Attainment of soil cleanup levels for protection of groundwater is determined by comparison to Table C-1 standards. If radionuclide soil cleanup levels for protection of groundwater in Table C-1 are exceeded, it is appropriate to perform a site-specific RESRAD evaluation as described in Section C.5.2 of Appendix C to determine if residual soil concentrations may actually be protective of groundwater. Comparison of peak radionuclide concentrations predicted by a site-specific RESRAD evaluation against the groundwater CULs is presented in a table similar to Table B-5.

Table B-5. Example RESRAD Predicted Peak Radionuclide Groundwater Concentrations Compared to Cleanup Levels

Radionuclide	Peak Concentration (pCi/L)	CUL (pCi/L)	CULs Attained? (Yes/No)
Example Language:			
Tritium	*18,500*	*20,000*	*Yes*

Example Footnotes:

CUL = cleanup level

B4.8.3.2 Nonradionuclide Groundwater Protection Cleanup Levels Attained

Comparison table(s), such as Table B-3b, provide a tool for evaluation of the nonradionuclide cleanup verification data against the groundwater and river protection CULs. Soil CULs protective of groundwater and the river were calculated as described in Section 8.2 of the 100-F/IU Area ROD (EPA 2014). Parameters specific to a residential land-use scenario were used in the STOMP model to perform these calculations. Under the 100-F/IU ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection would trigger additional evaluation based on risk to human health that could induce additional cleanup, a site-specific risk analysis, or other actions.

B4.9 Data Quality Assessment Process

The data quality assessment (DQA) has been integrated into the CVP and is presented here as a subsection. The DQA is very briefly summarized in the body of the CVP, with the detailed DQA (as represented in the following sections) placed in an appendix to the CVP. The DQA process involves evaluation of data to determine if the data are of the right type, quality, and quantity to support the

intended use (EPA 2000). The DQA process completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objective process.

The DQA process is not intended to be a definitive analysis of a project or problem, but instead provides an assessment of the reasonableness of the data that have been generated (EPA 2000). The DQA focuses on the laboratory data, statistical error tolerances, and the overall data quality objectives, specifically by addressing the question, "Are the data of the right type, quality, and quantity to support their intended use?" The intended use of the data is to make the appropriate decision regarding whether the site meets the RAOs as defined by the CULs. The site closeout or cleanup decision rules are the CULs. Completion of a CVP following this guidance inherently is the functional equivalent of performing a DQA for a waste site.

The DQA need not be performed on field screening data if the field screening data are not used in decisions regarding the rejection of the null hypothesis (a decision that the site is "clean"). Therefore, field decisions that the site is "dirty" will be made based on the field screening data with the understanding that the decision to remediate a site determined to be contaminated based on field readings may not be within error tolerances. This is a project risk management decision and is deemed as an acceptable risk by project decision makers.

After sampling is completed, sample data packages are validated, including review of the following items, as appropriate, for each analytical method:

- Sample holding times
- Method blanks
- Matrix spike recovery
- Surrogate recovery
- Matrix spike/matrix spike duplicate results
- Sample replicates
- Associated batch laboratory control sample results
- Data package completeness.

For CVPs and related documents (e.g., leachability study reports, data summary reports), all laboratory-applied "J" flags on radionuclide results will be deleted. A footnote will be included in the radionuclide data summary tables indicating that, because of laboratory reporting conventions, these results may have a nonrelevant "J" qualifier in the HEIS database and/or in the analytical report.

Where the "J" qualifier is applied through the validation process, the qualifier will not be deleted and the traditional "estimated" footnote will be presented. The footnote will also direct the reader to the DQA section of the document. The DQA section provides additional discussion regarding the reasons why the "J" qualifier was applied during validation and also discusses the usability of the data.

Data qualified as not detected (i.e., "U") indicate that the appropriate analysis was performed but that the analyte was not detected. The concentration associated with "U" qualified data represents the practical quantitation limit (PQL). The analyte may or may not exist in the sample at concentrations below the PQL.

Data qualified as rejected (i.e., "R") indicate that the data are not useable due to a major quality assurance/quality control deficiency. All other qualified results are considered accurate within the standard errors associated with environmental samples and the individual analytical methods performed.

The adequacy of laboratory quality assurance/quality control is evaluated as a subset of the PARCC parameters (i.e., precision, accuracy, representativeness, completeness, and comparability) in the 100 Area SAP (DOE/RL-2014-49). This evaluation is presented in a validation report that is prepared by a third-party contractor, who determines whether the laboratory met the required target detection limits of precision, accuracy, and completeness.

Reported analytical detection levels are compared to the specified detection limits in the 100 Area SAP (DOE/RL-2014-49). The data validation notes any analyses in which the PQL or minimal detectable activity was above the SAP-specified required quantitation limits (RQLs). The RQLs are based on optimal conditions. Interferences and different matrices may significantly affect the PQLs. Practical quantitation limits that exceed the specified RQLs do not necessarily invalidate the data for decision-making purposes; however, the exceedances need to be evaluated on a case-by-case basis within the DQA.

An evaluation of the matrix spike/matrix spike duplicate samples and the associated percent recoveries and relative percent differences is also performed. Acceptable limits are presented in the 100 Area SAP (DOE/RL-2014-49). However, it should be noted that the matrices of environmental samples are not homogenous. The natural heterogeneities in the matrices can cause significant variability in the percent recovery and relative percent difference calculations, which can exceed the limits presented in the SAP. Exceedances observed in the data set need to be evaluated on a case-by-case basis to determine if there is any indication that the analytical system or methodology is at fault.

B4.10 Summary for Waste Site Reclassification

The purpose of this section is to provide a statement that the given waste site has been evaluated in accordance with the 100-F/IU Area ROD and that the results of the verification sampling support a reclassification (in accordance with the TPA-MP-14 process [RL-TPA-90-0001]) of the given waste site to “final closed out” or “final no action.”

When field screening or sampling results indicate that residual concentrations of contaminants at the site meet the CULs for direct exposure, groundwater protection, and river protection without remediation, “final no action" is the appropriate reclassification status. Per the conceptual site model, waste site contamination does not extend into deep zone soils if it is not found in the shallow zone. Hence, sampling activities are normally not required for deep zone soils, and institutional controls to prevent uncontrolled drilling or excavation into the deep zone are generally not required.

When a waste site has been remediated in accordance with the 100-F/IU Area ROD or other decision documents, this is stated and the applicable version of the RDR/RAWP is cited. The amount of material for disposal at the Environmental Restoration Disposal Facility is noted for a general sense of magnitude. Sampling conducted to verify the completeness of remediation is briefly discussed and analytical results for the waste site shown to meet the cleanup objectives for direct exposure and groundwater and river protection are noted. Accordingly, it is stated that waste site reclassification to "final closed out" is supported for the waste site. The maximum depth of the waste site excavation area is identified as necessary to describe potential deep zone considerations and the possible need for institutional controls to prevent future intrusion into deep zone contamination. However, if deep zone areas can be demonstrated to meet the more restrictive shallow zone cleanup criteria, then institutional controls to prevent uncontrolled drilling or excavation into the deep zone may not be required.

B5. References

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40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," *Code of Federal Regulations*, as amended.

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Appendix C

Development of Cleanup Levels and Summary of RESRAD Methodology

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C1. Introduction

As described in the *Record of Decision for the Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU Area ROD) (EPA 2014), cleanup levels (CULs) have been developed for each media and/or exposure pathway to provide protection of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs).

Soil CULs for contaminants of concern (COCs) were developed based on direct human contact as well as groundwater and surface water protection and are summarized in Tables 5 and 6 of the 100-F/IU Area ROD (EPA 2014). Cleanup levels from this ROD are summarized in Table C-1 of this appendix. These CULs apply to soil and engineered structures that include pipelines and debris. The CULs do not apply to chemicals that are an integral part of manufactured structures, and site-specific consideration may be given for applying CULs to sediment/scales within pipelines or other structures. The need for remedial action is based on the existence of soil contamination. Direct contact CULs for nonradionuclides are based on current Washington State Department of Ecology 2007 standards at *Washington Administrative Code* (WAC) 173-340. The direct contact soil CULs for radionuclides were set at either the risk-based level of $1x10^{-4}$ cancer risk or the radiation dose limit of 15 mrem/yr that was used in the interim action RODs, whichever is lower.

The objective of this appendix is to document the development of CULs for nonradionuclide and radionuclide COCs that are protective of human health and the environment. Impacts to human health are addressed by evaluation of direct contact/exposure and groundwater/Columbia River pathways. The CULs for comparison against residual soil contamination concentrations and evaluation of site risk are contained in the 100-F/IU Area ROD (EPA 2014) based on development during the *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU Area RI/FS) (DOE/RL-2010-98) and are summarized in the following sections.

Cleanup levels are developed for waste site COCs to attain acceptable levels of human health risk and to protect groundwater and the Columbia River. Because of uncertainty with the nature and extent of contamination, the CULs are evaluated as if exposure comes from individual constituents and CULs are set at acceptable risk levels for exposure to individual constituents. For sites with multiple residual contaminants, risks from individual contaminants will be added and evaluated to ensure that the waste site meets total risk limits as specified in the 100-F/IU Area ROD (EPA 2014). When a groundwater protection cleanup level is exceeded, site-specific information will be evaluated to determine if remediation has achieved the remedial action objectives of the 100-F/IU Area ROD.

C2. Nonradionuclide Cleanup Levels

Numeric CULs, expressed in terms of concentration (mg/kg), were developed for 100-F/IU Area nonradionuclide COCs using the version of WAC 173-340 (Ecology 2007) that was in effect at the time the 100-F/IU Area ROD (EPA 2014) was approved. Soil residential CULs for nonradionuclides were calculated using the WAC 173-340-740 chemical standards for unrestricted use for all COCs using a hazard index of one and a cancer risk of $1x10^{-6}$.

Table C-1. Soil Cleanup Level Summary from the 100-F/IU Area Record of Decision

Contaminant	Direct Exposure	Protection of Groundwater and the River			Source [a]
		100-FR-1 & 100-FR-2	100-IU-2	100-IU-6	
Radionuclides	**(pCi/g)**	**(pCi/g)**	**(pCi/g)**	**(pCi/g)**	
Cesium-137	4.4	--	--	--	ROD
Cobalt-60	1.4	--	--	--	ROD
Europium-152	3.3	--	--	--	ROD
Europium-154	3.0	--	--	--	ROD
Nickel-63	608	--	--	--	ROD
Strontium-90	2.3	24,600	64,200	104,000	ROD
Metals	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Arsenic	20	--	--	--	ROD
Chromium VI	240	2.0	2.0	2.0	ROD
Lead	250	--	--	--	ROD
Mercury	24	--	--	--	ROD
Inorganics and TPH	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Nitrate	568,000	1,790	6,360	11,300	ROD
TPH – Diesel Range	2,000	2,000	2,000	2,000	ROD
TPH – Motor Oil	2,000	2,000	2,000	2,000	ROD
Organic Compounds	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	
Benzo(a)pyrene	0.14	--	--	--	ROD
PCB Aroclor-1254	0.5	--	--	--	ROD
PCB Aroclor-1260	0.5	--	--	--	ROD

-- = Not available; no CUL calculated (contaminant is not predicted to reach groundwater).

a Cleanup levels in this table are obtained from Section 8.2 of the 100-F/IU Area ROD. Geotechnical parameters specific to the area associated with different operable units were used in STOMP modeling calculations. Under the 100-F/IU Area ROD, exceedance of cleanup levels for direct exposure or groundwater and river protection are expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions.

CUL = cleanup level
PCB = polychlorinated biphenyl
ROD = Record of Decision
STOMP = Subsurface Transport Over Multiple Phases
TPH = total petroleum hydrocarbons

The direct exposure cleanup levels tabulated in Table C-1 apply to the upper 4.6 m (15 ft) of the soil column per WAC 173-340-740(6)(d) and represent concentrations for individual COCs that will be protective of human health from direct contact with contaminated waste for a residential land-use scenario. WAC 173-340 also specifies the evaluation of hazard quotients and excess carcinogenic risk. These parameters can be derived by rearranging Equations 740-1 and 740-2 of WAC 173-340, as shown in Tables C-2a and C-2b, respectively. Values for the reference doses (RfDs) and cancer potency factors (CPFs) that were in use at the time the 100-F/IU Area ROD (EPA 2014) was approved are provided in Table C-3. Institutional controls to prevent deep excavation or well drilling will be considered if the applicable direct exposure CULs are not attained in the soil below 4.6 m (15 ft) in depth.

C3. Groundwater and River Protection Cleanup Levels for Radionuclide and Nonradionuclide Contaminants In Soil

Soil CULs for radionuclide and nonradionuclide COCs for the protection of groundwater and surface water are summarized in Table C-1. These were calculated as described in the 100-F/IU Area ROD (EPA 2014) based on site-specific data and specific parameters using the STOMP (Subsurface Transport Over Multiple Phases) code with a one-dimensional model for all contaminants. For highly mobile contaminants (retardation coefficient <2), the model assumes the entire vadose zone from ground surface to groundwater is contaminated. For less mobile contaminants (retardation coefficient ≥ 2), the model assumes the top 70% is contaminated and the bottom 30% is not contaminated. A groundwater recharge rate of approximately 72 mm/yr was used, representing an irrigated condition. Based on this model, no soil CUL for groundwater or river protection is calculated for some contaminants because the contaminant is calculated to not reach the groundwater within 1,000 years.

Exceedance of cleanup levels for groundwater and river protection is expected to seldom occur but would trigger evaluation based on the likelihood of a threat to human health that could include additional cleanup, a site-specific risk analysis, or other actions. Site-specific evaluation of the attainment of National Primary Drinking Water Standards for radionuclides is described in Section C5.2 of this appendix.

C4. Radionuclide Cleanup Levels

Cleanup levels for radionuclide COCs are summarized in Table C-1 of this appendix. Soil radionuclide cleanup levels are based upon determinations of individual radionuclide activities that will be protective of a direct exposure carcinogenic risk limit of $1x10^{-4}$, or a 15 mrem/yr radiological dose limit for isotopes where that is more conservative. The RESidual RADioactivity (RESRAD) model was selected by the Tri-Parties as the radionuclide risk and dose assessment model for generating CULs for radionuclide contaminants in soil and for verifying that concentrations remaining after remedial action achieve cleanup levels to meet the cumulative carcinogenic risk limit of $1x10^{-4}$. The RESRAD model was developed by Argonne National Laboratory (ANL 2001, 2009) to implement U.S. Department of Energy (DOE) guidelines for residual radioactive material in soil. The most current version of RESRAD will be used for conducting radionuclide risk assessments.

Table C-2a. Parameters for Hazard Quotient for Residential Land Use

Rearrange Equation 740-1 of WAC 173-340 (2007)		
Hazard Quotient = (Concentration)*(SIR*AB1*EF*ED)/(RfD*ABW*UCF*AT)		
Hazard Quotient = (Concentration)*(Daily Intake Factor)/(RfD)		
Variable	Value	Description
SIR	200	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	1	unitless, Exposure Frequency
ED	6	years, Exposure Duration
ABW	16	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	6	years, Averaging Time
RfD	(Variable)	Chemical Specific Reference Dose
Daily Intake Factor =	**1.25E-05**	**per day**

Table C-2b. Parameters for Excess Cancer Risk for Residential Land Use

Rearrange Equation 740-2 of WAC 173-340 (2007)		
Cancer Risk = (Concentration)*(CPF*SIR*AB1*EF*ED)/(ABW*UCF*AT)		
Cancer Risk = (Concentration)*(Daily Intake Factor)*(CPF)		
Variable	Value	Description
SIR	200	mg/day, Soil Ingestion rate
AB1	1	unitless, Gastrointestinal absorption rate
EF	1	unitless, Exposure Frequency
ED	6	years, Exposure Duration
ABW	16	kg, Body weight (average)
UCF	1,000,000	mg/kg, Units conversion factor
AT	75	years, Averaging Time
CPF	(Variable)	Chemical Specific Cancer Potency Factor
Daily Intake Factor =	**1.00E-06**	**per day**

Table C-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] (mg/kg-day)$^{-1}$
Metals			
Antimony	0.13	4.00E-04	--
Arsenic	6.5	3.00E-04	1.50E+00
Barium	132	2.00E-01	--
Beryllium	1.51	2.00E-03	--
Boron	3.9	2.00E-01	--
Cadmium	0.563	1.00E-01	--
Chromium, total	19	1.50E+00	--
Chromium VI	--	3.00E-03	--
Cobalt	16	3.00E-04	--
Copper	22	4.00E-02	--
Lead	10	NA	NA
Lithium	13.3	2.00E-03	--
Manganese	512	1.40E-01	--
Mercury	0.013	3.00E-04	--
Molybdenum	0.47	5.00E-03	--
Nickel	19.1	2.00E-02	--
Selenium	0.78	5.00E-03	--
Silver	0.17	5.00E-03	--
Strontium	--	6.00E-01	--
Tin	--	6.00E-01	--
Uranium	3.2	3.00E-03	--
Vanadium	85	5.00E-03	--
Zinc	68	3.00E-01	--
Inorganics			
Chloride	--	NA	NA
Cyanide	--	6.00E-04	--
Fluoride	2.8	6.00E-02	--
Nitrate	52	7.10E+00	--
Nitrite	--	1.00E-01	--

Table C-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] (mg/kg-day)$^{-1}$
Nitrogen in Nitrite and Nitrate	--	1.60E+00	--
Sulfate	--	NA	NA
Volatile Organic Compounds			
Acetone	--	9.00E-01	--
Benzene	--	4.00E-03	5.50E-02
Carbon tetrachloride	--	4.00E-03	7.00E-02
Chloroform	--	1.00E-02	3.10E-02
Dichloroethylene; 1,1- (dichloroethene)	--	5.00E-02	--
Dichloroethylene;1,2-, total	--	9.00E-03	--
Dichloroethylene;1,2-,cis	--	1.00E-02	--
Ethyl Acetate	--	9.00E-01	--
Hexachlorobutadiene	--	1.00E-03	7.80E-02
Hexachloroethane	--	1.00E-03	1.40E-02
Methyl Ethyl Ketone (2-butanone)	--	6.00E-01	--
Methyl Isobutyl Ketone (4-M,2-P)	--	8.00E-02	--
Methylene chloride	--	6.00E-02	7.50E-03
Tetrachloroethene	--	1.00E-02	5.40E-01
Toluene	--	8.00E-02	--
Trichloroethane;1,1,1-	--	2.00E+00	--
Trichloroethylene (Trichloroethene; TCE)	--	--	8.90E-02
Vinyl Chloride	--	3.00E-03	7.20E-01
Xylene	--	2.00E-01	--
Semivolatile Organic Compounds and Polycyclic Aromatic Hydrocarbons			
Acenaphthene	--	6.00E-02	--
Anthracene	--	3.00E-01	--
Benzo(a)anthracene	--	--	7.30E-01
Benzo(a)pyrene	--	--	7.30E+00
Benzo(b)fluoranthene	--	--	7.30E-01
Benzo(k)fluoranthene	--	--	7.30E-01

Table C-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] (mg/kg-day)$^{-1}$
Benzo(g,h,i)perylene	--	NA	NA
Bis(2-chloro-1-methylethyl) ether	--	4.00E-02	7.00E-02
Bis(2-chloroethoxy)methane	--	3.00E-03	--
Bis(2-chloroethyl) ether	--	NA	NA
Bis(2-ethylhexyl) phthalate	--	2.00E-02	1.40E-02
Bromophenylphenyl ether; 4-	--	NA	NA
Butylbenzylphthalate	--	2.00E-01	1.90E-03
Carbazole	--	--	2.00E-02
Chloro-3-methylphenol, 4-	--	1.00E-01	--
Chloroanilene; 4-	--	4.00E-03	2.00E-01
Chloronaphthalene; 2-	--	8.00E-02	--
Chlorophenol, 2-	--	5.00E-03	--
Chrysene	--	--	7.30E-02
Dibenz[a,h]anthracene	--	--	7.30E-01
Dibenzofuran	--	1.00E-03	--
Dichlorobenzene; 1,2-	--	9.00E-02	--
Dichlorobenzene; 1,3-	--	3.00E-02	--
Dichlorobenzene, 1,4-	--	7.00E-02	5.40E-03
Dichlorobenzidine; 3,3-	--	--	4.50E-01
Dichlorophenol; 2,4-	--	3.00E-03	--
Diethylphthalate	--	8.00E-01	--
Dimethylphthalate	--	1.00E+00	--
Dimethylphenol; 2,4-	--	2.00E-03	--
Di-n-butylphthalate	--	1.00E-01	--
Dinitro-2-methylphenol; 4,6-	--	1.00E-04	--
Dinitrophenol; 2,4-	--	2.00E-03	--
Dinitrotoluene, 2,4-	--	2.00E-03	3.10E-01
Dinitrotoluene; 2,6-	--	1.00E-03	--
Ethylene glycol	--	2.00E+00	--
Fluoranthene	--	4.00E-02	--

Table C-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] (mg/kg-day)$^{-1}$
Fluorene	--	4.00E-02	--
Hexachlorobenzene	--	8.00E-04	1.60E+00
Hexachlorobutadiene	--	1.00E-03	7.80E-02
Hexachlorocyclopentadiene	--	6.00E-03	--
Hexachloroethane	--	7.00E-04	4.00E-02
Indeno(1,2,3-cd)pyrene	--	--	7.30E-01
Isophorone	--	2.00E-01	0.00095
Methylnaphthalene, 2-	--	4.00E-03	--
Methylphenol; 2- (cresol;o-)	--	5.00E-02	--
Methylphenol; 4- (cresol;p-)	--	1.00E-01	--
Naphthalene	--	2.00E-02	--
Nitroaniline; 2-	--	1.00E-02	--
Nitroaniline; 3-	--	3.00E-04	2.10E-02
Nitroaniline; 4-	--	4.00E-03	2.00E-02
Nitrobenzene	--	2.00E-03	--
Nitrophenol; 4-	--	8.00E-03	--
Nitrosodi-n-dipropylamine, n-	--	--	7.00E+00
Nitrosodiphenylamine;N-	--	--	4.90E-03
Pentachlorophenol	--	3.00E-02	1.20E-01
Phenol	--	3.00E-01	--
Pyrene	--	3.00E-02	--
Tributyl Phosphate	--	1.00E-02	9.00E-03
Trichlorobenzene, 1,2,4-	--	1.00E-02	2.90E-02
Trichlorophenol; 2,4,5-	--	1.00E-01	--
Trichlorophenol; 2,4,6-	--	1.00E-03	1.10E-02
Pesticides and Polychlorinated Biphenyls			
Aldrin	--	3.00E-05	1.70E+01
BHC, Alpha-	--	8.00E-03	6.30E+00
BHC, beta	--	--	1.80E+00
BHC, gamma (Lindane)	--	3.00E-04	1.10E+00

Table C-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] (mg/kg-day)$^{-1}$
Chlordane	--	5.00E-04	3.50E-01
Dalapon	--	3.00E-02	--
Db; 2,4- [4-(2,4-dichlorophenoxy) butanoic acid]	--	8.0E-03	--
DDD, 4,4'-	--	--	2.40E-01
DDE, 4,4'-	--	--	3.40E-01
DDT, 4,4'-	--	--	3.40E-01
Dicambra	--	3.00E-02	--
Dichlorophenoxyacetic acid; 2,4-	--	1.00E-02	--
Dieldrin	--	5.00E-05	1.60E+01
Dinoseb (DNBP)	--	1.00E-03	--
Endosulfan (I, II, sulfate)	--	6.00E-03	--
Endrin (and ketone, aldehyde)	--	3.00E-04	--
Heptachlor	--	5.00E-04	4.50E+01
Heptachlor epoxide	--	1.30E-05	9.10E+00
Methoxychlor	--	5.00E-03	--
Polychlorinated biphenyls	--	--	2.00E+01
PCB Aroclor 1016	--	7.00E-05	7.00E-02
PCB Aroclor 1221	--	--	2.00E+00
PCB Aroclor 1232	--	--	2.00E+00
PCB Aroclor 1242	--	--	2.00E+00
PCB Aroclor 1248	--	--	2.00E+00
PCB Aroclor 1254	--	2.00E-05	2.00E+00
PCB Aroclor 1260	--	--	2.00E+00
Silvex (tp;2,4,5-)	--	8.00E-03	--
Toxaphene	--	--	1.10E+01
Trichlorophenoxyacetic acid;2,4,5-	--	1.00E-02	--

Table C-3. Oral Reference Dose and Cancer Potency (Slope) Factors

Analyte	90th Percentile Background[a]	Oral Reference Dose (RfD)[b] (mg/kg-day)	Cancer Potency Factor (CPF)[b] (mg/kg-day)$^{-1}$

a Background from ECF-HANFORD-11-0038,2012, *Soil Background for Interim Use at the Hanford Site*, Rev. 0, CH2M HILL Plateau Remediation Company, Richland, Washington.

b Oral reference dose and cancer potency factor values that were in use at the time the 100-F/IU Area ROD (EPA 2014) was approved are from Table G-12 of DOE/RL-2010-98, 2014, *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units, Addendum*.

Single radionuclide soil concentrations corresponding to a carcinogenic risk limit of $1x10^{-4}$ in a rural-residential scenario were calculated using RESRAD version 6.5 (ANL 2009) and the appropriate parameters from the 100-F/IU Area RI/FS report (DOE/RL-2010-98) and ECF-HANFORD-10-0429, *Documentation of Preliminary Remediation Goals (PRGs) for Radionuclides Using the IAROD Exposure Scenario for the 100 and 300 Area Remedial Investigation/Feasibility Study (RI/FS) Report*. Determinations of radionuclide cleanup levels to be protective of human health direct exposure carcinogenic risk are reported in the calculation brief and summarized in Table 5 of the 100-F/IU Area ROD (EPA 2014). These RESRAD input parameters are reproduced in this appendix as Table C-4.

Table C-4. RESRAD Residential Input Parameters for the 100-F/IU Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
Exposure pathways	External Gamma: Inhalation: Plant Ingestion: Meat Ingestion: Milk Ingestion: Aquatic Foods: Drinking Water: Soil Ingestion: Radon:	NA	Active Active Active Active Active Active Active Active Suppressed	DOE/RL-96-17, Rev. 4
R011 – Contaminated Zone (CZ)	Area of CZ [a]	m^2	10,000 [a]	RESRAD default
	Thickness of CZ [a]	m	4.6 [a]	Shallow zone
	Length parallel to aquifer flow [a]	m	100 [a]	Square root of contaminated site area
	Radiation dose limit	mrem/yr	15	DOE/RL-99-40
	Elapsed time since waste placement	yr	0	RESRAD default
R012 – Principal Radionuclide Concentrations	All radionuclide contaminants of concern	pCi/g	Contaminant-specific	

Table C-4. RESRAD Residential Input Parameters for the 100-F/IU Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R013 – Cover and CZ Hydrological Data	Cover depth [a]	m	0	RESRAD default
	Cover material density	g/cm^3	1.6	DOE/RL-99-40
	Cover erosion rate	m/yr	Not Used	No cover
	Density OF CZ	g/cm^3	1.6	DOE/RL-99-40
	CZ erosion rate	m/yr	Not Used	Only used when rate is known
	CZ total porosity	Unitless	0.3	DOE/RL-99-40
	CZ field capacity	Unitless	0.25	DOE/RL-99-40
	CZ hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
	CZ b parameter	Unitless	15	DOE/RL-99-40
	Humidity in air	g/cm^3	8	RESRAD default
	Evapotranspiration coefficient	Unitless	0.91	WDOH/320-015
	Wind speed	m/sec	3.4	PNNL-12087
	Precipitation	m/yr	0.16	DOE/RL-96-17, Rev. 6
	Irrigation rate	m/yr	0.76	DOE/RL-96-17, Rev. 4
	Irrigation mode	NA	Overhead	RESRAD default
	Runoff coefficient	Unitless	0.2	RESRAD default
	Watershed area for nearby stream or pond	m^2	10,000,000	DOE/RL-99-40
	Accuracy for water/soil computations	NA	0.001	RESRAD default
R014 – Saturated Zone (SZ) Hydrological Data	Density of SZ	g/cm^3	1.6	DOE/RL-99-40
	SZ total porosity	Unitless	0.3	DOE/RL-99-40
	SZ effective porosity	Unitless	0.3	DOE/RL-99-40
	SZ hydraulic conductivity	m/yr	673,846	DOE/RL-99-40
	SZ hydraulic gradient	Unitless	0.0005	DOE/RL-99-40
	SZ b parameter	Unitless	3.5	DOE/RL-99-40
	Water table drop rate	m/yr	Not Used	Only used when rate is known
	Well pump intake depth below water table	m	4.6 (15 ft), typical RCRA well screen length	
	Nondispersion (ND) or mass balance (MB)	NA	ND	RESRAD default
	Well pumping rate	m^3/yr	250	RESRAD default
R015 – Uncontaminated and Unsaturated Strata Hydrological Data	Number of unsaturated strata [a]	Unitless	1 [a]	Site-specific
	Thickness [a]	m	5 [a]	Site-specific
	Soil density	g/cm^3	1.6	DOE/RL-99-40
	Total porosity	Unitless	0.3	DOE/RL-99-40
	Effective porosity	Unitless	0.3	DOE/RL-99-40
	Field capacity	Unitless	0.2	RESRAD default
	Soil-specific b parameter	Unitless	15	DOE/RL-99-40
	Hydraulic conductivity	m/yr	0.0022	DOE/RL-99-40
R016 – K_d for Individual Radionuclides	K_d for contaminated zone, uncontaminated zone, and saturated zone	mL/g	Contaminant-specific	DOE/RL-96-17, Rev. 6
	Saturated leach rate	yr^{-1}	Not used	Use Kd values
	Saturated solubility	g/mL	Not used	Use Kd values

Table C-4. RESRAD Residential Input Parameters for the 100-F/IU Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R017 – Inhalation and External Gamma	Inhalation rate	m^3/yr	7,300	WDOH/320-015
	Mass loading for inhalation	g/m^3	0.0001	WDOH/320-015
	Exposure duration	yr	30	RESRAD Default
	Indoor dust filtration factor	Unitless	0.4	RESRAD Default
	External gamma shielding factor	Unitless	0.4	DOE/RL-2010-99
	Indoor time fraction	Unitless	0.6	WDOH/320-015 15 hr/day, 350 days/yr
	Outdoor time fraction	Unitless	0.12	DOE/RL-2010-99 3 hr/day, 350 days/yr
	Shape factor	NA	Circular unless otherwise specified	
R018 – Ingestion Pathway Data, Dietary Parameters	Fruits, vegetables, and grain consumption	kg/yr	110	WDOH/320-015
	Leafy vegetable consumption	kg/yr	2.7	WDOH/320-015
	Milk consumption	L/yr	100	WDOH/320-015
	Meat and poultry consumption	kg/yr	36	WDOH/320-015
	Fish consumption	kg/yr	19.7	WDOH/320-015
	Other seafood consumption	kg/yr	0.9	RESRAD Default
	Soil ingestion	g/yr	73	WDOH/320-015
	Drinking water intake	L/yr	730	WDOH/320-015
	Drinking water contamination fraction	Unitless	1	RESRAD Default
	Household water contamination fraction	Unitless	1	RESRAD Default
	Livestock water contamination fraction	Unitless	1	RESRAD Default
	Irrigation water contamination fraction	Unitless	1	RESRAD Default
	Aquatic food contamination fraction	Unitless	0.5	RESRAD Default
	Plant food contamination fraction	Unitless	-1 [b]	RESRAD Default
	Meat contamination fraction	Unitless	-1 [b]	RESRAD Default
	Milk contamination fraction	Unitless	-1 [b]	RESRAD Default
R019 – Ingestion Pathway Data, Nondietary	Livestock fodder intake for meat	kg/d	68	RESRAD Default
	Livestock fodder intake for milk	kg/d	55	RESRAD Default
	Livestock water intake for meat	L/d	50	RESRAD Default
	Livestock water intake for milk	L/d	160	RESRAD Default
	Livestock intake of soil	kg/d	0.5	RESRAD Default
	Mass loading for foliar deposition	g/m^3	0.0001	RESRAD Default
	Depth of soil mixing layer	m	0.15	RESRAD Default
	Depth of roots	m	0.9	RESRAD Default
	Groundwater fractional usage – drinking water	Unitless	1	RESRAD Default
	Groundwater fractional usage – household	Unitless	1	RESRAD Default
	Groundwater fractional usage – livestock water	Unitless	1	RESRAD Default
	Groundwater usage – irrigation	Unitless	1	RESRAD Default

Table C-4. RESRAD Residential Input Parameters for the 100-F/IU Area

Category	Parameter	Units	User Input, Residential Scenario	Reference
R021 – Radon		NA	Not used	Radon is not a COPC

a The stated numeric values are only used when RESRAD is used to determine generic cleanup levels. Otherwise, site-specific input values for these parameters are determined on a site-by-site basis. All other values are fixed at the values shown unless modified with regulator approval.

b The default value of -1 specifies that the contaminated fraction of this input will be calculated from the appropriate area factor in RESRAD (for a waste site of less than the default of 10,000 m^2 RESRAD calculates and applies an area factor based on the actual waste site area). Setting the default value in this column to zero will turn off the pathways entirely.

COPC = contaminant of potential concern
CZ = contaminated zone
NA = not applicable
ND = nondetect
RCRA = *Resource Conservation and Recovery Act of 1976*
RESRAD = RESidual RADioactivity

C5. Using RESRAD for Waste Site Radionuclide Cleanup Verification

Where more than one radionuclide is detected and radionuclide cleanup levels in Table C-1 are not exceeded, a sum-of-fractions evaluation or a RESRAD evaluation must be performed to determine that the cumulative carcinogenic risk limit of $1x10^{-4}$ is not exceeded. The input parameters and assumptions used in RESRAD to generate the radionuclide direct exposure cleanup levels presented in this remedial design report/remedial action work plan are summarized in Table C-4. For the purpose of site cleanup verification, the RESRAD input values (e.g., the thickness of the contaminated zone, the thickness of the uncontaminated zone, and the size of the waste site) will be determined on a site-specific basis. RESRAD calculates all radionuclides in the decay chain (daughters) in calculating ingrowth and decay. It has not been determined if any daughters were present at the time of waste emplacement, but they would be insignificant dose contributors; therefore, estimated daughters are not included as input.

C5.1 Radionuclide Evaluation of Direct Exposure Risk

For waste sites with few radionuclide COCs, at concentrations all below the individual radionuclide CULs, Table B-5 of Appendix B provides an example comparison of the shallow zone radionuclide cleanup verification data to direct exposure single radionuclide cancer risk values and the cumulative carcinogenic risk limit of $1x10^{-4}$ using a sum-of-fractions evaluation. Typically, this will be sufficient to demonstrate that direct exposure cumulative risk limitations are met. It is not necessary to perform a sum-of-fractions or RESRAD evaluation for a waste site or decision unit if there is only one detected radionuclide or if the residual concentrations of multiple radionuclide COCs are all below background or are less than one-tenth of the single radionuclide soil concentration equivalent to a $1x10^{-4}$ carcinogenic risk calculated by RESRAD.

If the sum-of-fractions evaluation indicates the cumulative carcinogenic risk limit of $1x10^{-4}$ is exceeded, a site-specific RESRAD evaluation should be performed. The general process is to first determine the nature and extent of site-specific residual contamination (concentrations, thickness, and area of actual radionuclide contamination). This information is input to the RESRAD model with the general parameters from Table C-4 to evaluate the direct exposure carcinogenic risk. No cover material is assumed to exist on top of the contaminated shallow zone unless existence of cover is explicitly stated. To perform the calculations, the parameters are entered into the RESRAD data menu, and appropriate times for calculations are selected. Default times of 1, 3, 10, 30, 100, 300, and 1,000 years are used in a

preliminary run to determine the year when the peak risk occurs from each radionuclide COC, pathway, and layer (e.g., shallow zone or deep zone).

The RESRAD software is run and the summary report and graphical output for radionuclide risk are accessed to determine the peak year(s) in 1,000 years. The summary report is accessed by viewing the file "summary.rep" in the RESRAD output. The graphical output for excess cancer risk of radionuclides is accessed by selecting:

Results: Standard Graphics

Type: Risk

Radionuclide: Individual

Pathways: Summed/External

If the peak year of the maximum risk for individual radionuclides indicated in the graphical output is not the same as the year of maximum dose/risk in the "Contaminated Zone and Total Dose Summary" of the summary report, then individual RESRAD runs should be performed for the individual radionuclides to find the individual years of peak dose/risk. The years of peak dose/risk are entered as calculation times in the RESRAD calculation, and the RESRAD software is rerun.

The health risk report ("intrisk/rep") is accessed and the "All Pathways" total risk for each year of the RESRAD evaluation is recorded in an appropriate table. The table is included with other site-specific detailed information in a calculation brief presented in the calculations appendix to the cleanup verification package (CVP). A figure or figures may be provided to illustrate excess lifetime cancer risk as predicted using the RESRAD model.

C5.2 Radionuclide Evaluation for Groundwater Protection

Attainment of soil cleanup levels for protection of groundwater is determined by comparison to Table C-1 standards. If radionuclide soil cleanup levels for protection of groundwater in Table C-1 are exceeded, it is appropriate to perform a site-specific RESRAD evaluation to determine if residual soil concentrations may actually be protective of groundwater. After remediation, residual radioactive and nonradioactive contaminants remaining in soil must be at such levels that concentrations of contaminants that could migrate through the soil column to groundwater do not exceed CULs considered protective of groundwater in Table C-1. Protection of groundwater is intended to achieve CULs derived from maximum contaminant levels (MCLs) promulgated under the federal National Primary Drinking Water Regulations (40 CFR 141).

C5.2.1 Attainment of Radionuclide MCLs

Separate MCLs exist for strontium-90, tritium (H-3), radium-226, and radium-228. The MCLs for strontium-90 and tritium are 8 pCi/L and 20,000 pCi/L, respectively (40 CFR 141.66). The MCL for combined radium-226 and radium-228 is 5 pCi/L (40 CFR 141.66). The MCL for technetium-99 is 900 pCi/L as obtained from the *Soil Screening Guidance for Radionuclides: User's Guide* (EPA 2000). The MCL for total uranium (as uranium metal) is established at 30 µg/L (40 CFR 141.66). The MCL for individual alpha-emitting radionuclides (excluding radon and uranium) is 15 pCi/L (40 CFR 141.66). However, per the STOMP model evaluation of transport to groundwater summarized in Table C-1, no alpha-emitting radionuclides are predicted to migrate to groundwater within 1,000 years, so residual soil concentrations of all alpha-emitting radionuclides are protective of groundwater and surface water.

To predict site-specific groundwater radionuclide activities, risk, and dose based on activities in soil, exposure pathways in the RESRAD input file for external gamma exposure, inhalation, soil ingestion, and radon are suppressed. Pathways for ingestion of plants, meat, milk, aquatic foods, and drinking water are active in the residential scenario. Appropriate site-specific input parameters including contaminated site dimensions and radionuclide activities in soil and their distribution coefficients (K_d values) are entered into the RESRAD data menu and default calculation times of 1, 3, 10, 30, 100, 300, and 1,000 years are used for the initial calculation. The concentration of uranium metal in mg/kg is entered for uranium-238 as pCi/g, and the predicted uranium-238 groundwater concentration (presented as pCi/L in the RESRAD output) is the uranium metal concentration in µg/L. The basic radiation dose limit of 4 mrem/yr is input for groundwater protection.

The RESRAD software is run and the concentration report and graphical output for radionuclides in drinking water are accessed to determine which radionuclides do or do not reach groundwater in 1,000 years. The concentration report is accessed by viewing the file "concent.rep" in the RESRAD output. The graphical output for concentration of radionuclides in drinking water is accessed in the RESRAD version 6.5 Graphics Display (ANL 2009) by selecting:

Type: Concentration

Radionuclide: Individual

Media (Pathways): Drinking Water

If the drinking water concentrations predicted in the concentration report and the graphical output displays zero for the full 1,000 years, the contaminants do not impact groundwater within 1,000 years. Typically, the graphical output may show that strontium-90, technetium-99, and tritium (H-3) are predicted to reach groundwater within 1,000 years. The years of the maximum groundwater concentrations for these radionuclides are obtained from the RESRAD summary report for radiological dose in the RESRAD output table headed "Summed Dose/Source Ratios and Single Radionuclide Soil Guidelines." The year of maximum groundwater concentration for each radionuclide is in the column headed by "tmin, years."

The year of maximum groundwater concentration for each radionuclide from the column headed by "tmin, years" is entered in the calculation times of the RESRAD inputs and the software is rerun. The concentration report and graphical output for radionuclides in drinking water are accessed to determine that the predicted years of maximum groundwater concentration are correct. If the predicted maximum groundwater (well water) concentrations in the concentration report, "concent.rep," for strontium-90, technetium-99, and tritium are less than their respective MCLs of 8 pCi/L, 900 pCi/L, and 20,000 pCi/L (and the predicted uranium-238 groundwater concentration [shown as pCi/L in the RESRAD output but read as µg/L] is less than the uranium metal MCL of 30 µg/L), residual soil concentrations of these constituents are predicted to be protective of groundwater and the river. The findings of the RESRAD evaluation are typically reported in a calculation brief included in the calculations appendix to the waste site CVP. If the groundwater concentrations predicted by RESRAD indicate that COCs impact groundwater, a table is provided in the calculation brief that shows the predicted peak concentration for each detected radionuclide COC and provides the individual MCLs for comparison, as shown in the Table C-5 example.

Table C-5. Example Peak Radionuclide Groundwater Concentrations Compared to Maximum Contaminant Levels

Radionuclide	Groundwater Peak Concentration (pCi/L)	Year of Peak Concentration (years)	Groundwater MCL (pCi/L)
Americium-241	0 [a]	NA	15
Carbon-14	(Site-specific)	(Site-specific)	2,000
Cobalt-60	(Site-specific)	(Site-specific)	100
Cesium-137	(Site-specific)	(Site-specific)	60
Europium-152	0 [a]	NA	200
Europium-154	0 [a]	NA	60
Europium-155	0 [a]	NA	600
Nickel-63	(Site-specific)	(Site-specific)	50
Plutonium-238	0 [a]	NA	15
Plutonium-239/240	0 [a]	NA	15
Strontium-90	(Site-specific)	(Site-specific)	8
Technetium-99	(Site-specific)	(Site-specific)	900
Tritium (H-3)	(Site-specific)	(Site-specific)	20,000

a Per the STOMP model evaluation of transport to groundwater summarized in Table C-1, no alpha-emitting radionuclides are predicted to migrate to groundwater within 1,000 years.

MCL = maximum contaminant level

C5.2.2 Attainment of 4 mrem/yr Drinking Water Radionuclide Dose Rate

The average annual activity of beta particle and photon radioactivity from man-made radionuclides in drinking water shall not produce an annual dose equivalent to the total body or any internal organ greater than 4 mrem/yr, per 40 CFR 141.66. To determine if any organ receives a dose of more than 4 mrem/yr, the dose to each organ is calculated for the radionuclide COCs that are predicted to migrate to groundwater. However, if only one radionuclide is predicted to reach groundwater and this radionuclide attains its MCL as discussed in Section C.5.2.1, it is not necessary to evaluate the attainment of the 4 mrem/yr drinking water dose rate.

An example of a calculation brief to determine attainment of MCLs and the maximum allowable drinking water dose of 4 mrem/yr for beta/gamma emitters can be found in Calculation No. 0100H-CA-V0087. The 4 mrem/yr equivalent concentration for each organ for each radionuclide is determined from the maximum permissible concentrations listed in Table 1 of NBS Handbook 69 (NBS 1963). The factor C4 (i.e., the concentration that will produce a dose of 4 mrem/yr to that organ) is calculated for each organ and radionuclide.

The C4 factors for the COCs are summarized in Table C-6.

Table C-6. Factors for Calculating Radionuclide-Specific Organ Doses Using Methodology Mandated by the Safe Drinking Water Act for Comparison to the 4 mrem/yr Standard for Beta and Gamma Emitters

Radionuclide	Organ	C_4 [a], 4 mrem/yr Equivalent Concentration (pCi/L)
Carbon-14	Total Body	9,000
	Bone	2,000
	Fat	2,000
Cobalt-60	GI(LLI)	100
	Total Body	900
	Liver	3,000
Cesium-137	Bone	80
	GI(LLI)	2,000
	Total Body	200
	Liver	60
Europium-152	Bone	30,000
	GI(LLI)	200
	Total Body	2E+05
	Liver	1E+05
Europium-154	Bone	5,000
	GI(LLI)	60
	Total Body	7E+04
	Liver	6E+04
Europium-155	Bone	1E+05
	GI(LLI)	600
	Total Body	9E+05
	Liver	6E+05
H-3 (Tritium)	Total Body	20,000
Nickel-63	Bone	50
	GI(LLI)	3,000
	Total Body	2,000
	Liver	600
Strontium-90	Bone	8
	GI(LLI)	100
	Total Body	8

a Calculated by methodology given in *National Interim Primary Drinking Water Regulations*, Appendix IV, "Dosimetric Calculations for Man-Made Radioactivity" (EPA 1997).

GI(LLI) = gastrointestinal tract-lower large intestine

The cumulative dose for each organ at time "t" needs to be calculated separately and using a sum-of-fractions equation, as shown in the formula below. If a radionuclide does not have a maximum permissible concentration for the organ of interest, the C4 factor for total body dose is used in the calculation. The calculations performed are documented in the comparison to drinking water standards calculation brief. The organs for which doses need to be computed are total body, bone, gastrointestinal tract-lower large intestine, and liver. The individual organ doses are summed and compared to 4 mrem/yr.

$$\text{Dose}_{\text{organ}}\ x\ (t) = [\text{Conc}A(t)/C4A(x) + \text{Conc}B(t)/C4B(x) + \ldots]\ x\ (4\ \text{mrem/yr})$$

If the total dose for organ "x" is less than 4 mrem/yr, then the standard is met.

A figure may be provided in the CVP that shows the calculated dose to each organ from groundwater. An example of a calculation brief to determine attainment of MCLs and the maximum allowable drinking water dose of 4 mrem/yr for beta/gamma emitters can be found in Calculation No. 0100H-CA-V0087.

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