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A. Information Category

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3. Export Controlled Information ◉ No ○ Yes OUO Exemption No. 3
4. UCNI ◉ No ○ Yes
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J. Comments

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Engineering Evaluation/Cost Analysis for the Northern Part of the BC Controlled Area (UPR-200-E-83)

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Assistant Secretary for Environmental Management

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Hanford Federal Facility Agreement and Consent Order
(Tri-Party Agreement)

BC Controlled Area Waste Site Engineering Evaluation/Cost Analysis

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Tri-Party Agreement
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U.S. Environmental Protection Agency
Washington State Department of Ecology

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EXECUTIVE SUMMARY

This document presents the results of a non-time critical removal action engineering evaluation/cost analysis (EE/CA) addressing disposition of contaminated soil from the northern part of the BC Controlled Area. This EE/CA was prepared in accordance with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

The BC Controlled Area (Hanford Waste Information Data Systems unplanned release site UPR-200-E-83) is part of the 200-UR-1 Unplanned Release Waste Group Operable Unit (OU). Animal intrusion and wind dispersion of contaminants originating in the BC Cribs and Trenches (waste sites separate from the BC Controlled Area) resulted in shallow soil contamination within the northern part of the BC Controlled Area, an area of approximately 1,500 hectares (3,800 acres). For this EE/CA, the BC Controlled Area was divided into separate regions based on past historical information and recent analytical sampling events. The northern part of the BC Controlled Area is located north of the sand dunes that cross the controlled area from east to west. Within the northern part of the BC Controlled Area is a region (referred to as "Zone A"), which has the highest levels of contamination from cesium-137 and strontium-90 within the BC Controlled Area. Zone A is approximately 57 hectares (140 acres). The remainder of the northern part of the BC Controlled Area contains some areas of contamination in an irregular pattern; however, these are generally considered to be of lower risk to human health and the environment. This region is referred to as "Zone B". Figure 2-2 and Attachment 1 contain maps of the BC Controlled Area which identify the northern region and Zones A and B.

The purpose of this EE/CA is to evaluate removal action alternatives to mitigate threats to human health and the environment posed by contaminated soil in the northern part of the BC Controlled Area in Zones A and B. This contaminated soil has recently been determined through analytical sampling to pose an unacceptable risk to ecological receptors, containing levels of cesium-137 and strontium-90, which range between approximately 0.32 to 3420 pCi/g (see Section 2.3).

The northern part of the BC Controlled Area addressed by this EE/CA does not include the BC Cribs and Trenches, which are separate waste sites to be addressed in the 200-BC-1 OU. The southern part of the BC Controlled Area, an area located south of the northern boundary of the sand dunes is not addressed by this EE/CA, because recent surveys have shown it does not contain any radiological contamination above the preliminary remedial goals for the 200-UR-1 OU.

This EE/CA evaluated three removal action alternatives:

- Alternative One: No Action
- Alternative Two: Monitored Natural Attenuation/Institutional Controls
- Alternative Three: Remove, Treat, and Dispose.

Alternative One assumes all short-term and long-term survey and maintenance activities are terminated. Alternative Two evaluates using natural decay processes to lower contaminant concentrations, while relying on institutional controls of the area to prevent migration of the contaminants. Alternative Three includes removal of soil [to approximately 15.2 centimeters (6 inches) or to preliminary remediation goals, to the extent practicable] from Zone A and from select areas of elevated contamination in Zone B. These areas of elevated contamination above preliminary remediation goals are commonly referred to as "hotspots".

After summarizing site characteristics, providing a site description, and establishing removal action objectives, these alternatives were evaluated in terms of effectiveness, implementability, and cost.

The EE/CA contains a detailed summary and comparison of the relative performance of each alternative in Chapter 4.0

The recommended removal action alternative for the BC Controlled Area is Alternative 3: Remove, Treat, and Dispose. The total volume of contaminated soil that will be removed under Alternative 3 is approximately 181,000 m^3 (237,000 yd^3), estimated to weigh 327,000 tons.

This removal action would accomplish the following, which are summarized from the analysis of alternatives provided in Chapter 5.0:

- Remove contaminated soil that poses a threat to ecological receptors.

- Reduce the areas of contamination at the Hanford Site by removing the principal threat at the BC Controlled, Hanford's largest surface waste site.

- Support the Hanford cleanup mission by providing the Environmental Restoration Disposal Facility (ERDF) with contaminated soil to meet its operating requirements.

- Contribute to the long-term cleanup goal for the 200 Area.

This alternative is recommended based on its overall ability to protect human health and the environment and its effectiveness in maintaining protection for both the short and the long term. This alternative would also reduce the potential for further releases to the environment by reducing the inventory of contaminants to below the preliminary remediation goals. This alternative provides the best balance of protecting human health and the environment, protecting workers, and providing an end state that is consistent with future cleanup actions and commitments of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989). Chapter 5.0 describes the basis for this recommendation.

CONTENTS

ATTACHMENTS

FIGURES

TABLES

ACRONYMS

ARAR	applicable or relevant and appropriate requirement
BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation and Liability Act of 1980*
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DQO	data quality objectives
EcoDQO	ecological data quality objectives
Ecology	Washington State Department of Ecology
EE/CA	engineering evaluation/cost analysis
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
FR	Federal Register
HAB	Hanford Advisory Board
HCP-EIS	*Hanford Comprehensive Land-Use Plan*
IC	Institutional Control
LLW	low-level waste
MNA	Monitored Natural Attenuation
mrem/yr	millirem per year
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	*National Environmental Policy Act of 1969*
NPL	National Priorities List
OMB	U.S. Office of Management and Budget
OU	operable unit
pCi/g	picocuries per gram
PRG	preliminary removal goal
PUREX	Plutonium Uranium Extraction (Plant)
RAO	Removal Action Objective
RAWP	removal action work plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	Revised Code of Washington
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RTD	remove, treat, and dispose
SCA	Soil Contamination Area
TBC	to be considered
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
USC	United States Code
WAC	Washington Administrative Code
WIDS	Waste Information Data System

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
Inches	25.40	millimeters	millimeters	0.03937	inches
Inches	2.54	centimeters	centimeters	0.393701	inches
Feet	0.3048	meters	Meters	3.28084	feet
Yards	0.9144	meters	Meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	Square meters	10.7639	square feet
square yards	0.8361274	square meters	Square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
Acres	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.34952	grams	Grams	0.035274	ounces (avoir)
Pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	Tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	Liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	Liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
Kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

Source: Engineering Unit Conversions, M. R. Lindeburg, PE., Third Ed., 1993, Professional Publications, Inc., Belmont, California.

ENGINEERING EVALUATION/COST ANALYSIS FOR THE NORTHERN PART OF THE BC CONTROLLED AREA (UPR-200-E-83)

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This document presents the results of a *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) non-time critical removal action engineering evaluation/cost analysis (EE/CA) that was conducted to evaluate removal action alternatives for the northern part of the BC Controlled Area. The BC Controlled Area waste site is part of the 200-UR-1 Unplanned Release Waste Group Operable Unit (OU) and is reported in the Hanford Waste Information Data Systems (WIDS) as an unplanned release site (UPR-200-E-83). The contamination in the BC Controlled Area (UPR-200-E-83) was the result of animal intrusion and wind dispersion from the BC Cribs and Trenches. The BC Cribs and Trenches are separate waste sites and are part of the 200-BC-1 OU.

A final remedial decision for the 200-UR-1 OU has not been made; however, CERCLA radioactive hazardous substances[1] in the northern part of the BC Controlled Area present a potential threat to human health and the environment to the extent that a removal action[2] is warranted before a final remedial decision is documented. An action memorandum, which will be developed from this EE/CA, will document and authorize implementation of the removal action that is selected for the BC Controlled Area.

This EE/CA addresses the northern part of the BC Controlled Area, which is the region of the waste site that is north of the band of sand dunes that cross the controlled area from east to west. The Northern BC Area has variable surface radionuclide contamination, originating from the BC cribs and trenches and spread via animal, tumbleweeds and strong winds. The southern part of the BC Controlled Area is not addressed by this EE/CA (see Section 1.4). The 200-UR-1 OU remedial investigation/feasibility study (RI/FS) will evaluate remedial alternatives for the southern part of the BC Controlled Area as well as for any residual contamination that may remain in the northern part of the BC Controlled Area after implementation of the removal action, if appropriate. The final remedial action selected for the BC Controlled Area will be submitted for public review in a Proposed Plan and documented in a Record of Decision (ROD) for the 200-UR-1 OU.

This report is organized in the following manner:

- Chapter 1.0 provides an introduction, a regulatory overview, and the scope of this EE/CA.
- Chapter 2.0 provides relevant background and site information, and a description of the known hazardous substances associated with the northern part of the BC Controlled Area.

[1] "Hazardous substances" means those substances defined by the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), Section 101(14), and include both radioactive and chemical substances.

[2] "Remove" or "removal" as defined by CERCLA, Section 101(23), refers to the cleanup or removal of released hazardous substances from the environment; actions if a threat of release of hazardous substances occur; actions to monitor, assess, and evaluate the release (or threat of release) of hazardous substances; the disposal of removed material; or other actions that may be necessary to prevent, minimize, or mitigate damage to public health or welfare or the environment, which may otherwise result from a release or threat of release. If a planning period of at least 6 months exists before onsite actions must be initiated, the removal action is considered non-time critical and an EE/CA is conducted.

- Chapter 3.0 establishes removal action objectives for the alternatives that will be evaluated.

- Chapter 4.0 identifies the removal action alternatives evaluated to eliminate or reduce the risks associated with the northern part of the BC Controlled Area.

- Chapter 5.0 analyzes and compares each alternative relative to the criteria of effectiveness, implementability, and cost to each other.

- Chapter 6.0 presents the recommended alternative.

1.2 BACKGROUND

The 200-UR-1 OU consists of two waste sites located outside the 200 Areas near the center of the Hanford Site in south-central Washington State. The BC Controlled Area is located south of the 200 East Area (in what is commonly called the 600 Area). This waste site is located primarily outside the 200 Area Core Zone boundary[3].

The BC Controlled Area[4], separate from the BC Cribs and Trenches Area[5], is a 34.7 km^2 (13.4-mi^2) waste site located immediately south of the 200 East Area on the Hanford Site; see Attachment 1 for a waste site map. Route 4S is to the north and east of the BC Controlled Area, and the Columbia River is east of the BC Controlled Area. This waste site was contaminated as a result of several contamination transport mechanisms, summarized in Section 2.3.

Consistent with the Central Plateau strategy and the ongoing cleanup effort across the Hanford Site, the U.S. Department of Energy (DOE) has identified approaches for the Central Plateau cleanup process. One of these approaches is the removal of contaminated soil to reduce environmental risks and coordination of cleanup activities that occur throughout the Hanford Site. The recommended removal action in this EE/CA will serve two purposes: (1) remove contamination that poses a threat to the human health or the environment, and (2) provide the Environmental Restoration Disposal Facility (ERDF) with contaminated soil to meet its operating requirements.

The DOE scheduled a series of workshops with Washington State Department of Ecology (Ecology), U.S. Environmental Protection Agency (EPA), tribes, and stakeholders to develop the approach for determining ecological risk in the 200 Areas of the Hanford Site. The 200 Area Ecological Risk Assessment is currently in the Phase IV of its investigation to determine risk of waste sites in the 200 Areas to the ecological receptors. Data collected from Phases II and III has indicated that the BC Controlled Area is one of two areas in the Central Plateau that pose an unacceptable risk to the ecological receptors; the other waste site is Westlake (216-N-8), which is also in the 200-UR-1 OU.

This EE/CA evaluated removal actions that will address removal of the contamination in the BC Controlled Area that pose an unacceptable risk to human health and the environment, and shall, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action as required by National Contingency Plan (NCP) regulations of 40 *Code of Federal Regulations*

[3] This application of the Core Zone boundary is defined in the in the Hanford Site End State Vision (DOE/RL-2005-57).

[4] BC Controlled Area: As used in this report, the term "BC Controlled Area" refers to that part of the BC Area outside the immediate area of the cribs and trenches themselves. See Attachment 1 for a map showing the boundaries of the area.

[5] BC Cribs and Trenches Area: As used in this report, the term "BC Cribs and Trenches Area" refers to that part of the BC Area that includes the cribs and trenches and the area immediately surrounding the cribs and trenches. See Attachment 1 for a map showing the boundaries of the area.

(CFR) 300.415(2)(d). Additional remedial actions will be evaluated in the 200-UR-1 OU RI/FS process as appropriate to address any residual contamination. This final remedial decision for the remainder of the BC Controlled Area will be proposed by 2011, as required by the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) milestone M-15-00-C.

1.3 REGULATORY OVERVIEW

An overview of the Hanford Site designation as a National Priorities List (NPL) site and of the manner in which CERCLA applies to the northern part of the BC Controlled Area removal action is provided. This section also summarizes regulatory and community involvement requirements.

The BC Controlled Area is on the 200 Area NPL, one of three NPL sites remaining at Hanford. Activities undertaken for cleanup of these NPL sites are performed in accordance with the NCP, 40 CFR 300, and where applicable, the Tri-Party Agreement. Document preparation and planning for potential future actions at 200-UR-1 OU past-practice waste sites are following the CERCLA RI/FS process, as outlined in the Tri-Party Agreement Action Plan.

1.3.1 Removal Action Authority

40 CFR 300.415(b)(1) states when there is a threat to public health or welfare of the United States or the environment, the lead agency may take any appropriate removal action to abate, prevent, minimize, stabilize, mitigate, or eliminate the release or the threat of release. The BC Controlled Area contains radiological contamination that is above ecological protection limits. The DOE has determined the northern part of the BC Controlled Area waste site contains the potential for more widespread release of CERCLA hazardous substances, and that a non-time-critical removal action, pursuant to authority delegated under Executive Order 12580 and Section 7.2.4, *Interim Response Actions and Interim Measure Processes* of the Tri-Party Agreement Action Plan, is warranted to mitigate the threat of release.

This EE/CA was prepared in accordance with CERCLA and 40 CFR 300.415 to satisfy environmental review requirements for non-time critical removal action. After the public has had an opportunity to comment on the alternatives and the recommended approach presented in this document, an Action Memorandum will be issued to authorize the removal action.

1.3.2 Regulatory Involvement

The designated lead regulatory agency identified by the Tri-Party Agreement for BC Controlled Area UPR-200-E-83 is Ecology. Ecology involvement will be in accordance with the Tri-Party Agreement, as appropriate, to ensure that the selected removal action activity complies with applicable or relevant and appropriate requirements (ARARs), that protection of human health and the environment is achieved, and that the removal action is consistent with ongoing or subsequent related remedial actions. Accordingly, Ecology concurrence will be sought for the Action Memorandum from this EE/CA process. In addition, lead regulatory agency approval of the Removal Action Work Plan (RAWP) will be required.

1.3.3 Stakeholder Involvement

Actions taken pursuant to the results of this EE/CA will be conducted in compliance with the Tri-Party Agreement Community Relations Plan and public participation requirements established in 40 CFR 300.415(n) and any applicable DOE policies. This EE/CA will undergo a 30-day public comment period. Following the public comment period, a written response to significant comments will be provided in accordance with 40 CFR 300.820(a).

After all public comments have been considered and dispositioned, an Action Memorandum will document the selected removal action alternative. The Action Memorandum will contain a responsiveness summary to the public comments received. The Action Memorandum and the EE/CA will be placed in an Administrative Record established to provide a publicly accessible record for inspection and copying, consistent with the requirement of 40 CFR 300.415(n)(3)(iii).

1.3.4 National Environmental Policy Act of 1969 Values

In accordance with the Secretary of Energy's Policy Statement on the *National Environmental Policy Act* (NEPA) (DOE 1994), NEPA values have been incorporated into this EE/CA to the extent practicable.

1.4 AREAS EXCLUDED FROM EVALUATION FOR THIS REMOVAL ACTION

The scope of this EE/CA is to identify a recommended removal action alternative to eliminate or reduce the potential hazards associated with the northern part of the BC Controlled Area that could adversely impact human health and the environment. The BC Controlled Area footprint is currently 34.7 km^2 (13.4-mi^2). There are several separate WIDS waste sites located within the outer boundary of the northern part of the BC Controlled Area. These waste sites are not within the scope of this EE/CA. They are:

- The BC Cribs and Trenches waste sites that were the original source of the unplanned release including the area immediately surrounding the cribs and trenches, which will be remediated under the 200-BC-1 OU. Within the area surrounding the cribs and trenches is found:
  - A shallow pipeline burial trench located between the 216-B-29 and 216-B-53A trenches
  - Waste site 200-E-14, an inactive miscellaneous underground storage tank (also known as the 216-BC-201 Siphon Tank) adjacent to the 216-B-14 through 216-B -19 Cribs, and
  - Waste site 200-E-222-PL, several underground pipelines from the 216-BC-201 Siphon Tank to the 216-B-14 through 216-B -19 Cribs.

- Waste site 200-E-114-PL, two parallel underground pipelines from BY and C Tank Farms to the 216-BC-201 siphon tank. This site is located within the area immediately surrounding the cribs and trenches and will be remediated under the 200-BC-1 OU.

- Waste site 200-E-101, the buried 200 East Deep Lysimeter Site, which will be remediated under the 200-MG-1 OU.

Included in the northern part of the BC Controlled Area is a borrow pit just north of the BC Cribs and Trenches. This area has been rejected as a waste site per the Tri-Party Agreement MP-14 process. Radiological surveys will be performed during the removal action to confirm there is no surface contamination present in the borrow pit.

Other buried equipment may exist (e.g., inactive lead sheathed telephone cables) which are not addressed by this EE/CA.

Furthermore, the scope of this EE/CA does not address the southern part of the BC Controlled Area, an area approximately 19.2 km^2 (7.4 mi^2).

If, during this EE/CA, additional waste sites are discovered, they will undergo a WIDS classification process described in the Tri-Party Agreement Action Plan, and designated as a waste site if appropriate.

2.0 SITE CHARACTERIZATION

This chapter summarizes the characteristics of the northern part of the BC Controlled Area as related to the removal action including relevant background information about the waste site, a description of the physical features of the waste site location and a description of the potential hazardous substances contained within the waste site. Also included in this chapter is a description of the analytical information collected that demonstrates a removal action is warranted that was collected during the 200-UR-1 OU RI, as well as during the 200 Area Ecological Risk Assessment Activities.

2.1 BACKGROUND AND SITE DESCRIPTION

The BC Controlled Area is located south of the 200 East Area (in what is commonly called the 600 Area) near the center of the Hanford Site in south-central Washington State (Figure 2-1) and lies between Route 4S and the Army Loop Road. Route 4S is to the north and east of the BC Controlled Area, and the Columbia River is approximately 11.5 km (7 mi.) to the north-northeast of the BC Controlled Area. A detailed BC Controlled Area site map is located in Attachment 1.

Figure 2-1. Hanford Site and Washington State.
The BC Controlled Area boundary is identified in blue.

2.1.1 Site Access and Land Use

Public access to the Hanford Site is controlled at the Wye Barricade on Route 4, and the Yakima and Rattlesnake Barricades on State Highway 240. The 200 Area future land use is described in the *Hanford Comprehensive Land-Use Plan Environmental Impact Statement* (HCP-EIS) (DOE/EIS-0222-F). An area known as the 200 Area Core Zone boundary[6] surrounds the 200 East and 200 West areas. Parts of Zone A in the northernmost section of the BC Controlled Area are located within the 200 Area Core Zone boundary, while the greater part of the area is outside of the 200 Area Core Zone boundary, as shown in Figure 2-2. This boundary for Zone A was based on recent radiological surveys performed in 2006 and 2007 (see Sections 2.2 and 2.4 for further descriptions of Zone A and Zone B).

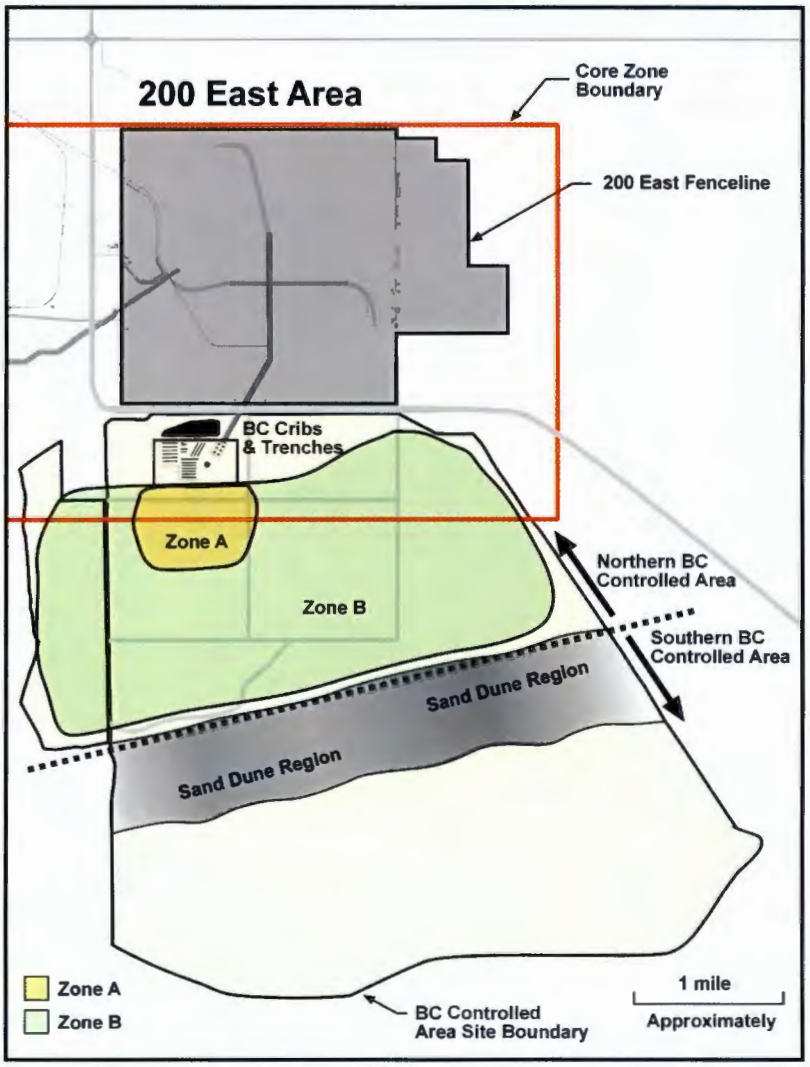

Figure 2-2. Conceptual Diagram of the BC Controlled Area.

2.1.2 Flora and Fauna

The land area around the northern BC Controlled Area has been disturbed from past animal activities. The plant community consists primarily of semi-arid species, such as sagebrush, Sandberg's bluegrass,

[6] This application of the Core Zone boundary is defined in the Hanford Site End State Vision (DOE/RL-2005-57).

rabbitbrush, Indian ricegrass, and non-native plant species, especially cheatgrass. Current fauna in this area includes, but is not limited to, rabbits, mice and coyotes. There are no known plants or animals on the federal or state list of endangered and threatened wildlife and plants in the vicinity of the northern part of BC Controlled Area. If new information reveals the presence of such wildlife or plants in the vicinity of these facilities, appropriate measures will be taken. Further information on ecological resources in the 200 Areas and threatened, endangered, and candidate species at the Hanford Site is available in *Hanford Site NEPA Characterization* (PNNL-6415). There are no perennial or ephemeral streams in the 200 Areas. There are no regulated wetlands within the BC Controlled Area.

The BC Controlled Area is described as a sagebrush-dominated shrub-steppe. These sagebrush dominated communities typically have at least 5% cover of sagebrush (*Artemisia tridentata*), but more typically between 10% and 30% sagebrush cover. Other shrubs may be present – especially spiny hopsage (*Grayia spinosa*) up to approximately 5% cover. The understory may be dominated by any of several species of native bunchgrass including needle-and-thread (*Hesperostipa comata*), Indian ricegrass (*Achnatherum hymenoides*), or Sandberg's bluegrass (*Poa secunda*), or it may be dominated by cheatgrass (*Bromus tectorum*) or a combination of these species. Sagebrush dominated communities account for approximately 36% of the land area within the broadly defined Central Plateau. The northern part of the BC Controlled Area contains this type of habitat.

2.1.3 Cultural Resources

During removal action activities, personnel will be directed to watch for any potential cultural or archaeological resources. If any are encountered, work in the vicinity of the discovery must stop until an archaeologist has been notified, assessed the significance of the find, and if necessary arranged for the mitigation of impacts to the find.

Prior to implementation of the selected alternative, any mitigation will be completed per the *Programmatic Agreement Among the U.S. Department of Energy, Richland Operations Office, The Advisory Council on Historic Preservation, and the Washington State Historic Preservation Office for the Maintenance, Deactivation, Alteration, and Demolition of the Built Environment on the Hanford Site, Washington* (DOE/RL-96-77).

2.2 WASTE SITE DESCRIPTION

The northern part of the BC Controlled Area is a geographical area approximately 1,500 hectares (3,800 acres) in size. Figure 2-2 shows the conceptual site model identifying the Zone A and Zone B radiological contamination areas within the northern BC Controlled Area. The BC Controlled Area waste site was divided into separate regions based on past historical information and recent analytical sampling events, as was discussed in *Historical Site Assessment of the Surface Radioactive Contamination at BC Controlled Area* (WMP-18647). The northern part of the BC Controlled Area is the region of the BC Controlled Area that is located north of the sand dunes that cross the controlled area from east to west. The northern part of the BC Controlled Area addressed by this EE/CA does not include the BC Cribs and Trenches; however, it does include a region referred to as "Zone A," which has the highest levels of contamination from cesium-137 and strontium-90 within the BC Controlled Area. The remainder of the northern part of the BC Controlled Area ("Zone B") contains detectable amounts of contamination; however, these are generally considered to be of lower risk. The southern part of the BC Controlled Area, the region south of and including the sand dunes, is not addressed by this EE/CA.

The BC Controlled Area waste site is the result of unplanned releases of contamination, primarily from the BC Cribs and Trenches, as summarized in Section 2.3. For the purposes of this EE/CA, the term "BC Cribs and Trenches" will include the area immediately surrounding the cribs and trenches assigned

to the 200-BC-1 OU, the shallow pipeline burial trench, and waste sites 200-E-14, 200-E-114-PL and 200-E-222-PL.

Several firebreak roads exist within the northern part of the BC Controlled Area, which will allow travel within the northern region of the waste site. Buried equipment (e.g., inactive lead sheathed telephone lines) can also be found in this region. The northern part of the BC Controlled Area also contains 200-E-101 200 East Deep Lysimeter Site, previously identified in Section 1.4 as out of scope for this EE/CA. This site is identified in the site diagram of Attachment 1 of this EE/CA. The 200-E-101 200 East Deep Lysimeter Site has been assigned to the 200-MG-1 OU. Activities planned to prevent disturbance of this waste site include locating the site and placing radiological postings around the area prior to the BC Controlled Area removal action. The final remedial action for the 200-E-101 200 East Deep Lysimeter Site will be documented in the 200-MG-1 ROD.

Also contained within the northern part of the BC Controlled Area is a borrow pit located to the north of the BC Cribs and Trenches. This pit is a shallow, scraped area that provided the clean backfill material needed to surface stabilize the BC Cribs and Trenches in the early 1980s. No waste was placed in the borrow pit from that activity. During the BC Controlled Area removal action, this borrow pit will be surveyed to verify that no surface contamination is present in this location.

2.3 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

This section provides a summary of the source of the unplanned contaminated release and the nature and extent of this contamination.

Historical Site Assessment of the Surface Radioactive Contamination at BC Controlled Area (WMP-18647) contains detailed information on the BC Controlled Area and a narrative of the contamination sources. According to WMP-18647, the BC Cribs and Trenches are known to be the source of the BC Controlled Area contamination. The BC Cribs and Trenches were constructed in 1955 and received radioactive discharges of waste from two general sources: the uranium recovery project and 300 Area wastes, with the majority of the waste coming from the uranium recovery project.

During the period of 1958 until 1960, animal intrusions into the trenches occurred. In 1969, about 46,000 m^3 (60,000 yd^3) of sand and gravel were used to cover and stabilize the BC Trenches thus stopping most of the remaining spread of contamination from these sources by animals. When the trenches were covered, it was identified that an adjacent area of about 10 km^2 (4 mi^2) was contaminated.

During 1972 to 1974, a program was implemented to study the distribution of the contamination and the mechanisms that could spread the contamination. This program included aerial gamma surveys of the BC Controlled Area, soil and in-situ exposure rate measurements, and a study of the physical and biological forces that could be spreading the contamination. The primary radionuclides found in the soil were cesium-137 and strontium-90. Other radionuclides also present included plutonium-239/240, europium-155, cobalt-60, and americium-241; however, more recent sampling has not identified detectable contamination from these radionuclides. Animals, tumbleweeds, and strong winds were identified as the contributors to the spread of radionuclide contamination.

In August 1974, it was concluded, that there was no indication of undue risk to the public and employees from the BC cribs and trenches and, therefore, no immediate action was necessary to decontaminate the BC Controlled Area (as identified at that time; 10 km^2 [4mi^2]) (WMP-18647). However, by the late 1970s and early 1980s, stabilization measures of the BC cribs and trenches that had been taken in the 1960s had failed and contamination was spreading into the BC controlled area, primarily due to contaminated tumbleweed and animal intrusions (WMP-18647). In 1982, additional stabilization was

completed of the BC Cribs and Trenches area. Discoveries of contamination in the BC Controlled Area continued to occur after this stabilization.

Aerial surveys in 1973, 1978 and 1988 showed varying amounts contamination by cesium-137 (aerial gamma survey results show approximately 15 percent of the total activity present at the time of the survey), with the highest levels in areas immediately adjacent the BC Cribs and Trenches. Additional characterization activities occurred throughout these years, as described in WMP-18647, all of which agree on the basic distribution of the contamination: the highest level of contamination is in the area south of the trenches (Zone A); an arm of the contaminated area extends toward the southeast; an arm of the contamination extends toward the southwest; a contaminated area exists west of Isochem Avenue and along Isochem Avenue; and contamination exists south of Rockwell Street and extends into the dunes (sparse contamination) that run generally east to west. The contamination shown in these surveys corresponds to the northern part of the BC Controlled Area (except for the sand dunes).

By late January or early February 1997, additional surveys had been completed that determined that either many contaminated spots would have to be posted as radiologically controlled areas or a larger area containing the contaminated spots would need to be established. Based on these findings, the area bounded by the Army Loop Road was established as the BC Controlled Area. This action expanded the posted area associated with the BC Cribs and Trenches from approximately 10 km^2 (4 mi^2) to approximately 34.7 km^2 (13.4 mi^2); this is the current waste site boundary as identified in WIDS.

An assessment of the nature and extent of contamination of the BC Controlled Area is described in greater detail in the *200-UR-1 Unplanned Release Waste Group Operable Unit Remedial Investigation/Feasibility Study Work Plan* (DOE/RL-2004-39) and WMP-18647, along with identification of supporting sources of historical information. In addition, recent analytical sampling of this area was conducted under the *200-UR-1 Unplanned Release Waste Group Operable Unit Sampling and Analysis Plan* (DOE/RL-2006-50) and the *Sampling and Analysis Instruction for BC Controlled Area Soil Characterization* (D&D-24693).

Past historical and recent characterization information shows that within the northern part of the BC Controlled Area is a zone of continuous radiological contamination, confirmed by both radiological screening and analytical measurements. This continuous zone is known as "Zone A" of the BC Controlled Area. The remainder of the Northern part of the BC Controlled area is non-continuous radiological contamination, generally being more dispersed to the South. This section is known as "Zone B"; this area contains differing levels of contamination than Zone A. Zone B contains what is sometimes referred to as "hotspots" of contamination. See Figure 2-2 for approximate sizes of Zone A and Zone B.

Contamination in the northern part of the BC Controlled Area is believed to be bound to the soil; cesium-137 and strontium-90 are the primary radiological contaminants. Sampling in 1999 showed that strontium surface soil concentrations range from 0.32 to 3420 pCi/g across the northern part of the BC Controlled Area. Cesium-137 surface soil concentrations range from 0.35 to 2290 pCi/g across the area. Thus, the surface soil concentrations of cesium-137 and strontium-90, the two radionuclides likely to deliver the greatest dose to a recipient, vary widely across the northern part of the BC Controlled Area. According to WMP-18647, soil depth profiles of activity are also expected to vary. Recent analytical data has shown the bulk of activity in places with contamination due to biological transport mechanisms (i.e., spread from animals) is primarily in the top 15 cm (6 in.) of soil, but is greater in some areas. For areas contaminated due to non-biological transport mechanisms (i.e. windblown contamination), primarily in Zone B, the radionuclides are probably in the top 2.5 cm (1 in.) of soil, except for strontium-90, which is distributed down about 6-in, based on sample results. The top inch is expected to contain about

40 percent of the strontium-90. Depth profiles are discussed in greater detail in Section 3.5 of WMP-18647.

2.4 RELEASE OR THREATENED RELEASE INTO THE ENVIRONMENT OF A HAZARDOUS SUBSTANCE OR POLLUTANT OR CONTAMINANT

Animal intrusions into the BC Cribs and Trenches, as well as wind dispersal of contaminated soils, are considered to be the most significant sources of contamination in the BC Controlled Area. Other contributing contamination mechanisms include contaminated tumbleweeds and radiological releases from the Plutonium-Uranium Extraction (PUREX) Plant in 1960. As stated previously, WMP-18647 contains extensive characterization information about the BC Controlled area and its contaminants of concern.

More recent characterization activities were conducted when the BC Controlled Area was identified as a candidate site for completion of the CERCLA RI/FS process (DOE/RL-2004-39). Data quality objective (DQO) processes was used to identify the data needs to determine the extent of radioactive and chemical contamination. In addition, earlier Central Plateau terrestrial ecological data quality objectives (EcoDQO) summary reports included an evaluation of the BC Controlled Area (WMP-25493, *Central Plateau Terrestrial Ecological Risk Assessment Data Quality Objectives Summary Report – Phase II*). The scope of the Central Plateau EcoDQO was to support the Central Plateau ecological risk assessment and, ultimately, remedial action decision making. DOE/RL-2006-50 provided a sampling strategy and analytical requirements for the BC Controlled Area and D&D-24693 addressed characterization of soils in the BC Controlled Area focusing on nonradiological contaminants.

Waste Sites in the 200-UR-1 OU currently are being evaluated via the CERCLA RI/FS process for final remedial decision, and final remedial action goals are not yet established. Therefore, this removal action will use the 200-UR-1 OU radionuclide soil cleanup preliminary remediation goals (PRGs) identified in DOE/RL-2006-50. As an operational guideline, preventing exposure to below a dose rate limit of 15 mrem/yr above background is in agreement with the EPA's radionuclide soil cleanup guidance, as described in OSWER Directive 9200.4-18, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* (EPA 1997). A dose rate limit of 15 mrem/yr above background generally controls risk to less than the EPA excess lifetime cancer risk threshold, which ranges from 10^{-6} to 10^{-4}.

Attachment 2 contains a detailed map showing a summary of the data collection locations. This shows the different isopleths of radioactivity concentrations, based on PRGs of two times the human health unrestricted exposure levels (6.2 pCi/g for cesium-137 and 4.5 pCi/g for strontium-90. This screening level accounts for the short decay time frame (approximately 30 years) for cesium-137, the radionuclide that was screened. Using the 30 year decay was determined to still be protective for ecological receptors, which have protective concentration guidelines of 20.8 pCi/g for cesium-137 and 22.5 pCi/g for strontium-90. The conclusion of the characterization results for the BC Controlled Area shows that cesium-137 and strontium-90 are the only known radioactive contaminants of concern. The map in Attachment 2 shows varying isopleths of contamination that justify splitting the northern BC Controlled Area into Zone A and Zone B. Zone A is identified in this EE/CA as the area with continuous radiological contamination over the PRGs and presents the greatest risk to human health and the environment. Zone A is located directly south of the BC Cribs and Trenches area. Zone B contains discrete areas of contamination above PRG levels; these areas are not continuous throughout the zone and therefore require a different removal action strategy. For Zone A, the results showed that the majority of contamination is contained in the upper 15.2 cm (6 in.). For Zone B, the contamination primarily resides in the top 2.5 cm (1 in.) of soil.

Samples were taken in 2005 and 2007 to determine if nonradioactive contamination existed above action levels in the BC Controlled Area. All average and maximum concentrations for metals and other chemical constituents were below the limits for human and ecological risk identified in *Washington Administrative Code* (WAC) 173-340-740, "Unrestricted Land Use Soil Cleanup Standards", with one maximum detection value for selenium exceeding the ecological screening values. However, these values were consistent with Hanford Site background for selenium, which is above the ecological screening values from WAC 173-340-740. Therefore, no nonradioactive constituents of concern were identified for the northern part of the BC Controlled Area for this removal action. The 200-UR-1 OU feasibility study will evaluate the selenium value and site specific data at the BC Controlled Area to determine if there is a threat to human health and the environment.

The results of the characterization effort through 2007 are summarized in Table 2-1 for the known contaminants of concern for the northern BC Controlled Area. The half-life for Cs-137 and Sr-90 is approximately 30 years; preliminary evaluations have estimated that the Cs-137 and Sr-90 levels will not decay to below unrestricted exposure levels for at least 130 years, and beyond for areas with the maximum detected values of contamination.

Table 2-1. Summary of 200-UR-1 OU BC Controlled Area Radioactive Contamination.

Average and Maximum Detected Values for Radionuclides above 1 pCi/g in BC Controlled Area Zone A			
		Cs-137	**Sr-90**
Detected Values	Number of Detected Values	30	29
	Average	164.5 pCi/g	303.2 pCi/g
	Maximum	1,820 pCi/g	4,700 pCi/g
200-UR-1 OU Preliminary Remediation Goals	Human Health Unrestricted Exposure	12.4 pCi/g[1]	9 pCi/g[1]
	Human Health Industrial Exposure	25 pCi/g	2,500 pCi/g
	Ecological Biota Concentration Guidelines	20.8 pCi/g	22.5 pCi/g

[1]The PRGs for Cs-137 and Sr-90 are based on two times the unrestricted exposure levels. These PRGs were based on using one 30-year decay period for both contaminants.

The PRG levels based on the 200-UR-1 OU work plan (DOE/RL-2004-39) and SAP (DOE/RL-2006-50) are included for comparison in Table 2-1. Final remedial action goals (cleanup levels) for the BC Controlled Area will be established in future 200-UR-1 OU remedial decision documents.

Recently, radiological surveys concluded that contamination levels within the southern part of the BC Controlled Area, and specifically within the sand dunes, were not sufficient to warrant classification as a Soil Contamination Area (SCA) and demonstrated that the SCA posting may be removed. These radiological downposting requirements were consistent with the 200-UR-1 OU PRGs for protection of human health and the environment. Therefore, this EE/CA does not address the southern part of the BC Controlled Area; this southern part of the BC Controlled Area final remedial alternatives will be evaluated in the 200-UR-1 OU RI/FS process.

2.5 RISK EVALUATION AND SITE CONDITIONS THAT JUSTIFY A REMOVAL ACTION

The NCP, 40 CFR, Section 300.415(b)(2), establishes factors to be considered in determining the appropriateness of a removal action. One factor identifies weather conditions that may cause hazardous

substances or pollutants or contaminants to migrate or be released. Hazardous substances in the northern part of the BC Controlled Area are present as radiological contamination at and below the surface soils. Severe weather and wind erosion can result in radiological releases. This could cause a threat to human health and the environment by direct exposure to nearby humans/animals and the environment, and exposure to the public through possibly airborne radioactive contaminants.

Without removal of some of the contaminated soil in the northern part of the BC Controlled Area weather conditions such as wind and rainfall, etc., could contribute to the spread of contamination outside of the BC Controlled Area boundaries. Summer wildfires that occur in the region could also further spread contamination in the area. In addition, the primary spread of contamination in the BC Controlled Area from the BC Cribs and Trenches was by animal intrusion. If contamination is present above ecological protection levels, ecological receptors may be contaminated by ingesting contaminated material. Additional biological discharges from contaminated animals could further contribute to the spread of contamination.

A potential for the spread of hazardous substances from the northern part of the BC Controlled Area that could result in an increased radiation, inhalation, and ingestion risk justify this CERCLA removal action.

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3.0 REMOVAL ACTION OBJECTIVES

This chapter discusses the objectives to be attained by the alternatives evaluated to reduce the risk associated with the northern part of the BC Controlled Area. The removal action objectives were developed in conjunction with the proposed remediation objectives for the 200-UR-1 OU, reasonable anticipated land use[7], contaminants of concern, potential ARARs, and potential exposure pathways. This removal action is an interim step in support of the 200-UR-1 OU remedial actions and implements a removal, treatment, and disposal (RTD) remedial alternative for Zone A and areas of elevated risk in Zone B region of BC Controlled Area.

The following removal action objectives (RAOs) were developed for this removal action, which were based on the preliminary remedial action objectives for the 200-UR-1 OU:

- Removal Action Objective 1 – Provide conditions suitable for the reasonable anticipated future land use and protect human health and ecological receptors, respectively, by
  - Preventing exposure to radiological constituents at concentrations that will cause a dose rate limit of 15 mrem/yr above background [OSWER Directive 9200.4-31P, EPA/540/R-99/006, *Radiation Risk Assessment At CERCLA Sites: Q & A* (EPA 1999), which is a to-be-considered criteria]. A dose rate limit of 15 mrem/yr above background generally controls risk to less than the EPA excess lifetime cancer risk threshold, which ranges from 10^{-6} to 10^{-4}.
  - Protecting ecological receptors based on a dose rate limit of 0.1 rad/day for terrestrial wildlife populations [DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*, which is a to-be-considered criteria].
- Removal Action Objective 2 – Prevent adverse impacts to cultural resources and threatened or endangered species, and minimize wildlife habitat disruption.

[7] While both industrial (inside the Core Zone) and conservation/mining (outside the Core Zone) land use scenarios apply to the northern part of the BC Controlled Area, final cleanup levels have not been established for the BC Controlled Area and the 200-UR-1 OU. Therefore, the preliminary removal goals (PRGs) for human health and environmental protection will be based on the 200-UR-1 OU PRGs, consistent with unrestricted land use, to preclude the need for additional cleanup in the future.

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4.0 DISCUSSION OF ALTERNATIVES

The following three removal action alternatives were identified for evaluation in this EE/CA:

- Alternative One: No Action
- Alternative Two: Monitored Natural Attenuation/Institutional Controls (MNA/ICs)
- Alternative Three: RTD

Consistent with guidance established by the U.S. Office of Management and Budget (OMB), present-worth analysis is used as the basis for comparing costs of cleanup alternatives under the CERCLA program (*Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, OMB 2006). For purposes of this evaluation, present-worth (discounted) cost values were calculated using a discount rate of 3.0% (OMB 2006). Because of the time-dependent value of money, future expenditures were not considered directly equivalent to current expenditures. The present-worth cost method shows the amount required at the initial point in time (e.g., in the current year) to fund activities occurring over the life of the alternative. Present-worth analysis assumes that the funding set aside at the initial point in time increases in value as time goes on, similar to how money placed in a savings account gains in value as a result of interest paid on the account. Although the federal government typically does not set aside funds in this manner, the present-worth analysis is specified under CERCLA as the approach for establishing a common baseline to evaluate and compare alternatives that have costs occurring at different times, though actual costs could vary. While the funds actually might not be set aside, the present-worth costs were considered directly comparable for the purpose of evaluating alternative costs.

In contrast with the present-worth costs, the total nondiscounted costs do not take into account the value of money over time. The nondiscounted cost method displays the total costs occurring over the entire duration of an alternative, with no adjustment (or discounting) to reflect current year or set aside cost based on an assumed interest rate. Because nondiscounted costs do not reflect the changing value of funds over time, presentation of this information under CERCLA is for information purposes only, not for response action alternative selection purposes.

Details on the removal alternative estimates are discussed in *Cost Estimate for the Engineering Evaluation/Cost Analysis for BC Controlled Area Removal Action* (D&D-35703).

4.1 ALTERNATIVE ONE: NO ACTION

The no-action alternative is required as a baseline for evaluating removal action alternatives. The no-action alternative represents a situation where no legal restrictions, institutional controls (ICs), access controls, or active removal action measures are applied to the waste site. No surveillance, maintenance or other activities are instituted or continued. Because no removal action activities would be implemented with the no-action alternative, human health and environmental risks from the northern part of the BC Controlled Area would remain until the final remedial actions for the 200-UR-1 OU are completed.

4.1.1 Cost Estimate For Alternative One: No Action

The No-Action alternative assumes no activities will be taken at the northern part of the BC Controlled Area. As a result, there are no costs for this alternative.

4.2 ALTERNATIVE TWO: MONITORED NATURAL ATTENUATION/INSTITUTIONAL CONTROLS

Natural attenuation relies on natural processes to lower contaminant concentrations, while preventing migration of the contaminants until cleanup levels are met. Annual perimeter surveys would be conducted to verify that contaminants are attenuating as expected and source control is being maintained. Sign maintenance is required as part of the ICs.

The *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions* (DOE/RL-2001-41) describes how the ICs are implemented and maintained and serves as a reference for the selection of ICs in the future. ICs generally include non-engineered restrictions on activities and access to land, groundwater, surface water, waste sites, waste-disposal areas, and other areas or media that contain hazardous substances. This is to minimize the potential for human exposure to the substances. Common types of ICs include procedural restrictions for access, warning notices, permits, easements, deed notifications, leases and contracts, and land-use controls. This alternative does not include maintaining existing clean soil cover, as the BC Controlled Area does not currently have a clean soil cover over the contamination. Also, soil stabilization fixatives are not included; the large size of this area makes this stabilization technique ineffective and repeated applications could cause increased damage to the environment.

The MNA/ICs alternative applies to the entire northern part of the BC Controlled Area, including Zone A. This alternative, which represents continuing activities as currently performed, is estimated to have a 50-year project duration based on an active IC period of no less than 50 years, consistent with the HCP-EIS (DOE/EIS-0222-F). A period of passive ICs may follow this 50 year active IC period; however, the costs for passive ICs are not included in the cost estimate for Alternative Two.

4.2.1 Cost Estimate For Alternative Two: Monitored Natural Attenuation/Institutional Controls

The costs associated with natural attenuation monitoring include radiological surveys of surface soils. The costs to perform radiological surveys of surface soils are assumed similar to those for current survey practices at the BC Controlled Area and are included in the surveillance and maintenance costs. Costs are included for signage replacement for 50-year duration. The cost estimates for Alternative Two are shown in Table 4-1. The present-worth (discounted) cost (as defined below) for Alternative Two is approximately $0.98 million. The total nondiscounted cost for Alternative Two is approximately $1.9 million.

Table 4-1. Cost Estimate for Alternative Two: Monitored Natural Attenuation/Institutional Controls.

Item	Estimated cost ($1,000)
Nondiscounted	1,900
Present-Worth (Discounted)	970

Note: Details on the removal alternative estimates are discussed in (D&D-35703).

4.3 ALTERNATIVE THREE: REMOVE, TREAT, AND DISPOSE

Under this alternative, contaminated soil above identified PRGs would be removed (by conventional excavation equipment) and transported in direct haul trucks. It is planned to dispose of the waste at an appropriate onsite facility (i.e., ERDF). It is not expected that the contaminated soil will require treatment to meet disposal facility waste acceptance criteria. Soil removal would be guided by the observational approach: a method of planning, designing, and implementing a removal action that relies on information

(e.g., samples, field screening) collected during the removal to guide the direction and scope of the activity. The data collected would be compared against the PRGs to determine if the removal action has met its objectives.

For this alternative, it is assumed that for Zone A, removal of contaminated soil is anticipated to a depth of approximately 15 cm (6 in.) or to PRGs, to the extent practicable. For Zone B, targeted removals of higher contamination areas are considered where contamination above screening levels is localized in known locations (see Attachment 2 for radiological survey information that identifies these areas).

The RTD alternative applies to the entire Zone A and to the areas of elevated radioactivity above the PRGs in Zone B of the BC Controlled Area. Near surface soil excavations must consider old-growth conservation and avoid destruction of existing plant life by using the smallest footprint for sizing equipment whenever possible. Clean backfill would be provided where necessary. Once the removal is complete, the affected areas within the northern part of the BC Controlled Area will be contoured and revegetated. Revegetation of the northern part of the BC Controlled Area, as an upland late-successional shrub-steppe, will follow the requirements in the *Hanford Site Biological Resources Mitigation Strategy*, DOE/RL-96-88. Prior to initiation of the removal action, an evaluation will be performed to determine the quality level of habitat disturbed and the compensatory mitigation required.

Also, surveillance and maintenance of the northern part of the BC Controlled Area will continue until final remediation decisions are implemented.

4.3.1 Cost Estimate for Alternative Three: Remove, Treat, and Dispose

The cost estimates for Alternative Three are shown in Table 4-2. The present-worth (discounted) cost for Alternative Three is approximately $37 million. The total nondiscounted cost for Alternative Three is approximately $38 million.

Table 4-2. Cost Estimate for Alternative Three: Remove, Treat, and Dispose.

Item	Estimated cost ($1,000)
Nondiscounted	38,400
Present-Worth (Discounted)	36,600

Note: Details on the removal alternative estimates are discussed in (D&D-35703).

For cost estimating purposes, removal of the entire Zone A is assumed at a 30 cm (1 ft) depth. While most contamination is anticipated within the top six inches of soil (WMP-18647), removal of the top 30 cm (1 ft) of the entire Zone A is assumed to compensate for areas where contamination might have penetrated deeper.

In Zone B, the areas of contamination that will need removal are irregular and vary throughout the zone in size and depth. For cost estimating purposes, this EE/CA estimated approximately 1000 removal areas assumed to be 1.8m long x 1.8 m wide x 15 cm (6 ft long x 6 ft wide x 6 in) deep. This assumption should bracket the variety of sizes of area and depths of removal in Zone B.

The total volume of excavated contaminated soil for both Zone A and Zone B is approximated to be 181,000 m^3 (237,000 yd^3). This volume of contaminated soil is estimated to weigh 327,000 tons. The cost for disposal of this soil at ERDF was based on FY2007 disposal rates of $23.94 per ton of soil, as disposal costs for this project at ERDF are not finalized. Disposal rates for this project are expected to significantly decrease from FY2007 rates due to the large volume of material disposed.

No waste debris including concrete, pipe, etc. is anticipated. The duration of contaminated soil removal and re-vegetation activities is approximately 990 days or four years.

The field work such as mobilization/demobilization, excavation, revegetation, and some post construction work will be contracted to the plant construction forces contractor or equivalent forces. The project management, radiological control technician support, sampling, and safety oversight will be performed by the plateau remediation contractor.

Prior to the removal action, an assessment of the quality level habitat of the BC Controlled Area will be performed as outlined in DOE/RL-96-88, to determine the required mitigation for the disturbance of the area. For the purposes of the cost estimate, the BC Controlled Area removal action is estimated to will require a 3:1 compensatory mitigation, which is based on the predicted disturbed area quality of habitat. Specific resources for the revegetation 3:1 compensatory mitigation are defined in DOE/RL-96-88.

Follow-on surveillance and maintenance of the northern part of the BC Controlled Area is assumed to continue for 50 years. The cost estimate for Alternative 3 includes conducting site reviews every 5 years to ensure the follow-on surveillance and maintenance are effective.

5.0 ANALYSIS OF ALTERNATIVE

CERCLA requires that non-time-critical removal action alternatives be evaluated against three criteria: effectiveness, implementability, and cost. To provide a more comprehensive evaluation, the criterion of effectiveness is divided into subcriteria that are consistent with the requirements for CERCLA actions. The removal action alternatives are evaluated against the following subcriteria:

- Effectiveness
  - Overall protection of human health and the environment
  - Compliance with ARARs
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, or volume through treatment
  - Short-term effectiveness.
- Implementability
- Cost.

State and public acceptance would be evaluated after Ecology and the public have had an opportunity to review and comment on this EE/CA. Each criterion is explained briefly in the following sections; a detailed analysis of each alternative relative to each criterion follows. Finally, the alternatives are compared against one another relative to each criterion. The alternatives are reiterated below:

- Alternative One: No Action
- Alternative Two: MNA/ICs
- Alternative Three: RTD.

5.1 EFFECTIVENESS

The effectiveness criterion refers to the ability to meet the removal objectives (as outlined in Chapter 3.0) within the scope of the removal action and in terms of overall protection of public health and the environment.

5.1.1 Overall Protection of Human Health and the Environment

This criterion evaluates whether an alternative achieves adequate overall elimination, reduction, or control of risks to human health and the environment posed by the likely exposure pathways. Reducing the potential threat to acceptable levels is a CERCLA threshold requirement and is the primary objective of the removal action. The evaluation of this criterion was based on qualitative analysis and assumptions regarding the radionuclides inventory.

Alternative One does not provide overall protection to human health and the environment. Over time with no ongoing maintenance, contamination could spread potentially exposing Hanford Site personnel, the local environment, and possibly the public to an unacceptable radiation dose. This alternative does not meet the threshold requirement of meeting overall protection of human health and the environment, especially in the long term.

Alternative Two provides adequate overall protection of human health and the environment in the short-term. However, Alternative Two would not remove any radioactive inventory or other hazardous substances increasing the potential for spread of contaminants over time (which does not ensure satisfaction of Removal Action Objective 2). The effort and funding to provide surveillance and maintenance and ICs required would continue for many years until activity decays to acceptable levels;

however, the contamination levels are expected to remain above levels that are protective of human health and the environment past the 50-year IC period, for a period of approximately 132 years. Therefore, remedial actions for the northern part of the BC Controlled Area potentially could be required to provide overall protection of human health and the environment.

Alternative Three would remove the majority of the radioactive inventory present at the northern part of the BC Controlled Area. This would reduce or eliminate release pathways to the environment and meet the removal action objectives. Under Alternative Three, remaining subsurface contamination, if any, would be characterized for possible future remediation. Removal of contaminated soil will mitigate the hazard such that future remedial action will not be necessary to protect human health and the environment.

Relative to Alternative Three, Alternative Two does not perform as well under this criterion. Alternative Three is the most protective of Human Health and the Environment. Alternative One is unacceptable and is not evaluated further.

5.1.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

For a site where material will remain on-site after completion of a CERCLA action, the level or standard of control that must be met for the hazardous substance, pollutant, or contaminant is at least that of any applicable or relevant and appropriate standard, requirement, criteria, or limitation under any Federal environmental law, or any more stringent standard, requirement, criteria, or limitation promulgated pursuant to a State environmental statute. An applicable requirement is one with which a private party would have to comply by law if the same action was being undertaken apart from CERCLA authority. All jurisdictional prerequisites of the requirement must be met in order for the requirement to be applicable. A requirement that is relevant and appropriate may "miss" on one or more jurisdictional prerequisites for applicability but still make sense at the site, given the circumstances of the site and release.

Response actions are required to comply with the substantive aspects of ARARs, not with corresponding administrative requirements. That is, permit applications and other administrative procedures, such as administrative reviews, and reporting and recordkeeping requirements, are considered administrative for actions conducted entirely onsite [40 CFR 300.400(e)] and therefore not required.

For the removal action being considered in this document, implementation of any selected alternative will be designed to comply with the ARARs cited in this section to the extent practicable. ARARs are selected from promulgated environmental regulations that have been evaluated to determine whether they are pertinent to the removal action. The purpose of this section is to identify the key ARARs proposed for the alternatives addressed in this EE/CA. ARARs which will be complied with during implementation of the selected removal action, will be documented in the CERCLA Action Memorandum. The proposed ARARs are discussed generally in the following sections and are documented in detail in Tables 5-1 and 5-2. In addition, To-Be-Considered information consists of nonpromulgated advisories or guidance issued by federal or state governments that are not binding legally and do not have the status of potential ARARs. As appropriate, To-Be-Considered should be considered in determining the removal action necessary for protection of human health and the environment. For the BC Controlled Area, these proposed removal action ARARs are consistent with the proposed 200-UR-1 OU preliminary ARARs, and are expected to be the ARARs selected in the final Record of Decision.

5.1.2.1 Waste Management Standards

It is anticipated that most of the waste will designate as low-level waste (LLW) in a solid form.

Radioactive waste is governed under the authority of the *Atomic Energy Act of 1954.*

The identification, storage, treatment, and disposal of hazardous waste and the hazardous component of mixed waste are governed by *Resource Conservation and Recovery Act* (RCRA) *of 1976.* The State of Washington, which implements RCRA requirements under WAC 173-303, has been authorized by the EPA to implement most elements of the RCRA program. The dangerous waste standards for generation and storage will apply to the management of any dangerous or mixed waste generated at the northern part of the BC Controlled Area. Treatment standards for dangerous or mixed waste subject to RCRA land disposal restrictions are specified in WAC 173-303-140, which incorporates 40 CFR 268 by reference.

Waste that is designated as LLW that meets ERDF acceptance criteria is assumed to be disposed at ERDF, which is engineered to meet appropriate performance standards. Alternate potential disposal locations may be considered when the removal action occurs if a suitable and cost effective location is identified. Any potential alternate disposal location will be evaluated for appropriate performance standards to assure that it is adequately protective of human health and the environment.

Waste designated as dangerous or mixed waste would be treated as appropriate to meet land disposal restrictions and ERDF acceptance criteria and disposed at ERDF. ERDF is engineered to meet minimum technical requirements for landfills under WAC 173-303-665. Applicable packaging and pre-transportation requirements for dangerous or mixed waste generated at the northern part of the BC Controlled Area would be identified and implemented before movement of any waste.

It is anticipated that Alternatives Two and Three can be performed in compliance with these waste management ARARs, identified in Section 5.1.2.1. Waste streams will be evaluated, designated, and managed in compliance with the potential ARAR requirements. Before disposal, waste will be managed in a protective manner to prevent releases to the environment or unnecessary exposure to personnel.

5.1.2.2 Standards Controlling Emissions to the Environment

The proposed removal action alternatives have the potential to generate both radioactive and nonradioactive airborne emissions.

The Revised Code of Washington (RCW) 70.94, "Washington Clean Air Act," requires regulation of radioactive air pollutants. The state implementing regulation WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides," sets standards that are as stringent or more so than the federal *Clean Air Act of 1990* and Amendments (42 United States Code 7401 et seq.), and under the federal implementing regulation, 40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities." EPA's partial delegation of the 40 CFR 61 authority to the State of Washington includes all substantive emissions monitoring, abatement, and reporting aspects of the federal regulation. The state standards protect the public by conservatively establishing exposure standards applicable to even the maximally exposed public individual. Under the Washington Administrative Code (WAC 246-247-030(15), the "Maximally exposed individual" (MEI) is any member of the public (real or hypothetical) who abides or resides in an unrestricted area, and may receive the highest TEDE from the emission unit(s) under consideration, taking into account all exposure pathways affected by the radioactive air emissions. All combined radionuclide airborne emissions from the DOE Hanford Site "facility" are not to exceed amounts that would cause an exposure to any member of the public of greater than 10 mrem/yr effective dose equivalent. The state implementing regulation WAC 246-247, "Radiation Protection – Air Emissions," which adopts the WAC 173-480 standards and the 40 CFR 61, Subpart H standard, requires verification of compliance with the 10 mrem/yr standard, and would potentially be applicable to the removal action.

The WAC 246-247 further addresses emission sources emitting radioactive airborne emissions by requiring monitoring of such sources. Such monitoring requires physical measurement of the effluent or ambient air. The substantive provisions of WAC 246-247 that require monitoring of radioactive airborne emissions would potentially be applicable to the removal action.

The above state implementing regulations further address control of radioactive airborne emissions where economically and technologically feasible [WAC 246-247-040(3) and -040(4), "Radiation Protection - Air Emissions," "General Standards," and associated definitions]. To address the substantive aspect of these potential requirements, best or reasonably achieved control technology could be addressed by ensuring that applicable emission control technologies (those successfully operated in similar applications) would be used when economically and technologically feasible (i.e., based on cost/benefit). If it is determined that there are substantive aspects of the requirement for control of radioactive airborne emissions once ARARs are finalized, then controls will be administered as appropriate using reasonable and effective methods.

Alternatives Two and Three are expected to comply with these standards.

Table 5-1. Identification of Proposed Federal Applicable or Relevant and Appropriate Requirements and To Be Considered for the Removal Action.

	ARAR or TBC	Requirement	Rationale for Use
National Archaeological and Historic Preservation Act of 1976 16 USC 469aa-mm	ARAR	Requires that removal actions at 200-UR-1 OU waste sites do not cause the loss of any archaeological or historic data. This act mandates preservation of the data and does not require protection of the actual waste site.	Archeological and historic sites have been identified within the 100 and 200 Areas, therefore the substantive requirements of this act are potentially applicable to actions that might disturb these sites. This requirement is location-specific.
National Historic Preservation Act of 1966 16 USC 470, Section 106	ARAR	Requires federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation and mitigation processes, and consultation with interested parties.	Cultural and historic sites have been identified within the 100 and 200 Areas, and therefore the substantive requirements of this act are potentially applicable to actions that might disturb these types of sites. This requirement is location-specific.
Native American Graves Protection and Repatriation Act, 25 USC 3001, et seq.	ARAR	Establishes federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects and items of cultural patrimony.	Substantive requirements of this act are potentially applicable if remains and sacred objects are found during remediation and will require Native American Tribal consultation in the event of discovery. This requirement is location-specific.
Endangered Species Act of 1973 16 USC 1531 et seq, subsection 16 USC 1536(c)	ARAR	Prohibits actions by federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification or critical habitat. If remediation is within critical habitat or buffer zones surrounding threatened or endangered species, mitigation measures must be taken to protect the resource.	Substantive requirements of this act are potentially applicable if threatened or endangered species are identified in areas where removal actions will occur. This requirement is location-specific.

Table 5-1. Identification of Proposed Federal Applicable or Relevant and Appropriate Requirements and To Be Considered for the Removal Action.

	ARAR or TBC	Requirement	Rationale for Use
National Primary Drinking Water Standards, 40 CFR 141			
"Maximum Contaminant Levels for Organic Contaminants," 40 CFR 141.61	ARAR	Establishes MCLs that are drinking water criteria designed to protect human health from the potential adverse effects of organic contaminants in drinking water.	The groundwater in the 200-UR-1 OU is not currently used for drinking water. However, Central Plateau groundwater may be considered a potential drinking water source and because the groundwater discharges to the Columbia River (which is used for drinking water), the substantive requirements in 40 CFR 141.61 for organic constituents are potentially relevant and appropriate. This requirement is chemical-specific.
"Maximum Contaminant Levels for Inorganic Contaminants," 40 CFR 141.62	ARAR	Establishes MCLs that are drinking water criteria designed to protect human health from the potential adverse effects of inorganic contaminants in drinking water.	The groundwater in the 200-UR-1 OU is not currently used for drinking water. However, Central Plateau groundwater may be considered a potential drinking water source and because the groundwater discharges to the Columbia River (which is used for drinking water), the substantive requirements in 40 CFR 141.62 for inorganic constituents are potentially relevant and appropriate. This requirement is chemical-specific.
"Maximum Contaminant Levels for Radionuclides," 40 CFR 141.66	ARAR	Establishes MCLs that are drinking water criteria designed to protect human health from the potential adverse effects of radionuclides in drinking water.	The groundwater in the 200-UR-1 OU is not currently used for drinking water. However, Central Plateau groundwater may be considered a potential drinking water source and because the groundwater discharges to the Columbia River (which is used for drinking water), the substantive requirements in 40 CFR 141.66 for radionuclides are potentially relevant and appropriate. This requirement is chemical-specific.
To-Be-Considered pursuant to risk evaluation			
Hanford Site End State Vision (DOE/RL-2005-57,)	TBC	Identifies the Core Zone area in the Central Plateau to evaluate risk based on future land use scenarios.	The BC Controlled Area primarily resides in areas outside the Core Zone, in areas identified for conservation/mining future land use.
To-Be-Considered pursuant to establishing radiological cleanup levels			
OSWER Directive 9200.4-31P, EPA/540/R-99/006, *Radiation Risk Assessment At CERCLA Sites: Q & A* (EPA 1999)	TBC	Identifies radiological levels that will be protective for human health	Provides basis for establishing PRGs for the BC Controlled Area for Cs-137 and Sr-90 that is protective for human receptors
DOE-STD-1153-2002, *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota*	TBC	Identifies radiological levels that will be protective for ecological receptors based on a dose rate limit of 0.1 rad/day	Provides basis for establishing PRGs for the BC Controlled Area for Cs-137 and Sr-90 that is protective for ecological receptors
Regulations pursuant to the *Resource Conservation and Recovery Act of 1976* and implemented through WAC 173-303, "Dangerous Waste Regulations".			

40 CFR 61, "National Emission Standards for Hazardous Air Pollutants."
40 CFR 141, "National Primary Drinking Water Standards."

ARAR = applicable or relevant and appropriate requirement.
CFR = *Code of Federal Regulations.*
MCL = maximum contaminant level.
OU = operable unit.
PRG = preliminary removal goal
TBC = to-be-considered.

Table 5-2. Identification of Proposed State Applicable or Relevant and Appropriate Requirements and To Be Considered for the Removal Action.

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Regulations pursuant to the *Resource Conservation and Recovery Act of 1976* and implemented through WAC 173-303, "Dangerous Waste Regulations".			
"Identifying Solid Waste," WAC 173-303-016	ARAR	Identifies those materials that are and are not solid waste.	Substantive requirements of these regulations are potentially applicable because they define how to determine which materials are subject to the designation regulations. Specifically, materials that are generated for removal from the CERCLA site during the removal action potentially would be subject to the procedures for identifying solid waste to ensure proper management. This requirement is action-specific.
"Designation of Dangerous Waste," WAC 173-303-070(3)	ARAR	Establishes the method for determining whether a solid waste is or is not a dangerous waste or an extremely hazardous waste.	Substantive requirements of these regulations are potentially applicable to materials encountered during the removal action. Specifically, solid waste generated for removal from the CERCLA site during this removal action potentially would be subject to the dangerous waste designation procedures to ensure proper management. This requirement is action-specific.
"Excluded Categories of Waste," WAC 173-303-071	ARAR	Describes those waste categories that are excluded from the requirements of WAC 173-303 (excluding WAC 173-303-050).	The conditions of this requirement are potentially applicable to removal actions identified in WAC 173-303-071 be encountered. This requirement is action-specific.
"Conditional Exclusion of Special Wastes," WAC 173-303-073	ARAR	Establishes the conditional exclusion and the management requirements of special waste, as defined in WAC 173-303-040.	Substantive requirements of these regulations are potentially applicable to materials encountered during the removal action. Specifically, the substantive standards for management of special waste are potentially applicable to the interim management of certain waste that will be generated during the removal action. This requirement is action-specific.
"Requirements for Universal Waste," WAC 173-303-077	ARAR	Identifies waste exempted from regulation under WAC 173-303-140 and WAC 173-303-170 through 173-303-9907 (excluding WAC 173-303-960). This waste is subject to regulation under WAC 173-303-573.	Substantive requirements of these regulations are potentially applicable to materials encountered during the removal action. Specifically, the substantive standards for management of universal waste are potentially applicable to the interim management of certain waste that will be generated during the removal action. This requirement is action-specific.

Table 5-2. Identification of Proposed State Applicable or Relevant and Appropriate Requirements and To Be Considered for the Removal Action.

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Land Disposal Restrictions," WAC 173-303-140(4)	ARAR	This regulation establishes state standards for land disposal of dangerous waste and incorporates by reference the Federal land disposal restrictions of 40 CFR 268 that are applicable to solid waste designated as dangerous or mixed waste in accordance with WAC 173-303-070(3).	The substantive requirements of this regulation are potentially applicable to materials encountered during the removal action. Specifically, dangerous and/or mixed waste generated and removed from the CERCLA site during the removal action for offsite (as defined by CERCLA) land disposal potentially would be subject to the identification of applicable land-disposal restrictions at the point of waste generation. The actual offsite treatment of such waste would not be ARAR to this removal action, but potentially would be subject to all applicable laws and regulations. This requirement is action-specific.
"Requirements for Generators of Dangerous Waste," WAC 173-303-170	ARAR	Establishes the requirements for dangerous waste generators.	Substantive requirements of these regulations are potentially applicable to materials encountered during the removal action. Specifically, the substantive standards for management of dangerous and/or mixed waste are potentially applicable to the interim management of certain waste that will be generated during the removal action. For purposes of this removal action, WAC 173-303-170(3) includes the substantive provisions of WAC 173-303-200 by reference. WAC 173-303-200 further includes certain substantive standards from WAC 173-303-630 and -640 by reference. This requirement is action-specific.
General Regulations for Air Pollution Sources, WAC 173-400			
Washington Clean Air Act of 1967, Ch. 70.94 and Ch. 43.21A RCW General Regulations for Air Pollution, WAC 173-400 Specific subsection: WAC 173-400-040	ARAR	The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. This section requires that all emission units use reasonably available control technology, which may be determined for some source categories to be more stringent than the emission limitations listed in this chapter.	Substantive requirements of the general standards for control of fugitive emissions are potentially applicable to removal actions at the site due to the generation of fugitive dust that occurs during excavation or other types of construction activities. These requirements are action-specific.
Specific subsection: WAC 173-400-113	ARAR	This regulation requires that methods of controls be employed to minimize the release of air contaminants resulting from new or modified sources of regulated emissions. Emissions are to be minimized through application of best available control technology.	Substantive requirements of this regulation potentially would be applicable to removal actions performed at the site if a treatment technology that emits regulated air emissions were necessary during the implementation of the removal action. This requirement is action-specific.
Controls for New Sources of Toxic Air Pollutants, WAC 173-460 Specific subsections: WAC 173-460-030 WAC 173-460-060 WAC 173-460-070	ARAR	This regulation requires that emissions of toxic air contaminants listed in the regulation be quantified, and ambient impacts evaluated. Best available control technology for toxics shall be used as determined by the lead agency to protect human health and the environment.	Substantive requirements of these regulations potentially would be applicable to removal actions performed at the site, if a treatment technology that emits toxic air emissions were necessary during the implementation of the removal action. These requirements are action-specific.

Table 5-2. Identification of Proposed State Applicable or Relevant and Appropriate Requirements and To Be Considered for the Removal Action.

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
Radiation Protection -- Air Emissions, WAC 246-247			
"Radiation Protection -- Air Emissions," WAC 246-247-035(1)(a)(ii)	ARAR	This regulation establishes requirements equivalent to 40 CFR 61, Subpart H, by reference. Radionuclide airborne emissions from the waste site shall be controlled so as not to exceed amounts that would cause an exposure to any member of the public of greater than 10 millirem per year effective dose equivalent.	Substantive requirements of this standard are potentially applicable because this removal action may include activities such as excavation, decontamination and stabilization of contaminated areas and equipment, each of which may provide airborne emissions of radioactive particulates to unrestricted areas. As a result, requirements limiting emissions potentially apply. This is a risk-based standard for the purposes of protecting human health and the environment. This requirement is action-specific.
"Radiation Protection -- Air Emissions," "Standards," WAC 246-247-040(3) WAC 246-247-040(4)	ARAR	Emissions shall be controlled to ensure that emission standards are not exceeded. Actions creating new sources or significantly modified sources shall apply best available controls. All other actions shall apply reasonably achievable controls.	Substantive requirements of this standard are potentially applicable because fugitive, diffuse and point source emissions of radionuclides to the ambient air may result from activities, such as excavation of contaminated soils and operation of exhausters and vacuums, performed during the removal action. This standard exists to ensure compliance with emission standards. These requirements are action-specific.

Table 5-2. Identification of Proposed State Applicable or Relevant and Appropriate Requirements and To Be Considered for the Removal Action.

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Monitoring, testing, and quality assurance, "WAC 246-247-075(1) and –(2) and –(4)	ARAR	Establishes the monitoring, testing, and quality assurance requirements for radioactive air emissions from major sources. Effluent flow rate measurements shall be made and the effluent stream shall be directly monitored continuously with an in-line detector or representative samples of the effluent stream shall be withdrawn continuously from the sampling site following the specified guidance. The requirements for continuous sampling are applicable to batch processes when the unit is in operation. Periodic sampling (grab samples) may be used only with lead agency prior approval. Such approval may be granted in cases where continuous sampling is not practical and radionuclide emission rates are relatively constant. In such cases, grab samples shall be collected with sufficient frequency so as to provide a representative sample of the emissions. When it is impractical to measure the effluent flow rate at a source in accordance with the requirements or to monitor or sample an effluent stream at a source in accordance with the site selection and sample extraction requirements, the waste site owner or operator may use alternative effluent flow rate measurement procedures or site selection and sample extraction procedures as approved by the lead agency. Emissions from nonpoint and fugitive sources of airborne radioactive material shall be measured. Measurement techniques may include, but are not limited to sampling, calculation, smears, or other reasonable method for identifying emissions as determined by the lead agency.	Substantive requirements of this standard are potentially applicable because fugitive and nonpoint source emissions of radionuclides to the ambient air may result from activities, such as excavation of contaminated soils and operation of exhausters and vacuums, performed during the removal action. This standard exists to ensure compliance with emission standards. These requirements are action-specific.
"Monitoring, testing, and quality assurance," WAC 246-247-075(3)	ARAR	Methods to implement periodic confirmatory monitoring for minor sources may include estimating the emissions or other methods as approved by the lead agency.	Fugitive and diffuse emissions from the excavation and related activities potentially will require periodic confirmatory measurements to verify low emissions. This requirement is action-specific.
"Monitoring, testing, and quality assurance," WAC 246-247-075(8)	ARAR	Site emissions resulting from non-point and fugitive sources of airborne radioactive material shall be measured. Measurement techniques may include ambient air measurements, or in-line radiation detector or withdrawal of representative samples from the effluent stream, or other methods as determined by the lead agency.	Fugitive and diffuse emissions of airborne radioactive material due to excavation and related activities potentially will require measurement. This requirement is action-specific.
"General Standards," WAC 246-247-040(4) and "General Standards for Maximum Permissible Emissions," WAC 173-480-050(1)	ARAR	At a minimum all emission units shall make every reasonable effort to maintain radioactive materials in effluents to unrestricted areas, as low as reasonably achievable (ALARA). Control equipment of sites operating under ALARA shall be defined as reasonably available control technology and as low as reasonably achievable control technology.	The potential for fugitive and diffuse emissions due to excavation and related activities potentially will require efforts to minimize those emissions. This requirement is action-specific.

Table 5-2. Identification of Proposed State Applicable or Relevant and Appropriate Requirements and To Be Considered for the Removal Action.

ARAR Citation	ARAR or TBC	Requirement	Rationale for Use
"Emission Monitoring and Compliance Procedures," WAC 173-480-070-(2)	ARAR	Determine compliance with the public dose standard by calculating exposure at the point of maximum annual air concentration in an unrestricted area where any member of the public may be.	Fugitive and diffuse emissions resulting from excavation and related activities potentially will require assessment and reporting. This requirement is action-specific.
To-Be-Considered pursuant to relevant waste site acceptance criteria			
Environmental Restoration Disposal Facility Waste Acceptance Criteria (BHI-00139)	TBC	This document establishes waste acceptance criteria for the Environmental Restoration Disposal Facility.	Waste destined for management at Environmental Restoration Disposal Facility must meet acceptance criteria to ensure proper disposal.

40 CFR 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities."
40 CFR 268, "Land Disposal Restrictions."
WAC 173-303, "Dangerous Waste Regulations."
WAC 173-340, "Model Toxics Control Act -- Cleanup."
WAC 173-400, "General Regulations for Air Pollution Sources."
WAC 173-460, "Controls for New Sources of Toxic Air Pollutants."
WAC 173-480, "Ambient Air Quality Standards and Emission Limits for Radionuclides."
WAC 246-247, "Radiation Protection -- Air Emissions."

ARAR = applicable or relevant and appropriate requirement.
CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980.*
CFR = *Code of Federal Regulations.*
TBC = to be considered.
WAC = Washington Administrative Code.

5.1.3 Long-Term Effectiveness and Permanence

The long-term effectiveness and permanence criterion addresses the risk after the removal action is completed. This criterion evaluates the ability of the removal action to maintain long-term reliable protection of human health and the environment, after removal action objectives have been met.

Alternative Two would be implemented until the end of its 50-year duration and would be effective at protecting human health during this time, due to the institutional control period preventing the public from exposure to the contamination. However, after the 50-year IC duration, contamination would be left in place above levels that pose an unacceptable risk to human health and the environment, based on the 200-UR-1 OU PRGs. The BC Controlled Area contamination is expected to be above these levels for a period of at least 130 years. Therefore, the risk of release would remain following the Alternative Two removal action. While this alternative is protective of human health exposure through access restrictions, it would not meet the 200-UR-1 OU RAO 1 as conditions suitable for the reasonably anticipated future land use may not be achieved until further remediation.

For Alternative Two, the effectiveness of this alternative would diminish with time due to the possibility for contamination to migrate out of the BC Controlled Area and into the soil column. Because of these continuing risks, this alternative may not provide a permanent solution and final inventory removal would still need to occur at some future time.

Alternative Three would provide greater long-term protection of human health and the environment compared to Alternative Two. This alternative would provide a permanent remedy for the purposes of meeting the removal action objectives, because it would remove the majority of contaminated soil from

the northern part of the BC Controlled Area. Surface contamination would be removed or reduced, and disposed of, allowing improved access to possible sub-surface contamination for future remedial action. This alternative has the potential to meet RAO 1 for the majority, if not all, of the northern part of the BC Controlled Area.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

This criterion refers to an evaluation of the anticipated performance of the treatment technologies that might be employed in the removal action. This criterion assesses whether the alternative permanently and significantly reduces the hazard posed through application of a treatment technology. This could be accomplished by destroying the contaminants, reducing the quantity of contaminants, or irreversibly reducing the mobility of contaminants. Reduction of toxicity, mobility, and/or volume contributes toward overall protectiveness.

No treatment is being contemplated, because cost-effective methods to reduce the toxicity, mobility, or volume of radiological constituents in this media have not been identified. Therefore, both alternatives of this removal action are anticipated to meet this criterion equally, though Alternative Three reduces mobility through placement in a controlled management facility.

5.1.5 Short-Term Effectiveness

The short-term effectiveness criterion refers to any potential adverse effects on human health (e.g., personnel or surrounding public) and the environment during the removal action implementation phases. The criterion also refers to an evaluation of the speed with which the removal action achieves protection.

Under Alternative Two, there would be a potential for exposure to personnel and the environment during the surveillance and maintenance period because personnel would be required to enter the northern part of the BC Controlled Area or conduct surveys around its perimeter. Furthermore, the speed with which full protection is achieved would be lengthy as sufficient radioactive decay or final removal of contaminant inventory would occur sometime in the future, estimated at greater than 130 years.

With regard to short-term risks to personnel and the environment during implementation, Alternative Three would increase potential exposure in relation to Alternative Two because personnel would be entering the northern part of the BC Controlled Area and handling more contaminated media. Removal of contaminated soil would inherently increase the potential for a release to the environment, especially to the air, in the near term. Strict adherence to appropriate environmental regulations and use of appropriate control technologies would mitigate the potential for releases.

Alternative Two would present a hazard of lesser magnitude but the hazards would continue for a longer period of time with the potential need for future remedial actions. Alternative Two would in the short-term better prevent adverse impacts to cultural resources and threatened or endangered species, and minimize wildlife habitat disruption (RAO 2), but this would only be temporary as final remediation would likely need to occur.

5.2 IMPLEMENTABILITY

Implementability refers to the technical and administrative feasibility of a removal action, including the availability of materials and services needed to implement the selected solution.

From a technical standpoint, Alternative Two can be implemented easily, as demonstrated by success of the surveillance and maintenance program currently ongoing at the northern part of the BC Controlled Area. Surveillance and maintenance techniques are widely used throughout the Hanford Site, and no specialized materials or services would be required. As time goes by, the primary implementation deterrent would be subjecting surveillance and maintenance personnel and the environment to continuing potential contamination exposure.

Alternative Three also can be implemented with relative ease. The specialized skills that would be required to work in a radiation contaminated area would be available within the existing workforce on the Hanford Site. ERDF already is authorized to dispose of CERCLA wastes generated on the Hanford Site (*Environmental Restoration Disposal Facility Record of Decision*, EPA et al. 1995 and 2002) that meet ERDF acceptance criteria (*Environmental Restoration Disposal Facility Waste Acceptance Criteria*, BHI-00139).

Although both of the alternatives would be implementable, Alternative Two is easier to implement in the near term because this alternative would not require the engineering, planning, and demolition activities necessary to implement Alternative Three. However, in the long term, implementation of Alternative Two could become more costly should surface soil contamination spread. Final remediation of the contaminated area as described in Alternative Three would likely eventually become necessary for Alternative Two.

None of the alternatives discussed in this report are expected to interfere with other nearby facility operations.

5.3 COST

This criterion considers the relative cost of the alternatives, to the extent that the costs can be quantified.

Total costs for each alternative as described in Sections 4.2.1 and 4.3.1 are presented in Table 5-3.

Table 5-3. Total Costs for the northern part of the BC Controlled Area Removal Action Alternatives.

Alternative	Total Cost ($1,000)	
	Present worth	Nondiscounted
Two – Monitor Natural Attenuation/Institutional Controls	976	1,875
Three – Remove, Treat, and Dispose	36,584	38,361

5.4 OTHER CONSIDERATIONS

There are several important other considerations when evaluating the removal action alternatives for the BC Controlled Area. Data collected from Phases II and III of the Ecological Risk Assessment has indicated that the BC Controlled Area is one of two areas in the Central Plateau that pose an unacceptable risk to the ecological receptors. The removal of contaminated soil from the BC Controlled Area would reduce this threat, thus accomplishing an important objective for cleanup at the Hanford Site.

The BC Controlled Area is Hanford's largest surface area waste site. The removal of contaminated soil to the PRGs would significantly reduce the area of contamination in the Central Plateau.

This removal action at this waste site would also contribute to the overall long-term clean-up goal in the 200 Area.

In addition, ERDF has current operational requirements that require soil mixing with demolition debris to achieve proper compaction in the landfill. Currently, demolition debris is being generated at a high rate by remedial activities in the 300 Area, another NPL site at Hanford. Implementation of Alternative Three would contribute to the overall Hanford Site mission of cleanup by providing the ERDF with contaminated soil to meet its soil compaction requirements for operation.

5.4.1 NEPA

In accordance with DOE NEPA policy, DOE CERCLA documents are required to incorporate NEPA values (e.g., analysis of transportation, cumulative, offsite, ecological, and socioeconomic impacts) to the extent practicable.

The no action alternative is excluded from the evaluation because it failed to meet the overall protection threshold criterion as documented in Chapter 5.0.

Neither of the removal alternatives would be expected to create any significant transportation impacts. All waste transportation would occur on the Hanford Site, primarily on roads where public access is restricted.

Cumulative impacts might occur in both the short term and long term because of the interrelationships between the removal action and other 200 Areas activities, such as remediation of waste sites and groundwater, deactivation and D&D of surrounding facilities, and operation of waste treatment or disposal facilities. For this action, short-term cumulative impacts were considered in terms of both air quality and resource allocation. With appropriate work controls, airborne releases from the northern part of the BC Controlled Area are expected to be minor under all of the removal action alternatives, so the contribution to cumulative impacts on local and regional air quality would be minimal. With respect to resource allocation, Alternatives Two and Three as well as other 200 Area activities would require resources in terms of budget, materials, and disposal space. Alternative Three also would require a commitment of resources required for excavation of the northern part of the BC Controlled Area.

Initially, the contribution to cumulative impacts would be less for Alternative Two and greater for Alternative Three, which would require additional budget resources as well as some disturbance to ecological resources. Eventually, Alternative Two could cost more than the estimated costs for Alternative Three because in addition to the long-term surveillance and maintenance costs incurred, the threat of release will still remain and a remedial action equivalent to Alternative Three would likely be required. The disturbance to ecological resources would be minimized by the selected RTD of Zone B as well as performing mitigation per DOE/RL-96-88.

In the long term, the overall cumulative effect of the removal action and other activities in the 200 Areas would be to enhance the protection of personnel, the public, and the environment, which is consistent with the values expressed by the regulators, stakeholders, affected tribes, and the public. Alternatives Two and Three would contribute to this enhanced protection, with Alternative Three creating the greatest and most positive long-term positive effect.

Finally, none of the alternatives would be expected to adversely affect existing cultural resources or to have any socioeconomic impact.

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6.0 CONCLUSIONS AND RECOMMENDED ALTERNATIVE

This EE/CA evaluated three removal action alternatives for the northern part of the BC Controlled Area (UPR-200-E-83). These alternatives were:

- Alternative One: No Action
- Alternative Two: Monitored Natural Attenuation/Institutional Controls (MNA/IC)
- Alternative Three: Remove, Treat, and Dispose (RTD).

Chapter 4.0 provided a description of the three alternatives, and Chapter 5.0 provided an analysis of the three alternatives with regards to the three CERCLA evaluation criteria for non-time critical removal actions: effectiveness, implementability, and cost. Table 6-1 provides a summary of the conclusions from this analysis, based on the information provided in Chapter 5.0:

Table 6-1. Comparative Analysis of the Removal Action Alternatives for the BC Controlled Area.

EE/CA Alternative	Non-Time Critical Removal Action Evaluation Criteria						
	Effectiveness					Implementability	Cost
	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness and Permanence	Reduction of toxicity, mobility or volume through treatment	Short-Term Effectiveness		
Alternative 1: No Action	Does not protect human health and the environment	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
Alternative 2: MNA/IC	√[2]	√	Does not meet RAO1	Does not reduce mobility	√	√	√
Alternative 3: RTD	√	√	√	√	√	√	Cost is higher than Alternative 2

RAO =Removal Action Objective (See Chapter 3.0)
[1]This alternative was not protective of human health and the environment; therefore, it was not evaluated further
[2]This alternative is protective in the short-term, but not as protective as Alternative 3 in the long-term

The recommended removal action alternative for the northern part of the BC Controlled Area is Alternative Three – Remove, Treat, and Dispose. This alternative would provide the best balance of protecting human health and the environment associated with the hazardous substance inventory within the northern part of the BC Controlled Area, meeting the removal action objectives, and provides long term cost-effective option. The total volume of contaminated soil that will be removed under Alternative 3 is approximately 181,000 m^3 (237,000 yd^3), estimated to weigh 327,000 tons.

Alternative One does not provide overall protection to human health and the environment. Alternative Two provides adequate overall protection of human health and the environment in the

short-term, but would not remove radioactive hazardous substance inventory within the northern part of the BC Controlled Area. Furthermore, the risk to human health and the environment from uncontrolled migration of contaminants increases over time. Alternatives One and Two are both less costly than Alternative Three, but only in the short term as future remediation would still be required which could result in similar costs as estimated for Alternative Three. Therefore, neither of these alternatives is selected.

Based on the evaluation criteria, as well as other considerations, Alternative Three was judged to provide better long-term protectiveness as removal of the contaminated soils substantially reduces the potential exposure threat to human health and the environment. Removal of contaminated soil would also reduce the risk to ecological receptors by removing soil that is above ecological protection criteria. In addition, this removal action would significantly reduce the footprint of contamination in the 200 Area. With removal of contaminated soils, conditions suitable for the reasonably anticipated future land use could be attained. Finally, implementation of Alternative Three would contribute to the expedited cleanup of contaminated areas within the Hanford Site by providing the ERDF with contaminated soil to meet its operating requirements, thus preserving clean fill for other clean construction and backfill applications.

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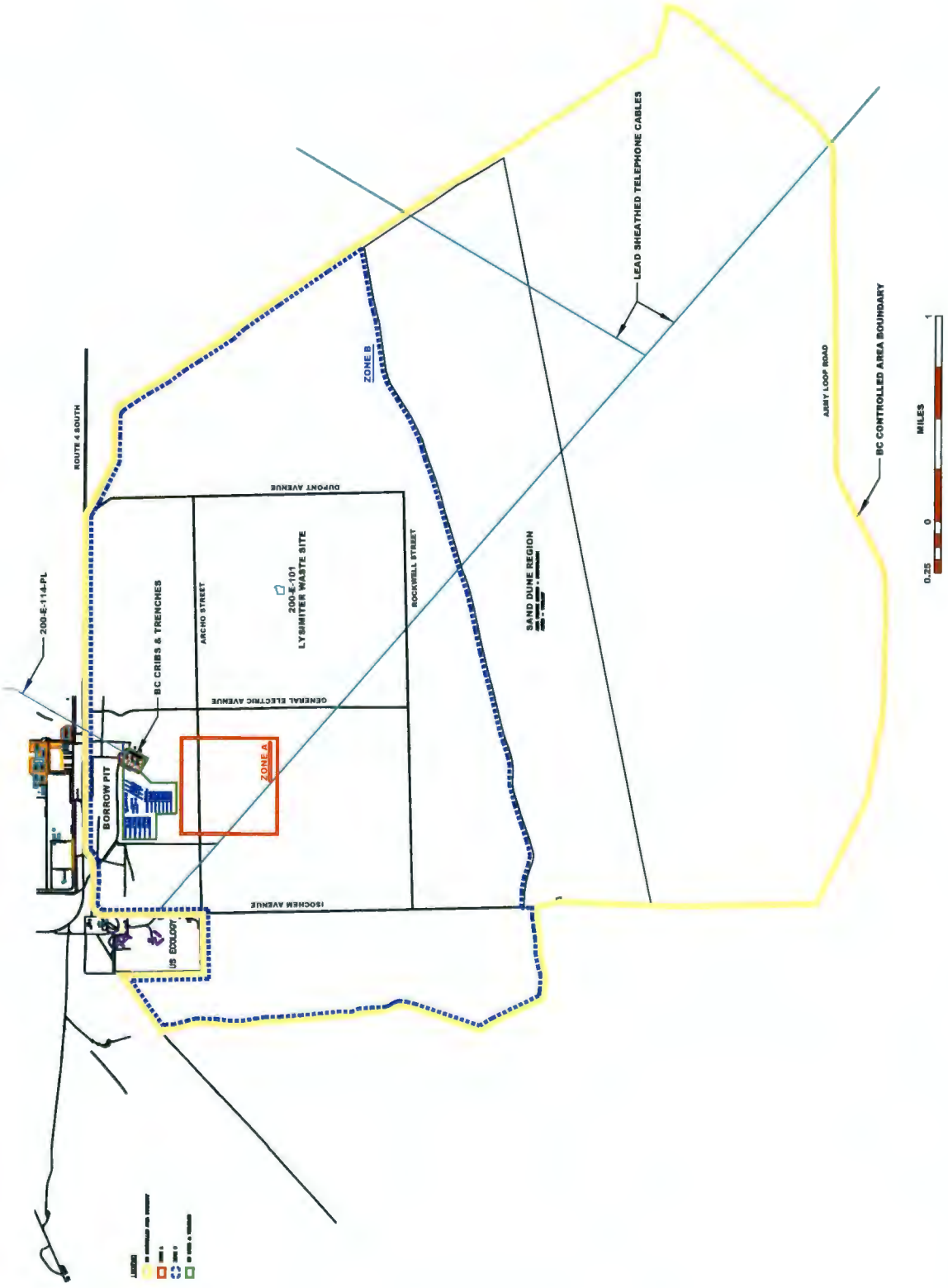
ATTACHMENT 1

BC CONTROLLED AREA SITE MAP



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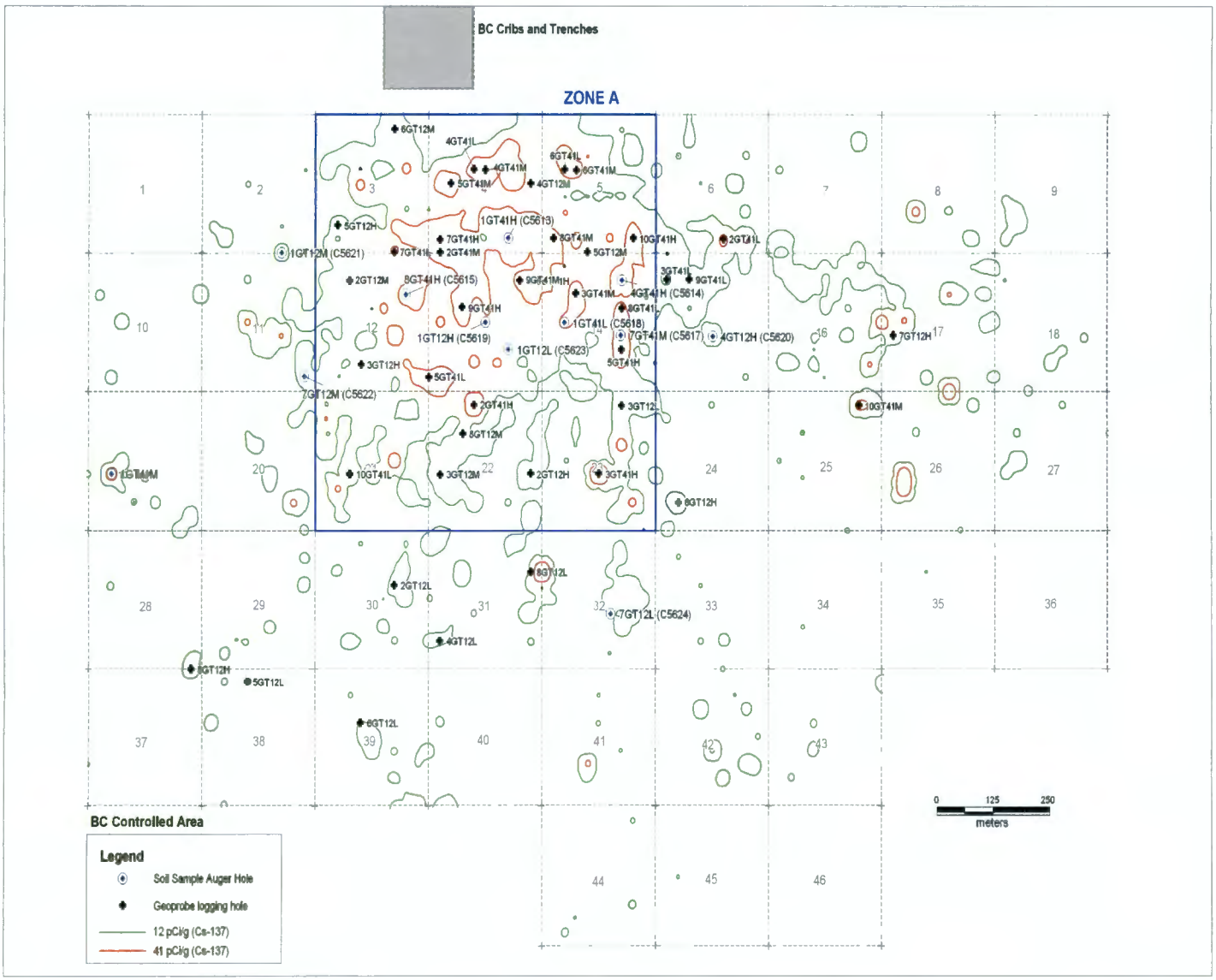
ATTACHMENT 2

RADIOLOGICAL DATA SUMMARY FOR THE BC CONTROLLED AREA

This attachment shows the radiological data collected in the BC Controlled area during the 200-UR-1 operable unit remedial investigation. Isopleths of radioactive contamination are shown, which identify areas that exceed the screening levels of Cesium-137, as described in DOE/RL-2006-50. Areas where soil sampling has occurred are also identified (D&D-24693).



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