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DOE/RL-99-59
Draft A

Proposed Plan for the 100 Area Burial Grounds Interim Remedial Action

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For External Review

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DISCLM-4.CHP (1-91)

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Proposed Plan for the 100 Area Burial Grounds Interim Remedial Action

December 1999

United States Department of Energy

P.O. Box 550, Richland, Washington 99352

For External Review

PROPOSED PLAN FOR THE 100 AREA BURIAL GROUNDS INTERIM REMEDIAL ACTION

Hanford Site, Richland, Washington

EPA, ECOLOGY, AND DOE ANNOUNCE PROPOSED PLAN

This **Proposed Plan**[1] identifies the preferred alternative for **interim remedial action** at 45 solid waste burial grounds located in the 100 Area source **operable units** of the Hanford Site. In addition, the Plan includes summaries of other alternatives analyzed for remediation of the burial grounds. The burial grounds were used for near-surface disposal of solid wastes containing primarily radiological **hazardous substances** that were generated during operation of the Hanford Site's nine former plutonium-production reactors. Because of these radioactive hazardous substances, the 100 Area Burial Grounds present a potential threat to human health and the environment.

This Proposed Plan is issued by the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), and the U.S. Department of Energy (DOE). These three agencies are referred to as the Tri-Parties. The *Hanford Federal Facility Agreement and Consent Order*, known as the Tri-Party Agreement, governs cleanup of the Hanford Site and requires that remediation programs at Hanford coordinate the requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA); the *Resource Conservation, and Recovery Act of 1976* (RCRA); and Washington State's dangerous waste program (the State program authorized under RCRA).

The Tri-Party Agreement designates operable units as CERCLA past-practice (CPP) sites or RCRA past-practice (RPP) sites. The burial grounds subject to this Proposed Plan are located within both CPP and RPP operable units. The EPA is the lead regulatory agency for most CPP operable units, and Ecology is the lead regulatory agency for most RPP operable units. The role of the lead regulatory agency is to oversee the activities at an operable unit to ensure that all applicable requirements are met. The DOE is responsible for performing the remedial actions selected for the operable unit.

The Tri-Parties are issuing this Proposed Plan as part of their public participation responsibilities under CERCLA, also known as "Superfund." The Tri-Parties have determined that burial ground remediation can be performed most effectively under CERCLA authority. The DOE is also issuing this Proposed Plan as part of its responsibility under the *National Environmental Policy Act of 1969* (NEPA).

MARK YOUR CALENDAR

This Proposed Plan is being issued by the Tri-Parties. These agencies encourage you to comment during the public comment period on the preferred alternative for the 100 Area Burial Grounds interim remedial action and other alternatives described in this Proposed Plan. Based on new information or public comments, the Tri-Parties may modify the preferred alternative or the remedy selection approach presented in this Proposed Plan.

A 45-day public comment period for this Proposed Plan will be from [redacted] to [redacted] A public hearing on this Proposed Plan is scheduled to be held on [redacted].

Send written comments to:

Dennis Faulk
U.S. Environmental Protection Agency
712 Swift Boulevard, Suite 5
Richland, WA 99352

Comments may also be made via e-mail to faulk.dennis@EPA.gov or by calling the Hanford Cleanup Toll-Free Line at 1-800-321-2008.

The Tri-Parties are proposing as the preferred alternative for the 45 burial ground sites to remove, treat as appropriate, and dispose of wastes at the Environmental Restoration Disposal Facility (ERDF) located on the Hanford Site. The public is requested to comment on the preferred alternative, as well as on the other alternatives presented in this Proposed Plan. Additional details on the alternatives for burial ground remediation can be found in the *100 Area Burial Grounds Focused Feasibility Study,*

[1] Technical terms in bold are defined in the glossary at the end of this document.

(DOE/RL-98-18) and in other documents contained in the Administrative Record for the 100 Areas. This Proposed Plan highlights key information from the **focused feasibility study**. The public is encouraged to review the focused feasibility study to gain a better understanding of the burial grounds and the environmental problems presented. Written comments on this Proposed Plan must be submitted by [redacted] (see box on previous page). Responses to comments will be presented in a responsiveness summary that will be part of the 100 Area Burial Grounds **Record of Decision** (ROD).

SITE BACKGROUND

The Hanford Site (Figure 1) is located in southeastern Washington. For more than 40 years, the Site produced plutonium for the nation's defense program. Nine uranium-fueled, graphite-moderated, water-cooled, plutonium-production reactors were constructed by the U.S. Government along the Columbia River in the 100 Areas of the Hanford Site during the 20-year period from 1943 to 1963. With the exception of the N Reactor (the last reactor constructed), the reactors' operations and the associated wastes and waste disposal practices were similar. Direct land burial in excavated trenches, termed "burial grounds," was used to dispose of solid low-level radioactive materials associated with reactor operations (e.g., equipment and structural debris). Each reactor area (except the 100-N Area) includes burial grounds containing irradiated reactor hardware and other solid waste materials incidental to facility operations, mixed with soil. Each reactor area also has specialty burial grounds, where wastes from reactor alterations or other specific activities (e.g., biological research and facility construction) were disposed. The burial grounds are listed in Table 1 with a general description of the wastes expected with each type of burial ground. Appendix A lists a more complete inventory for individual sites. The locations of the burial grounds are presented in Figures 2 through 6.

During the first 30 years of reactor operations, virtually all of the radioactive wastes were buried in the reactor areas where they were generated. Beginning in 1968, however, increasing amounts of waste were transported to the 200 Areas for disposal. Since 1973, essentially all of the contaminated solid waste generated at the Hanford Site has been stored or buried in the 200 Areas.

Previous investigations at the burial grounds have included borehole sampling at the 118-B-1 Burial Ground in 1978 (*Radiological Characterization of the Retired 100 Areas* [Dorian and Richards, UNI-946]) and test pit sampling at the same site in 1995 (*118-B-1 Burial Ground Excavation Treatability Test Report* [DOE/RL-94-65]). These sampling efforts helped define the nature and extent of contamination associated with the burial grounds. Waste inventory information for the 100 Area Burial Grounds has been summarized in *Estimates of Solid Waste Buried in the 100 Area Burial Grounds* (WHC-EP-0620]).

The 100 Area Burial Ground contents (i.e., contaminated hard waste and associated contaminated soil) could present a direct exposure concern to human health and the environment through intrusion or biotic uptake. With the possible exception of the 118-F-2 Burial Ground, where the bottom of the burial ground is at or near the maximum recorded water table elevation, no releases of contaminants to groundwater have occurred or would be expected to occur. This is due to the lack of sufficient water to act as a soil-to-groundwater driving force and the immobile, insoluble nature of the waste in the 100 Area Burial Grounds.

SITE CHARACTERISTICS

The Hanford Site lies within a semi-arid climate (average annual precipitation of 16 cm) with high evapotranspiration rates and relatively high winds. The 100 Area Burial Grounds and surrounding areas have low ecological or cultural value because they have been disturbed by industrial activities and have little vegetative cover. Public access to the burial grounds is prohibited. Two burial grounds (126-D-2 and 118-F-5) are located within the 400-m-wide strip of land that may be designated under the Federal Wild and Scenic River Act if the Hanford Reach is designated as "wild and scenic."

All of the burial grounds lie within 1.6 km of the Columbia River and are generally out of the reach of the Columbia River's 100-year regulated flood (12,400 m^3/s), with the possible exception of the 118-F-2 Burial Ground. This burial ground may have been wetted by elevated groundwater resulting from the extremely high Columbia River flows in 1997.

Nine other burial grounds lie over or adjacent to reactor effluent pipelines and may be partially or completely excavated with the remedial action activities for the pipelines. These burial grounds are 100-D-5, 100-D-6, 100-D-32, 100-D-46, 118-D-3, 100-K-2, 118-B-2, 118-B-5, and 118-B-10.

Figure 1. Map of the Hanford Site Showing the 100 Areas.

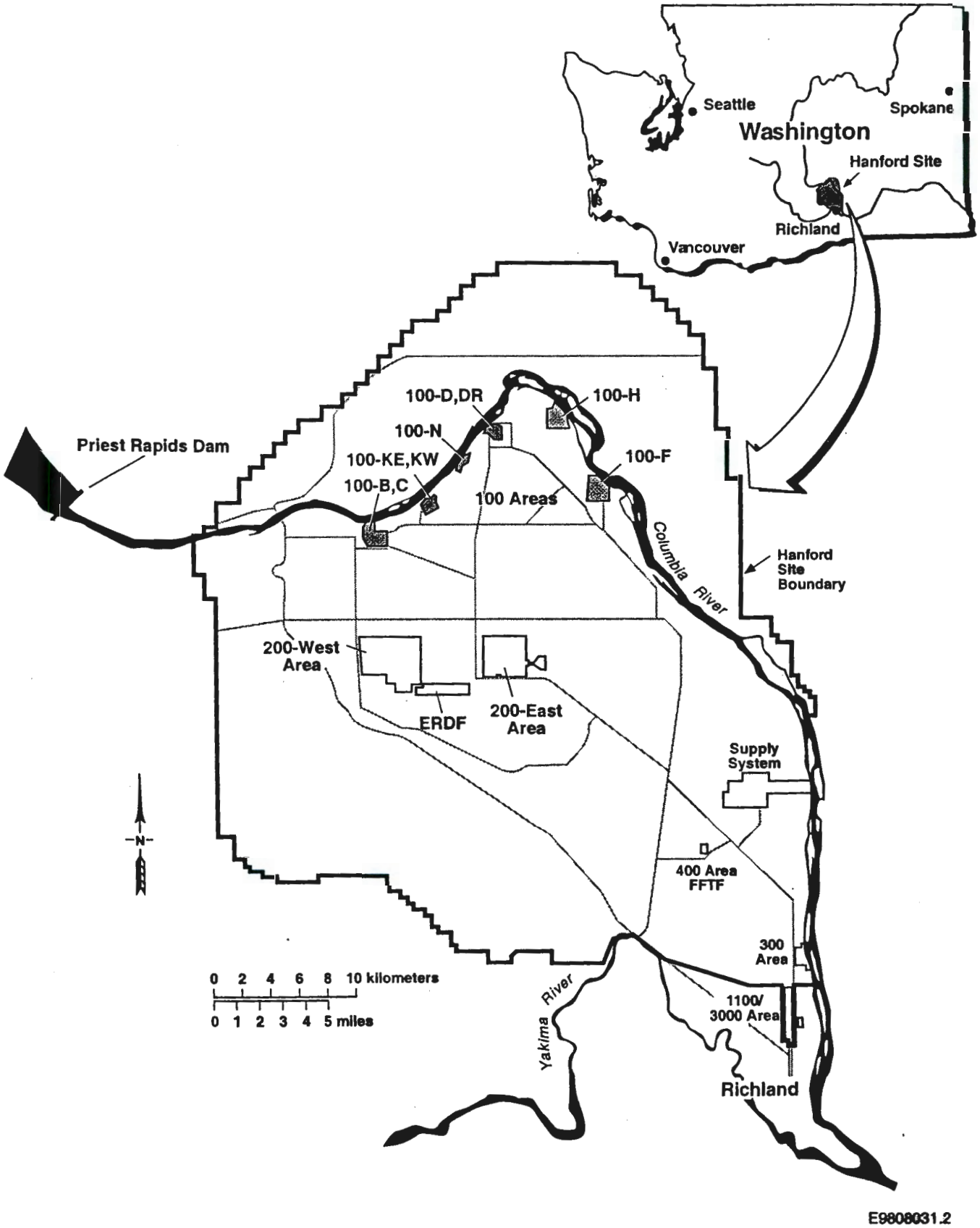


Table 1. Burial Ground Types, Names, and General Potential Waste Descriptions.

Site Type	Site Name	Description of Potential Waste[a]
Primary Solid Waste Burial Grounds (9 total)	118-B-1	Potential contaminants are: tritium (H-3), carbon-14 (C-14), cobalt-60 (Co-60), nickel-63 (Ni-63), strontium-90 (Sr-90), silver-108m (Ag-108m), cesium-137 (Cs-137), europium-152 (Eu-152), europium-154 (Eu-154), cadmium, lead, and mercury. H-3 and C-14 come from broaching and overbore of the channels in the graphite core of the reactor and from disposal of depleted desiccant (silica gel) used to dry the recirculated reactor gases. Co-60 and Ni-63 are present mainly as impurities of aluminum process tubes. Ag-108m is present as an impurity of the lead-cadmium poison pieces. Sr-90, Cs-137, Eu-152, and Eu-154 are present as scaling on the aluminum process tubes. Lead and cadmium are present as lead-cadmium poison pieces, cadmium sheets, and lead bricks. Mercury is present as elemental mercury from failed instruments such as manometers and mercury switches. The 118-F-2 Burial Ground also contains some biological wastes.
	118-C-1	
	118-D-1	
	118-D-2	
	118-D-3	
	118-F-1	
	118-F-2	
	118-H-1	
	118-K-1	
Construction Burial Grounds (12 total)	118-B-2	Potential contaminants (Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, U-238, Pu-238, Pu-239/240, chromium, lead, and mercury) are based upon data for rust flakes and sludge samples collected from inside the process effluent pipelines. These results are reported in Dorian and Richards (1978, UNI-946), the 100-BC-1 limited field investigation report (DOE/RL-93-06, BHI CCN 026588). Some of these waste sites may have received soil contaminated by process effluent and pieces of contaminated process effluent piping.
	118-B-3	
	100-D-5	
	100-D-32	
	100-D-33	
	100-D-40	
	100-D-41	
	100-D-45	
	100-D-46	
	100-D-47	
	118-D-4	
	118-H-3	
Ball 3X Burial Grounds (6 total)	118-B-5	Burial sites for vertical safety rod thimbles and other hardware removed from the reactors during replacement of a liquid boron system for emergency reactor shutdown with a system using boron-steel balls. The boron-steel balls were gravity-fed into the vertical safety rod channels in the graphite core of the reactor. The Ball 3X system was the third backup safety system for reactor shutdown after the horizontal control rods and vertical safety rods. Co-60 and Ni-63 were the only radionuclide contaminants of the wastes removed during the Ball 3X project (per WHC-EP-0620).
	118-C-2	
	100-D-35	
	118-D-5	
	118-F-3	
	118-H-4	
Thimble Pit Sites (3 total)	100-D-6	Burial sites for vertical safety rod thimbles removed during reactor maintenance. Thimbles are made of aluminum, similar to the aluminum used in process tubes, and are expected to also contain Co-60 and Ni-63.
	100-D-43	
	118-H-5	
Test Loop Burial Grounds (3 total)	118-DR-1	Burial sites for stainless-steel double tubes (test loops) that had been irradiated for long periods of time in the high neutron flux of the reactors. Contaminants are Co-60 and Ni-63 based upon the composition of stainless steel (WHC-EP-0620).
	118-H-2	
	600-33	
Animal Waste Sites (4 total)	100-F-20	Burial sites for waste materials from the experimental animal farm, including tools, piping, hardware, trash, and sawdust containing animal wastes. Potential contaminants (Co-60, Sr-90, Pu-239/240) were identified from test hole samples from the 118-F-5 Burial Ground reported by WHC-EP-0620.
	118-F-5	
	118-F-6	
	118-F-9	
Miscellaneous Reactor Solid Waste Burial Grounds (6 total)	118-B-4	Burial sites containing wastes not fitting into a general category.
	118-B-6	
	118-B-7	
	118-B-10	
	118-F-7	
	100-K-2	
Nonradioactive Solid Waste Landfills (2 total)	126-D-2	Known to have received asbestos and may have received containers holding hazardous materials. Soils may be contaminated with chromium.
	126-DR-1	

[a] For more complete description of individual waste sites, refer to Appendix A.

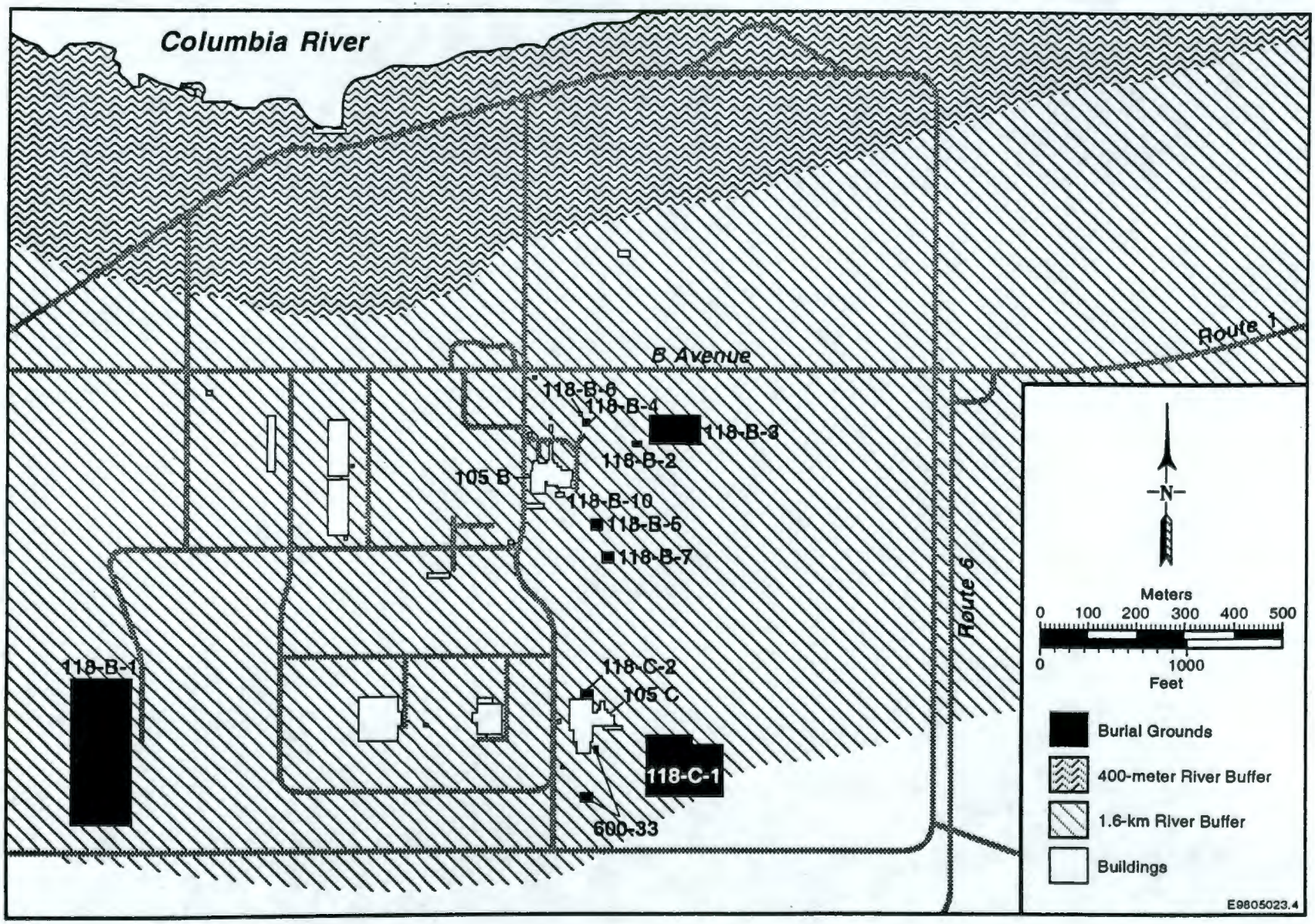
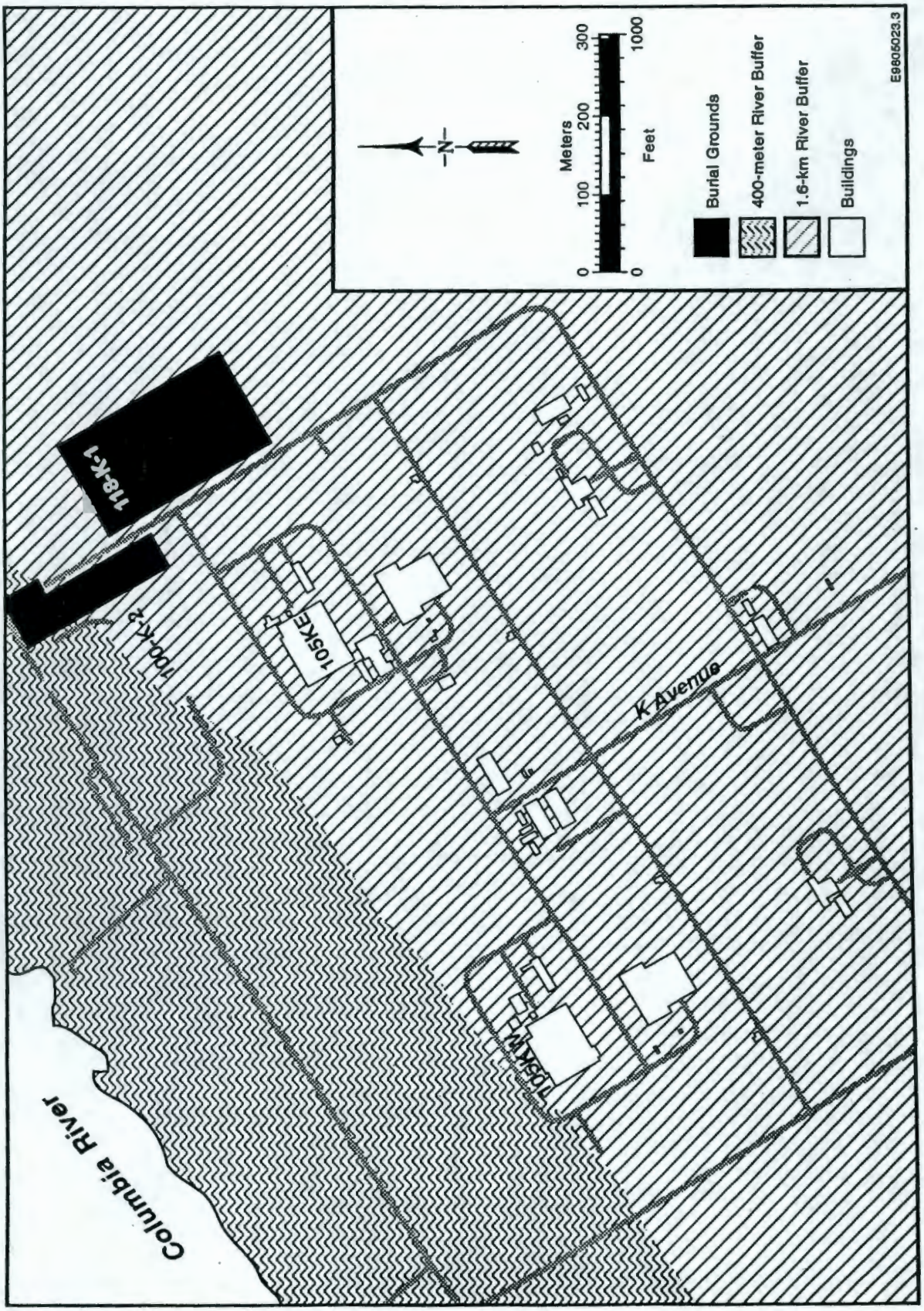


Figure 2. Burial Grounds at the 100-B/C Area.

Figure 3. Burial Grounds at the 100-K Area.



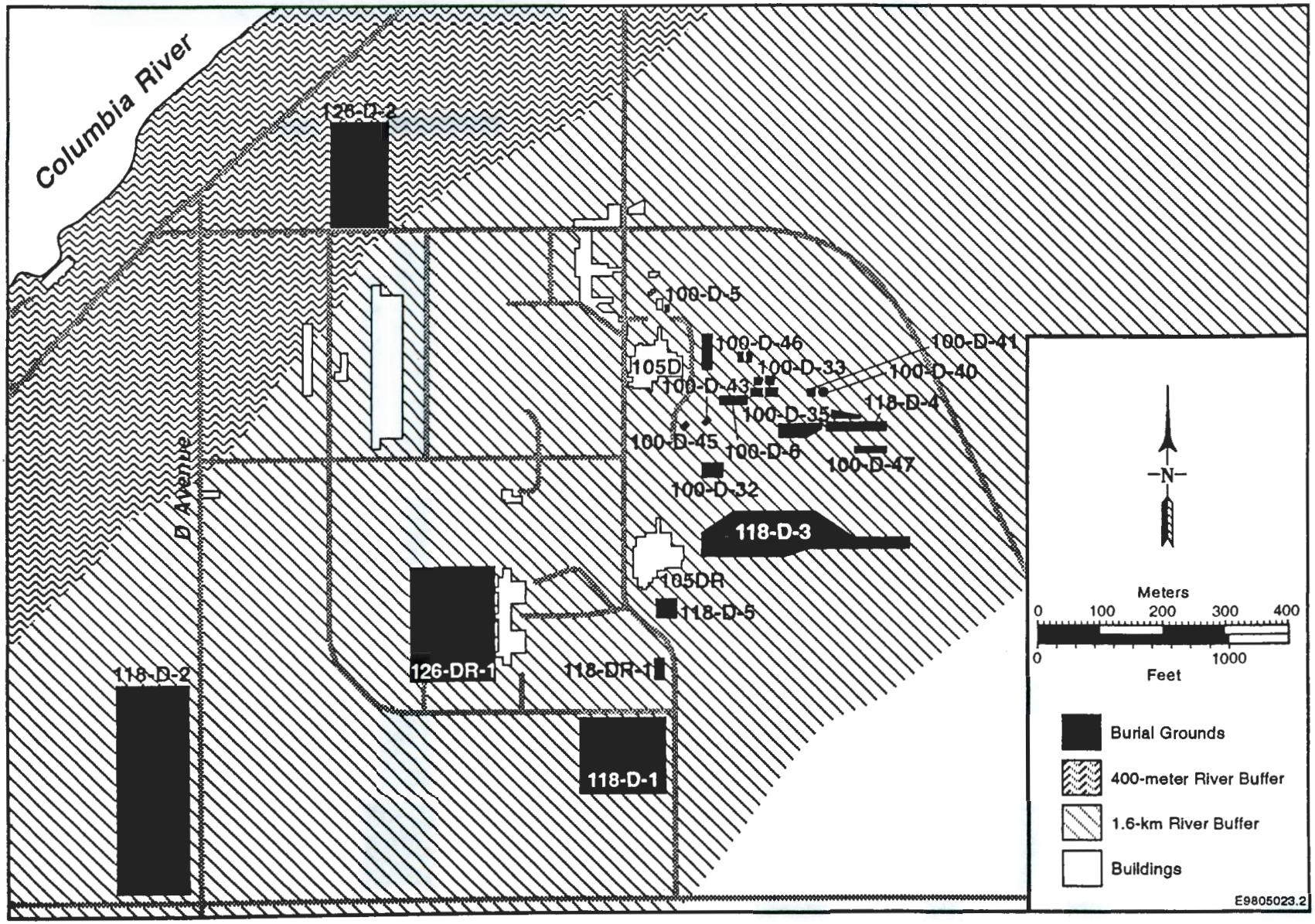
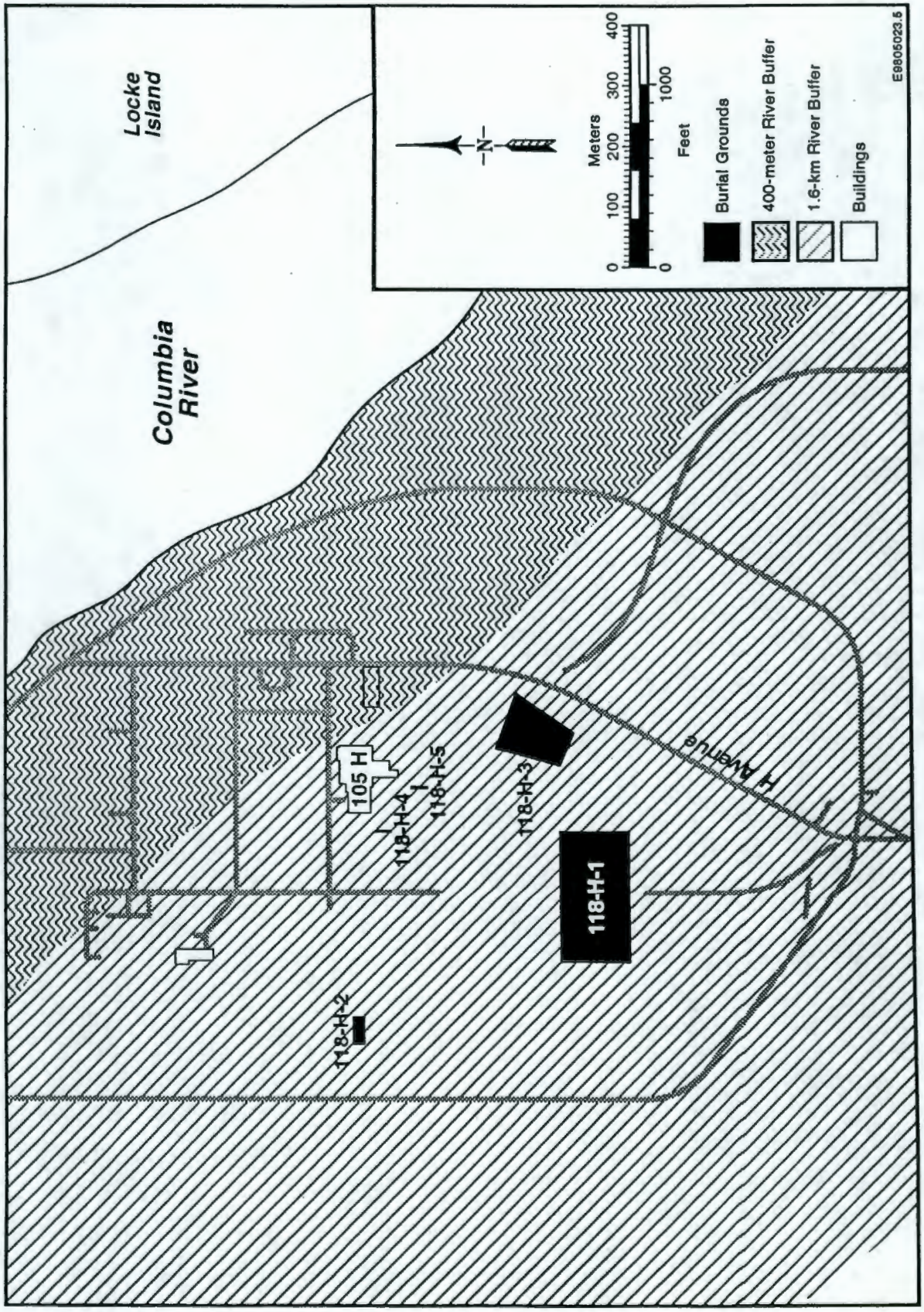


Figure 4. Burial Grounds at the 100-D Area.

Figure 5. Burial Grounds at the 100-H Area.



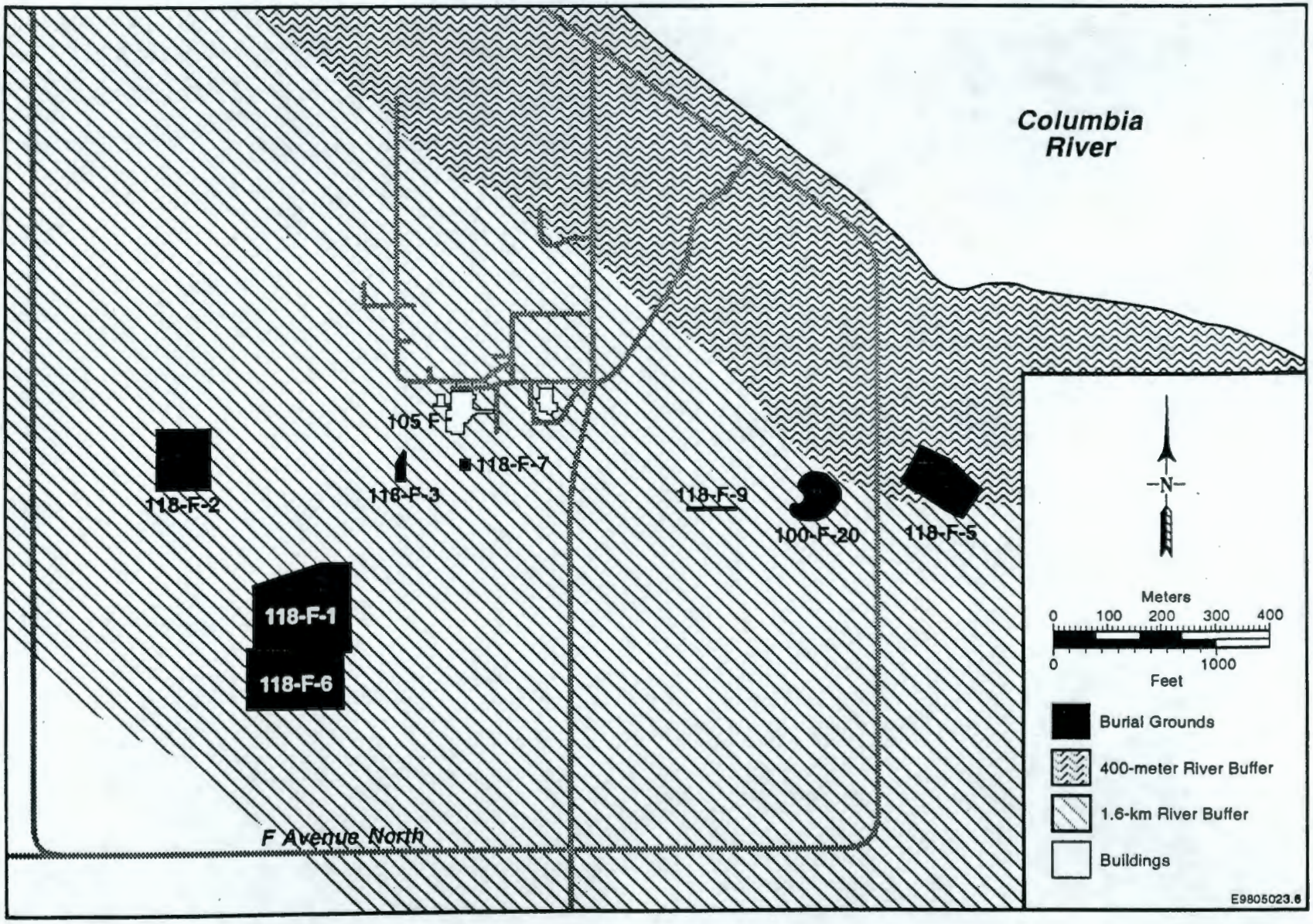


Figure 6. Burial Grounds at the 100-F Area.

Based on available disposal records, reactor operating history, and excavations at selected burial grounds, typical waste materials disposed in the 100 Area Burial Grounds include the following:

- Reactor hardware and equipment (especially metal pieces irradiated by the high neutron flux of the nuclear reactors)
- Metallic objects (e.g., lead bricks and cadmium sheets)
- Construction/demolition debris (e.g., piping and concrete debris)
- Personal protective clothing (e.g., gloves and booties)
- Miscellaneous debris (e.g., tools and soft wastes [i.e., paper, cloth, and plastic]).

The predominant contaminants of concern are radionuclides contained in hard wastes (greater than 99% metallic), with the exception of burial grounds in the 100-F Area that contain radiologically contaminated soft wastes from biological studies. The major radiological constituents in the burial grounds are hydrogen-3, carbon-14, cobalt-60, nickel-63, strontium-90, silver-108m, cesium-137, europium-152, and europium-154. No transuranic or high-level wastes are identified in historical documents or were identified in characterization studies at the 118-B-1 Burial Ground. Hard metallic wastes may include lead, boron, cadmium, cobalt, lead, and nickel-containing equipment. No bulk organic liquids were identified from historical information and are not expected in the 100 Area Burial Grounds. Asbestos is assumed to exist in association with buried equipment or structural material. Appendix A lists current site knowledge, including potential contaminants, for each of the 45 burial grounds.

Appendix A shows the estimated dimensions of each burial ground. In general, the smaller burial grounds have more homogeneous waste streams and better known inventories than do the larger main reactor burial grounds. As noted, the 100-F Area burial grounds contain biological wastes in addition to the solid wastes typical of the remainder of the burial grounds. The 126-D-2 and 126-DR-1 Burial Grounds contain nonradioactive solid wastes as opposed to radioactive wastes contained in the other burial grounds.

The 1995 and 1999 CERCLA interim action RODs for non-burial ground waste sites in the 100 Areas (see "Supporting Documents" at the end of this Proposed Plan for references) are based on the assumption that the 100 Area cleanup will not preclude any future land use, including residential, and state that this assumption may be revisited upon issuance of a final land-use decision. The *Final Hanford Comprehensive Land-Use Plan and Environmental Impact Statement* (HCP-EIS) (DOE/EIS-0222F), which became final after the 1995 and 1999 RODs were signed, designates area use for the land encompassing the burial grounds for the preservation and conservation of natural and cultural resources.

SCOPE AND ROLE OF ACTION

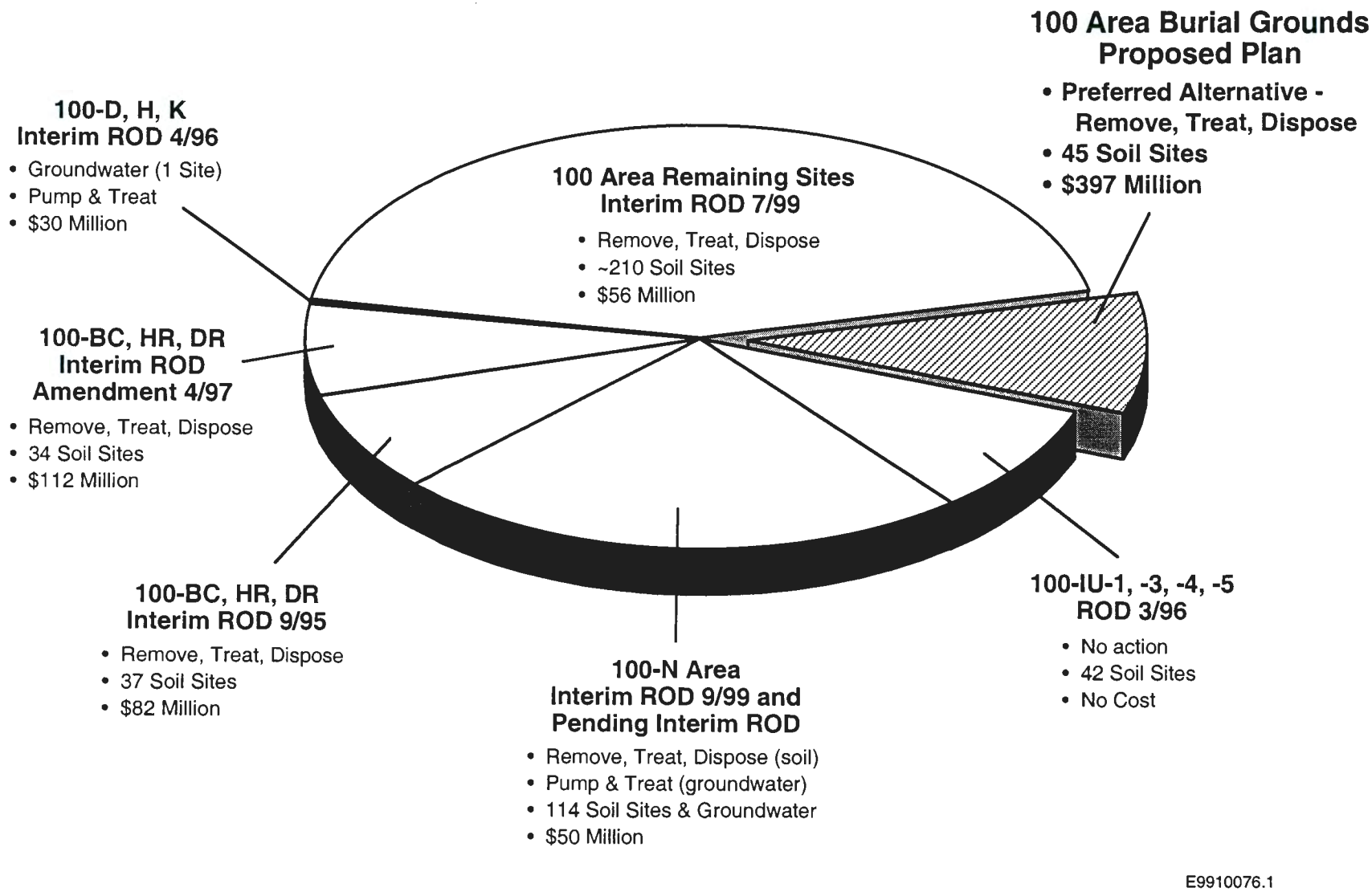
This Proposed Plan presents interim remedial actions for contaminated soil, structures, and debris at the 100 Area Burial Grounds. The proposed interim remedial actions are to reduce potential future threats to human health and the environment from burial ground contaminants. While these are designated as interim actions, it is expected that no additional remedial actions will be required at the burial grounds.

The scope of the interim remedial actions addresses all 45 burial grounds located in the 100 Area source operable units. Burial grounds are defined as areas used for near-surface disposal of solid wastes containing hazardous substances (radioactive and/or nonradioactive). Burial grounds exclude decontamination and demolition sites where subsurface concrete foundations and other building structures were left in place. Although the remedial action objectives address protection of groundwater and the Columbia River, existing contaminated groundwater underlying the burial grounds is being addressed under separate CERCLA actions. Other remedial actions have also been selected or are in progress for non-burial ground soil sites within the 100 Area operable units. Figure 7 contains a diagram of the cleanup strategies in the 100 Areas, highlighting the proposed actions at the 100 Area Burial Grounds.

SUMMARY OF SITE RISK

The primary risk from the burial grounds is direct exposure to the hazardous wastes and radioactive materials contained in the burial grounds. The conceptual model for the 100 Area Burial Grounds (as contained in the focused feasibility study)

Figure 7. Burial Ground Cleanup in Relation to Remaining 100 Area Cleanup (Weighted by Numbers of Waste Sites).



presents external exposure to radiation from hard wastes as the primary exposure route for human and ecological receptors because solid metallic objects represent the dominant source of potentially contaminated materials. Other exposure pathways will be of much lesser concern because the likelihood of other media (i.e., soil, air, biota, or groundwater) being contaminated is small and/or the magnitude of their potential contamination is small.

Human Health Risk – In the Superfund process, potential risks to human health and the environment are evaluated to determine if significant risks exist due to site contaminants. Two types of potential human health effects due to contact with site contaminants are evaluated at Superfund sites. The first is the potential increase in cancer risks. This potential increase is expressed exponentially as 1×10^{-4}, 1×10^{-5}, and 1×10^{-6} (i.e., one in ten thousand, one in one hundred thousand, one in a million, respectively). This means that for a 1×10^{-4} risk, if 10,000 people were exposed to a contaminant of concern for some period of time, one additional person may be diagnosed with cancer in his/her lifetime. Based on current national cancer rates, about 2,500 people out of 10,000 are expected to be diagnosed with cancer. Remedial actions generally are not required at risk levels between 1×10^{-4} and 1×10^{-6} unless there are other considerations such as adverse environmental impacts, the potential for future migration, or uncertainty regarding future land use.

Contamination detected or known to exist at the burial grounds poses the potential for increased human health risk to future site users.

For the purposes of defining risks associated with unrestricted use of the burial grounds, an **unrestricted rural-residential exposure scenario** was used in the focused feasibility study. Residents of a home with a basement would be exposed primarily via direct exposure. The pathways of dust inhalation, soil ingestion, and ingestion of plants, meat, milk, aquatic foods, and drinking water present lesser risk contributions because the contaminants of the burial grounds are primarily constituents of solid metallic objects. The contaminants of the burial grounds providing the highest contribution to potential increased human health risks are radionuclides, including carbon-14, cesium-137, cobalt-60, europium-152, europium-154, nickel-63, silver-108m, strontium-90, and hydrogen-3. Estimated risks for the 100 Area Burial Grounds under this scenario are summarized in Table 2. Where information regarding the concentrations of burial ground contaminants was not available, the risk was evaluated on the basis of information from analogous sites. Under existing conditions, 22 of the 27 burial grounds analyzed present estimated total risks of greater than 1×10^{-3}. The lowest burial ground risk was estimated at 8.4×10^{-5}.

To estimate risk associated with a restricted land use scenario, a **recreational exposure scenario** was used in the focused feasibility study. This scenario is considered representative of the conservation/preservation land use identified in the HCP EIS. Consideration of this scenario allows for an evaluation of risk basked on a lowest frequency use scenario. It is not intended to imply that other land use scenarios (e.g., a restricted rural-residential land use) would be precluded. This scenario assumes that an individual camps, and otherwise recreates, at a burial ground for 7 days per year, 24 hours per day. The majority of exposure would occur from burrowing animals or root penetration that can reach a maximum depth of 2.7 m. Direct exposure could occur through external radiation exposure (gamma), ingestion of contaminated soil, and inhalation of fugitive dust. Ingestion of plants and meat is also assumed. The same radionuclides identified under the unrestricted rural-residential exposure scenario are of concern under this scenario as well. Estimated risks under this scenario are summarized in Table 2. Under existing site conditions for the recreational exposure scenario, 9 of the 27 burial grounds present total risks of greater than 1×10^{-3}, and 19 of the burial grounds present total risks greater than 1×10^{-4}.

Ecological Risk – Because of the impracticality of assessing the risk of numerous contaminants to all potential ecological receptors, a representative species, the Great Basin pocket mouse, has been consistently used to define ecological risk at the Hanford Site. The pocket mouse lives in burrows that reach a reported depth of 2 m and feeds primarily on the seeds of local plant species. The pocket mouse may be exposed to contamination through direct exposure (including external gamma radiation) to burial ground waste. Qualitative evaluations at other sites, based on the pocket mouse as a maximally exposed species, have consistently shown that ecological risks are mirrored by human health risks and ecological protection can be attained if potential risks to human health are mitigated.

Conclusions – Based on the above risks, it has been determined by EPA, DOE, and Ecology that the preferred alternative identified in this Proposed Plan, or one of the other active measures considered in the

Table 2. Total Risk Presented by 100 Area Burial Grounds.

Burial Ground Type	Burial Ground Name	Total Risk[a]	
		Unrestricted Rural Residential Use	Restricted Recreational Use
Main Reactor Solid Waste Burial Grounds	118-B-1	1.92E-02	2.16E-03
	118-C-1	1.68E-02	9.04E-04
	118-D-1	1.93E-03	7.28E-05
	118-D-2	1.43E-02	7.83E-04
	118-D-3	1.30E-02	7.29E-04
	118-F-1	1.85E-02	1.04E-03
	118-F-2	1.05E-04	5.16E-06
	118-H-1	1.54E-02	8.74E-04
	118-K-1	1.32E-02	7.45E-04
Construction Burial Grounds	118-B-2	8.67E-03	2.78E-04
	118-B-3	1.30E-04	6.24E-06
	100-D-5[b]		
	100-D-32[b]		
	100-D-33[b]		
	100-D-40[b]		
	100-D-41[b]		
	100-D-45[b]		
	100-D-46[b]		
	100-D-47[b]		
	118-D-4	8.40E-05	4.14E-06
	118-H-3	1.65E-04	7.60E-06
Ball 3X Burial Grounds	118-B-5	4.42E-03	1.46E-04
	118-C-2	1.73E+01	5.14E-01
	100-D-35[b]		
	118-D-5	8.86E-03	2.82E-04
	118-F-3	1.79E-03	7.39E-05
	118-H-4	3.38E-03	1.21E-04
Thimble Pit Sites	100-D-6[b]		
	100-D-43[b]		
	118-H-5	1.42E-01	4.22E-03
Test Loop Burial Grounds	118-DR-1	1.26E-03	5.31E-05
	118-H-2	1.14E-03	5.01E-05
	600-33[b]		
Animal Waste Sites	100-F-20[b]		
	118-F-5	5.53E-03	5.17E-03
	118-F-6	1.92E-03	1.67E-03
	118-F-9[b]		
Miscellaneous Reactor Solid Waste Burial Grounds	118-B-4	5.97E-03	1.78E-04
	118-B-6	1.71E-01	8.05E-02
	118-B-7	1.72E-01	5.11E-03
	118-B-10[b]		
	118-F-7	1.24E-01	3.70E-03
	118-K-2[b]		
Nonradioactive Solid Waste Landfills	126-D-2[b]		
	126-DR-1[b]		
	Maximum Risk	1.73E+01	5.14E-01
	Minimum Risk	8.40E-05	4.14E-06

[a] Based on estimates of the radionuclide inventory in 27 of the forty-five 100 Area Burial Grounds (WHC 1987).
[b] Risks for the remaining 18 burial grounds cannot be calculated due to insufficient data. The methods and calculations supporting these risk results are presented in Appendix C.

Proposed Plan, is necessary to protect public health or welfare, or the environment from actual or threatened releases of hazardous substances into the environment.

REMEDIAL ACTION OBJECTIVES

The remedial action objectives for the 100 Area Burial Grounds are as follows:

- Prevent or mitigate risk to human and ecological receptors associated with external exposure to, ingestion of, inhalation of, and dermal contact with burial ground contents (i.e., solid wastes) and intermixed contaminated soils at levels that exceed **applicable or relevant and appropriate requirements** (ARARs) or risk-based criteria.

- Prevent the migration of contaminants through the vadose zone to groundwater, and ultimately the Columbia River, so the concentrations reaching groundwater and the river do not exceed ARARs or risk-based criteria.

- Prevent or mitigate health and occupational risks to workers performing remedial action.

- Provide conditions suitable for future land use of the 100 Areas.

- Minimize the disruption of cultural resources and wildlife habitat in general and prevent adverse impacts to cultural resources and threatened or endangered species.

SUMMARY OF REMEDIAL ALTERNATIVES

The 100 Area Burial Grounds focused feasibility study identified three alternatives for interim remedial action:

- No Action alternative - Evaluated as a comparative baseline for the other alternatives

- Remove/Treat/Dispose alternative - Protects human health and the environment by completely removing the sources of contamination and placing them in an engineered facility. The Remove/Treat/Dispose alternative is being proposed as the preferred alternative for the 100 Area Burial Grounds

- Containment alternative - Protects human health and the environment by eliminating exposure pathways for potential receptors (i.e., humans and biota) through construction of engineered surface barriers.

Each alternative is summarized below. A detailed description and evaluation of each alternative is contained in the focused feasibility study. It should be noted that because the 100 Area Burial Grounds vary in size, location, and content, some burial grounds could conceivably be remediated using an alternative that is different than that of other burial grounds. For example, the Containment alternative could be used to remediate some sites, while the Remove/Treat/Dispose alternative could be used for other sites depending on size and location. Therefore, selection of different alternatives for different burial grounds should be considered by the public as well as the selection of an individual alternative for all burial grounds.

No Action Alternative

The National Contingency Plan (NCP) (40 CFR 300) requires that a No Action alternative be evaluated as a baseline for comparison with other remedial alternatives. The No Action alternative represents a situation where no legal restrictions, access controls, or active remedial measures are applied to the site. No action implies "walking away from the burial ground" and allowing the wastes to remain in their current configuration, affected only by natural processes. Selecting the No Action alternative would require that a burial ground pose no unacceptable threat to human health or the environment.

Remove/Treat/Dispose Alternative

The removal aspect of the Remove/Treat/Dispose alternative involves several components:

- Applying the observational approach, which allows waste characterization, designation, and treatment to occur as excavation proceeds

- Removing and stockpiling the clean overburden

- Removing (excavating) all contaminated burial ground wastes and soils (i.e., to native soils at the bottom and sides of the burial ground trenches) using standard soil excavation equipment (e.g., backhoes and front-end loaders)

- Applying water sprays and/or crusting agents to control dust and dispersion of soft wastes (e.g., paper)

- Performing air monitoring in accordance with current Washington State Department of Health air quality requirements

- Performing soil sampling and analysis for site-specific contaminants of concern to document achievement of remediation goals

- Transporting clean soil from approved borrow pits to backfill remediated areas

- Grading remediated areas to match local area contours

- Revegetating remediated areas to control soil erosion and reflect the natural 100 Area environment.

Wastes resulting from implementation of the Remove/Treat/Dispose alternative would be disposed at the ERDF in the 200 Area of the Hanford Site. Most wastes and soils excavated from the burial grounds are expected to meet the criteria established for acceptance of waste at the ERDF. If the ERDF waste acceptance criteria cannot be achieved, waste treatment would be required to allow disposal at the ERDF as follows:

- Initially segregating materials, based on visual inspections and field screening to accommodate different treatment and disposal options

- Isolating or mechanically separating suspect or "unknown" materials (radioactive and nonradioactive) from other burial ground debris

- Conducting waste sampling and analysis

- Evaluating uncontaminated waste for reuse or recycle

- Consolidating compatible wastes for subsequent treatment or disposal

- Packaging and shipping waste to an appropriate facility (assumed to be ERDF for planning purposes; however, other facilities such as canyon buildings, as part of the Canyon Disposal Initiative, may be used in the future for certain radioactive wastes).

- Constructing cells at ERDF, placing of surface barriers for these cells, and continuing ERDF **institutional controls** and groundwater monitoring.

Specific treatment technologies would be applied to the contaminated media as appropriate to meet ERDF waste acceptance criteria. For example, waste volume may be minimized by void-space reduction, or macroencapsulation may be used to treat **dangerous wastes** (e.g., lead) that are subject to land disposal restrictions (LDRs).

If the Remove/Treat/Dispose alternative was applied to all 45 burial ground sites, approximately 1.5 million m^3 of contaminated soil and debris would be removed, treated if necessary, and disposed. Disposing this entire waste volume, without waste segregation or volume reduction, would require slightly more than two ERDF cells (each cell holds approximately 587,300 loose cubic meters) to accommodate the 100 Area Burial Ground waste. The RTD alternative would require approximately 2 million m^3 of borrow material for fill at the burial grounds and capping at ERDF.

Unrestricted use of the excavated area, both surface and subsurface to at least 4.6 m, could occur following removal, treatment, and disposal.

Estimated Costs – Capital costs, annual operation and maintenance costs, and total present worth costs for the Remove/Treat/Dispose alternative are contained in Table 3. The estimated time to construct and implement this alternative is unknown because it is constrained primarily by Federal budgets rather than technical issues. It is anticipated that remediation would take at least 13 years, assuming that the annual budget for burial ground remediation would remain fixed and similar to the allocation for other waste sites at Hanford.

Containment Alternative

The surface barriers and other controls proposed in the Containment alternative would be designed to prevent unintentional human and biotic intrusion into burial ground wastes, minimize potential human and biotic exposures, and control potential contaminant migration by preventing water infiltration into the waste materials. The Containment alternative would include restrictions on excavation below the surface barrier; however, all other land uses, including surface uses that do not compromise the integrity of the barrier, could occur. These restrictions would still allow for a variety of land use scenarios, including restricted residential use (residential use in the near vicinity of the contained burial grounds) as well as the conservation/preservation land use selected in the HCP EIS.

Table 3. Costs for 100 Area Burial Ground Remedial Alternatives.

	Capital Cost	Operation and Maintenance	Total Present Worth Cost
Remove/Treat/Dispose	$392,864,000	$4,958,000[a]	$397,824,000
Containment	$98,671,000	$44,465,000	$147,275,000

[a] Costs represent operation and maintenance costs for disposal of 100 Area Burial Ground waste at ERDF.

The following sections discuss the surface barrier, institutional controls, and EPA guidance considerations inherent in the Containment alternative for the 100 Area Burial Grounds. The description of this alternative concludes with the estimated time to construct and implement the remedy and estimated costs.

Surface Barrier – The modified RCRA Subtitle C-compliant surface barrier included in this alternative is a 1.2-m-thick, eight-layer cover system designed to provide protection against water (e.g., precipitation) infiltration, and biotic intrusion for 500 years. The barriers would be constructed of variable thickness, graded-fill bases that establish a stable, planar surface over the burial grounds. Once constructed, the barrier surface and side slopes would be vegetated to control soil erosion, promote moisture evapotranspiration, and reflect the natural 100 Area setting.

During remedial design, surveying (e.g., using ground-penetrating radar) would be conducted to verify the burial ground boundaries and to verify that the existing rock/soil cover at each burial ground satisfies the minimum requirements for the surface barrier (e.g., subsidence concerns).

It is expected that most barrier materials would be excavated and transported to the burial grounds from Hanford Site borrow areas with standard soil excavation equipment. If barriers were constructed on all 45 burial ground sites, approximately 1.15 million m^3 of borrow materials would be required. Water spraying would generally be used to control dust from materials associated with barrier construction. Operation and maintenance activities would include regular inspections, cover vegetation management (e.g., weed control), regular environmental monitoring (e.g., groundwater and neutron moisture-monitoring system), and barrier maintenance.

Institutional Controls – The Containment alternative would include physical and legal institutional controls. Access control, surveillance, and land-use restrictions (i.e., development limitations) would be implemented in conjunction with the surface barrier.

Public notices and community relation efforts would supplement site surveillance efforts. Burial ground land-use controls would be established through deed restrictions prohibiting any activities (e.g., residential development) that could compromise the integrity of the containment barrier. The DOE, or subsequent land managers, would enforce land-use restrictions as long as risks remain above acceptable levels.

Monitoring – A neutron probe moisture-monitoring system is assumed for each surface barrier to monitor barrier soil moisture and ensure that water is not infiltrating through the barrier into the burial ground waste. This system would incorporate a horizontal tube in the lowest layer of the barrier so moisture levels within the barrier could be measured with a neutron probe from numerous locations at regular (e.g., seasonal or annual) intervals.

Upgradient and downgradient groundwater monitoring wells would be required for each burial ground to ensure that waste isolation is achieved and contaminant migration is not occurring. The existing network of groundwater monitoring wells in the 100 Areas, plus the shallow groundwater monitoring system along the Columbia River shoreline, would be utilized to the extent possible for this groundwater monitoring effort. Burial ground monitoring would be incorporated into the ongoing Hanford Site environmental monitoring program. The monitoring data would be evaluated during each CERCLA 5-year review to determine if the action has been successful and if continued monitoring is required.

Estimated Costs – Capital costs, annual operation and maintenance costs, and total present worth costs for the Containment alternative are contained in Table 3. The estimated time to construct and implement this alternative is unknown because it is driven by Federal budget constraints rather than technical constraints. It is anticipated that remediation would take less time than the RTD alternative (estimated at 13 years), assuming that the annual budget for burial ground remediation would

remain fixed and similar to the allocation for other waste sites at Hanford.

EVALUATION OF REMEDIAL ALTERNATIVES

The following evaluation of remedial alternatives summarizes each alternative in relation to each of the nine CERCLA criteria (see box – Explanation of CERCLA Criteria). A comprehensive analysis of each alternative is contained in the 100 Area Burial Grounds focused feasibility study.

The first two criteria, overall protection and compliance with ARARs, are defined under CERCLA as "threshold criteria." Threshold criteria must be met by an alternative to be eligible for selection. The next five criteria are defined as "primary balancing criteria." These criteria are used to weigh major trade-offs among alternatives. The last two criteria, state and community acceptance, are defined as "modifying criteria." These criteria may be considered to the extent that information is available during the focused feasibility study but cannot be fully considered until after public comment is received on the Proposed Plan. In the final comparison of alternatives to select a remedy, modifying criteria are of equal importance to the balancing criteria.

Overall Protection. The Remove/Treat/Dispose alternative would protect human health and the environment by removing contaminants from the burial ground sites. The Containment alternative would protect human health and the environment by eliminating exposure pathways. The Containment and the Remove/Treat/Dispose alternatives would both meet this threshold criterion.

The No Action alternative would fail to meet this threshold criterion and, therefore, is not discussed further in this evaluation.

Compliance with Applicable or Relevant and Appropriate Requirements. The Remove/Treat/Dispose and Containment alternatives would both comply with ARARs. No waivers from ARARs are necessary to implement either the Remove/Treat/Dispose or Containment alternatives.

Long-Term Effectiveness and Permanence. The Remove/Treat/Dispose alternative provides a higher degree of long-term effectiveness and permanence than the Containment alternative. With the Remove/Treat/Dispose alternative, no contaminants of concern above approved cleanup levels would remain at the site. Thus, no long-term restrictions would be required for the burial grounds after remediation is completed. The removed contamination would be re-disposed and managed at the ERDF after any necessary treatment. Long-term use restrictions, monitoring, and barrier maintenance similar to those required for the Containment alternative would apply to the ERDF, but the greater degree of containment at the ERDF (e.g., trench-bottom liner) and consolidation of many sites into one inclusive site would result in this alternative being more effective in the long term than the Containment alternative. Because the Remove/Treat/Dispose alternative is more effective in the long term, it is a more permanent solution.

For the Containment alternative, the potential exists that the surface barrier could fail or institutional controls restricting access to the site would not be maintained. However, this same potential exists with the ERDF surface barrier under the Remove/Treat/Dispose alternative.

These situations are considered unlikely given the durability of cover systems in semi-arid environments (see the focused feasibility study for further information on the performance of these barrier systems). However, the possibility for failure of these systems results in less effective performance under the long-term effectiveness and permanence criterion.

The primary hazards associated with burial ground waste are from the radionuclides. Radionuclides will have decayed to levels protective of human health and the environment (i.e., below 15 mrem/yr, which is defined by EPA guidance to be a protective level) in approximately 30 years under a recreational exposure scenario. For complete unrestricted use of the burial ground surface and subsurface, radionuclides will have decayed to levels protective of human health and the environment within approximately 450 years. Chemical contaminants such as lead bricks and sheets will still be present in the burial grounds after all radionuclides have decayed. These contaminants are not considered a primary hazard in the burial grounds.

EXPLANATION OF CERCLA EVALUATION CRITERIA

1. *Overall Protection of Human Health and the Environment* is the primary objective of the remedial action and addresses whether a remedial action provides adequate overall protection of human health and the environment. This criterion must be met for a remedial alternative to be eligible for consideration.
2. *Compliance with Applicable or Relevant and Appropriate Requirements* addresses whether a remedial action will meet all of the applicable or relevant and appropriate requirements and other Federal and state environmental statutes, or provides grounds for invoking a waiver of the requirements. This criterion must be met for a remedial alternative to be eligible for consideration.
3. *Long-Term Effectiveness and Permanence* refers to the magnitude of residual risk and the ability of a remedial action to maintain long-term reliable protection of human health and the environment after remedial goals have been met.
4. *Reduction of Toxicity, Mobility, or Volume Through Treatment* refers to an evaluation of the anticipated performance of the treatment technologies that may be employed in a remedy. Reduction of toxicity, mobility, and/or volume contributes toward overall protectiveness.
5. *Short-Term Effectiveness* refers to evaluation of the speed with which the remedy achieves protection. It also refers to any potential adverse effects on human health and the environment during the construction and implementation phases of a remedial action.
6. *Implementability* refers to the technical and administrative feasibility of a remedial action, including the availability of materials and services needed to implement the selected solution.
7. *Cost* refers to an evaluation of the capital, operation and maintenance, and monitoring costs for each alternative.
8. *State Acceptance* indicates whether the state concurs with, opposes, or has no comment on the preferred interim alternative based on review of the focused feasibility study and the Proposed Plan.
9. *Community Acceptance* assesses the general public response to the Proposed Plan, following a review of the public comments received during the public comment period and open community meetings. The remedial action is selected only after consideration of this criterion.

Reduction of Toxicity, Mobility, or Volume Through Treatment. To the extent that wastes may be treated to achieve LDRs and ERDF waste acceptance criteria (the focused feasibility study estimates that only 5% of the wastes in the burial grounds may require such treatment), the Remove/Treat/Dispose alternative may provide a slightly greater reduction of mobility and possibly volume through treatment than the Containment alternative. Reduction of toxicity would be the same for both the Remove/Treat/Dispose and the Containment alternatives, as each would rely on the natural attenuation process to decay radioactive contaminants and degrade chemical contaminants to less toxic products over time.

Treatment is assumed to consist of stabilization technologies such as macroencapsulation for hard waste forms (e.g., lead bricks or metallic alloys). Treatment would slightly reduce the mobility of the waste, but the toxicity would not be reduced beyond the attenuation associated with natural processes. No radionuclide treatment is anticipated to be required.

Whether reduction of the overall waste volume can be achieved through treatment for the Remove/Treat/Dispose alternative is not known. The overall waste volume would increase if treatments such as macroencapsulation were employed but would decrease with the application of waste-reduction technologies such as compaction. Because the actual volume of material requiring treatment before disposal at the ERDF is not certain, the relative advantage of the Remove/Treat/Dispose alternative over the Containment alternative for this criterion is unknown.

Short-Term Effectiveness. The Containment alternative would be more effective in the short term than the Remove/Treat/Dispose alternative, predominantly because of lower risk to workers.

The Remove/Treat/Dispose alternative would generate a large volume of contaminated soils and debris, which would create a potential for short-term impacts during excavation, treatment, and transportation of the excavated materials. For example, risks to workers from potential exposure to contaminated soils and fugitive dust or from potential accidents would be greater for the Remove/Treat/Dispose alternative than for the Containment alternative. Multiple handling of waste necessary for segregation and treatment at some burial grounds would further increase worker risk. Certain types of

treatment may generate residuals that would require additional management to meet LDR or ERDF waste acceptance criteria, which would also increase short-term risks to workers. Short-term impacts to vegetation and wildlife would be slightly greater with the Remove/Treat/Dispose alternative than the Containment alternative because the former would disturb the largest land area. Similarly, the Remove/Treat/Dispose alternative has a greater probability of impacting cultural resources in the short-term due to the larger land area impacted.

Smaller burial grounds that typically contain more homogeneous waste streams would cause less of a short-term impact to workers than would the larger, heterogeneous burial grounds. At larger burial grounds, more waste would be segregated and treated, and there is a greater potential for unknown inventories that will require more precautions (e.g., a higher level of personal protection equipment) to prevent risk to workers.

With regard to the length of time for remediation, it would take longer for the Remove/Treat/Dispose alternative to achieve remedial action objectives because of the much higher cost of this alternative and Federal budgetary constraints. Assuming that the annual budget for burial ground remediation is fixed, more burial grounds could be contained in a given year than could be excavated; thus, the work involved for the Remove/Treat/Dispose alternative would be spread over a greater number of years.

The Containment alternative would pose relatively little risk to workers because workers would not be exposed to contaminants during implementation. Waste would not be handled, so the risks associated with this option would be much lower than those related to excavation, treatment, transportation, and disposal of wastes with the Remove/Treat/Dispose alternative. Some short-term risk to workers would be expected under this alternative from transportation of materials and construction of the engineered surface barrier, but these activities would pose significantly less short-term risk than that associated with the Remove/Treat/Dispose alternative. Because of the smaller area of land impacted and the shorter duration of time for implementation, the Containment alternative would be more effective in the short term with respect to reduced impact on cultural and ecological resources. Because of budgetary considerations (as discussed above), the remedial action objectives would be achieved more quickly through implementation of the Containment alternative.

Implementability. The Remove/Treat/Dispose alternative would be more complicated to implement than the Containment alternative because of the difficulties and safety requirements associated with the excavation, transportation, treatment, and disposal of large volumes of contaminated equipment, soft wastes, and soils and because of inherent unknowns in the burial grounds.

The Remove/Treat/Dispose alternative would involve excavation and segregation of an unknown quantity of pipes, bulky equipment, and other wastes and the treatment of some portion of these wastes. These tasks, combined with the necessity for workers to wear personal protection equipment, would result in relatively low worker productivity. The volume of waste generated by this alternative would require increased capacity at the ERDF. Construction of 2.1 ERDF cells would require coordination with the remedial action schedule.

The Remove/Treat/Dispose alternative is relatively more implementable for small, homogeneous waste sites, as these sites will require less segregation and will have less worker productivity issues than the larger, heterogeneous burial grounds.

Construction of an engineered surface barrier under the Containment alternative would follow proven construction practices and would be easier to implement than the excavation, treatment, and disposal activities associated with the Remove/Treat/Dispose alternative. Waste-handling problems associated with worker safety that would be encountered in the Remove/Treat/Dispose alternative would not be a factor under the Containment alternative, so associated risks and delays would be avoided.

Costs. For comparison purposes, the net present value (in 1999 dollars) was calculated for each of the alternatives. By using net present value estimates, a common baseline is established for comparing total costs for alternatives with expenditures that occur over different time frames. Net present value comparisons comprise the standard criteria for deciding whether an action can be justified on economic principles. The net present value cost of implementing the Containment alternative for all 45 sites is significantly less than the cost for employing the Remove/Treat/Dispose alternative. If the Remove/Treat/Dispose alternative is applied to all the burial grounds, the estimated cost is nearly three times greater than the estimated cost for the Containment alternative.

Individual cost estimates for each waste site and remedial alternative are presented in Table 4. Costs presented are estimates with an expected accuracy of +50% to -30%. It is estimated that applying the Remove/Treat/Dispose alternative to all of the burial grounds would cost in net present value dollars approximately $398 million, and implementing the Containment alternative would cost approximately $147 million. For information purposes, the non-discounted costs of the alternatives (i.e., costs that have not been discounted to reflect cost in 1999 dollars) are $832 million for RTD and $1.9 billion for containment.

Table 4 also includes cost numbers based on remediating the lowest cost alternative between Remove/Treat/Dispose and Containment (with the exception of the 118-F-2 Burial Ground where the proximity of groundwater to the bottom of the burial ground indicates that the containment alternative would not be appropriate. In general, smaller burial grounds can be remediated under the Remove/Treat/Dispose alternative for less cost than Containment while large burial grounds can be remediated for less cost under a Containment alternative. Under the lowest cost alternative, 29 of the 45 burial grounds would be remediated through removal, treatment, and disposal at a total cost of approximately $133 million.

State Acceptance. The State of Washington supports RTD as the preferred alternative.

Community Acceptance. Community acceptance will be considered after all public comments on this Proposed Plan have been received.

PREFERRED INTERIM REMEDIAL ALTERNATIVE

The Remove/Treat/Dispose alternative has been identified by the Tri-Parties as the preferred alternative for all 100 Area Burial Grounds. Based on information currently available, the Tri-Parties believes the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. The Tri-Parties expect the preferred alternative to satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of human health and the environment; (2) comply with ARARs (or justify a waiver); (3) be **cost-effective**; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element.

NATIONAL ENVIRONMENTAL POLICY ACT EVALUATION

Under the Remove/Treat/Disposes alternative, irreversible and irretrievable commitments of natural resources would occur from the removal and transportation of contaminated soils to the ERDF because of the commitment to expand and use portions of the ERDF for long-term waste management. Excavated material would be replaced with approximately 1.3 million m^3 of clean fill from onsite geologic resources. An additional 720,000 m^3 would be required for ERDF capping material. Future use of the Columbia River and adjacent lands would allow unrestricted use in areas formerly occupied by the burial grounds. Excavation could disturb cultural resources contained at a site, and careful adherence to cultural resource mitigation planning would be required. Cumulative impacts may occur at borrow sites and along transportation routes. Positive impacts would occur to natural resources from restoration actions by removing exposure pathways to contaminants, but short-term negative effects to wildlife could occur during the construction and implementation phases of this alternative.

The Containment alternative would require fewer natural resources than those required by the Remove/Treat/Dispose alternative, significantly less transportation, and less geologic resources for backfill material (1.15 million m^3). Using ERDF resources would not be required under this alternative and little disturbance of cultural resources would occur. Cumulative impacts may occur at borrow sites and along transportation routes. Irreversible and irretrievable loss of approximately 32 hectares of subsurface land area would occur through the commitment to maintain surface barriers. Positive impacts would occur to natural resources from restoration actions by removing exposure pathways to contaminants, but short-term negative effects to wildlife could occur during the construction and implementation phases of this alternative.

Irreversible and irretrievable commitment of natural resources would occur with the No Action alternative because contaminants would remain onsite and human and ecological receptors could be exposed. For radiological constituents, this exposure would remain until decay results in contaminant levels below concern. No direct impacts on natural resources would result from implementing this alternative.

Table 4. Estimated Costs for RTD and Containment Alternatives[a].

Site	Barrier Area, (ft^2)	Total Volume, bank(bcf) (ft^3)	Remove Treat/ Dispose Cost[b]	Containment	Lowest Cost Alternative[c]
118-C-2	256	1,298	$115,000	$5,777,063	**$115,000**
118-B-7	576	2,219	$117,000	$1,598,965	**$117,000**
118-F-7	768	3,225	$129,000	$1,545,810	**$129,000**
118-H-5	828	4,723	$139,000	$1,654,839	**$139,000**
600-33	1,600	9,333	$184,000	$1,703,784	**$184,000**
100-D-5	1,600	10,500	$192,000	$1,764,499	**$192,000**
118-B-6	2,781	36,538	$336,000	$1,659,725	**$336,000**
118-B-2	4,000	45,354	$384,000	$1,745,323	**$384,000**
118-H-2	3,900	45,910	$353,000	$1,723,124	**$353,000**
118-B-4	4,800	45,917	$199,000	$1,728,023	**$199,000**
100-D-43	3,898	49,630	$383,000	$1,769,740	**$383,000**
118-D-5	4,000	50,332	$385,000	$1,762,948	**$385,000**
118-F-9	4,200	51,562	$389,000	$1,767,312	**$389,000**
118-B-10	5,104	53,786	$572,000	$1,796,690	**$572,000**
100-D-45	6,670	69,218	$709,000	$1,843,774	**$709,000**
100-D-40	6,400	74,667	$757,000	$1,829,231	**$757,000**
118-B-5	8,100	100,667	$978,000	$1,831,351	**$978,000**
118-H-4	8,500	111,357	$747,000	$1,854,537	**$747,000**
100-D-41	4,800	142,355	$1,027,000	$1,890,411	**$1,027,000**
100-D-46	4,800	142,355	$1,027,000	$1,890,411	**$1,027,000**
100-D-32	8,100	145,834	$1,058,000	$1,939,125	**$1,058,000**
100-D-47	9,600	175,157	$1,260,000	$1,910,471	**$1,260,000**
118-K-2	16,154	214,343	$1,489,000	$2,154,364	**$1,489,000**
100-D-33	12,600	238,835	$1,702,000	$2,050,087	**$1,702,000**
100-D-35	12,600	238,835	$1,702,000	$2,049,864	**$1,702,000**
118-F-3	16,985	277,753	$1,764,000	$2,110,048	**$1,764,000**
118-DR-1	16,275	278,017	$1,902,000	$2,042,298	**$1,902,000**
100-F-20	36,375	301,687	$2,338,000	$2,621,698	**$2,338,000**
100-D-6	18,419	362,764	$2,563,000	$2,109,281	$2,109,281
126-DR-1	46,330	668,947	$5,947,000	$2,757,978	$2,757,978
118-H-3	74,784	897,501	$4,126,000	$3,148,898	$3,148,898
118-F-5	89,784	1,274,936	$8,596,000	$3,480,423	$3,480,423
118-D-1	203,350	1,699,039	$10,280,000	$5,154,224	$5,154,224
118-C-1	234,144	1,931,086	$9,912,000	$5,777,063	$5,777,063
126-D-2	116,600	2,060,268	$18,046,000	$3,760,610	$3,760,610
118-B-3	117,274	2,185,598	$15,711,000	$3,874,640	$3,874,640
118-D-2	190,560	2,226,804	$10,944,000	$8,573,350	$8,573,350
118-H-1	273,000	2,236,542	$19,668,000	$6,934,165	$6,934,165
118-F-2	149,328	2,687,609	$23,505,000	$4,444,019	$23,505,000[d]
118-D-4	153,600	3,517,854	$25,072,000	$4,493,822	$4,493,822
118-B-1	364,296	4,202,919	$24,608,000	$8,091,011	$8,091,011
118-F-6	231,110	4,545,935	$26,002,000	$5,787,420	$5,787,420
118-F-1	340,896	6,450,626	$51,209,000	$7,610,505	$7,610,505
118-D-3	301,600	7,046,869	$50,387,000	$7,019,916	$7,019,916
118-K-1	403,380	9,601,029	$68,911,000	$8,241,881	$8,241,881
			$397,824,000	**$147,274,724**	**$132,657,189**

[a] These costs do not include the estimated 3% design cost and 3% data collection cost associated with all sites. The containment costs are based on the use of a Modified RCRA Subtitle C-compliant barrier.

[b] These costs include the estimated $41 million present worth costs for construction and operations and maintenance costs for 2.1 additional ERDF cells required for this alternative. These costs are pro-rated for each burial ground based on volume.

[c] The lowest cost estimate includes 17 sites at which the RTD alternative would be employed (**in bold**) and 28 sites where the Containment alternative would be used.

[d] The bottom of 118-F-2 is in close proximity to groundwater and implementing the containment alternative at this site may not eliminate a groundwater/river pathway. Therefore, RTD is included as the "lowest cost alternative" that would achieve the groundwater/Columbia River protection RAO for the 118-F-2 Burial Ground.

SUPPORTING DOCUMENTS

The public is encouraged to read the following documents to gain a better understanding of the 100 Area Burial Grounds:

100 Area Burial Grounds Focused Feasibility Study, (DOE/RL-98-18)

Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement (DOE/EIS-0222F)

118-B-1 Burial Ground Excavation Treatability Test Report (DOE/RL-94-65)

Estimates of Solid Waste Buried in 100 Area Burial Grounds (WHC-EP-0620)

Radiological Characterization of the Retired 100 Areas (Dorian and Richards, 1978 [UNI-946])

Interim Remedial Action Record of Decision for the 100-BC-1, 100-DR-1, 100-HR-1 Operable Units, Hanford Site, Benton County, Washington (U.S. Environmental Protection Agency, 1995)

ADMINISTRATIVE RECORD

The Administrative Record can be reviewed at the following locations:

Lockheed Martin Services, Inc.
Administrative Record
2440 Stevens Center Place, Room 1101
Richland, Washington 99352
509/376-2530
ATTN: Debbi Isom

U.S. Environmental Protection Agency
1200 Sixth Avenue, HW-070
Seattle, Washington 98101
206/553-4494
206/553-4973
ATTN: Diane Richardson

Washington State Department of Ecology
Nuclear Waste Program Library
300 Desmond Drive
Lacey, Washington 98503
360/407-7100
ATTN: Marilyn Smith

POINTS OF CONTACT	INFORMATION REPOSITORIES
U.S. Department of Energy Representative Glenn Goldberg Project Manager 509/376-7465 U.S. Environmental Protection Agency Representative (Region 10) Dennis Faulk Project Manager 509/376-9884 Washington State Department of Ecology Representative Rick Bond Project Manager 509/736-3004	This Proposed Plan is available for viewing at the following public information repositories: University of Washington Suzzallo Library Government Publications Box 3529000 Seattle, Washington 98195 206/543-1937 ATTN: Eleanor Chase Gonzaga University, Foley Center Tri-Party Information Repository East 502 Boone Spokane, Washington 99258 509/323-3839 ATTN: Connie Scarpelli Portland State University Branford Price Millar Library Science and Engineering Floor Tri-Party Information Repository 934 SW Harrison Portland, Oregon 97207-1151 503/725-3690 ATTN: Michael Bowman U.S. DOE Richland Public Reading Room Washington State University Consolidated Information Center, Room 101L Richland, Washington 99352 509/372-7443 ATTN: Terri Traub

GLOSSARY

The first usage of technical terms and other specialized text in this Proposed Plan is shown in bold in the document and the terms are defined below.

Applicable or relevant and appropriate requirements – Cleanup standards, standards of control, and other environmental protection requirements based on Federal or state laws that address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, or that address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site.

Cost-effective – In accordance with the Superfund National Contingency Plan Section 300.430(f)(l)(ii)(D), a cost-effective remedy is one whose costs are proportional to its overall effectiveness. The "overall effectiveness" of a remedial alternative is determined by evaluated (1) long-term effectiveness and permanence; (2) reduction in toxicity, mobility and volume through treatment; and (3) short-term effectiveness.

Dangerous waste – Waste that, because of its source or characteristics, has been determined by the State of Washington to require controlled management to protect the public and environment. Dangerous waste is subject to land disposal restrictions that require specific treatment prior to land disposal.

Focused feasibility study – An engineering study on a CERCLA site that evaluates a limited number of remedial alternatives for cleaning up contaminants.

Hazardous substances – Chemical substances and radionuclides that may pose a threat to human health or the environment.

Institutional control – A general category of remedial alternatives that do not actively remediate contaminants at a waste site but rather limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at a waste site.

Interim remedial action – A remedial action that is taken at a site to address one or more of the contamination problems, but not necessarily all of the contamination problems.

Operable unit – A group of waste sites placed together for the purposes of investigation and subsequent cleanup actions.

Proposed Plan – A fact sheet that summarizes, for public review and comment, the analysis of different cleanup options.

Record of Decision – The formal document in which a regulatory agency sets forth the selected remedial measure and the reasons for its selection.

Recreational exposure scenario – A hypothetical, future exposure scenario that assumes that direct use of waste sites would be limited to the ground surface. The scenario assumes that an individual camps, and otherwise recreates, at a burial ground for 7 days per year 24 hours per day based upon EPA guidance as presented in the 1995 *Hanford Site Risk Assessment Methodology*, DOE/RL-91-45, Rev. 3. This exposure scenario is representative of the "conservation and preservation" designation selected for the 100 Areas in the *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (DOE/EIS-0222F).

Unrestricted rural-residential exposure scenario – A hypothetical, future exposure scenario that assumes unrestricted use of the surface and subsurface to 4.6 m (15 ft). In this scenario, a resident has a home with a basement in which an individual is exposed to burial ground water. The resident would also be exposed via the dust inhalation, soil ingestion, and plant, meat, milk, aquatic foods, and drinking water ingestion pathways. This scenario assumes that burial ground waste has no covering of soil to reduce direct exposure to external gamma radiation.

APPENDIX A

100 AREA BURIAL GROUNDS DESCRIPTIONS

Table A-1. Area Burial Ground Descriptions. (6 pages)

Site Name	Current Site Knowledge	Media/ Material	Potential Contaminants
118-B-1 105-B Burial Ground	Primary burial ground for general wastes from the operation of 100-B Reactor. Received approximately 10,000 m^3 (13,079 yd^3) of solid wastes, including aluminum tubes, aluminum thimbles, stainless-steel gun barrels, thermocouples, and miscellaneous irradiated reactor hardware, plus wastes from operation of the P-10 tritium separation project and project waste from replacing boiler tubes in eight steam generators in the Hanford Generating Plant in the 100-N Area. Operated from 1944 to 1973. Site contains 21 trenches in an area approximately 305 m x 98 m x 6 m (1,000 ft x 321 ft x 20 ft) deep. Located 915 m (3,000 ft) west of the 105-C Reactor. The principal radionuclide is long-lived nickel-63. References: WHC-SD-EN-TI-220, DOE/RL-94-61, WHC-EP-0620.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Ag-108m, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury
118-B-2 Minor Construction Burial Ground No. 1	Received approximately 100 m^3 (130 yd^3) of dry wastes from repair of the 107-B Retention Basin and conversion of the 115-B Gas Recirculation Building to serve both the B and C Reactors. Operated from 1952 to 1956. Site is described as a pit 18.3 m x 9.1 m x 77 m (60 ft x 30 ft x 13.8 ft) deep located 137 m (450 ft) east of the 105-B Reactor. The principal radionuclide is short-lived cobalt-60. References: WHC-SD-EN-TI-220, DOE/RL-94-61, WHC-EP-0620.	Solid waste mixed with soil	Co-60, Sr-90, Cs-137, Eu-152, Eu-154, chromium, lead, mercury
118-B-3 Minor Construction Burial Ground No. 2	Received solid wastes generated during modifications to the effluent lines and other 100-B Reactor alterations. Burial ground contains many trenches in an area 106.7 m x 84 m x 6.1 m (350 ft x 275 ft x 20 ft) deep located 198 m (650 ft) east of the 100-B Reactor building. Operated from 1956 to 1960. Site received approximately 5,000 m^3 (640 yd^3)of waste, which was primarily cold-rolled steel pipe. The principal radionuclide is short-lived cobalt-60. References: WHC-SD-EN-TI-220, WHC-EP-0620.	Solid waste mixed with soil	Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, U-238, Pu-238, Pu-239/240, chromium, lead, mercury
118-B-4 105-B Spacer Burial Ground	Disposal site for irradiated B Reactor aluminum fuel spacers. Site is 15.3 m x 9.2 m x 4.6 m (50 ft x 30 ft x 15 ft) deep and contains six vertical metal culverts, 1.8-m (6-ft) diameter and 4.6-m (15-ft) deep. Operated from 1956 to 1958. Located 91.5 m (300 ft) northeast of the 100-B Reactor building. Currently the site is covered with about 1 m (2 to 4 ft) of cobble. The principal radionuclide is short-lived cobalt-60. References: WHC-SD-EN-TI-220, WHC-EP-0620.	Solid waste in metal culverts	Co-60
118-B-5 Ball 3X Burial Ground	Received irradiated equipment and metallic wastes removed from 100-B Reactor during the Ball 3X Project in 1953. Site contains approximately 40 m^3 (52 yd^3) of highly irradiated metallic wastes in a pit 15 m x 15 m x 6.1 m (50 ft x 50 ft x 20 ft) deep covered with 1 m (3 ft) of cobble. The principal radionuclide is short-lived cobalt-60. References: WHC-SD-EN-TI-220, WHC-EP-0620.	Solid waste mixed with soil	Co-60, Ni-63
118-B-6 108-B Solid Waste Burial Ground	Site contains two vertical concrete pipes 5.5-m (18-ft) long and 1.8 m (6 ft) in diameter used for the disposal of wastes from "metal line" of the P-10 tritium separation project. One of the pipes was filled with waste and capped, then the other was partially filled with waste material and capped. Finally both pipes were capped with a concrete pad measuring 4.6-m (15-ft) long and 3-m (10-ft) wide. Site operated from 1950 to 1953. Waste disposed at the site was estimated at 21.2 metric tons (23.4 tons). The principal radionuclide was short-lived tritium. References: WHC-SD-EN-TI-220, WHC-EP-0620.	Solid waste in concrete pipes	H-3, lead, mercury, palladium
118-B-7 Solid Waste Burial Site	Received decontamination materials and assorted equipment from the 111-B Decontamination Facility and workshop from 1951 to 1968. Unlined inactive solid waste burial ground about 2.4 m x 2.4 m x 2.4 m (8 ft x 8 ft x 8 ft) deep. The principal radionuclide was short-lived cobalt-60. References: WHC-SD-EN-TI-220, DOE-RL 1992, WHC-EP-0620.	Solid waste mixed with soil	Co-60, Ni-63
118-B-10 Ball 3X Storage Tank	Location of a metal tank used to store highly radioactive boron-steel and carbon-steel balls. Tank is believed to be empty. During the demolition of the 115-B/C Gas Recirculation Building the ventilation tunnel to the B Reactor building was not demolished because this waste site is located on top of the tunnel. Site is 14.6 m x 5.5 m x 6.1 m (48 ft x 18 ft x 20 ft) deep. Operation dates unknown. Reference: WHC-SD-EN-TI-220.	Buried storage tank may contain solid waste	Co-60, Ni-63

Table A-1. Area Burial Ground Descriptions. (6 pages)

Site Name	Current Site Knowledge	Media/ Material	Potential Contaminants
118-C-1 105-C Solid Waste Burial Ground	Primary burial ground for general wastes from the operation of the 100-C Reactor. Received process tubes, aluminum fuel spacers, control rods, reactor hardware, and soft wastes from the 100-C Reactor building from 1953 to 1969. Estimated to contain 86 metric tons (94.8 tons) of boron, 1.1 metric tons (1.2 tons) of graphite, 0.51 metric tons (0.56 tons) of lead, 21.6 metric tons (23.8 tons) of lead/cadmium, and 96 metric tons (105.9 tons) of other materials. Solid waste was buried in trenches and pits in a trapezoidal area 156 m x 122 m x 6.1 m (510 ft x 400 ft x 20 ft) deep. The principal radionuclide was long-lived nickel-63. References: WHC-SD-EN-TI-220, WHC-EP-0620.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Ag-108m, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury
118-C-2 105-C Ball Storage Tank	Used in 1969 for disposal of 9,000 kg (19,800 lbs) of highly activated boron steel and carbon steel balls in their storage tank. Storage tank was buried under several feet of clean fill and has a shielding mound about 0.6 m (2 ft) above ground level. Site dimensions are 2.1 m x 2.1 m (7 ft x 7 ft) deep. References: WHC-SD-EN-TI-220, WHC-EP-0620, DOE/RL-94-65.	Solid waste in a buried storage tank	Co-60, Ni-63
600-33 105-C Reactor Test Loop Burial Site	Site contains a single trench that received an irradiated stainless-steel double tube (test loop) about 6.1-m (20-ft) long, 12.2 m (40 ft) of contaminated carbon steel shielding pipe, and about 305 m (1,000 ft) of cable used to remove the test loop from C Reactor in 1963. Trench was approximately 6.1 m x 6.1 m x 3 m (20 ft x 20 ft x 10 ft) deep. Reference: WHC-SD-EN-TI-220.	Solid waste mixed with soil	Co-60, Ni-63
100-D-5 Undocumented waste site near 103-D	Received contaminated soil and pipe from the tie-in of 100-D and 100-DR effluent lines during 1950. Trench was approximately 3 m x 3 m x 4.6 m (10 ft x 10 ft x 15 ft) deep, located north of the 105-D Reactor building and east of the 103-D Building. Operated in 1950. Material was covered with at least 0.6 m (2 ft) of soil and a concrete cap. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, U-238, Pu-238, Pu-239/240, chromium, lead, mercury
100-D-6 (118-D-4D) Buried VSR Thimble Site 4D	Received contaminated vertical safety rod thimbles, guides, and miscellaneous waste removed from 105-D Reactor during the Ball 3X project in 1953. Irregularly shaped pit with side lengths of 43 m x 46 m x 17 m x 18.6 m (140 ft x 153 ft x 56 ft x 61 ft) x 7.6-m (25-ft) deep. Solid waste was covered with 1.5 m (5 ft) of clean soil. Isotopic analysis found Mn-54 and Co-60 in aluminum process tubes that are similar to VSR thimbles but the short half-life of Mn-54 (0.85 yr) makes it unlikely to be present. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Co-60, Ni-63
100-D-32 Minor Construction Burial Ground No. 6	Received contaminated materials and equipment from 100-D/DR Reactor effluent system modifications. The burial pit was 15.2 m x 15.2 m x 7.6 m (50 ft x 50 ft x 25 ft) deep including a 1.5 m (5 ft) cover depth. Operated in 1956. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, U-238, Pu-238, Pu-239/240, chromium, lead, mercury
100-D-33 Minor Construction Burial Ground No. 4	Used for the disposal of low level construction wastes from modifications to the reactors. The site was 30.5 m x 15.2 m x 7.6 m (100 ft x 50 ft x 25 ft) including a cover depth of 1.5 m (5 ft). Operated in 1954. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Co-60, Ni-63
100-D-35 Minor Construction Burial Ground No. 1	Burial ground used for the disposal of 100-D Reactor thimbles, rod guides, and miscellaneous waste during the Ball 3X conversion. Burial ground measured 30.5 m x 15.2 m x 7.6 m (100 ft x 50 ft x 25 ft) deep. Operated in 1954. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Co-60, Ni-63
100-D-40 Minor Construction Burial Ground #5 Hole	Received solid wastes from D/DR Reactor alterations. Site is described as a 12.2-m (40-ft) diameter pit 6.1-m (20-ft) deep. Operated in 1956. Reference: Waste Information Data System (WIDS) database.	Solid waste mixed with soil	Co-60, Ni-63

Table A-1. Area Burial Ground Descriptions. (6 pages)

Site Name	Current Site Knowledge	Media/ Material	Potential Contaminants
100-D-41 (118-D-18) Construction Burial Ground	Received radioactive and nonradioactive materials from 100-D/DR Reactor alterations. Site was 12.2 m x 12.2 m x 7.6 m (40 ft x 40 ft x 25 ft) deep and covered with 1.5 m (5 ft) of material. Operated in 1956. Exact location of this solid waste site is uncertain. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Co-60, Ni-63
100-D-43 (118-D-4C) Buried VSR Thimble Site 4C	Received a vertical safety rod thimble removed from D Reactor. Site is believed to contain two trenches in an area 21.4 m x 7.6 m x 4.6 m (70 ft x 25 ft x 15 ft) deep. Operation dates unknown. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Co-60, Ni-63
100-D-45 (118-D-4B) Buried VSR Thimble Site	Received radioactive and nonradioactive solid wastes from D/DR Reactor alterations. Believed to contain a vertical safety rod thimble. Stated site dimensions are 24.7 m x 7.3 m x 5.2 m (81 ft x 24 ft x 17 ft) deep. Exact location of burial site is uncertain. References indicate it was part of the 118-D-4 Burial Ground site. Operation dates unknown. Reference: WIDS.	Solid waste mixed with soil	Co-60, Ni-63
100-D-46 (118-D-4A) Burial Ground 4A	Received radioactive and nonradioactive solid wastes from D/DR Reactor alterations. Stated site dimensions are 45.8 m x 6.1 m x 7.6 m (150 ft x 20 ft x 25 ft) deep. Exact location of burial site is uncertain. References indicate the site was contiguous with the 118-D-4 burial ground site and under the 116-D-1A and 116-D-1B trenches. Operation dates unknown. The principal radionuclide was short-lived cobalt-60. Reference: WIDS.	Solid waste mixed with soil	Co-60, Ni-63
100-D-47 Construction Burial Ground 4E (118-D-4E)	Received solid wastes from D/DR Reactor alterations. Stated site dimensions are 69.5 m x 57 m x 7.6 m (228 ft x 187 ft x 25 ft) deep. Operation dates unknown. Reference: WIDS.	Solid waste mixed with soil	Co-60, Ni-63
118-D-1 100-D Burial Ground No. 1	Burial ground for the disposal of irradiated reactor parts, dummies, thimbles, rods, gun barrels, and other contaminated solid wastes. Operated from 1944 to 1967. Received approximately 10,000 m^3 (13,079 yd^3) of wastes. Site was divided into four sections with many north-south trenches measuring 91.5 m x 6.1 m x 6.1 m (300 ft x 20 ft x 20 ft) deep, with 6.1 m (20 ft) spacing between them. Overall site dimensions were 137.3 m x 114.4 m (450 ft x 375 ft). The principal radionuclide was short-lived cobalt-60. References: WHC-SD-EN-TI-181, WHC-EP-0620, MCACES.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Ag-108m, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury
118-D-2 100-D Burial Ground No. 2	Primary burial ground for the disposal of 100-D Reactor operation waste. Received an estimated 10,000 m^3 (13,079 yd^3) of solid wastes including irradiated dummies, splines, rods, thimbles, and gun barrels. Operated from 1949 to 1970. Site was divided into four sections with overall dimensions of 305 m x 109 m x 7.6 m (1,000 ft x 357 ft x 25 ft) deep. Contains many east-west trenches and five disposal pits. Soil beneath the site may be contaminated as a result of large quantities of water used to extinguish a fire during the 1960s. The principal radionuclide was long-lived nickel-63. References: WHC-SD-EN-TI-181, WHC-EP-0620, MCACES.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Ag-108m, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury
118-D-3 100-D Burial Ground No. 3	Primary burial ground for the disposal of 100-DR Reactor operation waste. Received an estimated 10,000 m^3 (13,079 yd^3) of solid wastes including irradiated dummies, splines, rods, thimbles, and gun barrels. Operated from 1956 to 1973. Site also contained a burning pit used for the disposal of low-level radioactive combustible materials. Site was divided into five sections containing several unequally spaced trenches 61 m x 6.1 m x 7.6 m (200 ft x 20 ft x 25 ft) deep. The principal radionuclide was short-lived cobalt-60. References: WHC-SD-EN-TI-181, WHC-EP-0620, MCACES.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Ag-108m, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury

Table A-1. Area Burial Ground Descriptions. (6 pages)

Site Name	Current Site Knowledge	Media/ Material	Potential Contaminants
118-D-4 Construction Burial Ground	Burial ground received an estimated 20,000 m^3 (26,158 yd^3) of waste materials, primarily reactor components and hardware from special project-type maintenance. The construction waste contained low-level contamination. Operated from 1953 to 1967. Site contained many nonuniform trenches and had overall dimensions of 183 m x 61 m x 7.6 m (600 ft x 200 ft x 25 ft) deep. The principal radionuclide was short-lived cobalt-60. References: WHC-SD-EN-TI-181, WHC-EP-0620, MCACES.	Solid waste mixed with soil	C-14, Co-60, Ni-63, cadmium, lead
118-D-5 Ball 3X Burial Ground	Burial ground received thimbles from the 105-DR Reactor during the Ball 3X Project in 1954. Site contained two parallel trenches 12.2 m x 6.1 m x 4.6 m (40 ft x 20 ft x 15 ft) deep. The principal radionuclide was short-lived cobalt-60. References: WHC-SD-EN-TI-181, WHC-EP-0620.	Solid waste mixed with soil	Co-60, Ni-63
118-DR-1 105-DR Gas Loop Burial Ground	Test loop burial ground received about 20 m^3 (26 yd^3) of irradiated stainless-steel assemblies. Originally a gunnite-lined trench used to perform examination and sectioning of test assemblies. Operated from 1963 to 1964. Later, used for the disposal of irradiated metal assemblies from the 105-DR gas loop. Site was 38.1 m x 22.9 m x 8.8 m (125 ft x 75 ft x 29 ft) deep. The principal radionuclide was short-lived cobalt-60. References: WHC-SD-EN-TI-181, WHC-EP-0620, MCACES.	Solid waste mixed with soil	Co-60, Ni-63
126-D-2 184-D Coal Pit	Former coal storage area used as a demolition and excess material dump for the 100-D and 100-N Areas from the 1970s through 1986. Waste burial site is approximately 122 m x 68.6 m x 6.1 m (400 ft x 225 ft x 20 ft) deep. The location is 91.5 m (300 ft) north of the 183-D Water Treatment Facility. Suspected of containing hazardous materials including low-level radioactive waste because of uncontrolled dumping. Site has been observed to contain wood, asbestos, paint cans, dry chemicals, welding materials, solvent cans, oil drums, acid drums, creosote drums, herbicide cans, and other solid wastes. Some of the waste materials were removed in 1983 and 1984 and backfill added. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Chromate, lead, undetermined organic and inorganic chemicals
126-DR-1 190-DR Clearwell Tank Pit	Former site of four 14.2 x 10^6 L (3,750,000 gallon) water storage tanks. The tanks were removed during the 1970s and the site became a D&D burial ground. Waste burial site is 160 m x 12.8 m x 6.1 m (525 ft x 42 ft x 20 ft) deep and occupies about 25% of the clearwell pit. Location is directly east of the 183-DR Water Treatment Facility and about 366 m (1,200 ft) southwest of the 105-DR Reactor Building. Received D&D rubble including pipe insulation containing asbestos. Suspected of containing hazardous materials including low-level radioactive waste because of uncontrolled dumping. Site has been observed to contain paint and solvent cans, oil drums, sodium dichromate crystals, alum, creosote drums, herbicide cans, carbon tetrachloride containers, methanol containers, acetone containers, welding materials, laboratory glassware, furniture, and other solid wastes. The site may contain chromates in both the soil and underground piping because of the use of chromates in water treatment. Reference: WHC-SD-EN-TI-181.	Solid waste mixed with soil	Chromate, lead, undetermined organic and inorganic chemicals
100-F-20, PNL Parallel Pits	Two parallel earthen trenches used for disposal of radioactive and nonradioactive wastes from the 100-F Area experimental animal farm. Overall site dimensions are 80 m x 55 m x 6.1 m (262 ft x 180 ft x 20 ft) deep. The GPR and EMI investigations suggest that a significant portion of the debris in the northern trench is metallic. It is believed that the northern trench received non-radioactive experimental animal farm wastes including hardware, lumber, and soft materials. The southern pit may have received radioactively contaminated animal feces and pen sweepings. Operation dates unknown. Reference: DOE/RL-94-65, Appendix L; MCACES.	Solid waste mixed with soil. May include sawdust and animal wastes.	Co-60, Sr-90, Pu-239/240
118-F-1, Burial Ground No. 1	Primary solid waste burial ground for the 100-F Area. Site received approximately 20,000 m^3 (26,158 yd^3) of wastes during its operation from 1954 to 1965 consisting of radioactive material and reactor components from the 100-F Reactor. Site contained two north/south trenches, 183 m x 152.5 m x 6.1 m (600 ft x 500 ft x 20 ft) deep. Currently covered with 0.6 m (2 ft) of soil. The principal radionuclide was long-lived nickel-63. References: BHI-00031, WHC-EP-0620.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Ag-108m, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury

Table A-1. Area Burial Ground Descriptions. (6 pages)

Site Name	Current Site Knowledge	Media/ Material	Potential Contaminants
118-F-2, Burial Ground No. 2	Received approximately 10,000 m^3 (13,079 yd^3) of low-level radioactive material, including waste generated during maintenance to the reactor effluent system and waste from biological experiments. Operated from 1945 to 1965. Prior to its being backfilled during 1965, the site contained eight trenches of waste from the 105-F Reactor building and one trench of waste from the biology facilities. The site was 112.2 m x 99.4 m x 6.1 m (368 ft x 326 ft x 20 ft) deep. Individual trenches were 76.3-m (250-ft) long and 6.1-m (20-ft) wide. The site is stated to contain low levels of radionuclides. References: BHI-00031, WHC-EP-0620.	Solid waste mixed with soil	Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, U-238, Pu-238, Pu-239/240, chromium, lead, mercury
118-F-3, Burial Ground No. 3	Received irradiated parts from the Ball 3X Project at the 100-F Reactor during 1952. Waste was primarily vertical safety rod thimbles and step plugs. Site was 53.4 m x 15.3 m x 4.6 m (175 ft x 50 ft x 15 ft) deep. Received about 10 m^3 (13.1 yd^3) of waste prior to being backfilled with clean soil. Thirty-eight thimbles are known to have been buried there and possibly as many as 61. The principal radionuclide was short-lived cobalt-60. References: BHI-00031, WHC-EP-0620.	Solid waste mixed with soil	Co-60, Ni-63
118-F-5, PNL Sawdust Pit	Received sawdust contaminated with radioactive material from the animal pens at the experimental animal farm from 1954 to 1975. Site measured 152.5 m x 45.8 m x 4.6 m (500 ft x 150 ft x 15 ft) deep. Approximately 7,646 m^3 (10,000 yd^3) of sawdust containing strontium-90 and plutonium-239 were disposed at this site. Materials were placed in paper boxes or 55-gallon metal drums for burial. The site was later backfilled and stabilized with about 1 m (3-4 ft) of clean soil. References: BHI-00031, WHC-EP-0620.	Solid waste, sawdust, and animal wastes mixed with soil.	Co-60, Sr-90, Pu-239/240
118-F-6 PNL Solid Waste Burial Ground	Received approximately 10,000 m^3 (13,079 yd^3) of biological waste from animal research studies. Operated from 1965 to 1973. Site contained two rail tank cars and a waste disposal area. Overall dimensions were 122 m x 61 m x 6.1 m (400 ft x 200 ft x 20 ft) deep. Solid waste was covered with about 1 m (2 to 3 ft) of soil. The site contains small amounts of cobalt-60, strontium-90, and plutonium-239/240. References: BHI-00031, WHC-EP-0620.	Biological wastes and solid waste mixed with soil	Co-60, Sr-90, Pu-239/240
118-F-7 Burial Ground/ Hardware Storage Vault	Below-ground concrete vault 4.9 m x 2.4 m x 2.4 m (16 ft x 8 ft x 8 ft) deep with a wooden lid located a few meters south of the 100-F Reactor building, south of the security fence. Used from 1945 to 1965 for temporary storage of slightly contaminated reactor parts and mixed wastes. Use of the vault was discontinued after shutdown of the 100-F Reactor in 1965 but it continues to hold an inventory of waste material including 134.3 metric tons (148 tons) of lead and 5.4 metric tons (6 tons) of cadmium. The radionuclide inventory is listed in BHI-00031. The principal radionuclide was short-lived cobalt-60. References: BHI-00031, WHC-EP-0620.	Solid waste in a concrete vault below ground.	Co-60, Ag-108m, cadmium, lead
118-F-9 PNL Rad Site	Received miscellaneous solid wastes from animal research studies at the experimental animal farm. Burial ground dimensions are 30.5 m x 4.6 m x 4.6 m (100 ft x 15 ft x 15 ft) deep. Site is located in the southeastern corner of the 126-F-1 ash pit. Operation dates unknown. Reference: BHI-00031.	Animal wastes, sawdust, and solid waste mixed with soil	Co-60, Sr-90, Pu-239/240
118-H-1 100-H Burial Ground No. 1	Primary solid waste burial ground for the 100-H Area. Received approximately 10,000 m^3 (13,079 yd^3) of wastes during its operation from 1949 to 1965. The wastes included process tubing, contaminated lead brick, dummy fuel elements, and miscellaneous hardware. Site dimensions are 213.5 m x 106.8 m x 7.6 m (700 ft x 350 ft x 25 ft) deep. The site contains trenches and pits. Currently the site covered with about 1 m (3 ft) of soil. The principal radionuclide was long-lived nickel-63. References: BHI-00127, WHC-EP-0620, MCACES.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury
118-H-2 100-H Burial Ground No. 2	Two concrete vaults, one containing an irradiated stainless-steel double tube and the other contaminated pipe. Site dimensions are 42.7 m x 30.5 m x 4.6 m (140 ft x 100 ft x 15 ft) deep. Operated from 1955 to 1965. The void space of both vaults has been filled with gravel. The site contains short-lived radionuclides. References: BHI-00127, WHC-EP-0620.	Solid waste in gravel-filled concrete vaults.	Co-60, Ni-63

Table A-1. Area Burial Ground Descriptions. (6 pages)

Site Name	Current Site Knowledge	Media/ Material	Potential Contaminants
118-H-3 Construction Burial Ground	Received approximately 3,000 m^3 (3,924 yd^3) of reactor components and hardware from 100-H Reactor modification programs. Operated from 1953 to 1957. Site was 91.5 m x 61 m x 7.6 m (300 ft x 200 ft x 25 ft) deep with two or three trenches. Currently backfilled with about 2 m (6 ft) of soil. The principal radionuclide was short-lived cobalt-60. References: BHI-00127, WHC-EP-0620, MCACES.	Solid waste mixed with soil	Co-60, Ni-63
118-H-4 Ball 3X Burial Ground	Received solid waste from the Ball 3X Project during 1953. Waste burial site was a single trench in an area 45.8 m x 9.2 m x 4.6 m (150 ft x 30 ft x 15 ft) deep that was backfilled with about 1.5 m (5 ft) of clean soil. It is believed 55 vertical safety rod thimbles were buried at the site along with irradiated materials from the 100-H Reactor Building. The principal radionuclide was short-lived cobalt-60. References: BHI-00127, WHC-EP-0620, MCACES.	Solid waste mixed with soil	Co-60, Ni-63
118-H-5 Thimble Pit	Received a single experimental thimble assembly during 1953 and was backfilled to grade. Reopened during 1960 and received contaminated soil from the 105-H pluto crib site. Waste burial site was 9.2 m x 0.6 m x 3 m (30 ft x 2 ft x 10 ft) deep. References: BHI-00127, WHC-EP-0620, WIDS.	Solid waste mixed with soil	Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, U-238, Pu-238, Pu-239/240, chromium, lead, mercury
118-K-1 100-K Burial Ground	Received an estimated 10,000 m^3 (13,079 yd^3) of solid waste materials from the 100-K and 100-N Areas. Operated from 1953 to 1975. Site contains numerous trenches and pits of various sizes. Overall site dimensions are 366 m x 183 m x 6.1 m (1,200 ft x 600 ft x 20 ft) deep. Site has six vertical silos each 3-m (10-ft) diameter and 7.6-m (25-ft) deep that were used to hold reactor hardware having high dose rates. Site also contains a waste incinerator, which was built over an ash pit and later buried in the site. The principal radionuclide was long-lived nickel-63. References: WHC 1994b, WHC-EP-0620.	Solid waste mixed with soil	H-3, C-14, Co-60, Ni-63, Sr-90, Cs-137, Eu-152, Eu-154, cadmium, lead, mercury
118-K-2 (100-K-2) Sludge Burial Ground	Reportedly received sludge from the 116-KE-4 and 116-KW-3 Retention Basins. The GPR investigation showed a pipeline running through the area. Reported site dimensions are 53.4 m x 18.3 m x 4.6 m (175 ft x 60 ft x 15 ft) deep. Operation dates unknown. References: WHC-SD-EN-TI-239, DOE/RL-92-11.	Solid waste mixed with soil	Co-60, Sr-90, Cs-137, Eu-152, Eu-154, Th-228, Th-232, U-233/234, U-238, Pu-239/240, chromium, lead, mercury

D&D = decontamination and demolition
WIDS = Waste Information Data System (database)
MCACES = Micro Computer-Aided Cost Estimating System
GPR = ground-penetrating radar
EMI = electromagnetic induction.