APPENDIX G.5.1

BC CRIBS AND TRENCHES (CP-LS-1, CENTRAL PLATEAU) EVALUATION UNIT SUMMARY TEMPLATE

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PART I. EXECUTIVE SUMMARY

EU LOCATION:

CP-LS-1 includes the BC Cribs and Trenches which are part of the 200-BC-1 Operable Unit (OU) and Zone A in the northern portion of the adjoining unplanned release site UPR-200-E-83 which is part of the BC Control Zone and 200-UR-1 Operable Unit. This EU is located south of the 200 East Area near the center of the Hanford Site and lies between Route 4S and the Army Loop Road.

RELATED EUS

Other Central Plateau Projects

PRIMARY CONTAMINANTS, CONTAMINATED MEDIA AND WASTES

The primary contaminants of concern in the BC Cribs and Trenches area include nitrate (NO_3^-), Tc-99, Sr-90, Cs-137, and U-238. Other constituents and inventories are provided by Corbin et al. (2005), Kincaid et al. 2006 (PNNL-15829), and Serne et al. (2009); these are summarized in Table G.5.1-7 below.

Radiological surveys with mobile survey systems demonstrated that excavation and soil removal of soils in Zone A of the northern section of UPR-200-E-83 in 2009-2011 eliminated the direct contact exposure pathway for Cs-137, thereby preventing future releases of radiological contamination from this site.

BRIEF NARRATIVE DESCRIPTION

CP-LS-1, or the BC Cribs and Trenches Evaluation Unit (EU), includes the 200-BC-1 Operable Unit (OU) and the northern portion ("Zone A") of the adjoining unplanned release site UPR-200-E-83, which is part of the 200-UR-1 Operable Unit. This EU is part of the 200 Area National Priority List (NPL) site and located in the Central Plateau Inner Area of the Hanford Site. The BC Cribs and Trenches site lies within the 200-BC-1 OU, south of the 200 East area (DOE-RL 2011, p. 1-1). The 200-BC-1 OU consists of 28 waste sites, including 26 cribs and trenches, one siphon tank, and one pipeline (DOE-RL 2011, p. 1-15). These waste sites were used in the 1950s to dispose of more than 140 million L (38 million gal) of tank waste supernatant from the B, BX, BY, and C Tank Farms. Four trenches received smaller quantities of liquid waste that were generated in the 300 Area and transferred by tanker truck to the 200 Area. The largest volume of waste at these sites was disposed of in six cribs and 16 trenches and was conveyed by an underground pipeline from the B, BX, BY, and C Tank Farms (DOE-RL 2011). The primary contaminants present at the BC Cribs and Trenches include nitrate (NO_3^-), Tc-99, Sr-90, Cs-137, and U-238. The current land use activities in the Central Plateau Inner Area are industrial in nature. For the BC Cribs and Trenches Area waste sites, five remedial alternatives were identified for detailed and comparative analyses: (i) No Action; (ii) Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation; (iii) Removal, Treatment, and Disposal; (iv) Capping; and (v) Partial Removal, Treatment, and Disposal with Capping. These five alternatives also were evaluated for their applicability to the 200-E-14 Siphon Tank and 200-E-114 Pipeline.

The northern section of UPR-200-E-83 adjoins the BC Cribs and Trenches to its south and became contaminated as a result of animal intrusion and wind dispersion from the BC Cribs and Trenches. In 1969, about 46,000m^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 (Cs-137) and strontium (Sr-90). Animals, tumbleweeds, and strong winds were identified as the contributors to the spread of radionuclide contamination. In 1982**,** additional stabilization was completed of the BC Cribs and Trenches area, however discoveries of contamination in the UPR-200-E-83 waste site continued to occur. Sampling in 1999 showed that Sr-90 surface soil concentrations ranged from 0.32 to 3,420 pCi/g across the northern section adjacent to the BC Cribs and Trenches. Cs-137 surface soil concentrations range from 0.35 to 2,290 pCi/g across the area.[1]

A final remedial decision for the 200-UR-1 OU has not been made; however, in 2008, radioactive hazardous substances in the northern part of the site were found to present a potential threat to human health and the environment to the extent that a removal action[2] was warranted before a final remedial decision is documented. A 140-acre area designated as Zone A was identified as having the highest continuous radiological contamination over the PRGs and presenting the greatest risk to human health and the environment. Zone A is located directly south of the BC Cribs and Trenches area. The 3,660-acre balance of the northern section of UPR-200-E-83 was designated as Zone B and is included in the CP-LS-17 (BC Controlled Area) EU. Removal of the contaminated soils in Zone A began in 2008 and completed in 2011. Approximately 483,000 tons of contaminated soil was removed and the area was revegetated with seed and about 280,000 pounds of mulch.

The designated future land use of this EU is Industrial Exclusive Area (DOE-RL 2011, p. 3-25).

SUMMARY TABLE OF RISKS AND POTENTIAL IMPACTS TO RECEPTORS

Table G.5.1-1 provides a summary of nuclear and industrial safety related risks to humans and impacts to important physical Hanford site resources.

Human Health: A Facility Worker is deemed to be an individual located anywhere within the physical boundaries of the BC Cribs and Trenches EU; a Co-located Person (CP) is an individual located 100 meters from the physical boundaries of the BC Cribs and Trenches EU; and Public is an individual located at the closest point on the Hanford Site boundary not subject to DOE access control. The nuclear-related risks to humans are based on unmitigated (unprotected or controlled conditions) dose exposures expressed in a range of from Not Discernible (ND) to High. The estimated mitigated exposure that takes engineered and administrative controls and protections into consideration is shown in parentheses.

Groundwater and Columbia River: Evaluation of the threats to groundwater as a protected resource from saturated zone contamination utilized the groundwater evaluation framework procedure (CRESP 2015). These impacts are expressed in a range of from *Not Discernible* (*ND*) to *Very High*.

Ecological Resources: The risk ratings are based on the degree of physical disruption (and potential additional exposure to contaminants) in the current status and as a potential result of remediation options.

Cultural Resources: No risk ratings are provided for Cultural Resources. The Table identifies the three overlapping Cultural Resource landscapes that have been evaluated: Native American (approximately

[1] Action Memorandum for the Non-Time Critical Removal Action for the Northern Part of the BC Controlled Area (UPR-200-E-83), DOE/RL-2008-21, Revision 0, US Department of Energy, May 2008.
[2] *Removal Action Work Plan for the Northern Part of the BC Controlled Area (UPR-200-E-83) Located Within the 200-UR-1 Operable Unit*, DOE/RL-2008-22, US Department of Energy, June 2008.

10,000 years ago to the present); Pre-Hanford Era (1805 to 1943) and Manhattan/Cold War Era (1943 to 1990); and provides initial information on whether an impact (both direct and indirect) is KNOWN (presence of cultural resources established), UNKNOWN (uncertainty about presence of cultural resources), or NONE (no cultural resources present) based on written or oral documentation gathered on the entire EU and buffer area. Direct impacts include but are not limited to physical destruction (all or part) or alteration such as diminished integrity. Indirect impacts include but are not limited to the introduction of visual, atmospheric, or audible elements that diminish the cultural resource's significant historic features. Impacts to Cultural Resources as a result of proposed future cleanup activities will be evaluated in depth under Section 106 of the National Historic Preservation Act (16 USC 470, et. seq.) during the planning for remedial action.

Table G.5.1-1. Risk Rating Summary (for Human Health, unmitigated nuclear safety basis indicated, mitigated basis indicated in parentheses (e.g., "Very High" (Low)).

Population or Resource		Evaluation Time Period	
		Active Cleanup (to 2064)	
		Current Condition: Sampling & Monitoring	**From Cleanup Actions:** Five Options
Human Health	Facility Worker	Low	Low-High
	Co-located Person	Low to Not Discernible (ND)	Low-Medium
	Public	ND	Low to ND
Environmental	Groundwater (A&B) from vadose zone[a]	*High* (I-129, Tc-99, Cr(tot), Cr-VI) *Medium* (C-14) *ND* (Sr-90 and U(tot))[c]	*High* (I-129, Tc-99, Cr(tot), Cr-VI) *Medium* (C-14) *ND* (Sr-90 and U(tot))[c]
	Columbia River from vadose zone[a]	*ND*[d]	*ND*[d]
	Ecological Resources[b]	ND to Low	Low to Medium
Social	Cultural Resources[b]	**Native American:** Direct: Known Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: None **Manhattan/Cold War:** Direct: Known Indirect: Unknown	**Native American:** Direct: Known Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: None **Manhattan/Cold War:** Direct: Known Indirect: Unknown

a. Threat to groundwater or the Columbia River from Group A and B primary contaminants (PCs) (Table 6-1, CRESP 2015a) remaining in the vadose zone. Threats from plumes associated with the BC Cribs and Trenches EU are described in **Part V** with additional information provided in Appendix D.5 (CP-GW-1) for the 200-PO Groundwater Interest Area (GWIA).

b. For both Ecological and Cultural Resources see Appendices J and K, respectively, for a complete description of Ecological Field Assessments and literature review for Cultural Resources. Ecological ratings are described in Table 4-11 of the Final Report.

c. As described in **Part V**, the remaining inventories for Sr-90 and total uranium would translate to *Very High* and *Medium* ratings; however, these contaminants are not very mobile in the local subsurface and thus these are given *Not Discernible* (*ND*) ratings for the Active Cleanup period and *Low* afterwards to address uncertainties.

d. The TC&WM EIS (Appendix P; DOE/EIS-0391 2012) as described for the CP-TF-5 (A-AX) TF EU would suggest that hexavalent chromium would have *Medium* and *High* ratings for benthic and riparian zone impacts, respectively.

However, current well data suggest that chromium is moving much more slowly than predicted resulting in *ND* ratings for all.

SUPPORT FOR RISK AND IMPACT RATINGS FOR EACH TIME PERIOD

Human Health

Current

The Central Plateau industrial/exclusive zone contains the former processing facilities, tank farms, and the majority of the waste disposal sites. A buffer area around this zone has been proposed to facilitate implementation of institutional controls within it. Current remediation activities are associated with sampling and monitoring and site access maintenance only. The BC Cribs and Trench area is covered with clean soil backfill to isolate contaminated areas from the surface. Radiological surveys with mobile survey systems demonstrated that excavation and soil removal of soils in Zone A of the northern section of UPR-200-E-83 eliminated the direct contact exposure pathway for Cs-137, thereby preventing future releases of radiological contamination from this site.

The characterization workforce is thus described as Low risk. Risk to the Co-located Person is rated Low to ND and Public is rated as ND due to the remote distance to the site, depth from ground surface to soil contamination and depth to groundwater contamination. Groundwater threat is evaluated for the presence of Tc-99 and nitrate, both highly mobile primary contaminants, with high concentrations detected 18 to 53 m below the ground surface (Serne et al. 2009). Due to the large Tc-99 inventory (over 400 Ci), and high mobility of this contaminant, groundwater risk is categorized as *High* (Table G.5.1-12). Contaminants are not currently impacting the Columbia River and not expected to do so from this area within the next 150 years.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

The five cleanup alternatives for the BC Cribs and Trenches area span from no action (monitoring only with Alternative No. 1) to significant action associated with removal treatment and disposal (Alternative No. 3) to partial RTD and monitoring (Alternative No. 5). As such, impacts from potential cleanup approaches will vary significantly. The Facility Worker is thus described as low to high risk (Low for Alternatives 1 and 2; medium for Alternatives 4 and 5; and high for Alternative 3.

Unmitigated Risk: Facility Worker – Low to High; CP – Low to Medium; Public – Low to ND

Mitigation: The Department of Energy and contractor site-specific safety and health planning that includes work control, fire protection, training, occupational safety and industrial hygiene, emergency preparedness and response, and management and organization—which are fully integrated with nuclear safety and radiological protection—have proven to be effective in reducing industrial accidents at the Hanford site to well below that in private industry. Further, the safety and health program must effectively ensure that ongoing task-specific hazard analyses are conducted so that the selection of appropriate PPE can be made and modified as conditions warrant. Task-specific hazard analyses must lead to the development of written work planning documents and standard operating procedures (SOPs) [DOE uses the term work planning documents in addition to procedures] that specify the controls necessary to safely perform each task, to include continuous employee exposure monitoring.

Mitigated Risk: Facility Worker – Low; CP – Low; Public – ND

Groundwater and Columbia River

Current

Evaluation of the threats to groundwater as a protected resource from saturated zone contamination utilized the groundwater evaluation procedure (Table 6-3, CRESP 2015). No current plumes are associated with the BC Cribs and Trenches EU (DOE/RL-2016-09, Rev. 0). Groundwater risk related to the

remaining vadose zone inventory is evaluated based on the Groundwater Threat Metric: *High* for total and hexavalent chromium, Tc-99, and I-129 and *Medium* for C-14. The remaining Sr-90 and total uranium inventories would translate to *Very High* and *Medium* ratings, respectively; however, based on subsurface conditions as described in **Part V**, these contaminants are not predicted to reach groundwater during the Active Cleanup period. Thus Sr-90 and total uranium are given *Not Discernible* (*ND*) ratings during the Active Cleanup period and *Low* afterwards to address uncertainties in the analysis. As described in **Part V**, surface water is rated *Not Discernible* (*ND*) since there are no current groundwater contaminant plumes, and contaminants are not currently impacting the Columbia River.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Groundwater risk is evaluated based on the Groundwater Threat Metric where the risks to groundwater (High ratings) are driven by total and hexavalent chromium, Tc-99, and I-129. Despite large impacts on peak concentrations due to potential capping operations in the area (see **Part V** in Appendix E.6 for CP-TF-5), concentrations may exceed thresholds. This result coupled with the fact that no final remedial decisions have been made involving treating the vadose zone contamination (and no current treatment in the 200-PO GWIA) translates to no changes made to ratings during the Active Cleanup period. Furthermore, since the risk drivers are either non-radioactive or long-lived, no ratings are changed for the Near-term, Post-Cleanup period. The exceptions are Sr-90 and total uranium where the ratings for the Near-term, Post-Cleanup period are changed to *Low* to address uncertainties. Surface water is rated Not Discernible (ND) since there are no current groundwater contaminant plumes associated with the EU, and no contaminants from the EU are currently impacting the Columbia River. Furthermore, as described in **Part V** in Appendix E.6 for CP-TF-5, surface water is rated ND since the contaminants are not expected to impact the Columbia River because of potential cleanup approaches and the fact that chromium is moving much more slowly in the subsurface that predicted in the TC&WM EIS (Appendix P; DOE/EIS-0391 2012).

Ecological

Current

ND to Low in EU because nearly 30% is level 3 and 4 resources, along with the buffer area. There is the potential for disturbance and invasion of exotic species in both EU and buffer area.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Depending upon remediation option, could result in disturbance and disruption to level 3 and 4 (30% of EU and 77% of buffer), including increases in exotic species and changes in species composition of native species.

Cultural

Current

There are unevaluated cultural resources located within this EU. Manhattan Project/Cold War significant resources have already been mitigated. Traditional cultural places in view-shed.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

There is one unevaluated (for National Register) cultural resource. Traditional cultural places in view-shed. Indirect effects are possible from capping.

Considerations for timing of the cleanup actions

> "The primary risk to human health would be through direct contact with the waste, particularly cesium-137 and strontium-90. Because high concentrations of cesium-137 and slrontium-90 are at relatively shallow depths in the cribs and trenches, less than 4.6 m (15 ft), the potential for direct contact exists following the period of institutional controls. This direct contact could result from modest excavation activities such as pipeline installation or construction of a

building basement. The high concentrations of cesium-137 observed during characterization of the 216-B-26 Trench exhibited dose rates that could be lethal (~4.5 rad/h) if exposure time were sufficient (a few hundred years). The deep mobile contaminants (technetium-99 and nitrate) are predicted to eventually reach groundwater at levels exceeding the drinking water standard, potentially rendering the groundwater unfit for human consumption following the 150 year evaluation period. Baseline risk (without remedial action) assessment was performed using the industrial scenario to establish the need for remedial action. The inadvertent intruder scenario was considered to evaluate potential post-remediation risk. The baseline risk assessment for the 216-B-26 Trench indicated the significant shallow-zone contaminants (primarily cesium-137 and strontium-90) in the 3.7 to 4.6 m (12 to 15 ft) range would require nearly 450 yr to decay to levels corresponding to acceptable risk to industrial workers. The maximum dose to industrial workers is calculated to be 310,000 mrem/yr, which greatly exceeds the 15 mrem/yr criterion. Predicted migration of technetium-99 and nitrate may exceed the groundwater drinking water standards for those contaminants. With respect to potential intruders past the 150-yr period of active institutional controls, humans are not protected until radioactive decay proceeds for nearly 450 yr. The 216-B-46 Crib, which is representative of the BC Cribs and Trenches Area cribs, indicated similar risks. The baseline risk assessment for the 216-B-58 Trench indicated lesser shallow-zone contaminant concentration and essentially no deep mobile contaminants. Even so, human health risk standards related to direct exposure were exceeded. Groundwater protection standards (equivalent to drinking water standards (DOE/RL-2009-85, REV. 1, p. 5-58)) are not predicted to be exceeded. Risk to inadvertent intruders is essentially acceptable 250 yr from now with no action. Uncertainties with the exact nature of future industrial and inadvertent intruder exposures may lead to under- or over-estimation of human health risk. Another source of uncertainty is the limited sample data. Because the investigation and sampling focused on the most highly radioactive wastes, the risk assessment is more likely to overestimate the potential human risk." (DOE/RL-2004-69, Draft A, p. 12)

Near-Term, Post-Cleanup Risks and Potential Impacts

Tc-99 and nitrate are both highly mobile primary contaminants, with high concentrations detected 18 to 53 m below the ground surface (Serne, et al. 2009). Cs-137 and Sr-90 are expected to remain in the vadose zone with little to no migration due to their high sorption affinity for the surrounding soils and sediments. Tc-99 (Group A) is considered a highly mobile, highly persistent contaminant, while nitrate (Group C) may be categorized as a highly mobile, low persistence contaminant (CRESP 2015). Groundwater risk from contaminants remaining in the vadose zone is evaluated using the Groundwater Threat Metric where current ratings are provided in Table G.5.1-12. The *High* current ratings are related to Tc-99, I-129, and hexavalent and total chromium. AS described in **Part I**, no changes made to ratings during the Active Cleanup period or afterwards. The exceptions are Sr-90 and total uranium where the ratings for the Near-term, Post-Cleanup period are changed to *Low* to address uncertainties.

Surface water is rated *Not Discernible* (*ND*) since there are no current groundwater contaminant plumes, and thus the contaminants are not currently impacting the Columbia River. Risk to the public, inadvertent intruder, and trespasser is generally low due to the remote distance to the site, depth from ground surface to soil contamination, and depth to potential groundwater contamination. Furthermore, as described in **Part V** in Appendix E.6 for CP-TF-5, surface water is rated ND since the contaminants are not expected to impact the Columbia River because of potential cleanup approaches and the fact that chromium is moving much more slowly in the subsurface that predicted in the TC&WM EIS (Appendix P; DOE/EIS-0391 2012).

EU Designation: CP-LS-1 (BC Cribs and Trenches)

Long-Term, Post-Cleanup Conditions

The DOE is expected to continue industrial exclusive activities for at least 50 years, in accordance with DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement,* and the Record of Decision (64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)". Based on discussions with the HAB, the alternative risk evaluations used the following anticipated land-use assumptions:

- Industrial-Exclusive use for the next 50 years inside the Central Plateau industrial exclusive zone.
- Industrial land use (non-DOE worker) after the next 50 years inside the Central Plateau industrial/ exclusive zone.
- Native American uses consistent with treaty rights.
- No groundwater consumption for at least the next 150 yr.

In addition, risks were calculated considering the possibility of intruders beginning 150 yr from now (2155) to evaluate impacts from the potential loss of institutional control.

PART II. ADMINISTRATIVE INFORMATION

OU AND/OR TSDF DESIGNATION(S)

200-BC-1

COMMON NAME(S) FOR EU

BC Cribs and Trenches

KEY WORDS

BC Cribs and Trenches, BC Controlled Area, 200 Area, 200-BC-1 OU, Soils, Central Plateau

REGULATORY STATUS

Regulatory basis: The U.S. Department of Energy (DOE) is preparing a Remedial Investigation/Feasibility Study to satisfy requirements under the Comprehensive Environmental Response, and Liability Act of 1980 (CERCLA) (DOE/RL-2010-49, 2011, Draft A, p. iv). Cleanup of the Hanford Site is also subject to the Resource Conservation and Recovery Act of 1976 (RCRA) (DOE/RL-2010-49, 2011, Draft A, p. iv). The Washington State Hazardous Waste Management Act of 1976 and the corresponding regulations in WAC 173-303, "Dangerous Waste Regulations," implement the State of Washington's federally authorized program under RCRA (DOE/RL-2010-49, 2011, Draft A, p. iv).

APPLICABLE REGULATORY DOCUMENTATION

- DOE/RL-2010-49, 2011, *Draft A: Remedial Investigation Feasibility Study Work Plan 200-WA-1 and 200-BC-1 Operable Units,* U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2008-21, 2008, *Revision 0, Action Memorandum for the Non-Time Critical Removal Action for the Northern Part of the BC Controlled Area (UPR-200-E-83),* US Department of Energy, Richland Operations Office, Richland, Washington.

- DOE/RL-2008-22, 2008, *Removal Action Work Plan for the Northern Part of the BC Controlled Area (UPR-200-E-83) Located Within the 200-UR-1 Operable Unit*, US Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2004-66, 2004, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Site*, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE/RL-2003-64, 2004, *Feasibility Study for the 200-TW-1 Scavenged Waste Group, the 200-TW-2 Tank Waste Group, and the 200-PW-5 Fission-Product Rich Waste Group Operable Units,* Draft A Re-issue, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Applicable Consent Decree or TPA milestones:

M-015-00: Complete the RI/FS (or RFI/CMS and RI/FS) process for all non-tank farm operable units except for canyon/past practice waste site OUs covered in M-85-00. A day for day slip in submitting the feasibility study report and proposed plan milestone will be given for each day the RI/FS work plan is not approved following six months after submittal. Due Date amended in September 2015 to 6/30/2026.

RISK REVIEW EVALUATION INFORMATION

Completed: 20 January 2015; updated 26 May 2015; Updated to include the northern section of UPR-200-E-83 August 12, 2016; updated for groundwater March 16, 2017.

Evaluated by: E.J. LeBoeuf, J.H. Clarke, Henry Mayer and Kevin Brown

Ratings/Impacts Reviewed by: D. Kosson, M. Gochfeld, J. Burger, K. G. Brown, J. Salisbury, H. Mayer

PART III. SUMMARY DESCRIPTION

CURRENT LAND USE

DOE Hanford industrial site area

DESIGNATED FUTURE LAND USE

Industrial Exclusive Area (DOE-RL 2011, p. 3-25)

PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

The BC Cribs and Trenches waste sites, although currently covered with clean soil backfill, remain in place. The waste sites are separated into four distinct groups based on waste site configuration, primary waste source, and relative volume of waste received. These include: (i) High-volume Scavenged Waste Cribs and Trenches; (ii) Specific Retention Scavenged Waste trenches; (iii) Specific Retention 300 Area Waste Trenches; and one underground storage tank (200-E-14). An additional primary legacy source site is derived from the contaminated vadose zone underneath the cribs and trenches.

The northern section of UPR-200-E-83 which adjoins the BC Cribs and Trenches became contaminated as a result of animal intrusion, contaminated tumbleweed and wind dispersion from the BC Cribs and Trenches. Sampling in 1999 showed that strontium surface soil concentrations ranged from 0.32 to 3420 pCi/g across the northern section adjacent to the BC Cribs and Trenches. Cs-137 surface soil concentrations range from 0.35 to 2290 pCi/g across the area. A 140 acre area designated as Zone A was identified as having the highest continuous radiological contamination over the PRGs and presenting the

greatest risk to human health and the environment. Zone A is located directly south of the BC Cribs and Trenches area. The 3,660 acre balance of the northern section of UPR-200-E-83 was designated as Zone B and is included in the CP-LS-17 (BC Controlled Area) EU.

High-Level Waste Tanks and Ancillary Equipment

Not Applicable.

Vadose Zone and Groundwater Plumes

The depth of contamination varies by waste site and contaminant. Serne, et al. (2009) (pp. 9.2-9.3), indicate that there is a an approximately 15 ft thick layer of sandy silt and fine silty sand at a depth of approximately 120 to 130 feet below ground surface that contains “elevated technetium-99 and EC (electrical conductivity)”, and that “the most elevated nitrate concentrations are found from 28 to 245 ft bgs.” According to Ward et al. 2004, “Tc-99 at concentrations over 75,000 pCi/L were recently reported for a monitoring well near SX-115 (Hartman et al. 2004). In contrast, some 3.686×10^6 L (9.737×10^6 gal) of supernatant fluid containing 128 Ci of Tc-99 were discharged to seven trenches over a period of about 1.5 years in the BC Cribs and Trenches area, yet there is no evidence of groundwater contamination from the cribs or trenches. The current distribution of Tc-99 in the vadose zone beneath 216-B-26 is therefore not easy to explain using current conceptual models. Recent sampling at the 216-B-26 Trench shows a zone of Tc-99 contamination between 18 and 53 m. The peak soil concentration exceeds 100 pCi/g, while the pore water concentration is approximately 1.4×10^6 pCi/L, both at a depth of about 30 m.”

D&D of Inactive Facilities

Not Applicable.

Operating Facilities

Not Applicable.

EU Designation: CP-LS-1 (BC Cribs and Trenches)

LOCATION AND LAYOUT MAPS

The 200-BC-1 OU is located in the Central Plateau's Inner Area (see Figure G.5.1-1 and Figure G.5.1-2 below). The BC Cribs and Trenches site lies within the 200-BC-1 OU, in the southeast portion of the 200 East area (DOE-RL 2011, p. 1-1). Waste sites of the 200-BC-1 OU for the BC Cribs and Trenches are provided in Figure G.5.1-5 below. Each of these waste sites are separated into four groups based on (i) waste site configuration, (ii) primary waste source, and (iii) relative volume of waste received (DOE-RL 2011, p. 3-7).

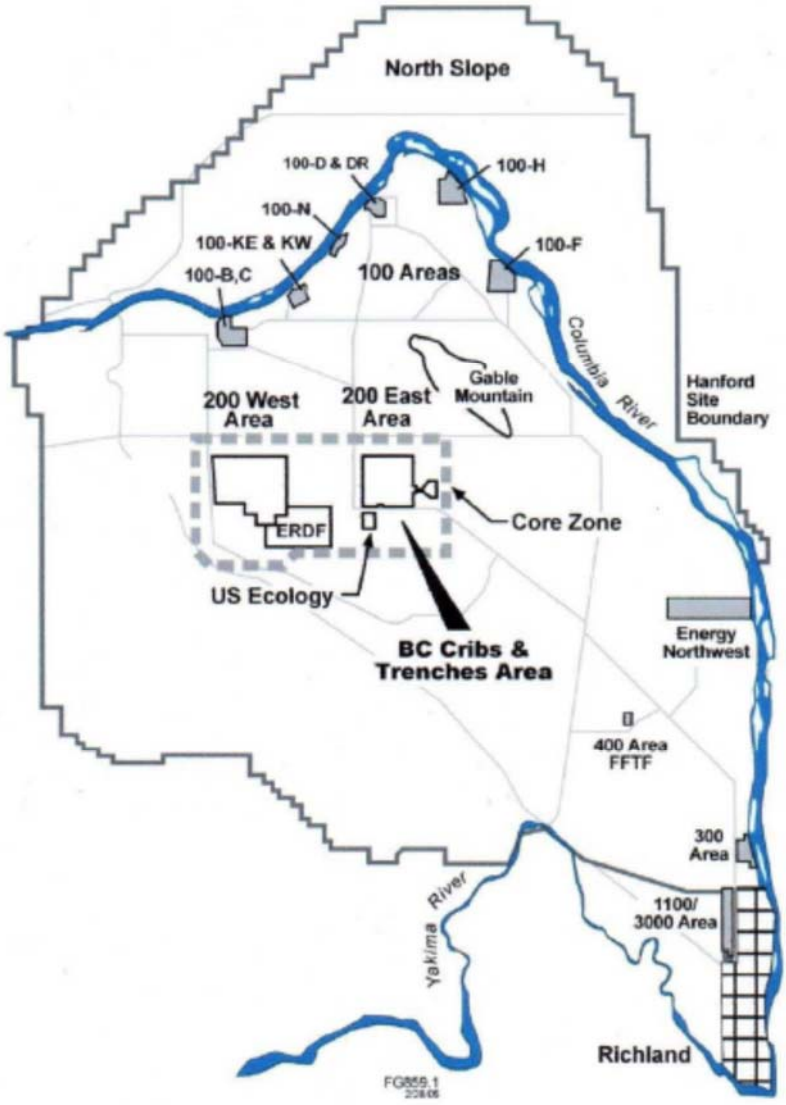

Figure G.5.1-1. Location of the BC Cribs and Trenches Area Waste Sites on the Hanford Site (DOE/RL-2004-69, Draft A, p. 5).

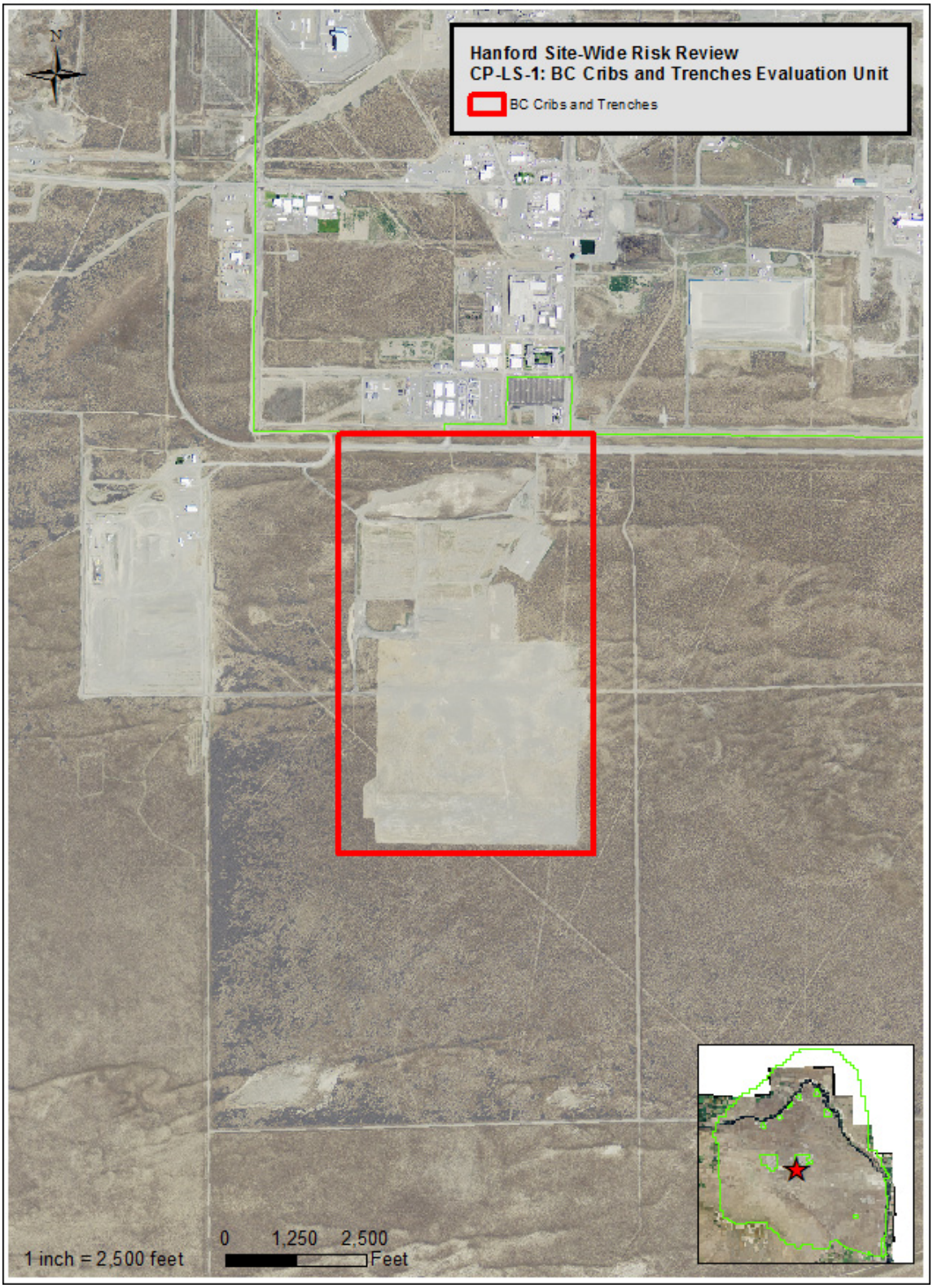

Figure G.5.1-2. CP-LS-1 EU Boundary Map

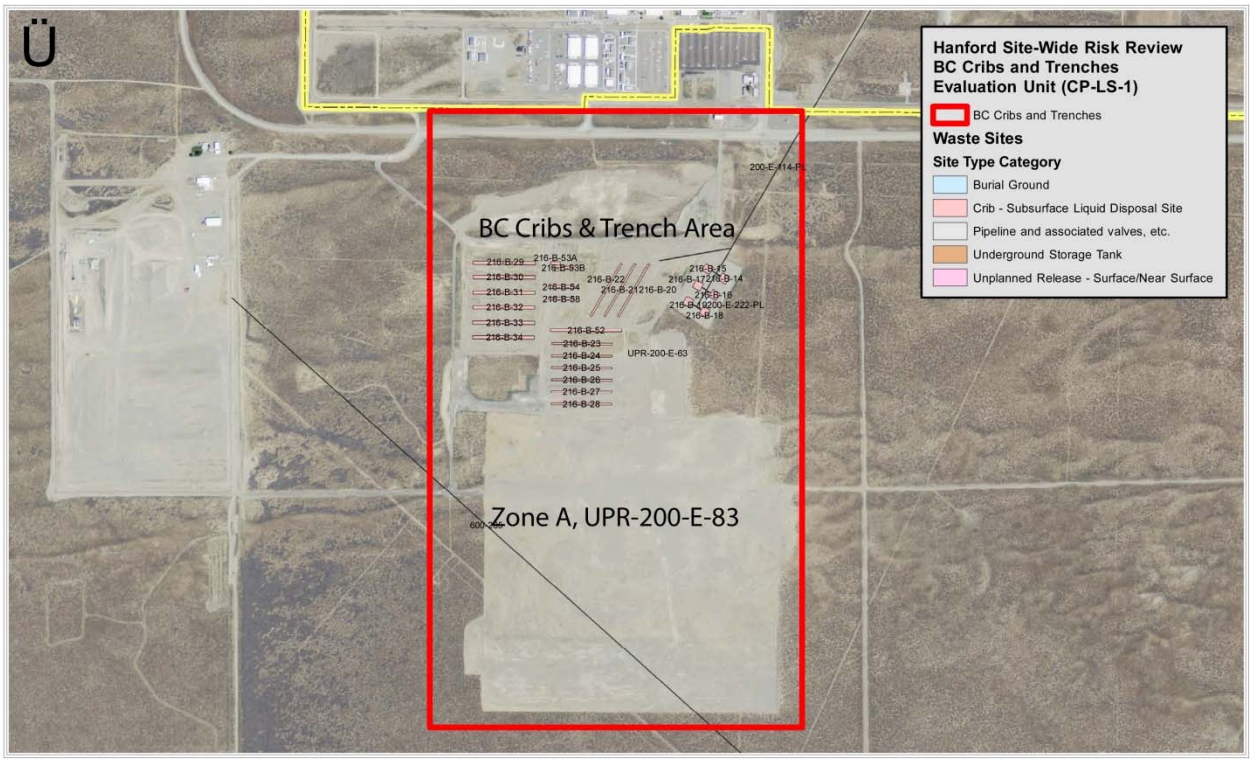

Figure G.5.1-3. EU Boundary Map showing location of Zone A relative to Cribs & Trenches Area.

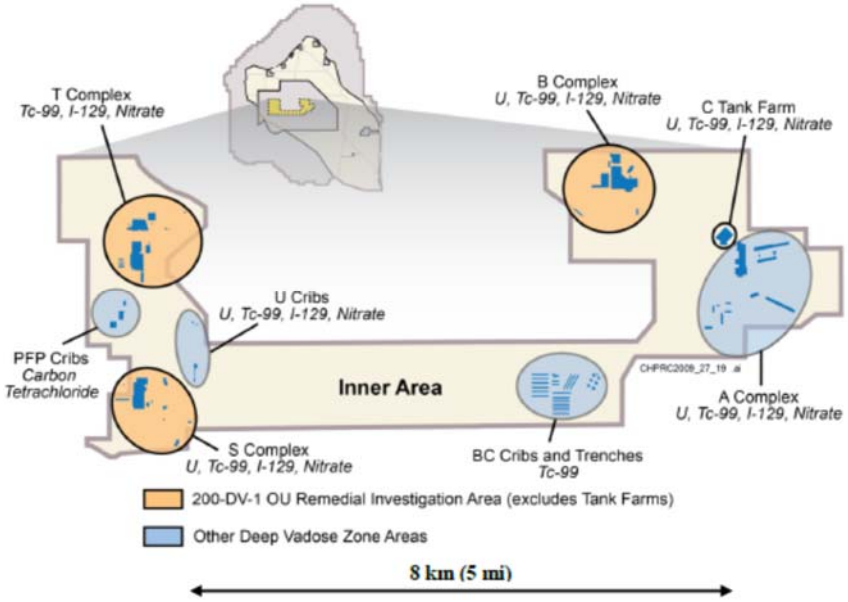

Figure G.5.1-4. Central Plateau Inner Area illustrating the location of the BC Cribs and Trenches, including examples of deep vadose zone (DVZ) problem areas (after Wellman et al. 2011, Figure 2.1, p. 2.5).

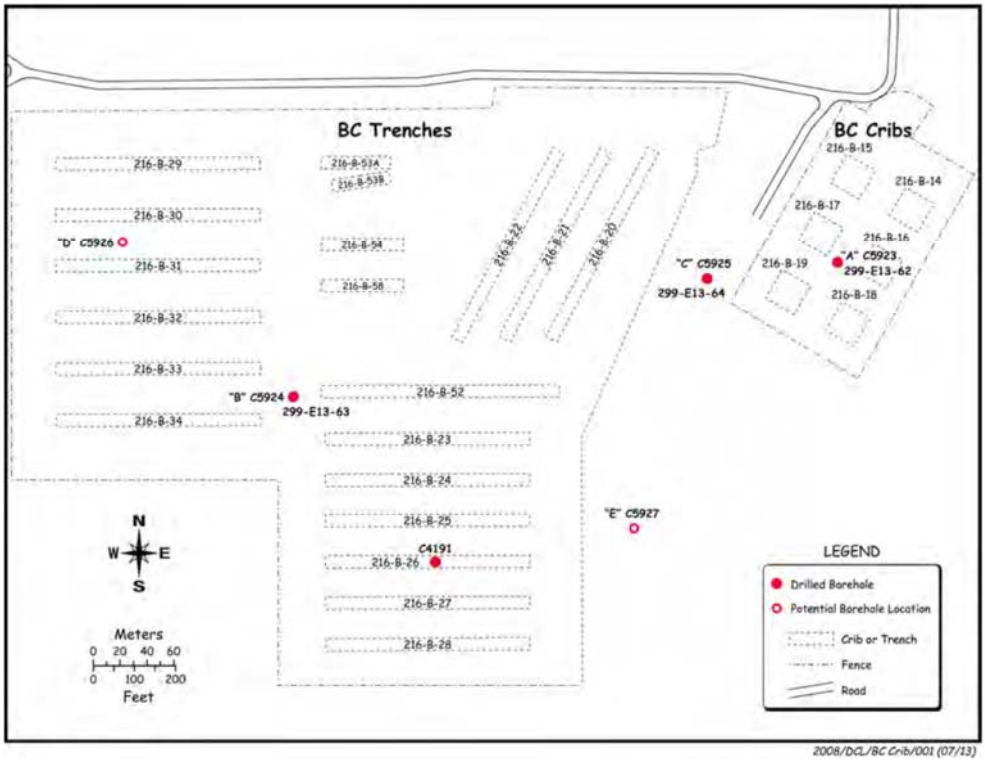

Figure G.5.1-5. Location of BC Cribs and Trenches waste sites (after DOE/RL-2011-50, Figure 1.1, p. 1.5).

PART IV. UNIT DESCRIPTION AND HISTORY

EU FORMER/CURRENT USE(S)

The BC Cribs and Trenches Area includes 6 cribs and 16 trenches. The area received "scavenged" waste (or waste where most of the highly radioactive Cs-137 is chemically removed) from uranium recovery and ferrocyanide processes at the 221/221-U Plant. Discharges of these scavenged wastes provided the primary liquid contribution of contaminants within the 200 Areas.

> "Four additional trenches, formerly in the 200-LW-1 Operable Unit, are also located in this area. Three of these four trenches received waste from the 300 Area laboratory facilities and the 340 Waste Neutralization Facility; the fourth trench received waste from the Plutonium Recycle Test Reactor. Discharges to these liquid waste disposal sites were limited to avoid exceeding the estimated capacity of the soil to retain the liquid above the water table. Two other waste sites are included in this area: a Siphon tank that held liquid waste before its discharge to the cribs and the pipeline that delivered liquid waste to the siphon tank…" (DOE/RL 2004-69, Draft A, p. 6).

The northern section of UPR-200-E-83 adjoins the BC Cribs and Trenches to its south and became contaminated as a result of animal intrusion and wind dispersion from the BC Cribs and Trenches. During the period between the 1950s and 1960s, animal intrusions into the trenches occurred. In 1969, about 46,000m^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 (Cs-137) and strontium (Sr-90). Animals, tumbleweeds, and strong winds were identified as the contributors to the spread of radionuclide contamination. In 1982**,** additional stabilization was completed of the BC Cribs and Trenches area, however discoveries of contamination in the UPR-200-E-83 (BC Controlled Area) continued to occur. Sampling in 1999 showed that strontium surface soil concentrations ranged from 0.32 to 3420 pCi/g across the northern section adjacent to the BC Cribs and Trenches. Cs-137 surface soil concentrations range from 0.35 to 2290 pCi/g across the area.[3]

A final remedial decision for the 200-UR- 1 OU has not been made; however in 2008, radioactive hazardous substances in the northern part of the BC Controlled Area were found to present a potential threat to human health and the environment to the extent that a removal action[4] was warranted before a final remedial decision is documented. A 140 acre area designated as Zone A was identified as having the highest continuous radiological contamination over the PRGs and presenting the greatest risk to human health and the environment. Zone A is located directly south of the BC Cribs and Trenches area. The 3,660-acre balance of the northern section of UPR-200-E-83 was designated as Zone B and is included in the CP-LS-17 (BC Controlled Area) EU. Removal of the contaminated soils in Zone A began in 2008 and was completed in 2011. Approximately 483,000 tons of contaminated soil was removed and the area was revegetated with seed and about 280,000 pounds of mulch.

LEGACY SOURCE SITES

As described above, the BC Cribs and Trenches EU includes a large number of cribs and trenches as well as two pipelines, one tank, and one unplanned release.

Tank Waste and Tank Farms

Not Applicable.

Groundwater Plumes

The BC Cribs and Trenches EU is within the 200-PO-1 Groundwater monitoring OU under CERCLA, as described in the Sampling and Analysis Plan for the 200-PO-1 Groundwater OU (DOE/RL 2003-04). No current plumes have been associated with the BC Cribs and Trenches EU (DOE/RL-2016-09, Rev. 0).

D&D OF INACTIVE FACILITIES

Not Applicable.

OPERATING FACILITIES

Not Applicable.

[3] Action Memorandum for the Non-Time Critical Removal Action for the Northern Part of the BC Controlled Area (UPR-200-E-83), DOE/RL-2008-21, Revision 0, US Department of Energy, May 2008.
[4] *Removal Action Work Plan for the Northern Part of the BC Controlled Area (UPR-200-E-83) Located Within the 200-UR-1 Operable Unit*, DOE/RL-2008-22, US Department of Energy, June 2008.

EU Designation: CP-LS-1 (BC Cribs and Trenches)

ECOLOGICAL RESOURCES SETTING

Landscape Evaluation and Resource Classification

The amount of each category of biological resources at the BC Cribs and Trenches EU was examined within a circular area radiating 1830 m from the geometric center of the unit (equivalent to 2598 acres). Approximately 71 percent of the total combined area (evaluation unit and associated adjacent landscape) is classified as level 3 or higher biological resources in the existing resource level map. However, the majority of the level 3 and level 4 resources lie to outside of the evaluation unit boundary (Appendix J, Figure J.9).

Field Survey

Reconnaissance of the BC Cribs and Trenches evaluation unit indicated that most of the EU currently consists of non-vegetated areas, heavily disturbed or revegetated areas, and compacted gravel areas (i.e., level 0 resources; Appendix J Table J.8). A portion of this area that was previously classified as level 3 and 4 (approximately 153 acres) was reclassified as level 0 for this assessment to reflect current vegetation conditions (Appendix J, Figure J.8 and Table J.8). Habitat around the level 0 resources in the disturbed area of the evaluation unit consists of level 3 and 4 resources along the boundary of the evaluation unit. These patches are contiguous with the adjacent landscape, but no pedestrian surveys or field data collection were attempted in these areas because this waste site and evaluation unit lie within a radiological control area. A project review letter summarizing data collected within the evaluation unit boundary in 2008 and 2009 provided information on habitat quality in the remaining level 3 and level 4 resources. Appendix J Figure J.9 shows the condition of the area where revegetation was attempted and failed, resulting in scattered cover of Russian thistle (*Salsola tragus)* and scurf pea (*Psoralea lanceolata*) across the southern portion of the EU.

CULTURAL RESOURCES SETTING

Cultural resources known to be recorded within the BC Cribs and Trenches EU are limited to the archaeological finds associated with the Native American Precontact and Ethnographic Landscape (an isolated find and a site). The site has been unevaluated for National Register eligibility and the isolate is considered to not be National Register-eligible. Additionally, the BC Cribs are contributing properties within the Manhattan Project and Cold War Era Historic District, with documentation required. In accordance with the 1998 *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56), all documentation requirements have been completed for this property.

A little over half of the BC Cribs and Trenches EU has been inventoried for archaeological resources and remediation of the BC Cribs and Trenches EU has been addressed by an NHPA Section 106 review. There is a possibility that intact archaeological material is present in the areas that have not been inventoried for archaeological resources (both on the surface and in the subsurface), particularly if undisturbed soil deposits exist within the BC Cribs and Trenches EU. There are two National Register-eligible buildings that are contributing properties within the Manhattan Project /Cold War Era District with documentation required (2101M Machine Shop/Office and 2750E Office Building), and three National Register-eligible contributing buildings within the Manhattan Project /Cold War Era District with no documentation required (2751E, 2752E and 2753E Office Buildings. In accordance with the 1998 *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan (*DOE/RL-97-56), all documentation requirements have been completed for these properties.

Geomorphology, ground disturbance, historic maps, and the presence of archaeological resources associated with the Native American Precontact and Ethnographic landscape located within the BC Cribs and Trenches EU all suggest that the potential exists for additional archaeological resources associated with the Native American Precontact and Ethnographic landscape to be present on the surface or within

the subsurface within the EU. The potential for intact archaeological resources associated with the Pre-Hanford Early Settlers/Farming Landscape and the Manhattan Project associated archaeological resources is also possible.

Because some areas of the BC Cribs and Trenches EU have not been investigated for archaeological sites and pockets of undisturbed soil likely exist, it may be appropriate to conduct surface and subsurface archaeological investigations in these areas prior to initiating a remediation activity. Consultation with Hanford Tribes (Confederated Bands of the Yakama Nation, Wanapum, Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce) and other groups associated with these landscapes (e.g. East Benton Historical Society, Prosser Cemetery Association, Franklin County Historical Society, the Reach, and the B-Reactor Museum Association) may need to occur. Indirect effects are always possible when TCPs are known to be located in the general vicinity. Consultation with Hanford Tribes may also be necessary to provide input on indirect effects to both recorded and potential unrecorded TCPs in the area and other cultural resource issues of concern.

PART V. WASTE AND CONTAMINATION INVENTORY

The BC Cribs and Trenches contain 27 waste sites (DOE-RL 2011) separated into four distinct groups based on waste site configuration, primary waste source, and relative volume of waste received. These include: (i) High-volume Scavenged Waste Cribs and Trenches (Table G.5.1-2); (ii) Specific Retention Scavenged Waste Trenches (Table G.5.1-3); (iii) Specific Retention 300 Area Waste Trenches (Table G.5.1-4), and one underground storage tank (200-E-14).

Table G.5.1-5 summarizes each of the four waste sites within the 200-BC-1 OU. These waste sites were used in the 1950s to dispose of more than 140 million L (38 million gal) of tank waste supernatant from the B, BX, BY, and C Tank Farms. Four trenches received smaller quantities of liquid waste that were generated in the 300 Area and transferred by tanker truck to the 200 Area. The largest volume of waste at these sites was disposed of in six cribs and 16 trenches and was conveyed by underground pipeline from the B, BX, BY, and C Tank Farms (DOE-RL 2011).

Table G.5.1-2. High-volume Scavenged Waste Cribs and Trenches (Data from Maxfield, RHO-CD-673).

WIDS Identification	Area (square feet)	Discharge Volume (liters)
216-B-14	40×40 = 1600	8.71×10^{6}
216-B-15	40×40 = 1600	6.32×10^{6}
216-B-16	40×50 = 2000	5.6×10^{6}
216-B-17	40×40 = 1600	3.41×10^{6}
216-B-18	40×40 = 1600	8.52×10^{6}
216-B-19	40×40 = 1600	6.4×106
216-B-20	500×10 = 5000	4.68×106
216-B-21	500×10 = 5000	4.67×106
216-B-22	500×10 = 5000	4.74×106

Table G.5.1-3. Specific Retention Scavenged Waste Trenches (Data from Maxfield, RHO-CD-673).

WIDS Identification	Area (square feet)	Discharge Volume (liters)
216-B-23	500×10 = 5000	4.52×10^{6}
216-B-24	500×10 = 5000	4.7×10^{6}
216-B-25	500×10 = 5000	3.76×10^{6}
216-B-26	500×10 = 5000	5.88×10^{6}
216-B-27	500×10 = 5000	4.42×10^{6}
216-B-28	500×10 = 5000	5.05×10^{6}
216-B-29	500×10 = 5000	4.84×10^{6}
216-B-30	500×10 = 5000	4.78×10^{6}
216-B-31	500×10 = 5000	4.74×10^{6}
216-B-32	500×10 = 5000	4.77×10^{6}
216-B-33	500×10 = 5000	4.74×10^{6}
216-B-34	500×10 = 5000	4.87×10^{6}
216-B-52	580×10 = 5800	8.53×10^{6}

Table G.5.1-4. Specific Retention 300 Area Waste Trenches (Data from Maxfield, RHO-CD-673).

WIDS Identification	Area (square feet)	Discharge Volume (liters)
216-B-53A	60×10 = 600	5.49×10^{5}
216-B-53B	150×10 = 1500	1.51×10^{4}
216-B-54	200×10 = 2000	9.99×10^{5}
216-B-58	200×10 = 2000	4.13×10^{5}

Table G.5.1-5. Summary of Waste Site Types within the 200-BC-1 OU (after DOE-RL 2011, Figure 3-1, p. 3-8). (See Table 1 above for complete WIDS information.).

Site Type	Associated Waste Sites	Overview of Impacted Vadose Zone	Historical Groundwater Impacts?
Underground Storage Tank	200-E-14	Residual waste in tank. No vadose impacts identified.	No
High-Volume Scavenged Waste Cribs and Trenches	216-B-14, 216-B-15, 16-B-16, 216-B-17, 216-B-18, 216-B-19216-B-20, 216-B-2,1216-B-22	Full thickness vadose zone impacts.	Yes
Specific Retention Scavenged Waste Trenches	216-B-23, 216-B-24, 216-B-25, 216-B-26, 216-B-27, 216-B-28, 216-B-29, 216-B-30, 216-B-31, 216-B-32, 216-B-33, 216-B-34, 216-B-52	Partial thickness vadose zone impacts.	No
Specific Retention 300 Area Waste Trenches	216-B-53A, 216-B-53B, 216-B-54, 216-B-58	Partial thickness vadose zone impacts.	No

The primary contaminants present at the BC Cribs and Trenches include nitrate (NO_3^-), Tc-99, Sr-90, Cs-137, and U-238. Other constituents and inventories are provided by Corbin et al. (2005); Kincaid, et al. 2006 (PNNL-15829); and Serne, et al. (2009). The contaminant inventories are summarized in Table G.5.1-7, as derived from RPP-26744, Rev. 0.

Table G.5.1-6. Primary contaminants and other constituents present at BC Cribs and Trenches.

Risk-Based COPCs[a]	Other COPCs[b]	Anions and Cations	Geochemical and Physical Properties
Nitrate (as nitrogen)[c, d]	Aluminum	Calcium	Moisture content
Selenium[e]	Manganese	Chloride	Electrical resistivity of soil/sediment
Uranium[c, d]	Mercury	Fluoride[b]	Specific electrical conductivity of pore water
Cesium-137[c, d, e]	Nickel-63	Magnesium	Ionic strength of pore water
Cobalt-60[e]	Nitrite	Nitrite (as nitrogen)[b]	Alkalinity (bicarbonate) of pore water
Plutonium-239/240[d]	Radium-226	Potassium	Borehole neutron and natural gamma logs
Strontium-90[c, d, e]	--	Phosphate	--
Technetium-99[c, d]	--	Sodium	--
--	--	Sulfate[b]	--

(a) Concentrations of risk-based COPCs that were identified in Table 3-1 of DOE/RL-2004-66.
(b) Concentration of other COPCs identified in Table 3-1 of DOE/RL-2004-66 that could correlate with electrical-resistivity data based on results for Borehole C4191.
(c) Applies to the 216-B-26 Trench representative site and analogous sites as presented in DOE/RL-2004-66.
(d) Applies to the 216-B-46 Crib (representative site in BY Tank Farm) and analogous sites as presented in DOE/RL-2004-66.
(e) Applies to the 216-B-58 Trench representative site and analogous sites as presented in DOE/RL-2004-66.

DOE/RL-2004-66, *Focused Feasibility Study for the BC Cribs and Trenches Area Waste Sites*.
COPC = contaminant of potential concern.

According to Ward, et al. (2004), the BC Cribs and Trenches are believed to have received approximately 30 Mgal of scavenged tank waste containing an estimated 400 Ci of Tc-99 as well as large quantities of NO_3^- and U-238. Kinkaid, et al. (2006) report cumulative inventories as of 2005. Detailed contaminant inventories are also provided in Table G.5.1-7 below. The physical state of the primary contaminants are adsorbed in the contaminated soil and presence in crib and trench debris.

Table G.5.1-7. Inventory of Primary Contaminants and Other Constituents at BC Cribs and Trenches (after RPP-26744, Rev. 0).

Contaminant	Cribs and Other Inventory WIDS: 216-B-14, 216-B-15, 216-B-16, 216-B-17, 216-B-18, 216-B-19 (Units: Radionuclides: Curies Non-Radionuclides: Kilograms)	Trenches Inventory WIDS: 216-B-20, 216-B-21, 216-B-22, 216-B-23, 216-B-24, 216-B-25, 216-B-26, 216-B-27, 216-B-28, 216-B-29, 216-B-30, 216-B-31, 216-B-32, 216-B-33, 216-B-34, 216-B-52, 216-B-53A, 216-B-53B, 216-B-54, 216-B-58 (Units: Radionuclides: Curies Non-Radionuclides: Kilograms)
Tritium	242.60	499.53
Nitrate (as nitrogen)	7,414,459	14,721,830
Selenium-79	0.40	0.80
Uranium-238	0.40	0.85
Cesium-137	1,364.27	3,639.01
Cobalt-60	8.35	18.90
Plutonium-239/240	34.29	78.04
Strontium-90	1,376.14	3,050.10
Technetium-99	138.98	271.80
Aluminum	3,000.04	11,067.37
Manganese	-	0.01
Mercury	11.79	23.48
Nickle-63	31.60	63.75
Nitrite (as nitrogen)	53,346	194,360
Radium-226	0.0019	0.0038
Calcium	5,737.33	11,908.75
Chloride	108,135	225,318
Fluoride	135,936	244,623
Potassium	24,824	49,908
Phosphate	252,650	507,490
Sodium	3,432,740	6,935,067
Sulfate	449,434	912,846

Table G.5.1-8. Detected Radionuclides in Zone A Prior to Soil Removal.

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	3	2
	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[a]	9 pCi/g[a]
	Human Health Industrial Exposure	25 pCi/g	2,500 pCi/g
	Ecological Biota Concentration Guidelines	20.8 pCi/g	22.5 pCi/g

a. 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.

Detailed inventories are provided in Table G.5.1-9 through Table G.5.1-11. All values are to 2 significant figures. The source document should be consulted for greater precision data. The sum for each primary contaminant is shown in the first row. Table G.5.1-12 provides a summary of the evaluation of threats to groundwater as a protected resource from saturated zone and remaining vadose zone contamination associated with the evaluation unit.

CONTAMINATION WITHIN PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

As described above, the BC Cribs and Trenches EU includes a large number of cribs and trenches as well as two pipelines, one tank, and one unplanned release.

High Level Waste Tanks and Ancillary Equipment

Not Applicable.

Vadose Zone Contamination

The reported inventories in Table G.5.1-9 through Table G.5.1-11 are for cribs and trenches that are considered capable of contaminating the environment. These waste sites are considered the inventory in the vadose for this EU.

Groundwater Plumes

Not Applicable. There are no current plumes associated with the BC Cribs and Trenches EU (DOE/RL-2016-09, Rev. 0).

Facilities for D&D

Please see above.

Operating Facilities

Not Applicable.

Table G.5.1-9. Inventory of Primary Contaminants(a).

WIDS	Description	Decay Date	Ref[(b)]	Am-241 (Ci)	C-14 (Ci)	Cl-36 (Ci)	Co-60 (Ci)	Cs-137 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	H-3 (Ci)	I-129 (Ci)
All	Sum			190	28	NR	27	5000	1.7	130	740	0.65
216-B-14	Cribs	2001	SIM	14	2.1	NR	1.6	300	0.13	9.7	54	0.042
216-B-15	Cribs	2001	SIM	11	1.5	NR	1.2	220	0.093	7.1	39	0.031
216-B-16	Cribs	2001	SIM	8.8	1.3	NR	1.2	200	0.079	6	35	0.03
216-B-17	Cribs	2001	SIM	4.7	0.74	NR	1	120	0.043	3.3	21	0.022
216-B-18	Cribs	2001	SIM	14	2.1	NR	1.6	300	0.13	9.6	53	0.042
216-B-19	Cribs	2001	SIM	9.2	1.4	NR	1.7	220	0.084	6.4	40	0.037
216-B-20	Trenches	2001	SIM	6.9	1.1	NR	1.2	550	0.063	4.8	29	0.027
216-B-21	Trenches	2001	SIM	7.6	1.1	NR	0.95	160	0.068	5.1	29	0.024
216-B-22	Trenches	2001	SIM	7.3	1.1	NR	1.1	170	0.066	5	30	0.026
216-B-23	Trenches	2001	SIM	7	1	NR	1	160	0.063	4.8	28	0.025
216-B-24	Trenches	2001	SIM	8.1	1.2	NR	0.92	170	0.072	5.5	30	0.024
216-B-25	Trenches	2001	SIM	8.2	1.2	NR	0.92	170	0.073	5.5	31	0.024
216-B-26	Trenches	2001	SIM	7.9	1.1	NR	0.89	590	0.07	5.3	30	0.023
216-B-27	Trenches	2001	SIM	7.4	1.1	NR	0.83	160	0.065	5	28	0.022
216-B-28	Trenches	2001	SIM	7.9	1.2	NR	1.1	180	0.071	5.4	32	0.027
216-B-29	Trenches	2001	SIM	8	1.2	NR	0.91	170	0.071	5.4	30	0.024
216-B-30	Trenches	2001	SIM	6.9	1.1	NR	1.3	170	0.063	4.8	30	0.028
216-B-31	Trenches	2001	SIM	7	1.1	NR	1.3	170	0.064	4.9	30	0.029
216-B-32	Trenches	2001	SIM	6.8	1.1	NR	1.3	170	0.062	4.7	30	0.029

WIDS	Description	Decay Date	Ref[(b)]	Am-241 (Ci)	C-14 (Ci)	Cl-36 (Ci)	Co-60 (Ci)	Cs-137 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	H-3 (Ci)	I-129 (Ci)
216-B-33	Trenches	2001	SIM	6.6	1	NR	1.4	170	0.061	4.6	30	0.029
216-B-34	Trenches	2001	SIM	6.8	1.1	NR	1.4	170	0.062	4.7	31	0.03
216-B-52	Trenches	2001	SIM	12	1.9	NR	2.4	300	0.11	8.4	53	0.052
216-B-53A	Trenches	2001	SIM	0.31	0.014	NR	0.0074	10	0.00018	0.013	0.018	NR
216-B-53B	Trenches	2001	SIM	0.015	0.0005	NR	0.00085	6.1	1.10E-04	0.0076	0.01	NR
216-B-54	Trenches	2001	SIM	0.55	0.026	NR	0.012	6.1	0.00011	0.0076	0.01	NR
216-B-58	Trenches	2001	SIM	0.23	0.011	NR	0.0053	4.9	8.40E-05	0.0061	0.0084	NR

a. NR = Not reported for indicated EU

b. SIM = RPP-26744, Rev. 0

Table G.5.1-10. Inventory of Primary Contaminants (cont)(a)

WIDS	Description	Decay Date	Ref[(b)]	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
All	Sum			1.1	95	170	4400	410	2.9
216-B-14	Cribs	2001	SIM	0.069	6	9.1	590	33	0.18
216-B-15	Cribs	2001	SIM	0.066	5.8	6.7	170	24	0.13
216-B-16	Cribs	2001	SIM	0.054	4.8	5.9	150	20	0.12
216-B-17	Cribs	2001	SIM	0.025	2.4	3.7	83	9.8	0.07
216-B-18	Cribs	2001	SIM	0.089	7.8	9	230	32	0.18
216-B-19	Cribs	2001	SIM	0.053	4.8	6.8	160	20	0.13
216-B-20	Trenches	2001	SIM	0.044	4	5.1	310	15	0.1
216-B-21	Trenches	2001	SIM	0.047	4.1	4.9	120	17	0.098
216-B-22	Trenches	2001	SIM	0.044	3.9	5	120	16	0.099
216-B-23	Trenches	2001	SIM	0.042	3.7	4.8	120	16	0.095
216-B-24	Trenches	2001	SIM	0.051	4.5	5.1	130	19	0.1
216-B-25	Trenches	2001	SIM	0.051	4.5	5.2	130	19	0.1
216-B-26	Trenches	2001	SIM	0.052	4.5	5.1	490	18	0.11
216-B-27	Trenches	2001	SIM	0.046	4	4.7	120	17	0.093
216-B-28	Trenches	2001	SIM	0.048	4.2	5.4	130	18	0.11
216-B-29	Trenches	2001	SIM	0.043	3.8	5.1	250	18	0.1
216-B-30	Trenches	2001	SIM	0.04	3.6	5.1	120	15	0.099
216-B-31	Trenches	2001	SIM	0.04	3.7	5.2	120	15	0.1
216-B-32	Trenches	2001	SIM	0.037	3.4	5.1	150	15	0.099
216-B-33	Trenches	2001	SIM	0.034	3.1	5.1	170	14	0.098

WIDS	Description	Decay Date	Ref[(b)]	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
216-B-34	Trenches	2001	SIM	3.50E-02	3.2	5.2	170	14	0.1
216-B-52	Trenches	2001	SIM	5.80E-02	5.4	9.1	390	26	0.18
216-B-53A	Trenches	2001	SIM	3.40E-05	0.0033	23	8.9	0.0031	0.22
216-B-53B	Trenches	2001	SIM	1.50E-05	0.0014	6.6	5.2	0.0018	0.064
216-B-54	Trenches	2001	SIM	1.50E-05	0.0014	7.2	5.2	0.0018	0.067
216-B-58	Trenches	2001	SIM	1.20E-05	0.0011	5.5	4.2	1.40E-03	5.30E-02

a. NR = Not reported for indicated EU
b. SIM = RPP-26744, Rev. 0

Table G.5.1-11. Inventory of Primary Contaminants (cont)(a)

WIDS	Descrip-tion	Ref[(b)]	CCl4 (kg)	CN (kg)	Cr (kg)	Cr-VI (kg)	Hg (kg)	NO3 (kg)	Pb (kg)	TBP (kg)	TCE (kg)	U (total) (kg)
All	Sum		NR	NR	23000	NR	35	22000000	61	NR	NR	3700
216-B-14	Cribs	SIM	NR	NR	1500	NR	2.8	1700000	NR	NR	NR	270
216-B-15	Cribs	SIM	NR	NR	1100	NR	2	1300000	NR	NR	NR	200
216-B-16	Cribs	SIM	NR	NR	1100	NR	1.7	1100000	2.3	NR	NR	170
216-B-17	Cribs	SIM	NR	NR	820	NR	0.87	560000	4.6	NR	NR	100
216-B-18	Cribs	SIM	NR	NR	1500	NR	2.7	1700000	NR	NR	NR	260
216-B-19	Cribs	SIM	NR	NR	1400	NR	1.7	1100000	5.9	NR	NR	190
216-B-20	Trenches	SIM	NR	NR	1000	NR	1.4	830000	3.8	NR	NR	150
216-B-21	Trenches	SIM	NR	NR	850	NR	1.4	910000	0.9	NR	NR	140
216-B-22	Trenches	SIM	NR	NR	940	NR	1.4	880000	2.5	NR	NR	150
216-B-23	Trenches	SIM	NR	NR	900	NR	1.3	840000	2.4	NR	NR	140
216-B-24	Trenches	SIM	NR	NR	840	NR	1.6	970000	NR	NR	NR	150
216-B-25	Trenches	SIM	NR	NR	840	NR	1.6	980000	NR	NR	NR	150
216-B-26	Trenches	SIM	NR	NR	820	NR	1.6	950000	NR	NR	NR	160
216-B-27	Trenches	SIM	NR	NR	760	NR	1.4	880000	NR	NR	NR	140
216-B-28	Trenches	SIM	NR	NR	990	NR	1.5	950000	2.3	NR	NR	160
216-B-29	Trenches	SIM	NR	NR	830	NR	1.5	960000	NR	NR	NR	150
216-B-30	Trenches	SIM	NR	NR	1100	NR	1.3	830000	4.7	NR	NR	150
216-B-31	Trenches	SIM	NR	NR	1100	NR	1.3	850000	4.7	NR	NR	150
216-B-32	Trenches	SIM	NR	NR	1100	NR	1.3	820000	4.9	NR	NR	150
216-B-33	Trenches	SIM	NR	NR	1100	NR	1.2	800000	5.7	NR	NR	140

WIDS	Description	Ref[(b)]	CCl4 (kg)	CN (kg)	Cr (kg)	Cr-VI (kg)	Hg (kg)	NO3 (kg)	Pb (kg)	TBP (kg)	TCE (kg)	U (total) (kg)
216-B-34	Trenches	SIM	NR	NR	1100	NR	1.3	820000	6	NR	NR	150
216-B-52	Trenches	SIM	NR	NR	1900	NR	2.3	1500000	9.3	NR	NR	260
216-B-53A	Trenches	SIM	NR	NR	3.9	NR	0.012	1500	0.28	NR	NR	31
216-B-53B	Trenches	SIM	NR	NR	2.1	NR	0.00033	890	0.0079	NR	NR	8.3
216-B-54	Trenches	SIM	NR	NR	2.6	NR	0.022	890	0.52	NR	NR	13
216-B-58	Trenches	SIM	NR	NR	1.9	NR	0.0091	710	0.22	NR	NR	8.8

a. NR = Not reported for indicated EU
b. SIM = RPP-26744, Rev. 0

Table G.5.1-12. Summary of the Evaluation of Threats to Groundwater as a Protected Resource from Saturated Zone (SZ) and Remaining Vadose Zone (VZ) Contamination associated with the Evaluation Unit.

PC	Group	WQS	Porosity[a]	K_d (mL/g)[a]	ρ (kg/L)[a]	VZ Source M^{Source}	SZ Total M^{SZ}	Treated[c] M^{Treat}	VZ Remaining M^{Tot}	VZ GTM (Mm^3)	VZ Rating[d]
C-14	A	2000 pCi/L	0.25	0	1.82	2.77E+01 Ci	---	---	2.77E+01 Ci	1.38E+01	*Medium*
I-129	A	1 pCi/L	0.25	0.2	1.82	6.45E-01 Ci	---	---	6.45E-01 Ci	2.63E+02	*High*
Sr-90	B	8 pCi/L	0.25	22	1.82	4.43E+03 Ci	---	---	4.43E+03 Ci	3.43E+03	*ND*[e]
Tc-99	A	900 pCi/L	0.25	0	1.82	4.11E+02 Ci	---	---	4.11E+02 Ci	4.56E+02	*High*
CCl4	A	5 µg/L	0.25	0	1.82	---	---	---	---	---	*ND*
Cr	B	100 µg/L	0.25	0	1.82	2.35E+04 kg	---	---	2.35E+04 kg	2.35E+02	*High*
Cr-VI	A	48 µg/L[b]	0.25	0	1.82	2.35E+04 kg	---	---	2.35E+04 kg	4.89E+02	*High*
TCE	B	5 µg/L	0.25	2	1.82	---	---	---	---	---	*ND*
U(tot)	B	30 µg/L	0.25	0.8	1.82	3.74E+03 kg	---	---	3.74E+03 kg	1.83E+01	*ND*[e]

a. Parameters obtained from the analysis provided in Attachment 6-1 to Methodology Report (CRESP 2015).

b. "Model Toxics Control Act—Cleanup" (WAC 173-340) Method B groundwater cleanup level for hexavalent chromium.

c. Treatment amounts from the 2015 Hanford Annual Groundwater Report (DOE/RL-2016-09, Rev. 0).

d. Groundwater Threat Metric rating based on Table 6-3, Methodology Report (CRESP 2015).

e. Based on an analysis similar to the one discussed in Appendix E.6 (A-AX Tank and Waste Farms) Section 6.5 (Vadose Zone Contamination), no appreciable total uranium or Sr-90 plume would be expected in the next 150 years due to transport considerations. The *Low* ratings would apply after the Active Cleanup is completed to account for uncertainties.

PART VI. POTENTIAL RISK/IMPACT PATHWAYS AND EVENTS

CURRENT CONCEPTUAL MODEL

Narrative description of pathways and barriers to receptors and conditions/events that can lead to completed pathways

Pathways and Barriers: (1. description of institutional, natural and engineered barriers (including material characteristics) that currently mitigate or prevent risk or impacts, 2. Time scale from loss of each barrier to realization of risk or impacts)

Briefly describe the current institutional, engineered and natural barriers that prevent release or dispersion of contamination, risk to human health and impacts to resources:

1. *What nuclear and non-nuclear safety accident scenarios dominate risk at the facility? What are the response times associated with each postulated scenario?*

Existing soil covers (e.g., the current soils that have been placed over the waste site to stabilize it, as well as the clean fill placed during construction of the waste site) are maintained as needed to continue to provide protection from intrusion by biological receptors (such as badgers who could burrow through the clean soil cover into the contaminated soils) and humans.

2. *What are the active safety class and safety significant systems and controls?*

Active controls include groundwater monitoring and active surveillance of the site surface to assist in the detection of intrusion of biological receptors such as burying animals (e.g., badgers).

3. *What are the passive safety class and safety significant systems and controls?*

The passive system and controls include the presence of clean soil backfill placed over the contaminated waste sites to prevent direct contact with contaminated soils and sediments.

4. *What are the current barriers to release or dispersion of contamination from the primary facility? What is the integrity of each of these barriers? Are there completed pathways to receptors or are such pathways likely to be completed during the evaluation period?*

The primary barriers to release from the contaminated soil include: (i) sorption to soil and other vadose zone components; (ii) temporary soil caps on select sites; and (iii) sorption and dispersion in saturated zone groundwater environments. The integrity of the soil barriers appears to be currently intact.

5. *What forms of initiating events may lead to degradation or failure of each of the barriers?*

In its current state, the greatest risk is an event that would (i) damage the integrity of soil caps, such as through a burrowing animal; and (ii) contribution of a very large amount of water on the ground above the cribs and trenches leading to infiltration into the vadose zone regions containing significant amounts of highly mobile nitrate and Tc-99 (especially beneath Cribs 216-B-18 and 216-B-19), which could cause additional mobilization of these two primary contaminants into groundwater.

6. *What are the primary pathways and populations or resources at risk from this source?*

Should such an event occur, both nitrate and ^{99}TC at concentrations at or above the drinking water standard could eventually make their way to the Columbia River.

7. *What is the time frame from each of the initiating events to human exposure or impacts to resources?*

It is unknown and dependent on the amount of infiltration being sufficient to cause considerable migration of the contaminants.

8. Are there current on-going releases to the environment or receptors?

Not at this time.

POPULATIONS AND RESOURCES CURRENTLY AT RISK OR POTENTIALLY IMPACTED

Facility Worker

Only workers at risk or impacted would be working on the active remediation activities. Otherwise, workers are not directly exposed to the contaminated soils because they are located below grade beneath a clean soil cover.

Radiological surveys with mobile survey systems demonstrated that excavation and soil removal of soils in Zone A of the northern section of UPR-200-E-83 in 2009-2011 eliminated the direct contact exposure pathway for cesium- 137, thereby preventing future releases of radiological contamination from this site.

Co-Located Person (CP)

Workers are not directly exposed to the contaminated soils because they are located below grade beneath a clean soil cover.

Public

The contamination remains underground, and there is not a dispersion pathway for the material to reach the atmosphere.

Groundwater

Tc-99 and nitrate are in large concentrations 18 to 53 m below the ground surface (Serne, et al. 2009). Cs-137 and Sr-90 are expected to remain in the vadose zone with little to no migration due to their high sorption affinity for the surrounding soils and sediments. Rate of contaminant migration is very slow (approximately 0.08 m/year). Individual groundwater ratings for this EU are *Medium* for C-14 and *High* for I-129, Tc-99, and total and hexavalent chromium. Sr-90 and uranium are rated *ND* based on an analysis similar to the one discussed in Appendix E.6 (A-AX Tank and Waste Farms). No appreciable total uranium or Sr-90 plume would be expected in the next 150 years due to transport considerations. The *Low* rating would apply after the Active Cleanup is completed to account for uncertainties.

There is an existing nitrate plume, but the focus is on Group A and B PCs based on persistence and mobility. Furthermore, the nitrate plume would be at most a Low rating and would not drive risk.

This leads to an overall rating of *High*.

Columbia River

Migration of the primary contaminants of concern (Tc-99 and nitrate) originating from the BC Cribs and Trenches EU have not migrated to groundwater, and based on migration rates of approximately 0.08 m/year, are not expected to impact the Columbia River within the next 150 years leading to an overall rating of *ND*.

Ecological Resources

ND to Low in EU because nearly 30% is level 3 and 4 resources, along with the buffer area. There is the potential for disturbance and invasion of exotic species in both EU and buffer area.

Cultural Resources

There are unevaluated cultural resources located within this EU. Manhattan Project/Cold War significant resources have already been mitigated. Traditional cultural places in viewshed.

CLEANUP APPROACHES AND END-STATE CONCEPTUAL MODEL

Selected or Potential Cleanup Approaches

As discussed in DOE/RL-2003-64, *Feasibility Study for the* 200-7W-l *Scavenged Waste Group, the* 200-7W-2 *Tank Waste Group, and the 200-PW-5 Fission Product Rich Waste Group Operable Units,* remedial technologies were identified and evaluated on the basis of their ability to reduce potential risks to human health and the environment at the waste sites. Collective experience gained from previous studies and evaluations of cleanup methods were used to identify technologies that would be carried forward to develop remedial alternatives to address the RAOs. This process focused on treatment and removal activities because the Regulatory Agencies (Washington State Department of Ecology (Ecology) and EPA) have a preference for these alternatives rather than containment remedies. For the BC Cribs and Trenches Area waste sites, five remedial alternatives were identified for detailed and comparative analyses.

These five alternatives also were evaluated for their applicability to the 200-E-14 Siphon Tank and 200-E-114 Pipeline. The volumes of sludge and/or liquid estimated to remain in this tank are uncertain. However, up to 3.8 m^3 (1,010 gal) of sludge and 41.9 m^3 (11,060 gal) of liquid may exist. The following alternatives were evaluated in the focused feasibility study.

- **Alternative 1: No Action**. When this alternative is selected, no further action is taken at the site, other than periodic review to ensure continued protection. No legal restrictions, access controls, or active remedial measures are applied to the site. "No action" implies "walking away from the site" and allowing the wastes to remain in their current configuration, affected only by natural processes.

- **Alternative 2: Maintain Existing Soil Cover, Institutional Controls, and Monitored Natural Attenuation**. When this alternative is selected, existing soil covers (e.g., the current soils .that have been placed over the waste site to stabilize it, as well as the clean fill placed during construction of the waste site) are maintained as needed to continue to provide protection from intrusion by biological receptors (such as badgers) and humans. Selective herbicides may be applied to prevent establishment of deep-rooted plants. In addition, institutional controls (such as deed restrictions, land-use zoning, and excavation permits) are put in place to further prevent human access to the site. Where appropriate, monitored natural attenuation (such as the decay of radionuclides) is accounted for, because this is an ongoing process that reduces risk over time. Monitoring would be conducted to demonstrate that natural attenuation is occurring and that contamination is being contained as the concentrations decrease.

- **Alternative 3: Removal, Treatment, and Disposal.** When this alternative is selected, soil and structures with contaminant concentrations above PRGs are excavated. The 216-B-20 through 216-B-34 and 216-B-52 Trenches would be excavated to a depth of ~46 m (~150 ft); the cribs would be excavated to a depth of ~67 m (-220 ft); and the 216-B-53A, 216-6-53B, 216-8-54, and 216-B-58 Trenches would be excavated to a depth of ~7.6 m (~25 ft). Because near-surface contamination levels at the majority of the waste sites pose a significant dose threat to workers, specialized equipment and activities are required to protect the workers, the environment in the area, and the public that could be exposed near roads or facilities In addition, some less-contaminated material is needed to blend with the more contaminated material to allow safe excavation, loading, transporting, and disposal of the material and to meet health and safety and waste acceptance criteria at the disposal facility. Excavated material that

is above the PRGs will be disposed of at the ERDF in accordance with that facility's established waste acceptance criteria. This disposal facility is near the waste sites and currently is being used for remediation wastes on the Hanford Site. Excavation would continue until all contaminated material exceeding the cleanup goal was removed. The site then would be backfilled with clean material.

• **Alternative 4: Capping**. When this alternative is selected, a surface barrier (such as an evapotranspiration barrier) is built over the contaminated waste site, thus "capping" the site to reduce the quantity of water infiltrating into the waste and to deter or prevent intrusion by human or ecological receptors into the waste. Cap intrusion-deterrence features would vary with the severity of the risk to a potential intruder. For those waste sites where the majority of the risk will diminish within a few hundred years, an evapotranspiration barrier with intruder-deterrent features is recommended for individual cribs and trenches. Between the waste sites and around the periphery of waste site groupings, a simple evapotranspiration barrier without intrusion-deterrent features is recommended. Details of the barrier design, particularly the intrusion-deterrent feature, would be determined later. Institutional controls (such as deed restrictions, land-use zoning, and excavation permits) are required to further minimize the potential for exposure to contamination and to ensure the integrity of the cap. Extension of the institutional control period beyond the nominal 150-yr period is considered because of the need to maintain the cap. Performance monitoring is included as a part of this alternative to ensure that the cap is performing as expected. Groundwater monitoring is included to watch for movement of more mobile contaminants.

• **Alternative 5: Partial Removal, Treatment, and Disposal with Capping**. When this alternative is selected, near-surface soil associated with high concentrations of cesium-137 is removed, reducing the intruder risk associated with the highly contaminated zone at the bottom of the waste site. This alternative removes contaminants to a lesser depth than Alternative 3 (4.6 to 6.1 m [15 to 20 ft]). Risk to remediation workers is similar to that associated with Alternative 3. Once the near-surface contamination has been removed and the excavation backfilled, a simple evapotranspiration barrier would be constructed to provide protection to the groundwater from contaminants that remain deeper in the soil column. This barrier would not require intrusion-deterrent features, because the high concentrations of near-surface contaminants would be excavated. This alternative would reduce the risks of potential intruders and provide protection of the groundwater. Performance monitoring is included as a part of this alternative to ensure that the cap performs as expected, and groundwater monitoring is included to watch for movement of more mobile contaminants. As with Alternative 4, extension of institutional controls beyond 150 yr is considered because of the need to maintain the cap.

CERCLA Evaluation Criteria and Process

As a critical part of the evaluation process, the alternatives are evaluated against nine CERCLA criteria:

- *Overall protection of human health and the environment* is the primary objective of the remedial action and addresses whether a remedial action provides adequate overall protection of human health and the environment. This criterion must be met for a remedial alternative to be eligible for consideration.
- *Compliance with ARARs* addresses whether a remedial action will meet all of the applicable or relevant and appropriate requirements and other Federal and State environmental statutes, or provide grounds for invoking a waiver of the requirements. This criterion must be met for a remedial alternative to be eligible for consideration.
- *Long-term effectiveness and permanence* refers lo the magnitude of residual risk and the ability of a remedial action to maintain long-term, reliable protection of human health and the environment after remedial goals have been met.

- *Reduction of toxicity, mobility, or volume through treatment* refers to an evaluation of the anticipated performance of the treatment technologies that may be employed in a remedy. Reduction of toxicily, mobility, and/or volume contributes toward overall protectiveness.
- *Short-term effectiveness* refers to evaluation of the speed with which the remedy achieves protection. It also refers to any potential adverse effects on human health and the environment during the construction and implementation phases of a remedial action.
- *Implementability* refers to the technical and administrative feasibility of a remedial action, including the availability of materials and services3 needed to implement the selected solution.
- Cost refers to an evaluation of the capital, operation and maintenance, and monitoring costs for each alternative.
- *State acceptance* indicates whether the State concurs with, opposes, or has no comment on the preferred alternative based on a review of the focused feasibility study and the Proposed Plan.
- *Community acceptance* assesses the public response to the Proposed Plan, following a review of the public comments received during the public comment period and open community meetings. The remedial action is selected only after consideration of this criterion.

The first two criteria (overall protection of human health and the environment and compliance with ARAR) are threshold criteria. Alternatives that do not protect human health and the environment or do not comply with ARAR, (or justify a waiver) do not meet statutory requirements and are eliminated from further consideration in the focused feasibility study.

The next five criteria (long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost) are balancing criteria on which the remedy selection is based.

The final two criteria (State and community acceptance) are modifying criteria. Ecology concurs with the proposed alternatives outlined in the plan. The ability of a preferred remedy to meet the criterion of community acceptance, however, can be evaluated only after the public review and comment period for this Plan. State and community acceptance criteria are not discussed separately in the following paragraphs or in the alternatives presented. The preferred alternatives could change in response to public comments or new information…."(DOE/RL 2004-69, Draft A)

Contaminant Inventory Remaining at the Conclusion of Planned Active Cleanup Period

The high concentrations of cesium-137 observed during characterization of the 216-B-26 Trench exhibited dose rates that could be lethal (-4.5 rad/h) if exposure time were sufficient (a few hundred years). The deep mobile contaminants (Tc-99 and nitrate) are predicted to eventually reach groundwater at levels exceeding the drinking water standard, potentially rendering the groundwater unfit for human consumption. Baseline risk (without remedial action) assessment was performed using the industrial scenario to establish the need for remedial action. The inadvertent intruder scenario was considered to evaluate potential post-remediation risk. The baseline risk assessment for the 216-B-26 Trench indicated the significant shallow-zone contaminants (primarily Cs-137 and Sr-90) in the 3.7 to 4.6 m (12 to 15 ft) range would require nearly 450 yr to decay to levels corresponding to acceptable risk to industrial workers. The maximum dose to industrial workers is calculated to be 310,000 mrem/yr, which greatly exceeds the 15 mrem/yr criterion. Predicted migration of Tc-99 and nitrate may exceed the groundwater drinking water standards for those contaminants. With respect to potential intruders past the 150-yr period of active institutional controls, humans are not protected until radioactive decay proceeds for nearly 450 yr. The 216-B-46 Crib, which is representative of the BC Cribs and Trenches Area

cribs, indicated similar risks. The baseline risk assessment for the 216-B-58 Trench indicated lesser shallow-zone contaminant concentration and essentially no deep mobile contaminants. Even so, human health risk standards related to direct exposure were exceeded. Groundwater protection standards are not predicted to be exceeded. Risk to inadvertent intruders is essentially acceptable 250 yr from now with no action. Uncertainties with the exact nature of future industrial and inadvertent intruder exposures may lead to under- or over-estimation of human health risk. Another source of uncertainty is the limited sample data. Because the investigation and sampling focused on the most highly radioactive wastes, the risk assessment is more likely to overestimate the potential human risk.

Risks and Potential Impacts Associated with Cleanup

Cleanup Alternative No. 1 (No Action), will not place cleanup workers at risk. All other alternatives (Alternatives No. 2 through 5) will put cleanup workers at risk. In particular, Alternative No. 3 (Removal, Treatment, and Disposal) and No. 5 (Partial Removal, Treatment, and Disposal with Capping) will place cleanup workers at the greatest risk due to site disturbance and exposure of workers to contaminated dust and debris.

POPULATIONS AND RESOURCES AT RISK OR POTENTIALLY IMPACTED DURING OR AS A CONSEQUENCE OF CLEANUP ACTIONS

Facility Workers

Please see above.

Co-located Person

Only workers at risk or impacted would be working on the cleanup.

Public

Risk to the Public is rated as low to ND because of long distance between contaminates and Hanford security boundary.

Groundwater

Please see above. Overall rating of *High* (I-129, Tc-99, and total and hexavalent chromium).

Columbia River

ND based on analysis provided above.

Ecological Resources

Depending upon remediation option, could result in disturbance and disruption to level 3 and 4 (30% of EU and 77% of buffer), including increases in exotic species and changes in species composition of native species.

Cultural Resources

There is one unevaluated (for National Register) cultural resource. Traditional cultural places in view-shed. Indirect effects are possible from capping.

ADDITIONAL RISKS AND POTENTIAL IMPACTS IF CLEANUP IS DELAYED

Please see above.

EU Designation: CP-LS-1 (BC Cribs and Trenches)

Near-Term, Post-Cleanup Status, Risks and Potential Impacts

Please see above.

POPULATIONS AND RESOURCES AT RISK OR POTENTIALLY IMPACTED AFTER CLEANUP ACTIONS (from residual contaminant inventory or long-term activities)

Table G.5.1-13. Populations and Resources at Risk or Potential Impacted After Cleanup Actions.

Population or Resource		Risk/Impact Rating	Comments
Human	Facility Worker	Low	Only workers at risk or impacted would be working on the active remediation activities, to include monitoring and sampling.
	Co-located Person	Low	Co-located persons are 100 m away from possible remediation activity.
	Public	Not Discernible (ND)	The contamination remains underground, except where the potentially contaminated groundwater may reach the Columbia River.
Environmental	Groundwater (A&B) from vadose zone[(a)]	*High* (I-129, Tc-99, Cr(tot), Cr-VI) *Medium* (C-14) *Low* (Sr-90, U(tot))	Current groundwater ratings are *Medium* for C-14 and *High* for I-129, Tc-99, Cr(tot), and Cr-VI. Sr-90 and total uranium (rated *ND* during the Active Cleanup period) are rated *Low* here to address uncertainties. This leads to an overall rating of *High*.
	Columbia River from vadose zone[(a)]	*ND*	The large dilution effect of the Columbia River results in a rating of *Not Discernable* for the free-flowing ecology for all evaluation periods. The rating threat evaluations to the benthic and riparian ecologies are not discernable due to the absence of a contaminant plume.
	Ecological Resources[(b)]	Low	Contamination remaining in areas for monitored natural attenuation may still result in uptake in biota, but is not likely to cause an effect to the biota. Continued long-term monitoring activities may disrupt terrestrial habitats.
Social	Cultural Resources[(b)]	**Native American:** Direct: Known Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: None **Manhattan/Cold War:** Direct: Known Indirect: Unknown	Permanent direct and indirect effects are possible due to high sensitivity of area.

a. Threat to groundwater or Columbia River for Group A and B contaminants remaining in the vadose zone. Threats from existing plumes associated with the BC Cribs and Trenches EU are described in **Part V** with more detailed evaluation in Appendix G.5 (CP-GW-1).

b. For both Ecological and Cultural Resources see Appendices J and K, respectively, for a complete description of Ecological Field Assessments and literature review for Cultural Resources. Ecological ratings are described in Table 4-11 of the Final Report.

LONG-TERM, POST-CLEANUP STATUS – INVENTORIES AND RISKS AND POTENTIAL IMPACT PATHWAYS

The long-term cleanup status is highly dependent on the selected remedial alternative. Regardless of that alternative selected, long-term site use restriction and groundwater monitoring must remain due to the long-term presence of contaminants deep in the vadose zone that are not amendable to excavation, and the likely continued migration of contaminants through the vadose zone to the groundwater.

The DOE is expected to continue industrial exclusive activities for at least 50 years, in accordance with DOE/EIS-0222-F, Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement, and the Record of Decision (64 FR 61615, "Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS)". Based on discussions with the HAB, the alternative risk evaluations used the following anticipated land-use assumptions:

- Industrial-Exclusive use for the next 50 years inside the Central Plateau industrial exclusive zone.
- industrial land use (non-DOE worker) after the next 50 years inside the Central Plateau industrial/ exclusive zone.
- *Native American uses consistent with treaty rights.*
- *No groundwater consumption for at least the next 150 yr.*

In addition, risks were calculated considering the possibility of intruders beginning 150 yr from now (2155) to evaluate impacts from the potential loss of institutional control.

PART VII. SUPPLEMENTAL INFORMATION AND CONSIDERATIONS

The BC Cribs and Trenches area needs to remain under DOE control to maintain a safety buffer for all remedial alternatives except Alternative No. 3 (complete RTD).

Table G.5.1-14. CP-LS-1 BC Cribs and Trenches Waste Site and Facility List. (Note that only those waste sites with a Waste Information Data System (WIDS) Classification of "Accepted" are shown, along with non-duplicate facilities.

Site Code	Name, Aliases, Description	Site Status	Site Type	Site Type Category	Operable Unit	Exclude from Evaluation
200-E-114-PL	200-E-114-PL; 216-BC-2805; 2805-E1, 2805-E2, 2805-E3 and 2805-E4; Pipeline from 216-BY-201 to 216-BC-201; Pipeline from 241-BY Tank Farm to 241-C Tank Farm and BC Cribs Trenches	Inactive	Radioactive Process Sewer	Pipeline and associated valves, etc.	200-BC-1	
200-E-14	200-E-14; 216-B-201; 216-BC-201 Siphon Tank; IMUST; Inactive Miscellaneous Underground Storage Tank	Inactive	Storage Tank	Underground storage tank	200-BC-1	
200-E-222-PL	200-E-222-PL; Distribution Pipelines from 216-BC-201 Siphon Tank to BC Cribs	Inactive	Radioactive Process Sewer	Pipeline and associated valves, etc.	TBD	
216-B-14	216-B-14; 216-BC-1 Crib	Inactive	Cribs	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-15	216-B-15; 216-BC-2 Crib	Inactive	Cribs	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-16	216-B-16; 216-BC-3 Crib	Inactive	Cribs	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-17	216-B-17; 216-BC-4 Crib	Inactive	Cribs	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-18	216-B-18; 216-BC-5 Crib	Inactive	Cribs	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-19	216-B-19; 216-BC-6 Crib	Inactive	Cribs	Pipeline and associated valves, etc.	200-BC-1	
216-B-20	216-B-20; 216-B-20 Trench; 216-BC-7 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-21	216-B-21; 216-B-21 Trench; 216-BC-8 Trench	Inactive	Trenches	Pipeline and associated valves, etc.	200-BC-1	
216-B-22	216-B-22; 216-B-22 Trench; 216-BC-9 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-23	216-B-23; 216-B-23 Trench; 216-BC-10 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-24	216-B-24; 216-B-24 Trench; 216-BC-11 Trench	Inactive	Trenches	Pipeline and associated valves, etc.	200-BC-1	
216-B-25	216-B-25; 216-B-25 Trench; 216-BC-12 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-26	216-B-26; 216-B-26 Trench; 216-BC-13 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-27	216-B-27; 216-B-27 Trench; 216-BC-14 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-28	216-B-28; 216-B-28 Trench; 216-BC-15 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-29	216-B-29; 216-BC-16 Trench	Inactive	Trenches	Pipeline and associated valves, etc.	200-BC-1	
216-B-30	216-B-30; 216-B-30 Trench; 216-BC-17 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-31	216-B-31; 216-B-31 Trench; 216-BC-18 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-32	216-B-32; 216-B-32 Trench; 216-BC-19 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-33	216-B-33; 216-B-33 Trench; 216-BC-20 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-34	216-B-34; 216-BC-21 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-52	216-B-52; 216-B-52 Trench; 216-BC-22	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-53A	216-B-53A; 216-B-53A Trench; PRTR Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-53B	216-B-53B; 216-B-53B Trench; 216-B-53 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
216-B-54	216-B-54; 216-B-54 Trench	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	

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216-B-58	216-B-58; 216-B-58 Trench; 216-B-59 Crib	Inactive	Trenches	Crib - Subsurface Liquid Disposal Site	200-BC-1	
600-235	600-235; Buried Lead Sheathed Telephone Cables	Inactive	Dumping Area	Burial Ground	TBD	
UPR-200-E-63	UPR-200-E-63; Radioactively Contaminated Tumbleweeds; UN-200-E-63; UN-216-E-63	Inactive	Unplanned Release	Unplanned Release – Surface/Near Surface	NA	
UPR-200-E-83	UPR-200-E-83; Zone A	Inactive	Contamination Migration	Unplanned Release – Surface/Near Surface	200-OA-1	
6120	Salt and Sand Storage	Active	Structure	Infrastructure Building	-	X

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