APPENDIX G.4

618-10 BURIAL GROUND AND 316-4 WASTE SITE
(RC-LS-4, RIVER CORRIDOR)
EVALUATION UNIT SUMMARY TEMPLATE

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PART I. EXECUTIVE SUMMARY

EU LOCATION

300 Area

RELATED EUS

RC-LS-1 (618-11 Burial Grounds)

PRIMARY CONTAMINANTS, CONTAMINATED MEDIA AND WASTES

The 618-10 Burial Ground received low- to high-activity radioactive waste including fission products, transuranics, small amounts of irradiated fuel element sample residue, and some plutonium-contaminated waste from the 300 Area laboratories and fuels development facilities. Radiological and chemical hazards include, but are not limited to, cesium, strontium, plutonium, americium, neptunium, beryllium, uranium, lead, zirconium, and deactivated sodium-potassium metals.[1]

Based on a thorough review of historical records and detailed modeling of waste disposals, the radiological inventory of the 618-10 Burial Ground is estimated to be 4.69E+03 curies (130.1 plutonium-239 dose-equivalent curies [DE-Ci], of which 3.59E+02 curies [10.3 DE-Ci] are located in the trenches and 4.33E+03 curies [119.8 DE-Ci] are located in the vertical pipe units (VPUs)). **[1]**

Residual quantities of chemical wastes associated with laboratory and fuel-manufacturing processes were also disposed of in the 618-10 Burial Ground. Small quantities of solid waste contaminated with beryllium as a result of N Reactor fuel development and fabrication activities were disposed in the trenches.[1]

The 316-4 Crib received an estimated 200,000 L of hexane-bearing uranium wastes, approximately 2,205 lb of nitrate, 4,409 lb of uranium, and 6,614 lb of hexane.[2] Radiological and volatile organic contamination has been found in several boreholes near the 618-10 and 316-4 sites.[3] Remediation of the site began in 2004 and the planned excavation completed in April 2005. Further evaluation of the extent of contamination in the soil resulting from the use of the 316-4 Crib will be determined during its remediation that was scheduled to begin on completion of the 618-10 site remediation work.[2]

BRIEF NARRATIVE DESCRIPTION

The 618-10 Burial Ground (also known as 300 North, 300 North Burial Ground, or 618-10 Waste Site) was operated from March 1954 until September 1963. This site consists of 12 slope-sided trenches and 94 VPUs. The base of the burial ground is about 36 feet above ground water with the average depth of the burial ground about 25 feet below the ground surface. The 618-10 Burial Ground received low- to high-activity radioactive waste including fission products, small amounts of irradiated fuel element

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[1] *Documented Safety Analysis for Remediation of the 618-10 Burial Ground*, WCH-459, Rev. 1, US Department of Energy, August 2014.
[2] 300 Area Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, DOE/RL-2009-30, Revision 0, US Department of Energy, April 2010
[3] *Applying Reflextion Tomography in the Postmigration Domain to Multifold Ground-Penetrating Radar Data*, John H. Bradford, Geophysics, Vol. 71, No. 1, January-February 2006.

sample residue, and some plutonium- contaminated waste from the 300 Area laboratories and fuels development facilities. The low-activity wastes were primarily disposed in trenches while the moderate- and high-activity wastes were primarily disposed in the VPUs. A portion of the moderate- to high-activity wastes was also disposed in trenches in concrete/lead-shielded drums.[1]

Wastes included radiological contaminated laboratory instruments, bottles, boxes, filters, aluminum cuttings, irradiated fuel element sample residues, metallurgical samples, electrical equipment, lighting fixtures, barrels, laboratory equipment and hoods, and low- and high-activity waste sealed in containers. The actual contents of the containers transported to the burial ground are uncertain; however, radiological survey records provide the number of waste shipments and the types of containers used. Trenches generally received low-activity waste in cardboard boxes. Materials with higher levels of radioactivity were packaged in concrete and lead-shielded drums for disposal in the trenches. [1]

Surveillance of site surfaces was conducted annually until mid-2009 to monitor the site for the rise of contamination to the surface of the burial ground and to monitor for the introduction of potential contamination from other areas. Radiological surveys were performed using hand-held radiological survey equipment. The annual surveys found no contamination and typically no signs of animal intrusion or erosion. Surveillance of the site surface ceased on completion of the nonintrusive characterization activities for the VPUs.

The 316-4 Crib is an inactive, liquid, radioactive, mixed waste site located about 35 meters southeast of the 618-10 site. It consists of two inverted, bottomless, 0.25-in. stainless steel tanks. The tanks had concrete footings and sit on a bed of gravel. They are 10 feet below grade and have discharge and ventilation pipes leading to the surface.[2]

SUMMARY TABLES OF RISKS AND POTENTIAL IMPACTS TO RECEPTORS

Table G.4-1 provides a summary of nuclear and industrial safety related risks to humans and impacts to important physical Hanford site resources.

The material at risk (MAR) used in evaluating human health risks at the 618-10 Burial Ground is defined in terms of dose-equivalent activity (curies) of plutonium-239 (DE-Ci).[4]

Human Health

Human health risks to a Facility Worker assume the person is at the location of the accident or release in question. A Co-located person is a hypothetical receptor located 100 m (328 ft) from a release. The maximally exposed offsite individual (MOI) is a hypothetical receptor at the location of the maximum offsite dose, typically at the closest point on the Hanford Site boundary. The distance to the Hanford Site boundary from the 618-10 Burial Ground (3,670 m [12,041 ft] east of the burial ground, on the near bank of the Columbia River). The unmitigated dose is shown in a range from Not Discernable (ND) to High. The estimated mitigated exposure that takes engineered and administrative controls and protections into consideration is shown in parentheses.

[4] *Documented Safety Analysis for Remediation of the 618-10 Burial Ground*, WCH-459, Rev. 1, US Department of Energy, August 2014.

Groundwater and Columbia River

Direct impacts to groundwater resources and the Columbia River have been rated based on available information for the current status and estimates for future time periods. These impacts are also expressed in a range of from *Not Discernible* (*ND*) to *Very High*.

Ecological Resources[5]

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[4]

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

[5] References throughout this Evaluation Unit Summary Template supporting analyses related to Ecological Resources and/or Cultural Resources may be found in Appendices J and K respectively. Refer to the specific EU when searching for the reference.

Table G.4-1. 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: Undergoing Remediation	**From Cleanup Actions:** Undergoing Remediation
Human Health	Facility Worker	Low-Not Discernible (ND)	Low-ND
	Co-located Person	Low-ND	Low-ND
	Public	ND	ND
Environmental	Groundwater (A&B) from vadose zone[a]	*Low* – All PCs with reported inventories **Overall**: *Low*	*Low* – All PCs with reported inventories **Overall**: *Low*
	Columbia River from vadose zone[a]	Benthic and Riparian: *ND* Free-flowing: *ND* **Overall**: *ND*	Benthic and Riparian: *ND* Free-flowing: *ND* **Overall**: *ND*
	Ecological Resources[b]	Low to Medium	Medium to High
Social	Cultural Resources[b]	**Native American** Direct: Known Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: Known **Manhattan/Cold War** Direct: None Indirect: None	**Native American** Direct: Known Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: Known **Manhattan/Cold War** Direct: None Indirect: None

a. Threat to groundwater or the Columbia River from Group A and B primary contaminants (PCs) (Table 6-1, CRESP 2015) remaining in the vadose zone. There are no plumes associated with the RC-LS-4 EU as described in **Part V** with additional information provided in Appendix D.2 (RC-GW-1) for the 300-FF 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.

SUPPORT FOR RISK AND IMPACT RATINGS FOR EACH POPULATION OR RESOURCE HUMAN HEALTH

Current

The 618-10 Burial Ground and 316-4 Crib is a closed waste site undergoing remediation, and has been covered with topsoil and vegetated for stabilization. As such, the author is indicating "Undergoing Remediation" and the same human health risks in both columns of Table 1. A 2014 Documented Safety

Analysis[6] considered eleven of the most likely and potentially most serious accidents that could happen at the 619-10 Burial Ground during active remediation and determined that five would cause an unmitigated radiological dose the Co-located Person that is equivalent to an ND human health risk rating. The other six would cause a radiological dose of greater than 0.1 Rem but less than 2.0 Rem to the CP, which is equivalent to a Low human health risk rating. Of these, four would cause a dose of 0.32 – 0.53 Rem. The two with highest consequential dose to the CP are:

Energetic Reaction/Fire During VPU Variant Identification (Potholing): This scenario involves an energetic event occurring during the removal of soil adjacent to a VPU (thereby exposing the VPU) during the VPU variant identification process (potholing). The reaction (e.g., a pyrophoric reaction) may occur due to exposure of waste to the atmosphere or water if the VPU has degraded or if the excavator breaches the VPU during removal of the soil. It is conservatively assumed that 10% of the entire VPU inventory is involved in the energetic event. A fire is assumed to follow the energetic event. It is also conservatively assumed that the entire VPU inventory (100%) is involved in the fire (even though a portion of the inventory will have been released in the energetic event). The resulting FW and CP dose is estimated to be 1.9 rems and the dose to the Public is 0.0083 rems

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

This energetic reaction/fire event is considered to have an *Unlikely* frequency, and no safety SSCs, TSR-level controls, or SACs are required to prevent or mitigate this event.

Fuel Pool Fire During VPU Variant Identification (Potholing): This fuel pool fire scenario involves the catastrophic failure of a trench excavator fuel tank of sufficient capacity to involve a large area, including the exposed potholing trench excavation face. The spilled fuel is then ignited. One excavation adjacent to a VPU will be completed at a time. However, there is a potential in several locations for two VPUs to be exposed in a single trench excavated between the VPUs. Although only a small portion of the tops of the VPUs could potentially be exposed to a fire in such an event, the MAR is conservatively assumed to be the entire inventory of the two adjacent VPUs with the highest inventories. The resulting FW and CP dose is estimated to be 1.2 rems and the dose to the Public is 0.0055 rems

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

This fire event is considered to have an *Anticipated* frequency, but no safety SSCs, TSR-level controls, or SACs are required to prevent or mitigate this event.

For hazard categorization purposes, the buried, undisturbed radiological inventory of the 618-10 Burial Ground is not considered dispersible or available for interaction with energy sources, and thus does not represent a risk to the Facility Worker, Co-located person or Public.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

See above discussion under Current since site is currently undergoing active remediation.

Groundwater, Vadose Zone, and Columbia River

Current

The RC-LS-4 EU overlays the 300-FF groundwater interest area (GWIA) that is described in the RC-GW-1 EU (Appendix D.2). The saturated zone beneath the RC-LS-4 EU has no plumes based on the 2014 groundwater monitoring results (http://phoenix.pnnl.gov/apps/gw/phoenix.html); however, sites within

[6] *Documented Safety Analysis for Remediation of the 618-10 Burial Ground*, WCH-459, Rev. 1, US Department of Energy, August 2014.

the RC-LS-4 EU have historically contributed contaminants to the saturated zone (DOE/RL-2016-09, Rev. 0). Current threats to groundwater and the Columbia River from contaminants already in the groundwater are evaluated as part of the RC-GW-1 EU (Appendix D.2). However, current threats to groundwater corresponding to only the RC-LS-4 EU contaminants *remaining* in the vadose zone (Table G.4-5) has an overall rating of *Low* (based on total uranium and total and hexavalent chromium) as described in **Part V**. Contamination sources are being treated in the area. As indicated in **Part V**, no current plumes have been linked to RC-LS-4 waste sites.

For the 300-FF GWIA, no plume currently emanating from the RC-LS-4 waste sites intersects the Columbia River at concentrations exceeding the corresponding water quality standard (WQS) as described in **Part V**. Thus current impacts to the Columbia River benthic and riparian ecology would be rated as *Not Discernible* (*ND*). Furthermore, the large dilution effect of the Columbia River on contamination from the seeps and groundwater upwellings also results in *ND* ratings. Thus the overall rating for the Columbia River during the Current period is *ND*.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

As described in **Part VI**, the remedial actions being conducted for the RC-LS-4 EU source sites include retrieval, thereby reducing risks to groundwater. Thus final cleanup actions will be protective of human health and the environment, and it is likely that at least some vadose zone contamination will be removed to satisfy remedial goals. Thus even though there are risks to workers associated with the cleanup of the RC-LS-4 waste sites (described above and in **Part VI**), there is unlikely any discernible impact from likely cleanup actions on groundwater or the Columbia River although these risks cannot be discerned at this time; no changes were made to the current ratings to account for uncertainties.

Contaminants from the RC-LS-4 EU waste sites have historically impacted the vadose zone and groundwater (DOE/RL-2016-09, Rev. 0); treatment using the actions mentioned in **Part VI** may not decrease all concentrations to below thresholds before the Active Cleanup phase commences although there should be significant decreases in contaminant levels. Secondary sources in the vadose zone may threaten groundwater in the future, including the Active Cleanup period. The *Low* rating associated with the RC-LS-4 EU waste sites (Table G.4-5) is associated with total uranium and total and hexavalent chromium that could potentially impact the 300-FF GWIA (RC-GW-1, Appendix D.2). As described in **Part VI**, treatment (i.e., removal) of contaminant sources would support that ratings would be *Not Discernible* (*ND*) by the end of the Active Cleanup period; however, ratings are maintained at *Low* to address uncertainties in the evaluation. There would not be a sufficient impact on peak concentrations in near-shore region of the Columbia River during or after cleanup to modify ratings (which are already *ND*). Thus the ratings for current threats provided in Table G.4-5 would not be modified as described in **Part V** and **Part VI** to address uncertainties. Thus the overall rating remains *Low* for the Active Cleanup and Near-term, Post-Cleanup periods.

Ecological Resources

Current

Both the EU and buffer have over 40% level 3 or greater resources. Loggerhead shrikes are present within the EU. Washington State candidate species coyote tobacco is present in EU and maybe in the buffer; coyote tobacco has not been observed in other places on the Hanford Site. The high value resources within the EU is continuous with level 4 resources within the buffer area (31%) and beyond the buffer.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Remediation has the high potential to impact the resources (population of coyote tobacco, State sensitive species) within the EU and adjacent buffer. Protection of sensitive species needs to be considered during remediation activities; revegetation with sensitive species is very difficult. Exotic species introduction can preclude the survival of existing native populations. Construction activity and noise can disrupt loggerhead shrike and other sensitive wildlife. Construction of temporary buildings associated with cleanup will increase pedestrian, car and truck traffic on a daily basis. Care should be taken to place the temporary buildings away from sensitive resources. Revegetation of area after remediation needs to consider the potential for competition with other level 4 resources.

Cultural Resources

Current

Known archaeological sites and TCPs located within the EU, and within the viewshed. Historic land use indicates low potential for historic farming era archaeological resources. Geomorphology and lack of ground disturbance suggest, however, a moderate potential. Known National Register ineligible archaeological site located within 500 meters of the EU.

No Manhattan Project/Cold War Era buildings within, or within 500 meters of the EU.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Archaeological investigations and monitoring may need to occur prior to remediation. Large portions of the EU are undisturbed and based on geomorphological indicators, there is a moderate potential for intact archaeological resources. Remediation disturbance may result in impacts to archaeological resources if they are present in the subsurface. Permanent indirect effects to viewshed are possible.

No Manhattan Project/Cold War Era facilities within, or within 500 meters of the EU.

Considerations for Timing of the Cleanup Actions

The 618-10 Burial Grounds are currently undergoing active remediation and expected to be completed in 2018.

Near-Term, Post-Cleanup Risks and Potential Impacts

The site will be cleaned to unrestricted land use standards. The site will need to be covered with topsoil and vegetated to maintain stabilization.

PART II. ADMINISTRATIVE INFORMATION

OU AND/OR TSDF DESIGNATION(S)

618-10 Waste Burial Ground and 316-4 crib are a part of 300-FF-2 OU

COMMON NAME(S) FOR EU

300 North, 300 North Burial Ground, or 618-10 Waste Site

KEY WORDS

Legacy site, burial ground

EU Designation: RC-LS-4

REGULATORY STATUS:

Regulatory basis

CERCLA

Applicable regulatory documentation

Hanford Site 300 Area Record of Decision for 300-FF-2 and 300-FF-5, and Record of Decision Amendment for 300-FF-1. U.S. Environmental Protection Agency, Region 10 and U.S. Department of Energy, Richland Operations Office, November 2013.

Applicable Consent Decree or TPA milestones

M-016-00B:[7] Complete all 300 Area remedial actions including the 618-10 burial grounds, but not including the 618-11 burial ground, 300-296 and sites associated with retained 300 Area facilities and the utility corridors. Completion of all remedial actions is defined as the completion of the ROD requirements in accordance with an approved RD/RA Work Plan.

Due date September 30, 2018

RISK REVIEW EVALUATION INFORMATION

Completed

August 22, 2016, updated February 20, 2017

Evaluated by

Henry Mayer, Amoret Bunn, Jennifer Salisbury and Kevin Brown

Ratings/Impacts Reviewed by

Kathryn Higley

PART III. SUMMARY DESCRIPTION

CURRENT LAND USE

The 618-10 Burial Ground and 316-4 Crib are closed waste sites undergoing active remediation, and use is currently restricted with no public access.

DESIGNATED FUTURE LAND USE

Unrestricted land-use[8]

[7] *Final Approval Package for the Tentative Agreement on Hanford Federal Facility Agreement and Consent Order Revisions for Central Plateau Cleanup,* U.S. Department of Energy, U.S. Environmental Protection Agency, and the Washington State Department of Ecology, May 2016

[8] *Record of Decision for 300-FF-2 and 300-FF-5 and Record of Decision Amendment for 300-FF-1*, US Environmental Protection Agency, Region 10 and US Department of Energy, Richland Operations Office, November 2013

PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

The 618-10 burial site is an inactive disposal site containing hazardous and radioactive waste from the 300 Area. The site operated from March 1954 to March 1962 and from October 1962 to September 1963. It reopened in 1962 to support waste-disposal activities while vertical pipe units (VPUs) were installed in the 618-11 Burial Ground and closed for the final time after the 618-11 Burial Ground was operational. The 618-10 site consists of 12 trenches and 94 VPUs (see Figure 1, Schematic of site).

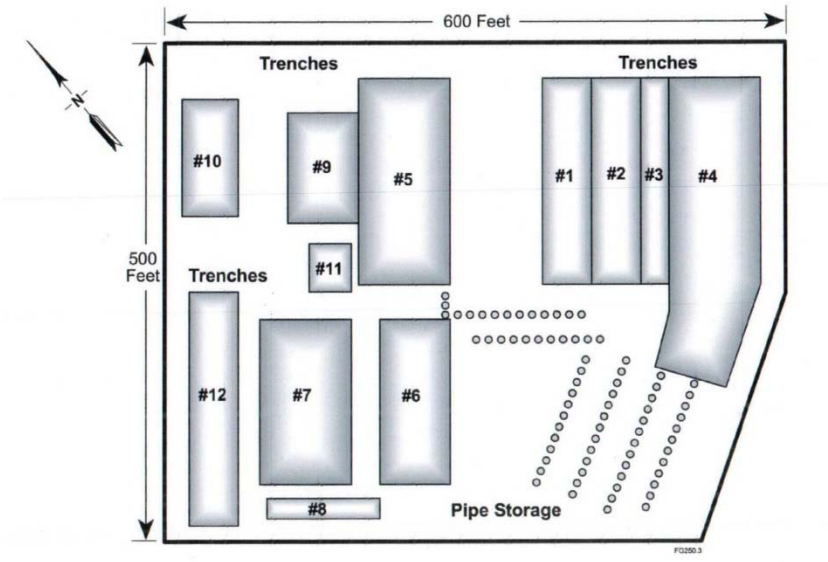

Figure G.4-1. Schematic of the 618-10 Burial Ground Trenches and VPUs

The trenches are of various sizes of up to 75 ft. wide and 301 ft. long. They were believed to be 20-25 feet in depth but excavations to date have found they exceeded 30 ft. in some locations. Historical records indicated that 2,255 drums were buried in the trenches (972 concrete, 178 DU black oxide, 537 DU chips/turnings, 47 Zirconium, 40 Thorium and 480 miscellaneous). The concreted drums were generated from the disposal of waste in the 300 Area laboratories. Waste was generally loaded into an 8-in. diameter culvert placed in the center of a 55-gal drum. The culvert was capped with a lead plug and the drum was then filled with concrete. Waste disposed in concrete drums included high activity waste and plutonium-contaminated liquid. Some of these drums also had up to 2 in. of lead shielding. Black uranium oxide was generated by the thermal treatment of uranium mill turnings to form an oxide. Incomplete oxidation of the uranium presents a significant handling risk. Uranium chips that have not completely oxidized can ignite when exposed to the atmosphere. Uranium and zirconium metal turnings were generated from fuel element fabrication. Both are pyrophoric and present an airborne exposure risk should they become ignited. Typically, uranium and zirconium turnings were packaged in 30-gal drums. For stabilization, the uranium turnings were immersed in cutting oil often containing polychlorinated biphenyls (PCBs). The zirconium chips were packaged in a water/oil mixture before disposal. Other waste disposed in the trenches includes bottles, shipping casks (i.e., transportation pigs), gloveboxes, hot cells, tank, processing equipment, and metallurgical samples of spent fuel. Radiological and chemical hazards include, but are not limited to, cesium, strontium, plutonium, americium, neptunium, uranium, beryllium, lead, zirconium, and deactivated sodium-potassium metals. Historical information is limited on the bottles sent to this burial ground. The bottles were suspected of containing

a wide variety of waste from unused laboratory chemicals and radionuclides including cesium and plutonium. Handling bottles presents safety risks such as the potential for a fire or explosion or being a source of alpha contamination. [9]

Early VPUs were constructed of carbon steel pipes 10 to 24 in. in diameter and up to 15 ft in length and corrugated steel pipes 14 in. in diameter and up to 15 ft in length. Later, five 55-gal open-end drums were stacked vertically, tack welded together, and placed on a concrete footing with the bottom being left open to the soil column (see Figure 2). The VPUs were used to dispose of containers holding moderate to high-activity solid wastes.

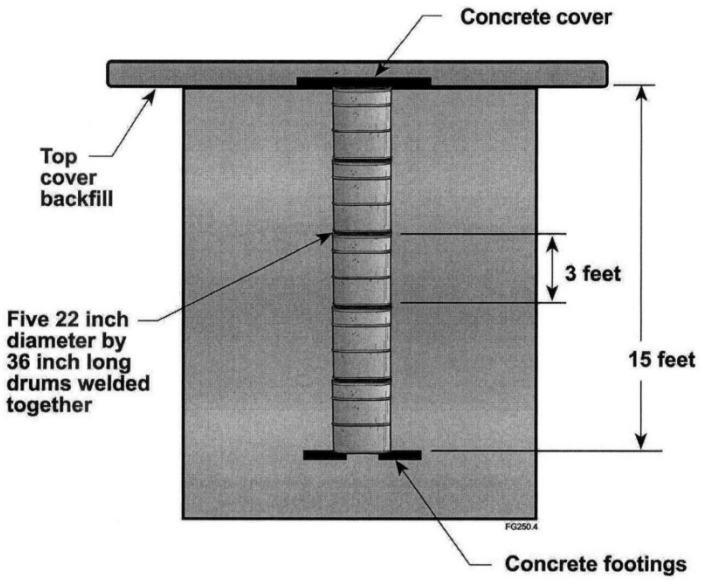

Figure G.4-2. VPU Design

The following four buildings contributed over 90 percent of the 618-10 inventory:

- 327 Building
- 325 Building
- 3706 Building
- 329 Building

Records indicate that the 618-10 Burial Ground wastes included radiologically contaminated laboratory instruments, bottles, boxes, filters, aluminum cuttings, irradiated fuel element samples, metallurgical samples, electrical equipment, lighting fixtures, barrels, laboratory equipment and hoods, and low- and high-activity liquid waste sealed in containers. The site is expected to contain hazardous wastes, radiological wastes, and mixed wastes (both low level and potentially TRU). The total volume of waste in the 618-10 Burial Ground that potentially contains TRU constituents is estimated to be 521 m^3.

The 316-4 Crib is an inactive, liquid, radioactive, mixed waste site located adjacent to the 618-10 Burial Ground. The site began operation in 1948 and reportedly closed between 1955 and 1956. There is some evidence waste was received in 1962. The 316-4 Crib consisted of two inverted, bottomless, 0.25-in. stainless steel tanks (Figure 2-11). The tanks had concrete footings and sit on a bed of gravel. They were

[9] *Remediation Progress of the High-Risk 618-10 Burial Ground at Hanford,* M.J. Haass and Z.P. Walton presentation 12427 at WM 2012 Conference, 2012.

7 ft high and 8 ft in diameter and approximately 10 ft below grade. One tank had an inlet line and a vent riser. The two tanks were 2 ft apart and were connected by a 2 in. stainless steel overflow pipe. From 1948 to 1955/1956, the site received hexane-bearing uranium wastes and limited amounts of other types of uranium bearing waste from the 321 Building R&D activities.[10]

In September 1995, groundwater radioactive contamination was identified in Well 699-S6-E4A during well improvement activities. The well is located adjacent to the 316-4 Crib. Sample analysis of the contamination identified hydrocarbons and uranium. Remedial excavation work to remove the crib structures began in 2004 and the last load-out of waste occurred in April 2005. Final remediation of the site was to occur in combination with the 618-10 remediation work that began in 2013.[5]

High-Level Waste Tanks and Ancillary Equipment

Not applicable

Groundwater Plumes

The 618-10 Burial Ground and adjacent 316-4 Crib are the sources of uranium detected in groundwater at the 618-10 Burial Ground site (DOE/RL-2016-09, Rev. 0). Uranium concentrations in nearby downgradient wells increased in 2004 and again in 2012 following application of dust-control water during implementation of the interim remedial action. The 316-4 Crib, which received liquid waste containing uranium, also is the source of tributyl phosphate contamination in groundwater.[9] However, there are currently no plumes indicated in the area near the RC-LS-4 waste sites (esp. 618-10 Burial Ground and 316-4 Crib).

Operating Facilities

Not applicable

D&D of Inactive Facilities

Not applicable

LOCATION AND LAYOUT MAPS

The 618-10 site is located approximately 4.3 mi northwest of the Hanford Site 300 Area.

[10] 300 Area Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units, DOE/RL-2009-30, Revision 0, US Department of Energy, April 2010

Figure G.4-3. Location of the 618-10 Burial Ground EU

Figure G.4-4. 618-10 Burial Ground Remediation Progress[11]

[11] *618-10 Remediation Progress Update* (PowerPoint presentation), US Department of Energy, September 2015

PART IV. UNIT DESCRIPTION AND HISTORY

EU FORMER/CURRENT USE(S)

LEGACY SOURCE SITES

The 300 Area Industrial Complex facilities began operations in 1943 and included fuel fabrication buildings, raw material storage, waste storage, finished product storage, technical support, service support and research and development related to fuel fabrication and other Hanford Site processes. The complex includes the buildings, facilities and process units where the majority of uranium fuel production and research and development activities took place. Solid wastes were disposed in burial grounds and shallow landfills from 1943 through the 1950s.[12]

The production of fuel elements involved numerous processing steps in which uranium billets were heated, extruded into rods, cut to the appropriate length, and then cladded. Numerous waste streams were generated from the process, including metal turnings (aluminum, stainless steel, beryllium, zirconium, and depleted uranium), cutting oils, solvents, and spent industrial equipment. During the years the 618-10 Burial Ground was in operation, approximately 30,000 fuel elements were produced weekly. Between 1944 and 1957 more than 1,000 research tests were performed in the 300 Area. Many of these tests produced unique waste that was sent to the 618-10 Burial Ground for disposal.[13] In later years, highly radioactive wastes, including wastes with transuranic contaminants, were disposed of in 600 Area burial grounds such as 618-10.[10]

The 618-10 Burial Ground (also known as 300 North, 300 North Burial Ground, or 618-10 Waste Site) was operated from March 1954 until September 1963. This site consists of 12 slope-sided trenches and 94 vertical pipe units (VPUs) (see Figure 1). The base of the burial ground is about 36 feet above ground water with the average depth of the burial ground about 25 feet below the ground surface. The 618-10 Burial Ground received low- to high-activity radioactive waste including fission products, small amounts of irradiated fuel element sample residue, and some plutonium- contaminated waste from the 300 Area laboratories and fuels development facilities. The low-activity wastes were primarily disposed in trenches while the moderate- and high-activity wastes were primarily disposed in the VPUs. A portion of the moderate- to high-activity wastes was also disposed in trenches in concrete/lead-shielded drums.[14]

Wastes included radiological contaminated laboratory instruments, bottles, boxes, filters, aluminum cuttings, irradiated fuel element sample residues, metallurgical samples, electrical equipment, lighting fixtures, barrels, laboratory equipment and hoods, and low- and high-activity waste sealed in containers. The actual contents of the containers transported to the burial ground are uncertain; however, radiological survey records provide the number of waste shipments and the types of containers used. Trenches generally received low-activity waste in cardboard boxes. Materials with higher levels of radioactivity were packaged in concrete and lead-shielded drums for disposal in the trenches.[10]

Early VPUs were constructed of carbon steel pipes 10 to 24 in. in diameter and up to 15 ft in length and corrugated steel pipes 14 in. in diameter and up to 15 ft in length. Later, five 55-gal open-end drums

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[12] *Record of Decision for 300-FF-2 and 300-FF-5 and Record of Decision Amendment for 300-FF-1*, US Environmental Protection Agency, Region 10 and US Department of energy, Richland Operations Office, November 2013

[13] *Remediation Progress of the High-Risk 618-10 Burial Ground at Hanford,* M.J. Haass and Z.P. Walton, presentation 12427 at WM 2012 Conference, 2012.

[14] *Documented Safety Analysis for Remediation of the 618-10 Burial Ground*, WCH-459, Rev. 1, US Department of Energy, August 2014.

were stacked vertically and welded together to form a larger-diameter VPU (see Figure 2). The drums were placed on a concrete footing with the bottom being left open to the soil column. Material disposed to the VPUs was typically high-dose metal fines from grinding and sawing, filters and residue, and fragments of fuel rods too small to return to the 200 Area for processing. Waste material disposed in the VPUs was typically placed in paint cans or other small, thin-walled containers, often centered within the container with gelatin to keep the contents from shifting during transport. These small containers were loaded into shielded casks on a special trailer for transport to the burial ground. The trailer was positioned over the VPU and a remote-operated trap door was opened at the bottom of the cask allowing the containers to fall through an opening in the floor of the trailer and into the VPU. Radiation emitted from the top of the VPUs was monitored, and dirt or concrete were dumped down a VPU to maintain acceptable levels of radiation at the surface.[15]

According to available records, over 97% of the waste disposed to the 618-10 VPUs was generated at the 327 facility during operations to examine failed reactor fuel and reactor hardware. The majority of the waste in the 618-10 VPUs was composed of fuel and activation products; approximately 50% irradiated uranium fuel and 50% activated metals (by weight).[14]

The 316-4 Crib waste site was constructed next to the 618-10 Burial Ground specifically to manage uranium bearing liquid wastes from the 321 Building, and began operation in 1948 and reportedly closed between 1955 and 1956. The waste site consisted of two inverted, bottomless, 0.25-in. stainless steel tanks. The tanks had concrete footings and sat on a bed of gravel. They were 7 ft high and 8 ft in diameter and located approximately 10 ft below grade. One tank had an inlet line and a vent riser. The two tanks were 2 ft apart and were connected by a 2 in. stainless steel overflow pipe. The site received hexane-bearing uranium wastes and limited amounts of other types of uranium bearing waste from the 321 Building R&D activities.[16]

Cleanup of 618-10 Site

Cleanup of the 618-10 Burial Ground trenches began in April 2011, and as of June 2016 workers had dug up and processed about 1,700 drums of waste. This work was considered to be high risk because the trenches are known to contain a large radiological inventory and have the potential to release airborne contaminants. To minimize these risks the remediation program used a combination of engineering controls and monitoring equipment. Development of the controls was based on experience gained from previous Hanford nuclear site burial ground remediation experience, including evaluations of operational parameters and past practices from a number of Hanford remediation projects utilizing open excavation designs.[17]

The engineering controls included limiting the size of active excavation, limiting the size of drum accumulation areas, storing material below grade using a surge trench and the application of soil fixatives. The use of radiological and chemical monitoring equipment is also used to provide near real-time information to guide remediation activities and limit contact of waste until risks can be evaluated. The selected remedial action for this burial ground required the contaminated material to be excavated and transported to the Environmental Restoration Disposal Facility (ERDF).[14]

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[15] *618-10 Burial Ground: Vertical Pipe Units Remediation – 14532*, R. Scott Myers, Washington Closure Hanford, presentation at WM2014 Conference, March 2-6, 2014.
[16] *300 Area Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, DOE/RL-2009-30, Revision 0, US Department of Energy, April 2010
[17] *Remediation Progress of the High-Risk 618-10 Burial Ground at Hanford,* M.J. Haass and Z.P. Walton, presentation 12427 at WM 2012 Conference, 2012.

Removal, treatment and disposal of the high activity wastes inside the VPUs presented a more complex issue. Extensive preparations were needed before this work could begin, starting with a mapping of the locations of all 94 pipes. In 2008 Washington Closure Hanford (WCH) installed four cone-penetrometers (CPTs) in a 90-degree pattern around each VPU. A gamma detector was then lowered through each CPT with total gamma measurements recorded every one foot along the length of each VPU. These gamma readings were then processed to estimate the Cs-137 and potential TRU inventory for each VPU. The data from this non-intrusive characterization program was in turn used to develop a preliminary ranking of VPUs in order of estimated TRU inventory. Under this ranking, approximately one-third of the 94 VPUs are estimated to be suspect-TRU.[13]

Remediation of the 618-10 VPUs was the subject of numerous papers and workshops over two decades. In 2007 WCH held a series of workshops to evaluate the potential remediation alternatives and to move towards a selection of the optimum approach.[14] The remediation process chosen was to install a steel over-casing around the VPU, and then auger the contents to size reduce and stabilize the VPU**,** its contents, and mix with the soil within the over-casing that form a waste/soil matrix. The over-casing is a 4 ft diameter, 0.5-in. thick carbon-steel pipe that is approximately 28.3 ft. in length. A crane with a vibratory hammer was used to drive the casing into the ground until it extended several feet below the bottom of the VPU. Approximately 3.5 ft of over-casing remains above the ground to provide a safety barrier during the subsequent remediation phases.[18]

Radiological characterization is then necessary to support a decision whether or not the augered VPU meets the ERDF Waste Acceptance Criteria. If the augered VPU is determined to meet the ERDF WAC for radiological constituents, grout will be introduced and mixed with the contents. If it is not determined that the augered VPU meets the ERDF WAC (e.g., suspect TRU or greater than Class C waste), the augered VPU will be retrieved and transferred into drums. The drums filled with the augered VPU will be radiologically characterized. Drums that contain waste that is determined to meet the ERDF WAC will be grouted and shipped to the ERDF. Drums that contain waste that are not determined to meet the ERDF WAC will be shipped to the CWC for eventual shipment to WIPP.[15]

This augering process became operational in September 2015 and by early July 2016 the waste in 76 of 80 VPUs had been augered, waste from 16 had been retrieved and mixed with grout, and non-TRU waste was beginning to be removed to ERDF.[19]

GROUNDWATER PLUMES

The 618-10 Burial Ground and adjacent 316-4 Crib are the sources of uranium detected in groundwater at the 618-10 Burial Ground site, but there are no plumes (i.e., measured concentrations above the drinking water standard) associated with the RC-LS-4 waste sites in the area (DOE/RL-2016-09, Rev. 0). Uranium concentrations in nearby downgradient wells increased in 2004 and again in 2012 following application of dust-control water during implementation of the interim remedial action. The 316-4 Crib, which received liquid waste containing uranium, also is the source of tributyl phosphate contamination in groundwater.

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[18] *Sampling and Analysis Plan for the Radiological Determination of the 618-10 Vertical Pipe Units*, WCH-534, Draft A, Washington Closure Hanford, May 2015.

[19] *100/300 Area Unit Managers Meeting, Approval of Meeting Minutes July 14, 2016*, US Department of Energy Richland Operations, August 15, 2016

D&D OF INACTIVE FACILITIES

Not Applicable

ECOLOGICAL RESOURCES SETTING

Landscape Evaluation and Resource Classification

Approximately 5% of the EU is classified as resource level 0 and none classified as level 1. Nearly 54% of the EU is classified as resource level 2 (Appendix J, Table J.6) containing native grasses and forbs with sparse, scattered bitterbrush and gray rabbitbrush (*Ericameria nauseosa*). The remaining 41% of the EU is classified as resource level 3 based on overlapping buffers around previous locations of coyote tobacco, a state sensitive species. Individual specimens of coyote tobacco identified during the June surveys fell within these patches of level 3 biological resources.

The amount and proximity of biological resources surrounding the 618-10 EU were examined within the adjacent landscape buffer area, which extends 4556 ft (1389 m) from the geometric center of the EU (Appendix J, Figure J.7). The landscape beyond the EU to the north, west and south is very similar to that within the EU. Fifty-seven percent of the combined EU and adjacent buffer area is classified as resource level 2 or level 0 (Appendix J, Table J.6). There are no level 1 resources identified within the combined area.

Field Survey

The 618-10 Burial Ground EU is currently being remediated and contains modular buildings, parking lots and laydown yards with primarily bare and graveled surfaces. Sand dunes stabilized by cheatgrass (*Bromus tectorum*) and native grasses including Sandberg's bluegrass and needle-and-thread grass (*Poa secunda* and *Hesperostipa comata*) lie beyond the burial ground (Appendix J, Table J.6). Various native forbs occur throughout the EU, but are relatively sparse. Two large wildfires, one in 1984 and the next in 2000, removed most of the shrub cover.

Isolated occurrences of coyote tobacco (*Nicotiana attenuata*), a state sensitive species, were noted in the somewhat disturbed open sand areas within the EU. Over 100 specimens were noted during the June survey. No estimate of vegetation cover was made for these level 3 occurrences. Two loggerhead shrikes were observed in a large bitterbrush (*Purshia tridentata*), but no nest was found.

CULTURAL RESOURCES SETTING

Approximately half of the RC-LS-4, 618-10 EU has been inventoried for archaeological resources. Additionally, remediation of the 618-10 Waste Site has been addressed in two NHPA Section Reviews: *Cultural Resources Review of the 618-10 and 618-11 Solid Waste Burial Grounds, HCRC# 2004-600-023 (*Kennedy 2004*)* and *Cultural Resources Review for Additional Area to Support the Remediation of the 618-10 Burial Ground in the 600 Area of the Hanford Site, Benton County, Washington (HCRC# 2012-600-016)* (Harrison et al. 2013). One archaeological site and one archaeological isolate associated with the Native American Precontact and Ethnographic Landscape have been recorded within the EU boundary. Both of these resources remain unevaluated for listing in the National Register of Historic Places, however, it should be noted that isolates are typically considered as not being eligible. Additionally, one unrecorded TCP is known to exist within the RC-LS-4, 618-10 EU. This TCP has not been formally evaluated for listing in the National Register of Historic Places.

Two archaeological resources (1 isolate and 1 site) associated with the Pre-Hanford Early Settlers/Farming Landscape have been recorded within 500 meters of the RC-LS-4, 618-10 EU. One of

these resources (archaeological site) has been determined not eligible for listing in the National Register of Historic Places. While the other remains unevaluated, it should be noted that isolates are typically considered as not being eligible.

Review of a historic maps and aerial imagery show minimal development in the area of the RC-LS-4, 618-10 EU suggesting that there is a low potential for archaeological resources associated with the Pre-Hanford Early-Settlers/Farming landscape to be present within the EU boundary. The geomorphology within the RC-LS-4, 618-10 EU suggests a moderate potential for archaeological resources associated with the Native American Precontact and Ethnographic Landscape to be present within the surface and subsurface component of this EU. Examination of 2012 aerial imagery indicates that portions of the EU have been heavily disturbed from the remediation of the 618-10 waste site. Large portions of undisturbed soil do appear to exist in the areas surrounding remediation operations within the EU boundary, suggesting a moderate degree of potential for intact archaeological resources to exist within this isolated undisturbed area. Resources if present would likely be limited to areas of intact or undisturbed soils.

Because of the potential for intact archaeological deposits within portions of the RC-LS-4, 618-10 EU, it may be appropriate to conduct surface and subsurface archaeological investigations in this area prior to initiating any remediation activities. Indirect effects are always possible when TCPs are known to be located in the general vicinity. 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 who may have an interest in the areas (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. 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

CONTAMINATION WITHIN PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

The 618-10 Burial Ground received low- to high-activity radioactive waste including fission products, transuranics, small amounts of irradiated fuel element sample residue, and some plutonium-contaminated waste from the 300 Area laboratories and fuels development facilities. Radiological and chemical hazards include, but are not limited to, cesium, strontium, plutonium, americium, neptunium, beryllium, uranium, lead, zirconium, and deactivated sodium-potassium metals.[20]

Based on a thorough review of historical records and detailed modeling of waste disposals, the radiological inventory of the 618-10 Burial Ground is estimated to be 4.69E+03 curies (130.1 plutonium-239 dose-equivalent curies [DE-Ci], of which 3.59E+02 curies [10.3 DE-Ci] are located in the trenches and 4.33E+03 curies [119.8 DE-Ci] are located in the VPUs). **[18]**

Residual quantities of chemical wastes associated with laboratory and fuel-manufacturing processes were also disposed of in the 618-10 Burial Ground. Small quantities of solid waste contaminated with

[20] *Documented Safety Analysis for Remediation of the 618-10 Burial Ground*, WCH-459, Rev. 1, US Department of Energy, August 2014.

beryllium as a result of N Reactor fuel development and fabrication activities were disposed in the trenches.[19]

The 316-4 Crib received an estimated 200,000 L of hexane-bearing uranium wastes, approximately 2,205 lb of nitrate, 4,409 lb of uranium, and 6,614 lb of hexane.[21] Radiological and volatile organic contamination has been found in several boreholes near the 618-10 and 316-4 sites.[22] Remediation of the site began in 2004 and the planned excavation completed in April 2005. Further evaluation of the extent of contamination in the soil resulting from the use of the 316-4 Crib will be determined during its remediation that was scheduled to begin on completion of the 618-10 site remediation work.

There were four documented unplanned releases at the 618-10 burial site. Three occurred during the sites operation and the fourth during the addition of topsoil for stabilization in 1983 after the site was closed. The first unplanned release was due to a fire in a trench and occurred in 1961. The contamination spread was about 50 to 70 feet outside the fenced area. The fire was extinguished and the trench was covered with dirt. The next unplanned release occurred in 1963 when a truck driver that had delivered waste to the site was found to be contaminated. Contamination was not found on the highway but a 5-ft radius in front of the grate to the burial site and the VPU were contaminated. The third unplanned release also occurred in 1963. A container that was not sealed properly was dropped into the VPU resulting in the lid coming off and about 600 ft^2 of contamination was spread around the VPU. After each release, the ground was either washed down using fire trucks or gravel was spread over the contaminated area to prevent the spread of contamination.[23] No contaminate inventory information is available for any of these sites.

The last documented unplanned release occurred in 1983 as soil for site stabilization was being brought into the area. A truck drove over a trench area and oil was seen rising to the surface. The oil indicated that at least one container was penetrated and about 100 ft^2 of soil was contaminated with levels of 10,000 counts per minute.[22]

Vadose Zone Contamination

The reported inventories for RC-LS-4 (Table G.4-2 through Table G.4-4) are for the 618-10 Burial Ground and 316-4 Crib that have contaminated the vadose zone and groundwater in the area (DOE/RL-2016-09, Rev. 0). The inventories provided in Table G.4-2 through Table G.4-4 thus represent the reported contamination originally discharged (without decay correction[24]) to the vadose zone from the RC-LS-4 EU waste sites. These values are used to estimate the inventory remaining in the vadose zone using the process described in the Methodology Report (CRESP 2015a) for the 2013 groundwater plume information as revised for the 2015 Groundwater Monitoring Data (DOE/RL-2016-09, Rev. 0) described in Appendix D.1. The focus in this section will be on the Group A and B contaminants (CRESP 2015) in the

[21] *300 Area Remedial Investigation/Feasibility Study Work Plan for the 300-FF-1, 300-FF-2, and 300-FF-5 Operable Units*, DOE/RL-2009-30, Revision 0, US Department of Energy, April 2010

[22] *Applying Reflextion Tomography in the Postmigration Domain to Multifold Ground-Penetrating Radar Data*, John H. Bradford, Geophysics, Vol. 71, No. 1, January-February 2006.

[23] *618-10 and 618-11 Waste Burial Grounds Basis for Interim Operation*, CP-14592, Revision 0, Flour Hanford, August 2003.

[24] As described in the Methodology Report (CRESP 2015a) values are typically not decay corrected because of the large uncertainties in many of the values used in the CRESP evaluations and the rough-order-of-magnitude evaluations presented in the Review. One exception, for example, is when evaluating long-term impacts to groundwater for Group A and B radionuclides (e.g., Sr-90) with half-lives that are relatively short relative to the evaluation period (CRESP 2015a).

vadose zone due to their mobility and persistence and potential threats to groundwater (a protected resource). To summarize[25]:

- *Chromium* – There is a small reported inventories for chromium in the 316-4 Crib (Table G.4-4) but no plume in the vicinity.
- *Uranium* – There is a small reported vadose zone inventories in the 316-4 Cribs (Table G.4-3 and Table G.4-4) but no plume in the area. Sporadic uranium contamination in the area has been linked to both the 316-4 Crib and 618-10 Burial Ground (DOE/RL-2016-09, Rev. 0).
- *Other Group A&B Primary Contaminants (PCs)* – There are no reported inventories or plumes in the area for the other Group A and B primary contaminants.

Using the process outlined in Chapter 6 of the Methodology Report (CRESP 2015) for the 2013 groundwater results as revised for the 2015 Groundwater Monitoring Data (DOE/RL-2016-09, Rev. 0) described in Appendix D.1, the remaining vadose zone inventories in Table G.4-5 are estimated by difference and used to calculate Groundwater Threat Metric (GTM) values for the Group A and B contaminants remaining in the vadose zone as illustrated in Table G.4-5. Note that the vadose zone (VZ) ratings are *Low* for the Group A and B PCs with reported inventories, including for total uranium because past and current uranium contamination in the groundwater (but not a plume) has been linked to RC-LS-4 EU sites (DOE/RL-2016-09, Rev. 0). The overall current rating is defined as the highest over all the ratings and thus *Low*.

Groundwater Plumes

The 618-10 Burial Ground and adjacent 316-4 Crib are the sources of uranium detected in groundwater at the 618-10 Burial Ground site; however, there are currently no plumes (i.e., areas with measured groundwater concentrations exceeding the drinking water standard) in the area. Uranium concentrations in nearby downgradient wells increased in 2004 and again in 2012 following application of dust-control water during implementation of the interim remedial action. The 316-4 Crib, which received liquid waste containing uranium, also is the source of tributyl phosphate contamination in groundwater.

Contaminant fate and transport modeling was performed to simulate and predict the movement of uranium from the vadose zone sediments, through the PRZ, and into the saturated zone, as well as the migration of uranium already present in the PRZ and saturated zone. The model predictions indicate a long-term declining trend in the dissolved uranium concentrations in groundwater for uranium transported from vadose zone sediments, with seasonal increases and decreases in concentrations as the water table rises and falls with river stage fluctuations. With no remedial actions, the dissolved uranium concentration was predicted to take approximately 28 years (starting in 2012) to drop below the DWS of 30 $\mu g/L$.[26] This decline is consistent with the fact that measured uranium concentration in local well are currently below the DWS (DOE/RL-2016-089, Rev. 0).

Impact of Recharge Rate and Radioactive Decay on Groundwater Ratings

There should be no impact of radioactive decay on risks or potential impacts from contaminants currently in the vadose and saturated zones because of the persistent nature of the contaminants. The

[25] The plume information is primarily taken from PHOENIX (http://phoenix.pnnl.gov/apps/gw/phoenix.html) that shows the 2014 groundwater plumes. These plumes were assumed representative of 2015 groundwater plumes.

[26] *Record of Decision for 300-FF-2 and 300-FF-5 and Record of Decision Amendment for 300-FF-1*, US Environmental Protection Agency, Region 10 and US Department of energy, Richland Operations Office, November 2013

remedial actions described in **Part VI** indicate that there will be continued retrieval of wastes decreasing risks and recent groundwater monitoring results indicate a slower movement of contaminants than was predicted in the past for these areas. Thus there is no basis to modify ratings (that are already *Low*) based on recharge or decay factors.

Columbia River

There are currently no plumes from the RC-LS-4 EU sites that intersect the Columbia River. Groundwater monitoring results indicate that any such plume from RC-LS-4 sites would not be expected during the evaluation period, and thus risks and potential impacts are rated *Not Discernible* (*ND*).

Table G.4-2. Inventory of Primary Contaminants [(a)]

WIDS	Description	Decay Date	Ref[(b, c, d)]	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			NR	NR	NR	NR	NR	NR	NR	NR	NR
316-4	Cribs	2001	SIM	NR	NR	NR	NR	NR	NR	NR	NR	NR
618-10	Trenches		DSA	NR	NR	NR	NR	NR	NR	NR	NR	NR
618-10	VPUs		DSA	NR	NR	NR	NR	NR	NR	NR	NR	NR

a. NR = Not reported
b. EIS-S = DOE/EIS-0391 2012
c. SIM = RPP-26744, Rev. 0; Further evaluation of contaminants to occur on completion of 618-10 cleanup
d. DSA = WCH-459, Rev. 1 (inventory is stated in Pu-239 dose-equivalent curies [DE-Ci], no decay date noted)

Table G.4-3. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Description	Decay Date	Ref[(b, c,d)]	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Pu-239 (DE-Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
All	Sum			NR	NR	NR	130.1	NR	NR	0.00013
316-4	Cribs	2001	SIM	NR	NR	NR	NR	NR	NR	0.00013
618-10	Trenches		DSA	NR	NR	NR	10.3	NR	NR	NR
618-10	VPUs		DSA	NR	NR	NR	119.8	NR	NR	NR

a. NR = Not reported
b. EIS-S = DOE/EIS-0391 2012
c. SIM = RPP-26744, Rev. 0; Further evaluation of contaminants to occur on completion of 618-10 cleanup
d. DSA = WCH-459, Rev. 1 (inventory is stated in Pu-239 dose-equivalent curies [DE-Ci], no decay date noted)

Table G.4-4. Inventory of Primary Contaminants (cont)[a]

WIDS	Description	Ref[b, c,d]	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	0.77	NR	NR	350	NR	NR	NR	0.19
316-4	Cribs	SIM	NR	NR	0.77	NR	NR	350	NR	NR	NR	0.19
618-10	Trenches & VPUs	DSA	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

a. NR = Not reported
b. EIS-S = DOE/EIS-0391 2012
c. SIM = RPP-26744, Rev. 0; Further evaluation of contaminants to occur on completion of 618-10 cleanup
d. DSA = WCH-459, Rev. 1 (inventory is stated in Pu-239 dose-equivalent curies [DE-Ci], no decay date noted)

Table G.4-5. Summary of the Evaluation of Current 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	0.18	0	1.84	---	---	---	---	---	*ND*
I-129	A	1 pCi/L	0.18	0.2	1.84	---	---	---	---	---	*ND*
Sr-90	B	8 pCi/L	0.18	22	1.84	---	---	---	---	---	*ND*
Tc-99	A	900 pCi/L	0.18	0	1.84	---	---	---	---	---	*ND*
CCl_4	A	5 µg/L	0.18	0	1.84	---	---	---	---	---	*ND*
Cr	B	100 µg/L	0.18	0	1.84	7.73E-01 kg	---	---	7.73E-01 kg	7.73E-03	*Low*
Cr-VI	A	10 µg/L[b]	0.18	0	1.84	7.73E-01 kg	---	---	7.73E-01 kg	7.73E-02	*Low*
TCE	B	5 µg/L	0.18	2	1.84	---	---	---	---	---	*ND*
U(tot)	B	30 µg/L	0.18	0.8	1.84	1.94E-01 kg	---	---	1.94E-01 kg	7.03E-04	*Low*[e]

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

b. Criteria for chronic exposure in fresh water, WAC 173-201A-240. "Water Quality Standards for Surface Waters of the State of Washington," "Toxic Substances," Table 240(3).

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. Unlike for other EUs, total uranium has been found above the drinking water standard from the RC-LS-4 EU, and thus the current rating is *Low* and not *ND*.

PART VI. POTENTIAL RISK/IMPACT PATHWAYS AND EVENTS

CURRENT CONCEPTUAL MODEL

Pathways and Barriers

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?

A 2014 Documented Safety Analysis[27] considered eleven events with the largest potential releases or consequences at the 618-10 Burial Ground during active remediation. It determined that five would cause an unmitigated radiological dose to the Co-located Person that is equivalent to an ND human health risk rating. The other six would cause a radiological dose of greater than 0.1 Rem but less than 2.0 Rem to the CP, which is equivalent to a Low human health risk rating. Of these, four would cause a dose of 0.32 – 0.53 Rem. The two with highest consequential dose to the CP are:

- An energetic event occurring during the removal of soil adjacent to a VPU (thereby exposing the VPU) during the VPU variant identification process (potholing). The reaction (e.g., a pyrophoric reaction) may occur due to exposure of waste to the atmosphere or water if the VPU has degraded or if the excavator breaches the VPU during removal of the soil.
- A catastrophic failure of a trench excavator fuel tank of sufficient capacity to involve a large area, including the exposed potholing trench excavation face. The spilled fuel is then ignited.

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

None

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

It was determined that no safety SSCs, TSR-level controls, or SACs are required to prevent or mitigate these events.

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?

For hazard categorization purposes, the buried, undisturbed radiological inventory of the 618-10 Burial Ground is not considered dispersible or available for interaction with energy sources[24], and thus does not represent a risk to the Facility Worker, Co-located person or Public. Risks to human health occur during excavation and other active remediation of the area.

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

See 1 above.

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[27] *Documented Safety Analysis for Remediation of the 618-10 Burial Ground*, WCH-459, Rev. 1, US Department of Energy, August 2014.

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

Airborne exposure from fire/explosion/accidental drum penetration are the primary pathways of exposure from the waste site during remediation.

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

The initiating events described would result in immediate exposure to facility workers.

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

The uranium ground plume in the 300 Area Complex is the only current on-going release to the environment.

POPULATIONS AND RESOURCES CURRENTLY AT RISK OR POTENTIALLY IMPACTED

Facility Worker

For hazard categorization purposes, the buried, undisturbed radiological inventory of the 618-10 Burial Ground is not considered dispersible or available for interaction with energy sources[24], and thus does not represent a risk to the Facility Worker, Co-located person or Public. Risks to human health occur during excavation and other active remediation of the area.

Co-Located Person (CP)

See above

Public

See above

Groundwater

The 618-10 Burial Ground and adjacent 316-4 Crib are the sources of uranium detected in groundwater at the 618-10 Burial Ground site; however, there are no plumes (areas with measured concentrations above the corresponding drinking water standard) currently in the area (DOE/RL-2016-09, Rev. 0). Uranium concentrations in nearby downgradient wells increased in 2004 and again in 2012 following application of dust-control water during implementation of the interim remedial action. The 316-4 Crib, which received liquid waste containing uranium, also is the source of tributyl phosphate contamination in groundwater.

Table G.4-5 represents the risks and associated ratings for the saturated zone (groundwater) from remaining vadose zone contamination associated with the RC-LS-4 waste sites. Sites within the RC-LS-4 EU have likely contaminated both the vadose zone and saturated zone (DOE/RL-2016-09, Rev. 0). The overall current risk and potential impact rating for the RC-LS-4 EU is *Low* (Group A and B primary contaminants with reported inventories) (Table G.4-5). Monitoring and treatment of wastes in trenches and vertical pipe units has been conducted, which will help reduce risks to human and ecological receptors and protected resources, including groundwater and the Columbia River.

Columbia River

As described in **Part V**, no plumes from the RC-LS-4 waste sites currently intersect the Columbia River, thus current ratings for all contaminants for the benthic, riparian, and free-flowing ecology are *ND*.

Ecological Resources

Summary of Ecological Review:

- More than 59% of the EU is classified as resource level 2 or below.
- Within the EU, almost all of the level 3 resources are based on occurrences of a state sensitive species, coyote tobacco. The loss of all habitat within the EU could be a significant impact to this species on the Hanford Site. It is not known what the impact would be at a larger landscape scale.
- 2 loggerhead shrikes, a state candidate species were noted using the habitat in the EU

Cultural Resources

The RC-LS-4, 618-10 EU is located in the 600 Area of the Hanford Site, northwest of the 300 Area and southeast of FFTF. Approximately half of the EU has been inventoried for cultural resources under various survey efforts including, HCRC# 87-600-004 (Hoover & Chatters 1988), HCRC# 92-600-026 (Gard et al. 1992), HCRC# 93-600-013 (Wright 1993), HCRC# 2003-600-012 (Kennedy 2003), HCRC# 2004-600-023 (Kennedy 2004), HCRC# 2011-600-048 (Hay et al. 2011), HCRC# 2012-600-016 (Harrison et al. 2013) and HCRC# 2013-600-031 (Gilmour et al. 2013). Remediation of the 618-10 waste site has been addressed in two NHPA Section Reviews: *Cultural Resources Review of the 618-10 and 618-11 Solid Waste Burial Grounds, HCRC# 2004-600-023 (*Kennedy 2004*)* and *Cultural Resources Review for Additional Area to Support the Remediation of the 618-10 Burial Ground in the 600 Area of the Hanford Site, Benton County, Washington (HCRC# 2012-600-016)* (Harrison et al. 2013).

Portions of the EU have been heavily disturbed from operations associated with the remediation of the 618-10 waste site. Large portions of the EU remain undisturbed, suggesting a high potential for intact surface and subsurface archaeological resources.

Archaeological sites, buildings and Traditional Cultural Properties (TCPs) located within the EU[28]

- One archaeological site and one archaeological isolate associated with the Native American Precontact and Ethnographic Landscape have been recorded within the EU boundary. Both of these resources remain unevaluated for listing in the National Register of Historic Places, however, it should be noted that isolates are typically considered as not being eligible.
- There is one unrecorded Traditional Cultural Property (TCP) known to exist within the EU boundary. This TCP is currently unevaluated for listing in the National Register of Historic Places.

Archaeological sites, buildings and TCPs located within 500 meters of the EU

- Two archaeological resources (1 isolate and 1 site) associated with the Pre-Hanford Early Settlers/Farming Landscape have been recorded within 500 meters of the RC-LS-4, 618-10 EU. One of these resources (archaeological site) has been determined not eligible for listing in the National Register of Historic Places. While the other remains unevaluated, it should be noted that isolates are typically considered as not being eligible.

[28] Traditional cultural property has been defined by the National Park Service as "a property, a place, that is eligible for inclusion on the National Register of Historic Places because of its association with cultural practices and beliefs that are (a) rooted in the history of a community, and (b) are important to maintaining the continuity of that community's traditional beliefs and practices" (Parker & King 1998).

Closest Recorded TCP

There are 3 recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the RC-LS-4, 618-10 EU.

CLEANUP APPROACHES AND END-STATE CONCEPTUAL MODEL

Selected or Potential Cleanup Approaches

The 618-10 Burial Ground was in operation from 1954 to 1963 and consists of 94 VPUs and 12 solid waste disposal trenches. Remediation of the trenches began in March of 2011. This work was considered to be high risk because the trenches are known to contain a large radiological inventory and have the potential to release airborne contaminants. To minimize these risks the remediation program used a combination of engineering controls and monitoring equipment. Development of the controls was based on experience gained from previous Hanford nuclear site burial ground remediation experience, including evaluations of operational parameters and past practices from a number of Hanford remediation projects utilizing open excavation designs. [29]

The engineering controls included limiting the size of active excavation, limiting the size of drum accumulation areas, storing material below grade using a surge trench and the application of soil fixatives. The use of radiological and chemical monitoring equipment is also used to provide near real-time information to guide remediation activities and limit contact of waste until risks can be evaluated. The selected remedial action for this burial ground required the contaminated material to be excavated and transported to the Environmental Restoration Disposal Facility (ERDF), located in the 200 Area of the Hanford Site.

One of the highest risk waste forms is the opening and characterization of unknown drums. To assist with drum characterization a remotely operated Drum Penetration Facility (DPF) was used. The DPF provides a contained environment in which a drum can be punched, visually inspected, monitored, and stabilized before sampling. The DPF operates on a negative air pressure and passes discharged air through a high-efficiency particulate (HEPA) filter before it is vented to the atmosphere. It is equipped with a video monitor system and radiological and gas monitoring equipment. After puncturing the lid, a video camera can be used to inspect the drum contents. Mineral oil or water can be added to stabilize drums that contain potentially pyrophoric metal turnings.

Bottles present a significant challenge to remediation operations. Due to the potential for bottles to contain reactive chemical or plutonium solutions, Washington Closure Hanford obtained DOE and EPA approval to solidify bottles directly in the trench. When a bottle was found in the burial ground it was staged directly in a steel mixing box. After placement in the mixing box, the bottles are covered with a layer of soil. Once the mixing box is full (approximately 50 to 100 bottles), the bottles are removed and placed in another mixing box to be solidified. The bottles are added to the second mixing box in small groups not exceeding a volume of 4.5 L (1.2 gal) at a time. The bottles are crushed and thoroughly mixed in the grout mixture before adding more. After the bottles have been crushed, the grout is removed from the mixing box and placed in a disposal container. A sample is collected to verify that the solidified grout does not exceed the toxicity characterization leaching procedure limits for heavy metals.

[29] *Remediation Progress of the High-Risk 618-10 Burial Ground at Hanford,* M.J. Haass and Z.P. Walton, presentation 12427 at WM 2012 Conference, 2012.

Ground penetrating radar has identified about 1,930 drums buried in the trenches, of which about 1,300 had been retrieved as of September 2015.[30]

Removal, treatment and disposal of the high activity wastes inside the VPUs presented a more complex issue. In 2008 Washington Closure Hanford (WCH) installed four cone-penetrometers (CPTs) in a 90-degree pattern around each VPU. A gamma detector was then lowered through each CPT with total gamma measurements recorded every one foot along the length of each VPU. These gamma readings were then processed to estimate the Cs-137 and potential TRU inventory for each VPU. The data from this non-intrusive characterization program was in turn used to develop a preliminary ranking of VPUs in order of estimated TRU inventory. Under this ranking, approximately one-third of the 94 VPUs are estimated to be suspect-TRU.[31]

Remediation of the 618-10 VPUs was the subject of numerous papers and workshops over two decades. In 2007 WCH held a series of workshops to evaluate the potential remediation alternatives and to move towards a selection of the optimum approach.[14] The remediation process chosen was to install a steel over-casing around the VPU, and then auger the contents to size reduce and stabilize the VPU**,** its contents, and mix with the soil within the over-casing that form a waste/soil matrix. The over-casing is a 4 ft diameter, 0.5-in. thick carbon-steel pipe that is approximately 28.3 ft. in length. A crane with a vibratory hammer was used to drive the casing into the ground until it extended several feet below the bottom of the VPU. Approximately 3.5 ft of over-casing remains above the ground to provide a safety barrier during the subsequent remediation phases.[32]

Radiological characterization is then necessary to support a decision whether or not the augered VPU meets the ERDF Waste Acceptance Criteria. If the augered VPU is determined to meet the ERDF WAC for radiological constituents, grout will be introduced and mixed with the contents. If it is not determined that the augered VPU meets the ERDF WAC (e.g., suspect TRU or greater than Class C waste), the augered VPU will be retrieved and transferred into drums. The drums filled with the augered VPU will be radiologically characterized. Drums that contain waste that is determined to meet the ERDF WAC will be grouted and shipped to the ERDF. Drums that contain waste that are not determined to meet the ERDF WAC will be shipped to the CWC for eventual shipment to WIPP.[33]

This augering process became operational in September 2015 and by early July 2016 the waste in 76 of 80 VPUs had been augered, waste from 16 had been retrieved and mixed with grout, and non-TRU waste was beginning to be removed to ERDF.[34]

Contaminant Inventory Remaining at the Conclusion of Planned Active Cleanup Period

Post cleanup, the contaminant levels will be below those necessary for unrestricted land use standards.

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[30] *618-10 Remediation Progress Update* (PowerPoint presentation by Jon Peschong, DOE-RL), US Department of Energy, September 21, 2015.
[31] *618-10 Burial Ground: Vertical Pipe Units Remediation – 14532*, R. Scott Myers, Washington Closure Hanford, presentation at WM2014 Conference, March 2-6, 2014.
[32] *Sampling and Analysis Plan for the Radiological Determination of the 618-10 Vertical Pipe Units*, WCH-534, Draft A, Washington Closure Hanford, May 2015.
[33] *Remediation Progress of the High-Risk 618-10 Burial Ground at Hanford,* M.J. Haass and Z.P. Walton, presentation 12427 at WM 2012 Conference, 2012.
[34] *100/300 Area Unit Managers Meeting, Approval of Meeting Minutes July 14, 2016*, US Department of Energy Richland Operations, August 15, 2016.

Risks and Potential Impacts Associated with Cleanup

The risks and potential impacts associated with the remediation of the 618-10 Burial Ground and the 316-4 Crib are from the potential for fire/explosion and the potential for airborne release of radioactive material. This potential accidents present risk for the facility worker completing the remediation of the 618-10 site and 316-4 Crib.

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

Facility Worker

There is a Low to ND risk for Facility Workers from the potential for fire/explosion and the potential for airborne release of radioactive material.

Co-located Person

ND

Public

ND

Groundwater

Insufficient information is available to determine if there is any increased risk to groundwater from the ongoing site remediation.

As described in **Part V**, there will be a threat during this period to the vadose zone and groundwater (as a protected resource) from mobile primary contaminants from the RC-LS-4 EU waste sites. These impacts are described in more detail in Appendix D.2 for the RC-GW-1 EU. Furthermore, there are contaminant sources (legacy source sites) in the vadose zone that pose continuing risk to groundwater (via the vadose zone). The vadose zone (VZ) GTM values for the Group A and B primary contaminants for the RC-LS-4 EU translate to ratings of *Low* (to represent uncertainty). These ratings correspond to an overall rating of *Low* for both the Active and Near-term, Post-Cleanup periods to account for uncertainties.

Remedial actions are being performed in the area to address vadose zone sources and thus to limit additional contamination; these operations are assumed to be still active during this evaluation period.

Columbia River

Insufficient information is available to determine if there is any increased risk to groundwater from the ongoing site remediation.

As described in **Part V**, impacts to the Columbia River benthic, riparian, and free-flowing ecology for the Active Cleanup and Near-term, Post Cleanup periods are rated as *Not Discernible* (*ND*). Additional information on groundwater plumes and potential threats associated with sources including those from the RC-LS-4 waste sites are described in Appendix D.2 for the RC-GW-1 EU (300-FF groundwater interest area).

Ecological Resources

Remove, Treat and Dispose of waste involves personnel through the target (remediation) area, car and pickup truck traffic through the non-target and target (remediation) area, truck, heavy equipment (including drill rigs) traffic on roads through the non-target and target area, caps (and other containment), soil removal and contamination in the soil, vegetation control, and irrigation (for revegetation) will cause the following disturbance from remediation activities: Carry seeds or propagules (pieces of vegetation or other biological parts that can grow and/or reproduce) on tires of vehicles or blowing from heavy equipment; injure or kill vegetation or small invertebrates or small animals; vehicle traffic can make paths, compact soil, scare or displace animals, can impact animal behavior or reproductive success; affect animal dispersion and habitat use (e.g., some birds avoid nesting near roads because of song masking); displacement of animals from near roads due to increased noise or other disturbances; and heavy equipment may permanently destroy areas of the site with intense activity. Soil removal can cause more severe effects because of blowing soil (and seeds). During remediation, radionuclides or other contaminants could be released or spilled on the surface, and depending upon the type and quantity, could have adverse effects on the plants and animals on-site. Use of non-specific herbicides for vegetation control results in some mortality of native vegetation (especially native forbes), and allows exotic species to move in; it may change species composition of native communities, but it also could make it easier for native species to move in; improved methods could yield positive results. Irrigation requires a system of pumps and water, resulting in physical disturbance; repeated irrigation from the same locations could result in some soil compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area.

Alternatively, barriers could be the remediation option and involves personnel car and pickup truck traffic through the non-target and target (remediation) area, truck and heavy equipment traffic on roads through the non-target and target area, dust suppression, and irrigation (for revegetation) will cause the following disturbance from remediation activities: Carry seeds or propagules (pieces of vegetation or other biological parts that can grow and/or reproduce) on person (boots, clothes, equipment) or tires of vehicles or blowing from heavy equipment; injure vegetation or small invertebrates or small animals (e.g., insects, snakes); make paths or compact soil; scare or displace animals. Caps and other containment can cause compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area. Destruction of soil invertebrates at depths of pits. Potential bringing up of dormant seeds from soil layers; disruption of ground-living small mammals and hibernation sites of snakes and other animals on-site of containment; often disrupts local aquatic environment and drainage; often non-native plants used on caps (which can become exotic/alien adjacent to the containment site). Additional water from dust suppression could lead to more diverse and abundant vegetation in areas that receive water, which could encourage invasion of exotic species; the latter could displace native plant communities; excessive dust suppression activities could lead to compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area. Irrigation requires a system of pumps and water, resulting in physical disturbance; repeated irrigation from the same locations could result in some soil compaction, which can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area. These effects will be higher in the EU itself.

Cultural Resources

Potential direct effects are possible from personnel, car, pick-up, truck and heavy equipment traffic/use through both target (remediation) and non-target areas during active cleanup. These activities may

inadvertently expose resources close to the surface. Additionally, traffic through these areas may lead to the introduction of invasive species and/or a decrease in the presence of native plants used for medicinal or tribal religious purposes. Heavy equipment use for remedial activities (such as RTD of waste sites) may lead to an alteration of the landscape, and the act of soil removal may destroy resources; if resources are not destroyed, then, soil removal may disturb or adversely affect resources. Utilization of caps, barriers and/or other containments may destroy resources located close to the surface. If resources are not destroyed, containments may disturb or adversely effect resources. Lastly, during remediation, radionuclides or other contamination released or spilled on the surface could have long-term effects if the contamination remains and resources become contaminated and/or plants having cultural importance to Tribes do no recolonize or thrive.

Potential indirect effects are possible from personnel traffic through target (remediation) areas as well as car, pick-up, truck and heavy equipment traffic/use through both target (remediation) and non-target areas. It is possible that these activities may decrease viewshed values and/or impact viewshed through the introduction of increased dust, the creation of trails, etc. Heavy equipment use for remedial actions/soil removal and the utilization of caps and/or other containments (i.e. barriers) could potentially cause alterations to the landscape and impacts to viewsheds. Lastly, during remediation, radionuclides or other contamination released or spilled on the surface could have long-term effects if the contamination remains and resources become contaminated and/or plants having cultural importance to Tribes do no recolonize or thrive.

ADDITIONAL RISKS AND POTENTIAL IMPACTS IF CLEANUP IS DELAYED

None

NEAR-TERM, POST-CLEANUP STATUS, RISKS AND POTENTIAL IMPACTS

Near-term risks associated with remediation of the 618-10 site and 316-4 Crib are the potential for fire/explosion and an airborne release of contaminants. This poses immediate risk to the Facility Worker performing the remediation. Site remediation is being completed to unrestricted future land use standards.

POPULATIONS AND RESOURCES AT RISK OR POTENTIALLY IMPACTED AFTER CLEANUP ACTIONS (FROM RESIDUAL CONTAMINANT INVENTORY OR LONG-TERM ACTIVITIES)

Table G.4-6. Summary of Populations and Resources at Risk or Potentially Impacted after Cleanup.

Population or Resource		Risk/Impact Rating	Comments
Human	Facility Worker	ND	Being cleaned to unrestricted land use
	Co-located Person	ND	
	Public	ND	
Environmental	Groundwater (A&B) from vadose zone[(a)]	*Low* (Group A&B PCs) **Overall**: *Low*	*Current* GTM values for Group A&B primary contaminants (Table G.4-5): *Low* (PCs with reported inventories). Remedial actions will treat sources and reduce risks by end of Active Cleanup period. Ratings are maintained at *Low* to address uncertainties.
	Columbia River from vadose zone[(a)]	Benthic: *ND* Riparian: *ND* Free-flowing: *ND* **Overall**: *ND*	Remedial actions will treat sources and reduce risks by end of Active Cleanup period. Dilution factor of greater than 100 million between Columbia River and upwellings.
	Ecological Resources[(b)]	Low to High	Post-cleanup monitoring might pose a risk to level 3 and above resources in the buffer area. Possible disruption of migratory birds and loggerhead shrike. Past revegetation efforts with introduced species will likely not be replaced by native species over time. High impacts would occur if remediation activities affect the coyote tobacco population.
Social	Cultural Resources[(b)]	**Native American** Direct: Known Indirect: Known **Historic Pre-Hanford** Direct: Unknown Indirect: Known **Manhattan/Cold War** Direct: None Indirect: None	Permanent direct effects are likely from remediation.

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 RC-LS-4 EU are described in **Part V** with more detailed evaluation in Appendix D.2 (RC-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 618-10 site and 316-4 Crib areas are being cleaned to the unrestricted land use.

PART VII. SUPPLEMENTAL INFORMATION AND CONSIDERATIONS

Table G.4-7. Hanford Site-Wide Risk Review; RC-LS-4 (618-10 Burial Ground) Waste Site and Facility List

Site Code	Name, Aliases, Description	Feature Type	Site Status	ERS Classification	ERS Reclassification	Site Type	Site Type Category	Operable Unit	Exclude from Evaluation	Comments
600-367	600-367; Burial Pit near the Geotechnical Engineering and Development Facility (Little Egypt)	Waste site	Inactive	Accepted	None	Burial Ground	Burial Ground	TBD		
618-10	618-10; 300 North Solid Waste Burial Ground; 318-10	Waste site	Inactive	Accepted	None	Burial Ground	Burial Ground	300-FF-2		
316-4	316-4; 316-N-1; 321 Cribs; 616-4; 300 North Cribs	Waste site	Inactive	Accepted	None	Crib	Crib - Subsurface Liquid Disposal Site	300-FF-2		
600-63	600-63; Buried Waste Test Facility; BWTF; Recharge Study Site; Vadose Zone Field Study - 300 North; VZFS300N; 300-N Lysimeter Area	Waste site	Active	Accepted	None	Experiment/Test Site	Field Test Site	300-FF-2		
UPR-600-1	UPR-600-1; Contamination Spread at 618-10 Burial Ground; UN-600-1	Waste site	Inactive	Accepted	Consolidated	Unplanned Release	Unplanned Release - Surface/Near Surface	Not Applicable		
UPR-600-2	UPR-600-2; Contamination Spread at 618-10; UN-600-2	Waste site	Inactive	Accepted	Consolidated	Unplanned Release	Unplanned Release - Surface/Near Surface	Not Applicable		
UPR-600-3	UPR-600-3; Contamination Spread at 618-10	Waste site	Inactive	Accepted	Consolidated	Unplanned Release	Unplanned Release - Surface/Near Surface	Not Applicable		
600-265	600-265; Unidentified Pipes Near the 618-10 Burial Ground	Waste site	Inactive	Not Accepted	None	Depression/Pit (nonspecific)	Burial Ground	Not Applicable	X	Not Accepted
600-96	600-96; 618-10 Borrow Pit	Waste site	Inactive	Not Accepted	None	Depression/Pit (nonspecific)	Burial Ground	Not Applicable	X	Not Accepted
600-259	600-259; Grout Waste Test Lysimeter; Inactive Lysimeter Site East End; Special Waste Form Lysimeter	Waste site	Inactive	Accepted	Final Closed Out	Experiment/Test Site	Field Test Site	300-FF-2	X	Closed Out

600-357	600-357; Geophysical Testing Pit #2 near 618-10	Waste site	Inactive	Not Accepted	None	Experiment/Test Site	Field Test Site	TBD	X	Not Accepted
600-276	600-276; Cold Test Facility; GEDF; Hanford Geotechnical Engineering and Development Facility; Little Egypt	Waste site	Inactive	Not Accepted	None	Laboratory	Field Test Site	Not Applicable	X	Not Accepted
637	DS SURVEY STRUCTURE AT 618-10 BURIAL SITE	Facility	ACTIVE			STRUCTURE	Infrastructure Building			
MO074	CONTROL MOBILE AT WEST SIDE OF618-10 BURIAL SITE	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6104	DRUM PUNCH CONTROL TRAILER AT 618-10 BURIAL GROUND	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6107	EQUIPMENT TRAILER AT 618 BURIAL GROUND	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6108	RCT EQUIPMENT TRAILER AT 618 BURIAL GROUNDS	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6109	CHANGE TRAILER AT 618-10 BURIAL GROUND	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6114	OFFICE TRAILER AT 618-10 BURIAL GROUND	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6116	OFFICE TRAILER AT 618-10 BURIAL GROUNDS	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6117	MOBILE OFFICE AT 618-10 BURIAL GROUND	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6118	RCT OFFICE AT 618 BURIAL GROUND	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6119	SHIPPER FIELD TRAILER AT 618-10 SITE	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6301	RESTROOM TRAILER AT 618-10 BURIAL	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO6502	SHOWER TRAILER AT 618-10 BURIAL GROUNDS	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office
MO998	FIELD TRAILER LOCATED AT 618-10 BURIAL GROUNDS	Facility	ACTIVE			BUILDING	Infrastructure Building		X	Mobile Office

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