APPENDIX F.6

PUREX (CP-DD-1, CENTRAL PLATEAU)
EVALUATION UNIT SUMMARY TEMPLATE

Table of Contents

TABLE OF FIGURES

TABLE OF TABLES

EU Designation: CP-DD-1

PART I. EXECUTIVE SUMMARY

EU LOCATION

200 East (Inner) Area

RELATED EUS

Other D&D Canyon Related Projects

PRIMARY CONTAMINANTS, CONTAMINATED MEDIA AND WASTES

The Plutonium-Uranium Extraction (PUREX) facility is one of the five plutonium process canyon facilities in the Hanford 200 area, and operated from 1953 to 1990. The PUREX deactivation project in 1995 removed, reduced, or stabilized the major radioactive sources and wastes within the main 202-A building. Liquids in equipment/tanks were flushed and emptied, or have a minimum heel remaining. Radioactive materials are primarily in the form of contaminated equipment and surfaces, dust, debris, sludge, with some remaining Pu metal and oxide dust in gloveboxes and deep bed filters. In 1996, four areas were identified as containing significant quantities of Plutonium: L-Cell, which is estimated to contain between 3 and 4 Kg of Pu in sludge on the floor; Deep-Bed filters #1 and #2, each containing 100-200 g of Pu; and N-Cell, which contains 1-2 Kg of Pu material in gloveboxes. The predominant radioactive contaminants of concern are the following: ^{137}Cs, $^{238-242}$Pu, ^{90}Sr and ^{241}Am.

The deactivation project also removed, reduced, or stabilized the hazardous chemicals and waste. All bulk chemicals were removed, and only residual quantities remain. Various pieces of dangerous debris and equipment containing or contaminated with dangerous/mixed waste that had been on the PUREX Canyon Deck were removed and placed in PUREX Storage Tunnel #2. Some mixed waste and debris remains in storage in the PUREX Plant, and are considered to be managed in a containment building (F-Cell). These wastes consist of a steel open-top skid containing concrete chips from the floor of E-Cell.

In addition to the PUREX building, there are two railroad tunnels in which waste material was stored from 1956 to 2000. During deactivation some material from Building 324, including remote-handled mixed waste from B-Cell was placed in Tunnel #2. The equipment and other materials stored in the two Tunnels are heavily contaminated with ^{137}Cs and ^{90}Sr, as well as $^{238-242}$Pu and ^{241}Am. The Tunnels are designated as a Miscellaneous Unit for storage of mixed wastes by the State of Washington (WAC 173-303-680), and contain barium, cadmium, chromium, lead, mercury, lead, silver and silver salts, and mineral oil. The potential for ignition of the silver nitrates is considered negligible because this material is dispersed on ceramic packing and is physically isolated from contact with any combustible material or ignition source.

Based on the facility inventory and potential energy sources, all three facility segments (i.e., 202-A Building and ventilation system, Storage Tunnel No. 1 and No. 2) are categorized as Hazard Category 2 nuclear facilities. The primary contractor is CH2MHill Plateau Remediation Company (CMHPRC).

The PUREX site also includes a number of legacy crib-subsurface liquid disposal areas, several burial grounds and unplanned release-surface/near surface areas. No contaminant data are available for 100 of the 139 individual waste areas, and the aggregate amounts of each of Cs-137, Sr-90, C-14, H-3, I-129, U-232 to -238, and Pu-239 to -242 that are believed to be present across the 39 sites having data are estimated be in a range of from about 5E-04 curies to as little as 5E-09 curies.

EU Designation: CP-DD-1 (PUREX)

BRIEF NARRATIVE DESCRIPTION:

The PUREX complex is a nuclear fuel processing facility that was constructed between 1953 and 1955 and was operated until 1990 to chemically separate plutonium, uranium and neptunium from Hanford Site nuclear reactor fuel elements. Plutonium was recovered as an acidic solution of plutonium nitrate or was converted to plutonium oxide in N-cell. Various products were then transferred to the Plutonium Finishing Plant. Uranium was recovered as uranyl nitrate hexahydrate, which was transferred for further processing to the Uranium Trioxide Plant (U Plant). It quickly became the most efficient and largest processor of plutonium output, and when the REDOX Plant closed in 1967, PUREX became the sole, operating processing facility. Nearly 70% of Hanford's uranium was reprocessed through PUREX.

The main 202-A Building consists of three main structural components: a thick-walled, heavily shielded concrete portion called the canyon, which contains the former processing equipment; a section comprised of three gallery levels parallel to and isolated from the canyon; and a steel and transite annex to the north of the gallery section that houses offices, the laboratory, and a number of building service areas. The plant's canyon is approximately 860 feet long and 39.5 feet deep from floor to underside of the reinforced concrete cover blocks, and subdivided into a single row of 12 process cells paralleled on the south side by a hot (radioactive) pipe trench. An air tunnel lies directly below the pipe trench and exhausts the ventilation air from the individual cells (which in turn draws air from the canyon void above each cell and pipe trench cover blocks) to the main ventilation exhaust filters and from there to the main 291-A Stack. Adjoining the north wall of the building is a 750-foot long, 60-foot wide service area containing three control rooms (central, head end, and power unit), the PUREX process control laboratory, the aqueous make-up and storage area, and the acid concentration vault. An underground solvent storage and make-up facility was adjacent to the service side of the 202-A Building.

The PUREX Plant incorporated a unique feature for disposing of large pieces of radioactive solid waste, such as failed or outworn equipment. A 500-foot rail extension running southward was built onto the single-track rail tunnel that was used to bring irradiated slugs to the east end of the PUREX building. Between June 1960 and January 1965, eight railcars with radioactive equipment were pushed into the tunnel by a remote controlled electric engine. In 1964 a 1,700-foot tunnel was constructed to provide storage space for 40 railcars after the first tunnel had become full and was sealed. It currently contains 28 railcars of radioactively contaminated equipment.

In 1972, the PUREX Plant entered a temporary shutdown period, intended to be 18 months but which became 11 years. In 1983, the Plant reopened to process N Reactor fuel. Following a safety violation, it closed for about six weeks in 1988, and operated intermittingly until being placed in standby status in 1990. A final closure order was issued by DOE in December 1992. During 1995-1997 the PUREX Plant was brought to a safe, low-cost, low-maintenance deactivation status, and active facility systems are limited to electrical distribution, exhaust ventilation, instrumentation systems, and fire detection/alarms systems in 252-AB and 217-A buildings. Since the facility was placed into S&M, a new roof was placed over the canyon and aqueous makeup areas. According to a 2014 report[1] from the primary contractor CH2MHill Plateau Remediation Company (CHPRC), conditions in the facility have been relatively stable since deactivation with minor exceptions. Final D&D of the PUREX building is expected to be similar to the "Close in Place-Partially Demolished Structure" alternative chosen for the U Canyon.

The two PUREX Tunnels represent a short-term hazard and risk to an individual located 100 meters from the PUREX site boundaries ("CW") if the final D&D of the 202-A processing canyon building is delayed,

---

[1] CH2MHill Plateau Remediation Company, *Plutonium-Uranium Extraction Facility Documented Safety Analysis, CP-14977 Revision 7*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, September 25, 2014

because of their highly radioactive contents and intent to be used as "temporary" storage units. Tunnel #1, which contains similar total curies of Pu, ^{241}Am, ^{137}Cs and ^{90}Sr as the 202-A canyon building (21,205 versus 29,304 curies) was constructed almost entirely of railroad ties in 1956. Ongoing degradation is occurring from continued exposure to the gamma radiation from equipment being stored there. Although no contaminants were released, a 20-foot section collapsed in May 2017. Tunnel #2 was constructed with stronger materials as additional temporary storage 10 years later, but it contains nearly 25 times the radiation of Tunnel #1 measured in curies (508,977 curies). A recent engineering evaluation of Tunnel #2[2] found that "overstressed conditions in structural support members and connections and uncertainty of additional unknown stresses induced during original construction, Tunnel 2 has a potential high risk of localized collapse."

There are several D&D options for the rail cars and equipment in the two tunnels. One is to retrieve each rail car unit and dispose of it as part of the main building D&D, and a second is to grout the railcars and equipment in place and backfill the storage tunnels. An RI/FS Work Plan is scheduled to be submitted by DOE for EPA and Washington Ecology review in September 2015, although this schedule may be shortened to deal with the recent collapse and engineering evaluations.

SUMMARY TABLES OF RISKS AND POTENTIAL IMPACTS TO RECEPTORS

Table F.6-1 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 PUREX facility boundary; a Co-located Person (CP) is an individual located 100 meters from the PUREX boundary line; and Public is an individual located at the closest point on the Hanford Site boundary not subject to DOE access control, which in this instance is about 9.5 miles away. 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: 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: 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 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

[2] *CH2M, PUREX Tunnel 2 Engineering Evaluation, Project Number: 693839.BS, June 2017, p6.*

evaluated in depth under Section 106 of the National Historic Preservation Act (16 USC 470, et. seq.) during the planning for remedial action.

Table F.6-1. Risk Rating Summary (for Human Health, unmitigated nuclear safety basis indicated, mitigated basis indicated in parentheses (e.g., "Very High" (Low)).

		Evaluation Time Periods	
		Active Cleanup (to 2064)	
Population or Resource		Current Condition - Surveillance & Maintenance	From Cleanup Actions - D&D
Human	Facility Worker	High (Low)	High (Low)
	Co-located Person	High (Low)	Medium (Low)
	Public	ND-Low (ND)	ND-Low (ND)
Environmental	Groundwater (A&B) from vadose zone[(a)]	*ND* (Sr-90 and U(tot))[(c)] *Low* (Other PCs)	*ND* (Sr-90 and U(tot))[(c)] *Low* (Other PCs)
	Columbia River from vadose zone[(a)]	ND	ND
	Ecological Resources[(b)]	ND-Low	Low-Medium
Social	Cultural Resources[(b)]	**Native American:** Direct: Unknown Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: None **Manhattan/Cold War**: Direct: Known Indirect: None	**Native American**: Direct: Unknown Indirect: Known **Historic Pre-Hanford**: Direct: Unknown Indirect: None **Manhattan/Cold War**: Direct: Known 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. Threats from plumes associated with the PUREX EU are described in **Part V**.

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. These ratings are for PCs with reported inventories. (See **Parts V** and **VI** for additional details.) The Sr-90 and total uranium remaining in the PUREX EU would translate to a *Very High* and a *Medium* rating, respectively; however, there is no current Sr-90 or total uranium plume in the area, and it would likely require more than 150 years to reach groundwater in a sufficient amount to exceed the drinking water standard over an appreciable area (**Part V**). The Sr-90 and total uranium ratings after the Active Cleanup period are *Low* to account for uncertainties in the evaluation.

SUPPORT FOR RISK AND IMPACT RATINGS FOR EACH TIME PERIOD

Human Health

Current

The PUREX physical boundary (see Figure F.6-4) includes the buildings/structures with greater than Hazard Category 3 inventory (identified as 202-A, Laboratory Annex, 203-A, 204-A, 211-A, 213-A, 214-A, 221-A, 271-AB, 276-A, 291-A, 291-AE, Storage Tunnels 1 and 2, deep-bed filters No. 1 and No. 2), and the yard area within the fence topped with concertina wire surrounding the facility to prevent public or inadvertent access. The only current planned activities consist primarily of S&M, which includes pre-approved activities for surveillance of the facility, preventative maintenance of selected equipment, and incidental storage of necessary supplies and equipment. The two tunnels are sealed and the stored equipment is not currently accessible.

Seismic Event: The highest risk in the facility's current condition is a seismic event that causes a catastrophic structural failure of the 202-A Building and PUREX Storage Tunnel Nos. 1 and 2. The Hazard Analysis does not provide a radiation dose consequence for the Facility Worker, but its binning of risks indicate that the Facility Worker would have the same risk rating as a Co-located Person.

Unmitigated Risks:

Building 202-A: Facility Worker – High; CP – High; Public – ND to Low

Tunnel #1: Facility Worker – High; CP – High; Public – ND to Low

Tunnel #2: Facility Worker – High; CP – High; Public – ND to Low

PUREX Site Total: Facility Worker – High; CP – High; Public – Low

Mitigation: This is a natural phenomenon hazard event for which there are no mitigation controls, however it is deemed to have an "unlikely" (10^{-2} to 10^{-4} per year) frequency that cannot be prevented from occurring. Applicable safety management and emergency response programs that reduce worker injury for these types of events include the work control process, hazardous material control program, and initial testing, in service surveillance, and maintenance program.

Mitigated Risk PUREX Site: Facility Worker – Low; CP – Low; Public – ND to Low

Fire in PUREX Tunnel #1: A fire is postulated in PUREX Storage Tunnel No. 1. The potential for a fire is considered due to the extensive use of timbers as storage tunnel structural material. It is assumed that the entire inventory of the storage tunnel is at risk. The scenario assumes that the resulting fire burns with sufficient energy to result in releasing material to the environment.

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

Mitigation: The storage tunnel is isolated with no access and the site's work control program, which includes a thorough Job Hazard Analysis, prohibit access to the storage tunnels, the combination of which reduce the likelihood of such an event. The DOE Hanford and contractor security and safety policies and procedures reduce the potential exposure risk of these events to the S&M worker and CP 100 meters from the PUREX boundaries to Low

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

Partial Roof Collapse Over Cells A, B and C: Use of a crane outside the facility or a moderate seismic event may result in a partial roof collapse. The east crane maintenance platform (ECMP) is a less robust structure than the remainder of the 202-A Building, a failure of the ECMP and adjoining roof structure is postulated from the crane drop. A moderate seismic event would cause the same damage. The failure is assumed to impact the three adjacent cells (A, B, and C) located in close proximity to the platform. The crane drop event impacting the 202-A Building is considered an "anticipated" event, while the seismic event is "unlikely."

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

Mitigation: There are limited authorized activities at these S&M facilities and control of any crane work on or around the 202-A Building by implementation of the applicable requirements of DOE/RL-92-36, *Hanford Site Hoisting and Rigging Manual,* will serve to reduce the potential for a crane drop event; particularly one that could result in the catastrophic failure of the entire structure.

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

Staged Waste Fire:

A hypothetical waste container with an inventory of 100 g of 239Pu is engulfed in a fire while being removed from the 202-A Building. The isotopic distribution is based on A-cell. This is a conservative assessment of the distribution of materials within the 202-A Building and results in the most conservative dose consequences.

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

Mitigation: No safety -significant or safety-class SSCs or TSRs are required to prevent or mitigate this event. However, because the inventory value is an assumed number and because of uncertainties regarding the actual staged TRU, an administrative TSR for inventory control is a prudent control selection for the designated waste staging area. Additional controls include commitment to the Radiological Control Program, Hazardous Material Control Program, and the Work Control Program

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

N-Cell Gloveline Fire:

The most significant fire hazard in the canyon building is the lubrication oil for the mechanical pulsers in the process cells. A potential fire in N-cell was deemed to have the greatest risk and potential consequences because of the residual inventory in the gloveboxes, potential combustibles, and potential ignition from S&M operations. The dry gloveline was selected because it is a single glovebox assembly that contains a significant portion of the total N-cell inventory.

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

Mitigation: Commitment to the Work Control Program, the Fire Protection Program, which includes combustible control, and the Radiological Control Program will ensure the safety of the activities.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

The several radiological event scenarios identified with current S&M activities at the PUREX site would still likely be present during the early D&D phases of the building and tunnels, but the most serious consequences would diminish as contaminated areas and equipment are removed and/or grouted in place.

The radioactive material inventory remaining at the end of PUREX deactivation was primarily in the form of contaminated equipment and surfaces, dust and debris, located below the deck in the process cells, with some remaining plutonium and oxide dust stabilized in gloveboxes in N Cell. No workers are expected to enter the process Cells during D&D, except for possible further decontamination and disposition of the gloveboxes. A fixative would be applied to all equipment located on the deck surface before being moved into the cells and all workers would wear protective gear.

The D&D of the U Canyon is being used as a pilot for D&D of the other four canyons, and CHPRC has developed an extensive review of lessons learned that will benefit similar work carried out at PUREX in the future. Although the PUREX and U Plants are not identical with respect to their prior uses and levels of contamination, the two U Plant DSAs (HNF-13829 Revisions 4 [OUO Doc] and 5) provide discussions of some of the accidents or events that could cause radiological exposure to workers and co-located persons during D4 of the PUREX canyon facilities. The primary risks were determined to be a seismic event and accidents involving size reduction and waste management types of activities, that are required for the preparations for the canyon demolition but which could cause a fire.

Radiological, chemical and industrial related risks during D&D of the two tunnels should be low if the rail cars and equipment are grouted in place and the tunnel walls used as a permanent cover, since no workers will need to enter the tunnels and thus come into contact with the contaminants. The risk of seismic events and fire will still exist during this final D&D phase however.

Unmitigated Risks: Facility Worker – High; CP – Medium; Public – ND

Mitigation: The PUREX structures provide passive confinement of the significant residual contamination in the 202-A Building and Tunnels #1 and #2. Grouting of contaminated equipment in the cells and tunnels and application of a fixative to all above grade equipment should also reduce the PUREX facilities, like the U Plant to less than HC-3. In addition, worker risks should be minimized through benefit of lessons learned from the D4 of the U Plant and through contractor implemented safety management programs that include the work control process, hoisting and rigging requirements and the radiological protection program.

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

An RI/FS Work Plan for future D&D phases is scheduled to be submitted by DOE for EPA and Washington Ecology review in September 2015.

Groundwater, Vadose Zone, and Columbia River

Current

The PUREX EU lies above the 200-PO groundwater interest area (GWIA) that is described in the CP-GW-1 EU (Appendix D.5). The saturated zone beneath the vicinity of the CP-LS-3 (U Plant Cribs and Ditches) area has elevated levels of I-129, nitrate, tritium (H-3), and total uranium based on the 2014 groundwater monitoring results (http://phoenix.pnnl.gov/apps/gw/phoenix.html); sites within the PUREX EU are suspected of being able to contribute mobile contaminants to the saturated zone (DOE/RL-92-16, Rev. 0). The current threats to groundwater and the Columbia River from contaminants already in the groundwater are evaluated as part of the CP-GW-1 EU (Appendix D.5). However, current threats to groundwater corresponding to only the PUREX EU contaminants *remaining* in the vadose zone (Table F.6-7) has an overall rating of *Low* (based on various primary contaminants) as described in **Part V**. Contaminated groundwater is monitored in the 200-PO GWIA (DOE/RL-2016-09, Rev. 0). As indicated in **Part V**, no plumes have been linked to PUREX waste sites. Threats from contaminated groundwater in the area to contaminate additional groundwater or the Columbia River are evaluated as part of the CP-GW-1 EU (Appendix D.5).

For the 200-PO GWIA, no plume currently emanating from the PUREX 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
The remedial actions being considered for the PUREX EU waste sites described in **Part VI** involve the PUREX canyon; however, no cleanup decisions have been made for the contamination in the legacy sites (e.g., cribs and UPRs) associated with the PUREX canyon. Because no final cleanup decisions have been made, there is no way to definitively determine the risks and potential impacts to protected resources (groundwater and Columbia River). However, final cleanup decisions will be made to be protective of human health and the environment and thus it is likely that at least some vadose contamination will be removed to satisfy remedial goals and a cover will be installed (at least in places) to limit infiltrating water that tends to be the primary motive force to mobilize contamination in the vadose zone. Thus even though there are risks to workers associated with the cleanup of the PUREX waste sites (described in **Part VI**), there is unlikely any discernible impact from likely cleanup actions on groundwater or the Columbia River (and thus no changes were made to current ratings to account for uncertainties).

Contaminants from the PUREX EU waste sites are currently impacting the vadose zone and secondary sources in the vadose zone threaten to continue to impact groundwater in the future, including the Active Cleanup period[3]. The *Low* rating associated with the PUREX EU waste sites (Table F.6-7) is associated with mobile contaminants (C-14, I-129, Tc-99, and total and hexavalent chromium)) that could potentially continue to impact the 200-PO GWIA (which is part of CP-GW-1, Appendix D.5). As described in the TC&WM EIS and summarized in **Part V**, there appears to little impact from radioactive decay or recharge rate; thus ratings are maintained at *Low* after the Active Cleanup period.

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 ratings for current threats in Table F.6-7 would not be modified except for Sr-90 and total uranium that would be changed from *ND* to *Low* after the Active Cleanup Period (to address uncertainty) as described in **Part V**. The ratings for the remaining Group A and B primary contaminants remain unchanged (*Low*) as in Table F.6-7 to address uncertainties. The overall rating thus remains *Low* during the Active Cleanup period.

Ecological Resources

Current
The impacts on Ecological Resources would be generally Not Discernable (ND) because there are few ecological resources (5 % level 3 resources), Low because of possible contamination to ecological receptors on buffer area (31 % level 3 and 4 resources)

Risks and Potential Impacts from Selected or Potential Cleanup Approaches
There are few high level Ecological Resources in this EU (5 % level 3 resources), but low to medium in buffer area because of high value resources (nearly a third of area has level 3 and 4 resources).

Cultural Resources

Current
Manhattan Project/Cold War significant resources have already been mitigated. Area is heavily disturbed and even thought the entire area has not been inventoried for archaeological resources, it has very low potential to contact intact archaeological resources on the surface or subsurface. Traditional cultural places (e.g., Gable Mountain) are visible from EU.

---

[3] Note that Sr-90, which has a large remaining vadose zone source, is not considered a significant threat to groundwater due to its limited mobility in the Hanford subsurface and decay. See **Part V** for details.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Area has not been investigated either on the surface or subsurface, archaeological investigations may need to occur within pockets of undisturbed land if any prior to remediation. Potential for intact archaeological material to be present is very low.

Considerations for timing of the cleanup actions

The PUREX building is being maintained in a safe low-maintenance condition and is surround by barbed wire fencing to prevent public or inadvertent access, and the two tunnels are sealed and the stored equipment is not currently accessible. There is however the ongoing risk of a seismic event causing damage to the building and/or tunnels. In addition, PUREX Tunnel 1 was constructed in 1956. Except for a 103-foot section one wall that is composed of 3-foot thick reinforced concrete, the remaining walls and roof of the 358-foot long tunnel were constructed using 12 inch by 14 inch creosoted No. 1 Douglas Fir timbers, arranged side by side with the 12-inch side exposed. The last evaluation of the structural integrity of the tunnel was made in May 1991 by Los Alamos Technical Associates (LATA). It concluded that there was very low probability of any degradation of the timbers due to decay or insect attack, but that there was ongoing degradation occurring from continued exposure to the gamma radiation from equipment being stored there. It estimated that the strength of the timbers would be 60% of their original strength in 2001. Applying the same formulas used in that analysis to the year 2014 would indicate that the timbers are currently at about 55% of their original strength. This study indicated that standard factor of safety would be breached about 2040. However, the recent collapse of a 20-foot section of Tunnel #1 would indicate that degradation and weakening of the timbers is occurring faster. A follow-on engineering evaluation of the second tunnel found that it was also at risk of early failure.

Near-Term, Post-Cleanup Risks and Potential Impacts

The PUREX EU and surrounding areas are designated industrial-exclusive in the CLUP, with the intention of maintaining control of the residual contamination by the U.S. Federal Government, in perpetuity. The most probable D&D scenarios would clean-up the PUREX site so that its highly contaminated equipment and refuse is buried and grouted in place within the subsurface concrete canyon walls, and an engineered barrier constructed to cover the collapsed building structure to reduce water infiltration and the risk of human and biotic intrusion. Periodic inspection and maintenance would be required in perpetuity to maintain these barriers and Institutional controls would be required to protect the remedy and ensure that the potential for human exposure to contaminants is minimized by limiting land and resource use to industrial uses. The remediated area would be fenced (size not determined) in case future industrial construction in the 200 Area, includes nearby facilities.

PART II. ADMINISTRATIVE INFORMATION

OU AND/OR TSDF DESIGNATION(S)

200-CP-1

COMMON NAME(S) FOR EU

PUREX Building

KEY WORDS

D&D, Canyons, Tunnels

Regulatory Status

Regulatory basis: The 1996 Agreement in Principle (DOE-RL1996) among the Tri-Parties of DOE, USEPA, and Washington State Department of Ecology established that the CERCLA Remedial Investigation/Feasibility Study process would be followed, on a case-by-case basis, to evaluate potential cleanup remedies and identify preferred alternatives for the final end state for the five major canyon buildings in the 200 Area of the Hanford Site. The 221-U Facility was selected as a pilot project for this effort.

Applicable regulatory documentation

Applicable Consent Decree or TPA milestones:

M-85-80: Submit to Ecology a Remedial Investigation/Feasibility Study Work Plan for 200-CP-1 (PUREX). Due September 30, 2020

M-085-80A: Submit to Ecology as a secondary document a data quality objectives report to assess the structural integrity of the PUREX storage tunnels 1 and 2. Due September 30, 2017

M-085-82: Submit to Ecology for approval proposals for expedited response action(s) for one or more of the Tier 1 and Tier 2 facilities in the PUREX Geographic Area listed in HFFACO Appendix J. Due December 31, 2017

M-085-84: Initiate response actions for the PUREX Geographic Area in accordance with the schedule in the approved Remedial/Removal Action Work Plan developed under M-085-82.

Risk Review Evaluation Information

Completed (revised): June 23, 2015, September 1, 2016 and revised March 9, 2017

Evaluated by: H. Mayer

Ratings/Impacts Reviewed by: M. Gochfeld, D. Kosson and K.G. Brown

PART III. SUMMARY DESCRIPTION

Current land use

Industrial

Designated future land use

Pursuant to the 1999 Record of Decision: Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS), the Central Plateau (200 Areas) geographic area is designated as Industrial-Exclusive (an area suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, nonradioactive wastes, and related activities).

Primary EU Source Components

Legacy Source Sites

The PUREX site includes a number of legacy crib-subsurface liquid disposal areas, several burial grounds and unplanned release-surface/near surface areas. No contaminant data are available for 100 of the 139 individual waste areas, and the aggregate amounts of each of Cs-137, Sr-90, C-14, H-3, I-129, U-232 to 238, and Pu-239 to 242 that are believed to be present across the 39 sites having data are estimated be in a range of from about 5E-04 to as little as 5E-09. See attached schedule of all legacy source sites by WIDS code which have known contaminant data.

High-Level Waste Tanks and Ancillary Equipment

Not Applicable

Groundwater Plumes

Groundwater in the 200 Area is contaminated from multiple sources (not related to the PUREX EU) and is being addressed separately by DOE.

D&D of Inactive Facilities

The PUREX deactivation project in 1995 removed, reduced, or stabilized the major radioactive sources and wastes within the main 202-A building. Liquids in equipment/tanks were flushed and emptied, or have a minimum heel remaining. Radioactive materials are primarily in the form of contaminated equipment and surfaces, dust, debris, sludge, with some remaining Pu metal and oxide dust in gloveboxes and deep bed filters. In 1996, four areas were identified as containing significant quantities of Pu: L-Cell, which is estimated to contain between 3 and 4 Kg of Pu in sludge on the floor; Deep-Bed filters #1 and #2, each containing 100-200 g of Pu; and N-Cell, which contains 1-2 Kg of Pu material in gloveboxes.

The predominant radioactive contaminants of concern are the following (with estimated current curie levels): $Pu^{238\text{-}242}$ (871 Ci), Am^{241} (1,210 Ci), Cs^{137} (11,200 Ci) and Sr^{90} (9,010 Ci). In addition to the PUREX building, there are two railroad tunnels in which waste material was stored (1956-2000). During deactivation some material from Building 324, including remote-handled mixed waste from B-Cell was placed in Tunnel #2. The equipment and other materials stored in the two Tunnels are contaminated with $Pu^{238\text{-}242}$ (653 Ci) and Am^{241} (785 Ci), and especially Cs^{137} (347,300 Ci) and Sr^{90} (180,240 Ci). The Tunnels are designated as a Miscellaneous Unit for storage of mixed wastes by the State of Washington (WAC 173-303-680), and contain barium, cadmium, chromium, lead, mercury, lead, silver and silver salts, and mineral oil.

Operating Facilities

Not Applicable

LOCATION AND LAYOUT MAPS

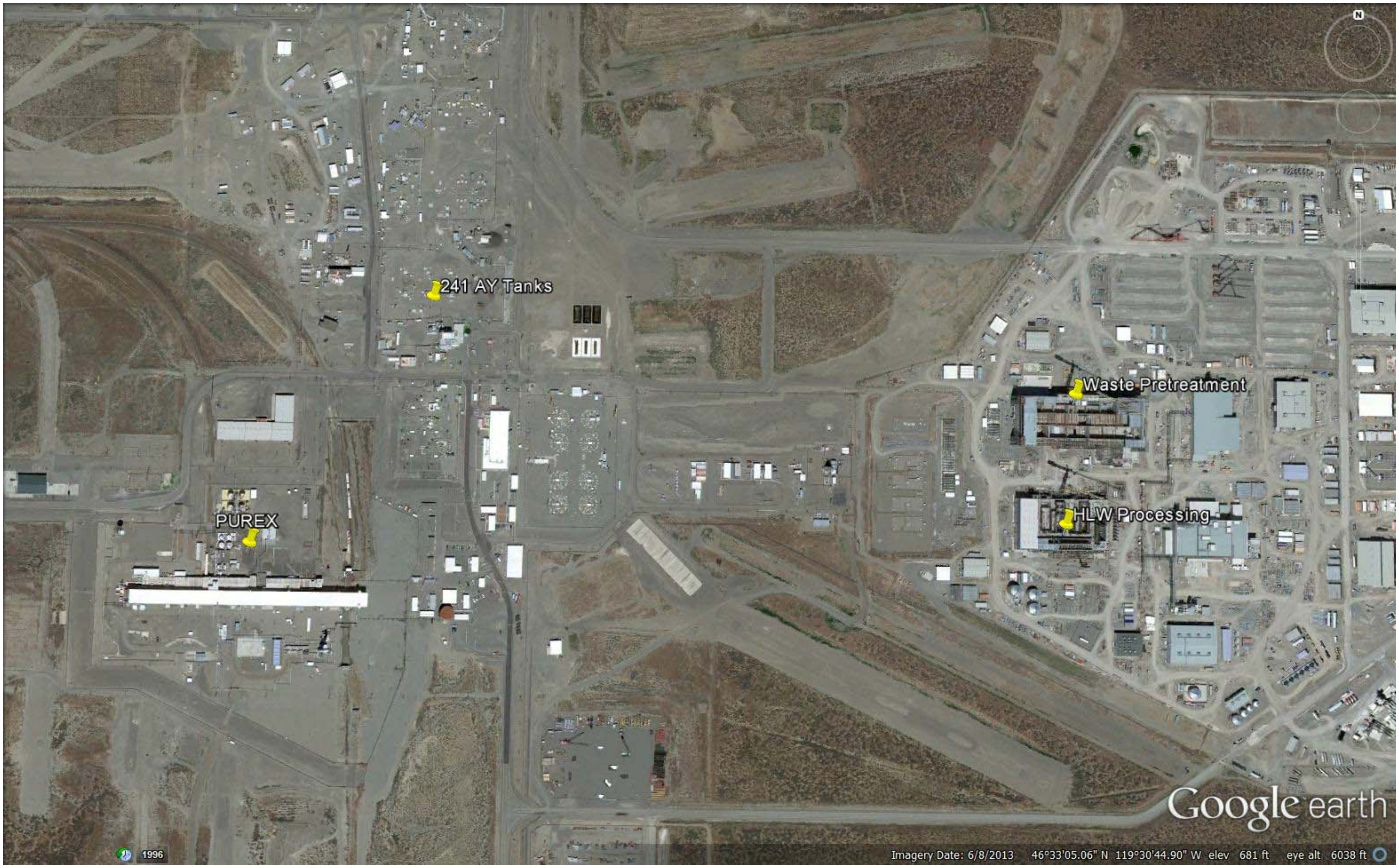


Figure F.6-1. PUREX Plant and Tunnels Location Relative to AY Tank Farm and HLW Treatment Facilities in 200 Area

EU Designation: CP-DD-1

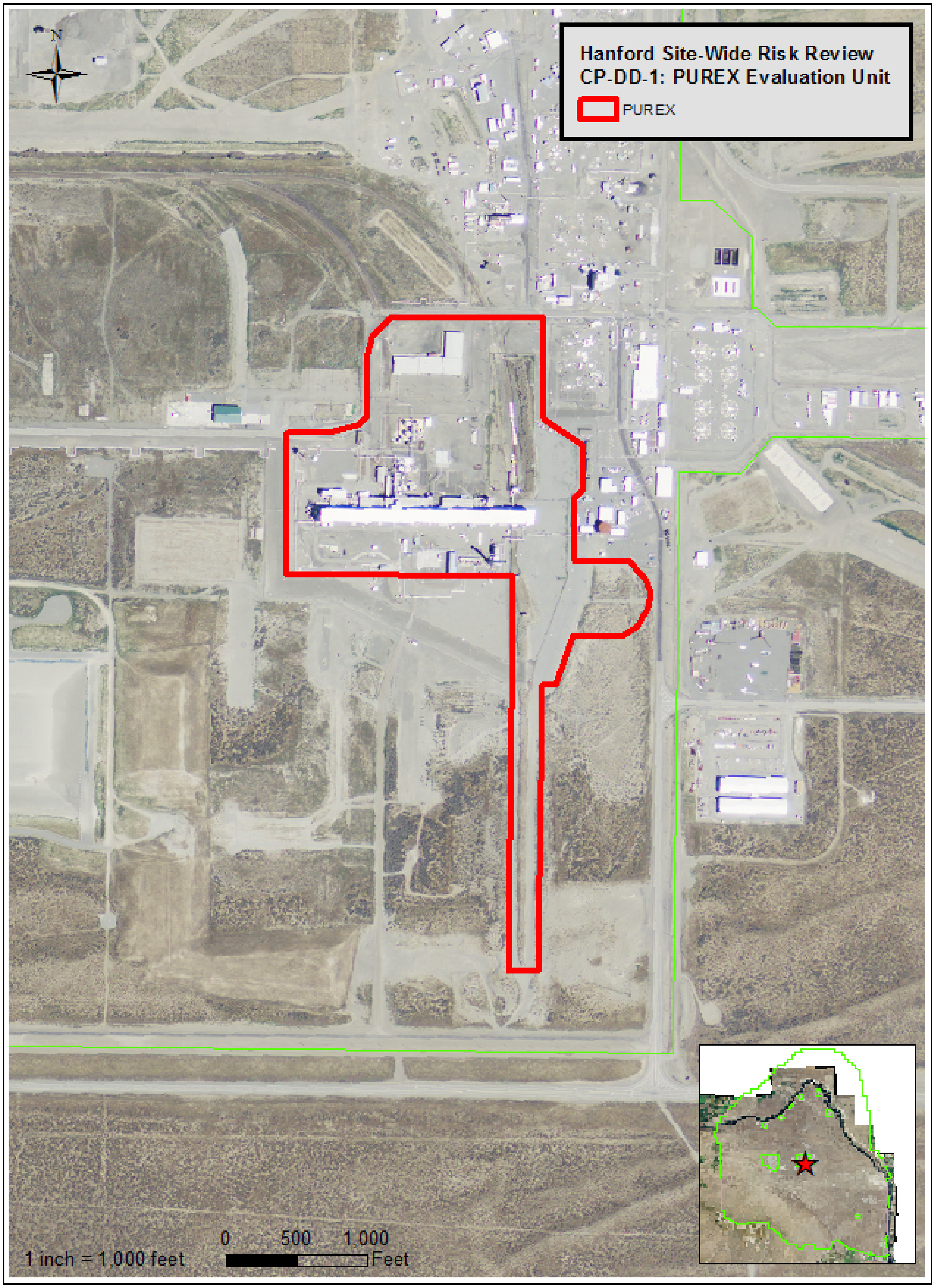


Figure F.6-2. PUREX Evaluation Unit

Figure F.6-3. PUREX Plant and Tunnels to South (above the plant in photo)

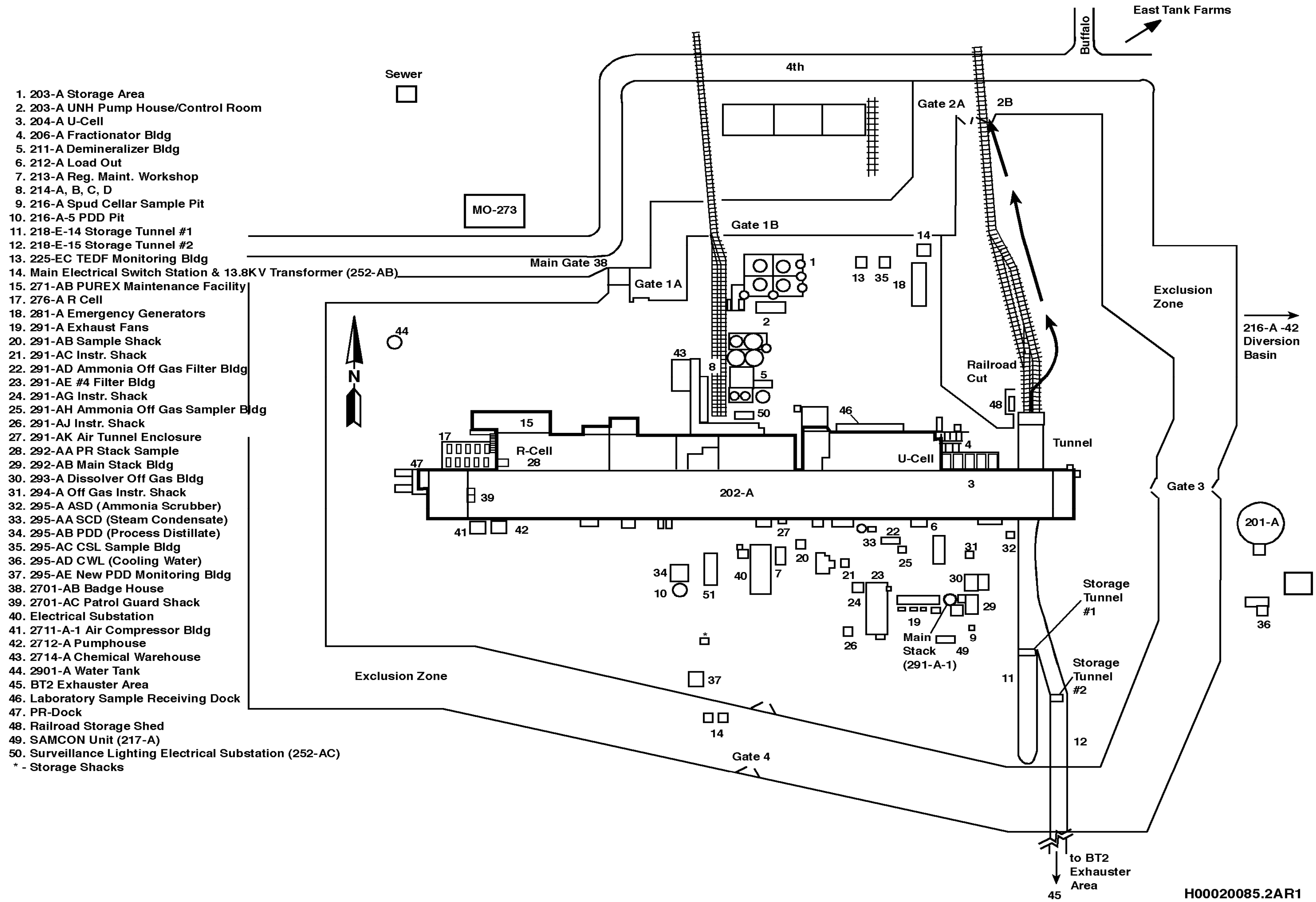


Figure F.6-4. PUREX Facilities Boundaries (Geographic Direction Reversed from Photo in Figure F.6-2)

PART IV. UNIT DESCRIPTION AND HISTORY

EU Former/Current Use(s)

The Plutonium-Uranium Extraction (PUREX) facilities are located in the 200 East Area, which is an elevated, flat area that is approximately 3.2 sq. mi. in size near the middle of the Hanford Site and about 5 miles from the Columbia River. The 200 Area contains waste management facilities and former irradiated-fuel reprocessing facilities, and is often referred to as the Central Plateau. The PUREX complex is a nuclear fuel processing facility used to chemically separate plutonium, uranium and neptunium from Hanford Site nuclear reactor fuel elements. Construction was completed in 1955 and the plant operated until 1990. It quickly became the most efficient and largest processor of plutonium output, and when the REDOX Plant closed in 1967, PUREX became the sole, operating processing facility at the Hartford Site. Nearly 70% of Hanford's uranium was reprocessed through PUREX. During 1995-1997 the PUREX Plant was brought to a safe, low-cost, low-maintenance deactivation status. Since the facility was placed into the S&M, a new roof was placed over the 202-A canyon and aqueous makeup (AMU) areas. According to a 2014 report[4], conditions in the facility have been relatively stable since deactivation with minor exceptions. An RI/FS Work Plan is scheduled to be submitted by DOE for EPA and Washington Ecology review by September 2015.

Legacy Source Sites

The PUREX site includes a number of legacy crib-subsurface liquid disposal areas, several burial grounds and unplanned release-surface/near surface areas. No contaminant data is available for 100 of the 139 individual waste areas, and the aggregate amounts of each of Cs-137, Sr-90, C-14, H-3, I-129, U-232 to 238, and Pu-239 to 242 that are believed to be present across the 39 sites having data are estimated be in a range of from about 5E-04 to as little as 5E-09.

High-Level Waste Tanks

Not Applicable

Groundwater Plumes

Groundwater in the 200 Area is contaminated from multiple sources (unrelated to the PUREX EU) and is being addressed separately by DOE.

D&D of Inactive Facilities

Construction of the PUREX plant was completed in 1955 and the facilities were operated until 1990. The original Plant was a concrete rectangle 1,005 feet long, 104 feet high (with approximately 40 feet below grade), and 61.5 feet wide. The shielding capacity of the concrete was designed so that personnel in non-regulated service areas would not receive radiation in excess of 0.1 millirem per hour. Its main "canyon" portion is approximately 860 feet long and contains 11 cells, each 14 feet wide, 42.5 feet deep, and 39.5 feet deep from floor to underside of the reinforced concrete cover blocks. The cells were used as follows:

---

[4] CH2MHill Plateau Remediation Company, *Plutonium-Uranium Extraction Facility Documented Safety Analysis, CP-14977 Revision 7*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, September 22, 2014.

- A-, B-, C-Cells housed metal dissolution equipment and activities
- D-Cell contained equipment used in preparing dissolved metal into feed solution for the PUREX process
- F-Cell housed waste treatment and acid recovery operations
- G-Cell used for organic recovery (sometimes called first-cycle solvent recovery)
- H-, J-, K-, L-Cells incorporated remaining solvent extraction and concentration steps.

Additional portions of the PUREX Plant (the 202-A building) are comprised of a hot pipe trench (an 860-foot by 12-foot by 33-foot enclosure which housed pipes that transported radioactive solutions) and an air tunnel (an 860-foot by 11-foot by 7.5-foot space through which contaminated air from the canyon and the process ventilation system passed on its way to the filters and the 291-A Stack). Adjoining the north wall of the main 202-A Building is a 750-foot long, 60-foot wide service area containing three control rooms (central, head end, and power unit), the PUREX process control laboratory, the aqueous make-up and storage area, and the acid concentration vault. An underground solvent storage and make-up facility was adjacent to the service side of the 202-A Building.

Additionally, a regulated area of the 202-A Building contained M-Cell with a water pool for decontamination of major process equipment, a "hot shop," and a regulated shop for decontamination and repair of smaller equipment having varying levels of radioactivity. The decontamination cell incorporated leaded glass windows and flexible jumpers for the first time in a Hanford processing plant.

Many other service facilities were built adjacent to the PUREX Plant building. These included the 203-A Uranium Storage and Pumping Station; the 207-A Retention Basin; 211-A Chemical Tank Farm; the 252-A Electrical Substation; the 272-E Mock-Up Building; additions to the 282-E Raw Water Pump House, the 283-E Filter Plant, and the 284-E Power House; the 291-A Stack and Filter Building; a series of electrical and piping facilities, warehouses, rail systems; and many other structure (see Figure F.6-4).

The main canyon building; deep-bed filters No. 1 and 2; exhaust plenum, fans, main stack and No. 4 filter building; U-cell; liquid chemical tank farm; and buildings 211-A, 213-A, 214-A, 221-A and 271-AB are categorized as Hazard Category 2 (HC-2; potential for significant on-site consequences) and all others are less than HC-3.

PUREX Tunnels

The original PUREX Plant incorporated a unique feature for disposing of large pieces of radioactive solid waste, such as failed or outworn equipment. A 500-foot extension running southward was built onto the single-track rail tunnel to bring irradiated slugs to the east end of the PUREX building. Material selected for storage is loaded on railcars modified to serve as both transport and storage platforms. Normally, a remote-controlled, battery-powered locomotive was used to position the railcar in the storage tunnel. Each railcar is retrievable; however, because the railcars are stored on a single, dead-end railroad track, the railcars can be removed only in reverse order (i.e., last in, first out). Each storage tunnel is isolated from the railroad tunnel by a water-fillable shielding door.

The PUREX Storage Tunnels are permitted as a miscellaneous unit under WAC 173-303-680 because the tunnels are not a typical containerized storage unit. That is, the bulk of the material stored in the tunnels is not placed in a container; rather, this material is placed on a portable device (railcar) used as a storage platform. The mixed waste stored in the Tunnels is encased or contained within carbon or stainless steel plate, pipe, or vessels that meet the WAC 173-303-040 definition of container. Therefore, the mixed waste normally is not exposed to the tunnel environment.

EU Designation: CP-DD-1

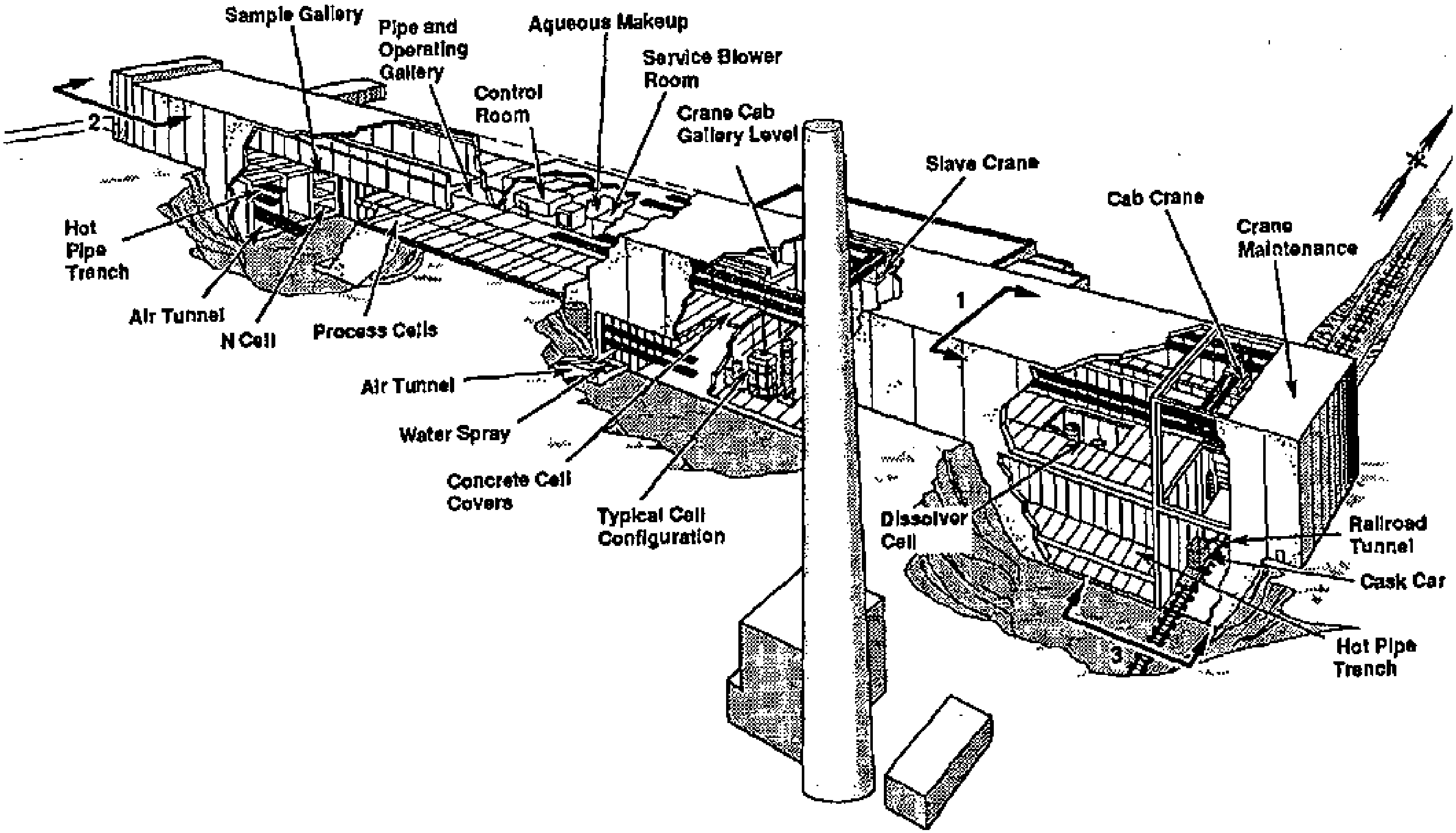


Figure F.6-5. PUREX Building 202-A Configuration

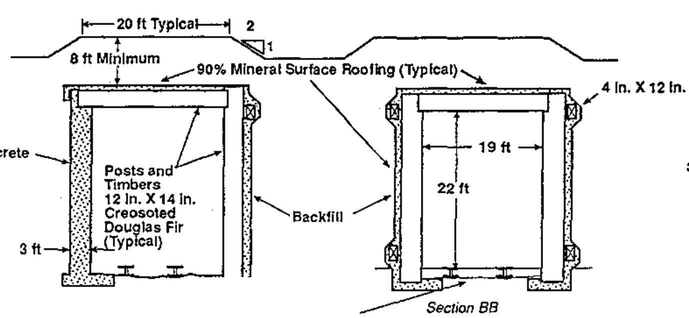
EU Designation: CP-DD-1

Tunnel Number 1 was completed in 1956. It is rectangular in construction and approximately 19 feet wide by 22 feet high by 358 feet long and provides storage space for eight railcars. The first 100 feet of the tunnel wall closest to Tunnel #2 is constructed with a three-foot concrete wall. The other walls and ceiling are constructed of 12 in. x 14 in. creosoted timbers arranged side by side with the 12-inch face exposed. Vertical sidewall timbers were placed on a reinforced concrete footing 3 feet wide and 1 foot thick. A 9-inch high curb on the interior face of the footing restrains the timbers and resists forces imposed by the earth backfill. Continuous creosoted wood rail ties between the east and west footings carry the steel rails and permit soil loads to be transferred from one footing to the other. All timbers and rail ties are No. 1 Douglas Fir. A 90 lb. mineral-surface roofing material was used to cover the exterior roofing surface of the timbers, and then covered with at least eight feet of fill. There is a vent shaft at the tunnel end, but as part of the deactivation process, the ventilation fan was deactivated electrically and the exhaust stack and filter were isolated from the system by installing blanks upstream and downstream of both the exhaust fan and filter and the stack was removed. The descriptions are of PUREX equipment. Some of the equipment is in boxes. Most of the equipment is large and was placed directly on railroad cars. The rail cars serve as both transport and storage platforms. The description does not include a fissionable material inventory.

The construction of Tunnel Number 2 was completed in 1964. It is semicircular in cross-section, and is 19 feet wide by 22 feet high by 1,686 feet long, and has the capacity to provide storage space for up to 40 railcars. The semicircular walls/ceiling (17 ft. 3 in. radius) are supported by internal I-beams attached to externally constructed three-foot thick reinforced concrete arches, with a bituminous coated steel liner on the interior. The top is covered with a minimum of eight feet of fill, and there is a vent shaft at the far end of the tunnel. The first railcar was placed in Tunnel Number 2 in December 1967 and as of August 2000, 28 railcars have been placed in the tunnel. The first 23 contain PUREX equipment, the next two hold equipment from 324 Building, and the last three are 20,000-gallon liquid waste tank railroad cars. Some of the equipment is in boxes. Most of the equipment is large and was placed directly on a railroad car. During deactivation of Tunnel #2, a blank was installed downstream of the filter and the Tunnel's ventilation shaft was capped and sealed with the fans abandoned in place.

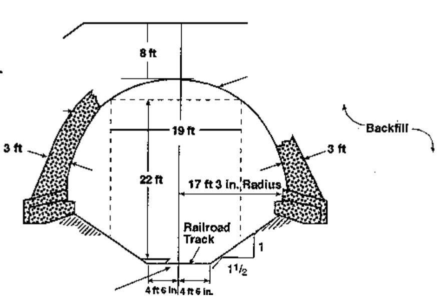
The tracks are on a one percent downward slope to the south to ensure that the railcars remain in their storage position. A railcar bumper is located about eight feet from the south end of the tracks to act as a stop. There are no electrical utilities, water lines, drains, fire detection or suppression systems, radiation monitoring, or communication systems provided inside either of the PUREX Storage Tunnels.

Tunnel #1



Sand and Gravel Floor

Tunnel #2



Sand and Gravel Floor

EU Designation: CP-DD-1 (PUREX)

Current Status

During 1995-1997 the PUREX Plant was brought to a safe, low-cost, low-maintenance deactivation status. As part of the deactivation, the water-fillable doors of both tunnels and the outer PUREX railroad tunnel door were sealed. The scope of work includes S&M that maintains confinement of hazardous wastes and protects the worker. This work scope includes pre-approved activities for surveillance of the facility, preventative maintenance of selected equipment, and incidental storage of necessary supplies and equipment. Since the facility was placed into the S&M, a new roof was placed over the 202-A canyon and aqueous makeup (AMU) areas. According to the 2014 report (CPA-14977 DSA Rev. 7), conditions in the facility have been relatively stable since deactivation with minor exceptions. Final D&D of the PUREX building is expected to be similar to the "Close in Place-Partially Demolished Structure" alternative chosen for the 221-U Plant.

Although no contaminants were released, the recent collapse of a 20-foot section of Tunnel #1 indicates that degradation and weakening of the timbers is occurring faster than expected. A follow-on engineering evaluation of the second tunnel found that "overstressed conditions in structural support members and connections and uncertainty of additional unknown stresses induced during original construction, Tunnel 2 has a potential high risk of localized collapse." There are several D&D options for the rail cars and equipment in the two tunnels, ranging from retrieving each rail car unit and disposing of it as part of the main building D&D, to leaving the railcars in place and injecting grout and backfilling the storage tunnels. The Tri Party Agreement DOE to submit a change package by September 30, 2015 to establish a schedule for submittal of the RI/ES Work Plans for PUREX and other 200 Area canyon facilities, although this schedule may be shortened to deal with the recent tunnel collapse and updated engineering evaluations.

Final D&D of the PUREX building is expected to be similar to the "Close in Place-Partially Demolished Structure" alternative chosen for the 221-U Plant. There are several D&D options for the rail cars and equipment in the two tunnels, ranging from retrieving each rail car unit and disposing of it as part of the main building D&D, to leaving the railcars in place and injecting grout and backfilling the storage tunnels. The Tri Party Agreement DOE to submit a change package by September 30, 2015 to establish a schedule for submittal of the RI/ES Work Plans for PUREX and other 200 Area canyon facilities. No firm date for D&D of the buildings or tunnels has been established.

In July 2016, DOE proposed to demolish and remove tanks TK-P4 and TK-40, along with remaining tanks, piping, and ancillary structures in the PUREX 203A and 211A storage areas. The 203A acid storage area and the 211A chemical storage area are located north of the PUREX canyon building (see #1 and #5 on Figure F.6-4). Tank TK-P4 is located in the southeast corner of the 203A acid storage area, and tank TK-40 is located in the northeast corner of the 211A chemical storage area. Tanks TK-P4 and TK-40, which stored process chemicals during PUREX facility operations, were drained, flushed, and deactivated in 1998 to meet RCRA clean closure requirements. This proposed removal action is needed to facilitate access to the PUREX canyon building in support of future remedial and site closure actions.[5]

OPERATING FACILITIES

Not Applicable

[5] *Closure Plan for the PUREX Tanks TK-P4 and TK-40*, DOE/RL-2015-72, Revision 0, US Department of Energy, Richland Operations Office, May 2016.

ECOLOGICAL RESOURCES SETTING

Landscape Evaluation and Resource Classification

The amount of each category of biological resources at the PUREX EU was examined within a circular area radiating approximately 995 m from the geometric center of the unit (equivalent to 768 acres). Within the 44.6 acres of the EU, only 2.2 acres are classified as level 3 habitat, but these consist of fragmented and narrow patches. Approximately 31% of the total combined area (EU plus adjacent landscape buffer) consists of level 3 or greater resources.

Field Survey

The EU associated with the PUREX facilities was surveyed by pedestrian and vehicle reconnaissance and field measurement of remaining habitat on the southeast side of the area in October 2014. The majority of the EU consists of buildings, disturbed areas, parking lots, and facilities, except for the extension of the unit to the south and a small area just south of the parking lot on the east side of the unit. Field measurements in the southeast habitat confirmed that the area consisted of level 2 habitat resources. Patches of level 3 resources within the EU are associated with individual occurrences of sensitive plant species; Piper's daisy (*Erigeron piperianus*) had been noted in previous ECAP surveys and an Erigeron spp. was noted in the field survey, but could not be verified as Piper's daisy.

Wildlife observations within the level 2 habitat included several side-blotched lizards (*Uta stansburiana*), small mammal burrows and trails, coyote (*Canis latrans*) tracks, and a common raven (*Corvus corax*) flying overhead. No wildlife were observed within the fenced area around PUREX facilities.

CULTURAL RESOURCES SETTING

Cultural resources known to be recorded within the PUREX EU are limited to the National Register-eligible buildings associated with the Manhattan Project/Cold War Era Landscape some with documentation required and some without documentation requirements. Those with documentation required include the Hanford Site Plant Railroad, 202A (PUREX Canyon and Service Facility), 2701AB (PUREX Badge House), 294A (Offgas Treatment Monitoring Station), and 293A (Offgas Treatment Facility), and the 218-E-14 and 218-E-15 Burial Grounds. Those with no documentation required include the 212A Fission Product Load Monitoring Station, 275EA Storage Warehouse at 202A, and the 291A PUREX Maintenance Exhaust System. All National-Register-eligible Manhattan Project and Cold War Era buildings have been mitigated (e.g. documented as described in the *Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan* (DOE/RL-97-56 1998).

Most of the PUREX EU has not been inventoried for archaeological resources and it is unknown if an NHPA Section 106 review has been completed for remediation of the PUREX EU as one was not located. A few archaeological surveys with negative findings have been completed in the PUREX EU. No archaeological sites have been located by any of these surveys within the PUREX EU or near it. There is a slight 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 PUREX EU. Given the extensive ground disturbance in the PUREX EU however, this is unlikely. The closest recorded archaeological site, located within 500 meters of the PUREX EU is an historic-era isolated find likely associated with the Pre-Hanford Early Settlers/Farming Landscape and is not considered to be National Register-eligible.

Geomorphology, ground disturbance, historic maps, and the lack of cultural resources located within and in the vicinity of PUREX EU all suggest that the potential for archaeological resources associated with the all three landscapes to be present on the surface or within the subsurface areas within the EU is very low. Because large areas have not been investigated for archaeological sites and pockets of undisturbed soil may exist, it may be appropriate to conduct 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, the Franklin County Historical Society, Prosser Cemetery Association, B-Reactor Museum Association and the Reach) 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

CONTAMINATION WITHIN PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

The PUREX site includes a number of legacy crib-subsurface liquid disposal areas, several burial grounds and unplanned release-surface/near surface areas. No contaminant data is available for 100 of the 139 individual waste areas, and the aggregate amounts of each of Cs-137, Sr-90, C-14, H-3, I-129, U-232 to 238, and Pu-239 to 242 that are believed to be present across the 39 sites having data are estimated be in a range of from about 5E-04 Ci to as little as 5E-09 Ci. See attached schedule of all legacy source sites by WIDS code which have known contaminant data.

High Level Waste Tanks and Ancillary Equipment

Not Applicable

Vadose Zone Contamination

The cribs and UPRs represent the vadose zone contamination originally discharged to the vadose zone; reported values are provided in Table F.6-4. through Table F.6-6. The contamination discharged to the injection/reverse wells (directly to groundwater) is not considered part of the vadose zone source.

Groundwater Plumes

Not Applicable

Facilities for D&D

The radioactive material inventory remaining at the end of deactivation in 1995-97 was primarily in the form of contaminated equipment and surfaces, dust and debris, with some remaining plutonium and oxide dust stabilized in gloveboxes. However, there are sufficient quantities to warrant a nuclear Hazard Category 2 (potential for significant on-site consequences) classification of the PUREX building and both tunnels. Other hazardous materials that remain are a relatively minor risk, as there are no substantial volatiles, caustics, or reactives remaining. Former process solution and stocks were removed as part of deactivation. Only residual quantities remain in the tank, vessels, and piping system that were pumped, emptied, and/or flushed. Various pieces of dangerous debris and equipment containing or contaminated with dangerous/mixed waste stored on the PUREX Canyon Deck were removed and placed in PUREX Storage Tunnel #2. Some mixed waste and debris remains in storage in the PUREX Plant, and are considered to be managed in a containment building (F-Cell). These wastes consist of a steel open-top skid containing concrete chips from the floor or E-Cell.

Table F.6-2. Inventory of Primary Radiological Contaminants (grams)[6]

Material	202-A building, including ventilation system (grams)	Storage Tunnel No. 1 (grams)	Storage Tunnel No. 2 (grams)
Total Pu	14,000	4,960	5,530
Am-241	350	129	97.5
Cs-137	126	116	3,790
Sr-90	65.5	59.9	1,250

Table F.6-3. Inventory of Primary Radiological Contaminants (Curies – 2003 Decayed Values)[7]

Material	202-A building, including ventilation system (Curies)	Storage Tunnel No. 1 (Curies)	Storage Tunnel No. 2 (Curies)
Total Pu	8,134	2,460	7,178
Am-241	1,210	442	334
Cs-137	11,000	10,127	330,873
Sr-90	8,940	8,175	170,611

The PUREX Storage Tunnels are permitted as a miscellaneous unit under WAC 173-303-680 because the tunnels are not a typical containerized storage unit. That is, the bulk of the material stored in the tunnels is not placed in a container; rather, this material is placed on a portable device (railcar) used as a storage platform. The mixed waste stored in the Tunnels is encased or contained within carbon or stainless steel plate, pipe, or vessels that meet the WAC 173-303-040 definition of container. Therefore, the mixed waste normally is not exposed to the tunnel environment. The only free-liquid dangerous waste stored in the tunnels is elemental mercury. The mercury is contained within thick-walled (0.8-centimeter) thermowells. The amount of mercury per thermowell is less than 1.7 liters. The only stored mixed waste that is designated as either reactive or ignitable is silver nitrate in the silver reactors [WAC 173-303-090(5)]. The potential for ignition from this source is considered negligible because this material is dispersed on ceramic packing and is physically isolated from contact with any combustible material or ignition source. There is no reactive or incompatible waste known to be stored in the PUREX Storage Tunnels.

The Report authors have not located data on the aggregate inventories of each of the various mixed wastes by amount or weight that are located in the PUREX Tunnels or main canyon building.

---

[6] CH2MHill Plateau Remediation Company, *Plutonium-Uranium Extraction Facility Documented Safety Analysis, CP-14977 Revision 7*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, September 22, 2014

[7] CH2MHill Plateau Remediation Company, *Plutonium-Uranium Extraction Facility Documented Safety Analysis, CP-14977 Revision 7*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, September 22, 2014

Detailed inventories are provided in Table F.6-4., Table F.6-5, and Table F.6-6. 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 F.6-7 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.

Operating Facilities

Not Applicable

Primary Contaminants[a]

on	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)
			2000	1.50E-05	NR	0.00018	350000	1.20E-05	0.0013	42	2.60E-06
nd	2003	Footnote 7	440	NR	NR	NR	10000	NR	NR	NR	NR
nd	2003	Footnote 7	330	NR	NR	NR	330000	NR	NR	NR	NR
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	3.70E-10	7.20E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	8.90E-08	2.80E-08	NR	2.30E-07	0.0031	8.70E-09	7.00E-07	1.20E-06	1.50E-09
l	2001	SIM	3.80E-10	7.30E-07	NR	NR	NR	NR	NR	NR	1.00E-08
l	2001	SIM	5.10E-10	9.90E-07	NR	NR	NR	NR	NR	NR	1.40E-08
ding	2003	Footnote 7	1200	NR	NR	NR	11000	NR	NR	NR	NR
	2001	SIM	2.00E-10	3.90E-07	NR	NR	NR	NR	NR	NR	5.50E-09

EU Designation: CP-DD-1 (PUREX)

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-A-12	Cribs	2001	SIM	2.00E-10	3.90E-07	NR	NR	NR	NR	NR	NR	5.50E-09
216-A-13	Cribs	2001	SIM	2.00E-09	6.20E-10	NR	5.00E-09	6.90E-05	1.90E-10	1.50E-08	2.70E-08	3.20E-11
216-A-14	Cribs	2001	SIM	2.00E-10	6.20E-11	NR	5.00E-10	6.90E-06	1.90E-11	1.50E-09	2.70E-09	3.20E-12
216-A-22	Cribs	2001	SIM	4.70E-12	9.10E-09	NR	NR	NR	NR	NR	8.00E-02	1.30E-10
216-A-26	Cribs	2001	SIM	7.60E-10	2.40E-10	NR	1.90E-09	2.70E-05	7.30E-11	5.90E-09	1.00E-08	1.20E-11
216-A-26A	Cribs	2001	SIM	2.00E-10	6.20E-11	NR	5.00E-10	6.90E-06	1.90E-11	1.50E-09	2.70E-09	3.20E-12
216-A-28	Cribs	2001	SIM	NR	NR	NR	NR	NR	NR	NR	0.37	NR
216-A-3	Cribs	2001	SIM	2.70E-05	4.00E-07	NR	2.70E-06	2.50E-02	4.20E-07	3.00E-05	4.10E+01	NR
216-A-32	Cribs	2001	SIM	7.90E-10	2.50E-10	NR	2.00E-09	2.80E-05	7.60E-11	6.20E-09	1.10E-08	1.30E-11
216-A-35	Cribs	2001	SIM	2.00E-09	6.20E-10	NR	5.00E-09	6.90E-05	1.90E-10	1.50E-08	2.70E-08	3.20E-11
200-E-103	UPR	2001	SIM	7.80E-10	2.50E-10	NR	2.00E-09	2.80E-05	7.60E-11	6.20E-09	1.10E-08	1.30E-11
200-E-107	UPR	2001	SIM	5.30E-10	1.70E-10	NR	1.30E-09	1.90E-05	5.10E-11	4.10E-09	7.30E-09	2.30E-06
200-E-54	UPR	2001	SIM	3.90E-08	1.20E-08	NR	1.00E-07	0.0014	3.80E-09	3.10E-07	5.40E-07	6.40E-10
UPR-200-E-39	UPR	2001	SIM	0.0034	NR	NR	1.60E-04	0.97	1.10E-05	1.20E-03	0.14	NR
UPR-200-E-40	UPR	2001	SIM	0.00026	NR	NR	1.30E-05	0.075	8.40E-07	9.30E-05	0.011	NR

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

Table F.6-5. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Description	Decay Date	Source[(b)]	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
All	Sum			1.10E-07	1.00E-05	18000	190000	0.28	2.2
218-E-14	Burial Ground	2003	Footnote 7	NR	NR	2500	8200	NR	NR
218-E-15	Burial Ground	2003	Footnote 7	NR	NR	7200	1.70E+05	NR	NR
200-E-62	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-63	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-64	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-65	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-67	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-68	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-69	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-70	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-71	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-73	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-74	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-75	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-76	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-77	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-78	Reverse well	2001	SIM	NR	NR	0.00013	4.40E-08	NR	7.10E-06
200-E-79	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-80	Reverse well	2001	SIM	NR	NR	1.30E-04	4.40E-08	NR	7.10E-06
200-E-81	Reverse well	2001	SIM	4.50E-08	4.30E-06	4.60E-07	2.50E-05	7.60E-07	2.50E-09
200-E-82	Reverse well	2001	SIM	NR	NR	0.00014	4.50E-08	NR	7.30E-06
200-E-84	Reverse well	2001	SIM	NR	NR	0.00018	6.10E-08	NR	9.70E-06
200-E-136	Process Building	2003	Footnote 7	NR	NR	8,100	8.90E+03	NR	NR
216-A-11	Cribs	2001	SIM	NR	NR	4.40E-05	2.40E-08	NR	3.50E-06
216-A-12	Cribs	2001	SIM	NR	NR	4.30E-05	2.40E-08	NR	3.50E-06

EU Designation: CP-DD-1 (PUREX)

WIDS	Description	Decay Date	Source(b)	Ni-59 (Ci)	Ni-63 (Ci)	Pu (total) (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	U (total) (Ci)
216-A-13	Cribs	2001	SIM	1.00E-09	9.50E-08	1.00E-08	5.50E-07	1.70E-08	5.40E-11
216-A-14	Cribs	2001	SIM	9.90E-11	9.50E-09	1.00E-09	5.50E-08	1.70E-09	5.40E-12
216-A-22	Cribs	2001	SIM	NR	NR	6.40E-07	5.60E-10	4.90E-04	3.10E-03
216-A-26	Cribs	2001	SIM	3.80E-10	3.70E-08	3.90E-09	2.10E-07	6.40E-09	2.10E-11
216-A-26A	Cribs	2001	SIM	1.00E-10	9.50E-09	1.00E-09	5.50E-08	1.70E-09	5.40E-12
216-A-28	Cribs	2001	SIM	NR	NR	NR	NR	0.0025	0.44
216-A-3	Cribs	2001	SIM	3.80E-08	3.70E-06	7.90E-04	2.10E-02	2.70E-01	1.80E+00
216-A-32	Cribs	2001	SIM	4.00E-10	3.80E-08	4.00E-09	2.20E-07	6.70E-09	2.20E-11
216-A-35	Cribs	2001	SIM	9.90E-10	9.50E-08	1.00E-08	5.50E-07	1.70E-08	5.40E-11
200-E-103	UPR	2001	SIM	4.00E-10	3.80E-08	4.00E-09	2.20E-07	6.70E-09	2.20E-11
200-E-107	UPR	2001	SIM	2.70E-10	2.60E-08	2.70E-09	1.50E-07	4.50E-09	1.40E-11
200-E-54	UPR	2001	SIM	2.00E-08	1.90E-06	2.00E-07	1.10E-05	3.30E-07	1.10E-09
UPR-200-E-39	UPR	2001	SIM	NR	NR	0.029	1.1	6.90E-04	1.70E-04
UPR-200-E-40	UPR	2001	SIM	NR	NR	0.0022	0.086	5.30E-05	1.30E-05

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

Table F.6-6. Inventory of Primary Contaminants (cont)[(a)]

WIDS	Description	Source[(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	NR	2	NR	0.011	47000	1.80E-06	NR	NR	3300
218-E-14	Burial Ground	Footnote 7	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
218-E-15	Burial Ground	Footnote 7	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
200-E-62	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-63	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-64	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-65	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-67	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-68	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-69	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-70	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-71	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-73	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-74	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-75	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-76	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-77	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-78	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	0.0089
200-E-79	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-80	Reverse well	SIM	NR	NR	NR	NR	NR	0.1	NR	NR	NR	8.90E-03
200-E-81	Reverse well	SIM	NR	NR	0.012	NR	2.30E-09	140	1.20E-06	NR	NR	6.40E-07
200-E-82	Reverse well	SIM	NR	NR	NR	NR	NR	0.11	NR	NR	NR	0.0091
200-E-84	Reverse well	SIM	NR	NR	NR	NR	NR	0.14	NR	NR	NR	0.012
200-E-136	Process Building	Footnote 7	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
216-A-11	Cribs	SIM	NR	NR	NR	NR	NR	0.056	NR	NR	NR	0.0048
216-A-12	Cribs	SIM	NR	NR	NR	NR	NR	0.056	NR	NR	NR	4.80E-03
216-A-13	Cribs	SIM	NR	NR	2.60E-04	NR	5.00E-11	3	2.60E-08	NR	NR	1.40E-08

EU Designation: CP-DD-1 (PUREX)

WIDS	Description	Source[(b)]	CCl4 (kg)	CN (kg)	Cr (kg)	Cr-VI (kg)	Hg (kg)	NO3 (kg)	Pb (kg)	TBP (kg)	TCE (kg)	U (total) (kg)
216-A-14	Cribs	SIM	NR	NR	2.60E-05	NR	5.00E-12	0.3	2.60E-09	NR	NR	1.40E-09
216-A-22	Cribs	SIM	NR	NR	0.00083	NR	2.60E-05	120	NR	NR	NR	4.60E+00
216-A-26	Cribs	SIM	NR	NR	1.00E-04	NR	1.90E-11	1.2	1.00E-08	NR	NR	5.40E-09
216-A-26A	Cribs	SIM	NR	NR	2.60E-05	NR	5.00E-12	0.3	2.60E-09	NR	NR	1.40E-09
216-A-28	Cribs	SIM	NR	NR	0.0031	NR	0.00011	430	NR	NR	NR	650
216-A-3	Cribs	SIM	NR	NR	0.34	NR	1.10E-02	47000	NR	NR	NR	2.60E+03
216-A-32	Cribs	SIM	NR	NR	0.0001	NR	2.00E-11	1.2	1.00E-08	NR	NR	5.60E-09
216-A-35	Cribs	SIM	NR	NR	0.00026	NR	5.00E-11	3	2.60E-08	NR	NR	1.40E-08
200-E-103	UPR	SIM	NR	NR	0.0001	NR	2.00E-11	1.2	1.00E-08	NR	NR	5.60E-09
200-E-107	UPR	SIM	NR	NR	1.7	NR	NR	39	NR	NR	NR	3.80E-09
200-E-54	UPR	SIM	NR	NR	0.0052	NR	1.00E-09	60	5.20E-07	NR	NR	2.80E-07
UPR-200-E-39	UPR	SIM	NR	NR	NR	NR	NR	6.2	NR	NR	NR	0.21
UPR-200-E-40	UPR	SIM	NR	NR	NR	NR	NR	4.80E-01	NR	NR	NR	0.016

a. NR = Not reported

b. SIM = RPP-26744, Rev. 0

Table F.6-7. 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	0.25	0	1.82	1.53E-05Ci	---	---	1.53E-05Ci	7.64E-06	*Low*
I-129	A	1 pCi/L	0.25	0.2	1.82	2.56E-06Ci	---	---	2.56E-06Ci	1.04E-03	*Low*
Sr-90	B	8 pCi/L	0.25	22	1.82	1.79E+05Ci	---	---	1.79E+05Ci	1.39E+05	*ND*[(e)]
Tc-99	A	900 pCi/L	0.25	0	1.82	2.77E-01Ci	---	---	2.77E-01Ci	3.08E-01	*Low*
CCl4	A	5 µg/L	0.25	0	1.82	0.00E+00kg	---	---	0.00E+00kg	0.00E+00	*ND*
Cr	B	100 µg/L	0.25	0	1.82	2.03E+00kg	---	---	2.03E+00kg	2.03E-02	*Low*
Cr-VI	A	48 µg/L[(b)]	0.25	0	1.82	2.03E+00kg	---	---	2.03E+00kg	4.22E-02	*Low*
TCE	B	5 µg/L	0.25	2	1.82	---	---	---	0.00E+00kg	0.00E+00	*ND*
U(tot)	B	30 µg/L	0.25	0.8	1.82	3.30E+03kg	---	---	3.30E+03kg	1.61E+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 (U(tot)) or Sr-90 plume would be expected in the next 150 years due to transport and decay (Sr-90) considerations. Thus a rating of *ND* is given for the Active Cleanup period and *Low* rating afterwards 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?*

The 2014 DSA (CP-14977 Revision 7*)* prepared by CH2MHill Plateau Remediation Company identified six potential events that might cause a release of radioactive materials having an unmitigated dose of at least 10 rems to an individual located 100 meters outside the PUREX boundary. They are:

- Structural failure of each of the 202-A Building and PUREX Storage Tunnel Nos. 1 and 2 would cause approximately 120, 58 and 76 rems release respectively in each from a seismic event (aggregate total of 254 rems).
- Fire in PUREX Storage Tunnel No. 1 – about 70 rems
- Isolated failure of a portion of the 202-A building from a moderate seismic event, vehicle impact or an external crane drop (roof collapse over Cells A, B and C) – about 25 rems
- N-Cell Gloveline Fire – about 25 rems
- Crane falling on top of Tunnel #2 – about 14 rems
- Staged Waste Fire – about 14 rems

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

Facility structural damage can occur as a consequence of either local seismic activity or a facility mechanical structural failure from other Natural Phenomenon Hazards (snow/ash load, winds). Based on the PUREX facility design criteria, a Uniform Building Code (UBC) seismic demand is expected to result in some structural damage (cracking, spalling, and minor structural damage) to building structures. A much more significant seismic event would be required to cause catastrophic failure of these structures. Such an event assumes that the entire radiological inventory of the structures is at risk; therefore, no safety significant or safety-class structure, systems, or components (SSCs) or Technical Safety Requirements (TSRs) are required.

A fire in PUREX Storage Tunnel No. 1 would result in an unmitigated dose of about 70 rems to the CW, however, given the conservatism identified in the analysis of the fire, and because the storage tunnel is isolated with no access, the DSA concluded that no safety SSCs or TSRs are required.

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

The large canyon structure provides passive containment of radiological contaminants, as does the fully sealed and entombed storage tunnels. In addition, the DSA noted that the work control, including job hazards analysis (JHA), program prohibits access to the storage tunnels, which reduces the likelihood of such an event.

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 PUREX Plant physical construction was designed as a radiation and blast barrier which will remain until demolished. It is a concrete rectangle 1,005 feet long, 104 feet high (with approximately 40 feet below grade), and 61.5 feet wide. The concrete walls and floor range from approximately 3 feet to 9 feet thick, and the shielding capacity of the concrete was designed so that personnel in non-regulated service areas would not receive radiation in excess of 0.1 millirem per hour. The main 202-A building has been maintained in a safe low-maintenance condition since 1997 and is surround by barbed wire fencing to prevent public or inadvertent access. The two tunnels are under eight feet of earth, are sealed and the stored equipment is not currently accessible. Active facility systems are limited to electrical distribution, exhaust ventilation, instrumentation systems, and fire detection/alarms systems in 252-AB and 217-A buildings. Since the facility was placed into an S&M mode, a new roof was placed over the canyon and aqueous makeup areas. Unless there is an emergency, no workers are permitted to enter the building except for scheduled S&M inspections. According to the 2014 DSA, conditions in the facility have been relatively stable since deactivation with minor exceptions.

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

See #1 above

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

Primary pathways would be airborne releases of contaminant materials and smoke affecting workers and CWs. A seismic catastrophic failure of building and tunnels would exposure the public at the site's boundary (9.5 miles from PUREX facility) to about 0.17 rems.

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

DSA models assume near immediate co-worker human exposure of TED as noted in #6 above.

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

The PUREX deactivation project reduced the four separate ventilation systems in the facility to one cascaded flow scheme, and the 13 effluent points from the PUREX facility and storage tunnels were reduced to one main exhaust stack. Of the 177 fans in the facility, only two main exhaust fans (one active and one on standby) continue to function. The 202-A Building is ventilated by cascade systems into the canyon ventilation system with the exhaust through deep-bed filter 2 that remove 99.9 percent of the particulates from the air stream before discharging to the atmosphere through the 61 m (200 ft) stack. The ventilation system is designed to flow air from clean areas to progressively more contaminated areas.

POPULATIONS AND RESOURCES CURRENTLY AT RISK OR POTENTIALLY IMPACTED

Facility Worker

Only those involved in quarterly S&M activities.

Co-located Person

Not Applicable

Public

The nearest public access point is 9.5 miles (CP-14977 Revision 7).

Groundwater

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 uranium or Sr-90 plume would be expected in the next 150 years due to transport and decay (Sr-90) considerations. Thus the *ND* rating would apply during the Active Cleanup period, and a rating of *Low* afterwards to address uncertainties in the evaluation.

The overall groundwater rating for the EU is based on the Low ratings for C-14, I-129, Tc-99, Cr, and Cr-VI as shown in Table F.6-7.

Columbia River

Based on an analysis similar to the one discussed in Appendix E.6 (A-AX Tank and Waste Farms) Section 6.6, the Columbia River rating for this EU is ND.

Ecological Resources

- The majority of the EU consists of buildings, disturbed areas, parking lots, and facilities.
- Patches of level 3 resources within the EU are associated with individual occurrences of sensitive plant species, Piper's daisy.
- Removal or loss of individual occurrences of the sensitive plant species, Piper's daisy, would be unlikely to alter population viability for this species.
- Remediation actions would result in only a 0.3% change in level 3 and above biological resources at the landscape scale.
- Because the PUREX facilities are adjacent to and contiguous with other disturbed and industrial areas within the 200 East Area, the loss of habitat that could potentially occur within this EU would not be expected to impact habitat connectivity on the 200 Area plateau.

Cultural Resource

- There are no known recorded archaeological sites or TCPs located within the EU.
- Segments of the National Register-eligible Hanford Site Plant Railroad a contributing property within the Manhattan Project and Cold War Era Historic District, with documentation required, are located within the PUREX EU. 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.
- There are several National Register-eligible buildings that are contributing properties within the Manhattan Project and Cold War Era Historic District, with documentation required, that are located within the PUREX EU. 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. These include:

202A	PUREX Canyon and Service Facility
2701AB	PUREX Badge House
294A	Offgas Treatment Monitoring Station
293A	Offgas Treatment Facility

- The 218-E-14 and 218-E-15 Burial Grounds are also contributing properties within the Manhattan Project and Cold War Era Historic District, with documentation required, that are located within the PUREX EU.
- The 212A Fission Product Load Monitoring Station, 275EA Storage Warehouse at 202A, and the 291A PUREX Maintenance Exhaust System, are National Register-eligible contributing properties within the Manhattan Project and Cold War Era Historic District, with no documentation required located within the PUREX EU.

Archaeological sites and TCPs located within 500 meters of the EU

- An isolated find associated with the Pre-Hanford Early Settlers/Farming Landscape is located within 500 meters of the PUREX EU is ineligible for the National Register.

Recorded TCPs Visible from the EU

- Two recorded TCPs associated with the Native American Precontact and Ethnographic Landscape that are visible from the PUREX EU.

Cleanup Approaches and End-State Conceptual Model

Selected or Potential Cleanup Approaches

The 1996 Agreement in Principle (DOE-RL1996) among the Tri-Parties of DOE, USEPA, and Washington State Department of Ecology (Ecology) established that the CERCLA Remedial Investigation/Feasibility Study process would be followed, on a case-by-case basis, to evaluate potential cleanup remedies and identify preferred alternatives for the final end state for the five major canyon buildings in the 200 Area of the Hanford Site. The 221-U Facility was selected as a pilot project for this effort. Its final RI/FS evaluated five remedial action alternatives, one of which was "Full Removal and Disposal". In this alternative, the 221-U Facility structure and contents would be removed and demolished, including the foundation below existing grade level. Structural material, facility contents, and associated soil above risk-based standards would be disposed at the ERDF. The selected remedy was "Close in Place-Partially Demolish Structure", under which equipment on the canyon deck will be consolidated into the process cells and hot pipe trench; equipment, process cells, and other open areas will be filled with grout, the structure will be partially demolished, and the remaining structure will be buried under an engineered barrier. This alternative was determined to be more protective of remedial action workers and provide somewhat greater long-term effectiveness and permanence when compared to full removal and disposal of the facilities. It was also determined to provide somewhat greater long-term effectiveness and permanence at a lower cost than the two Entombment alternatives considered.

As described in a U Plant DSA (HNF-13829, p 2-15), "grouting the canyon was done by grouting the most contaminated areas first, beginning with the grouting of the cell drain header and followed by the process cells and hot pipe trench. The base of equipment in the process cells was locked into place with a layer of strong grout to prevent shifting and cavities of equipment with large voids were grouted to prevent buoyancy during flood grouting of the process cells through the key block opening. The top couple of feet in each cell was filled with a flowable non-aggregate void-filling slurry grout which filled the remaining voids and locked the cover blocks into place.

The hot pipe trench ventilation pipes were plugged with selected risers installed. The ventilation pipe extensions (risers) permitted grouting the hot pipe trench while the ventilation system continued operating. The lower galleries were then grouted beginning with the electrical gallery and followed by the pipe gallery. The ventilation tunnel was grouted last, through ventilation pipes in the hot pipe trench or from the ventilation duct outside the canyon. The order of grouting ensured that all the voids in the canyon were filled to the maximum extent practical."

A 2011 Interim Completion Report for the 221-U Facility indicate that the first three of five D&D project components were been completed successfully. The remaining components of the remedy selected for the disposition of the U Plant Facility items are to demolish the canyon to the level of the operating deck and the placement of an engineered barrier.

A 2011 Waste Management Conference presentation indicated that an engineering study had been undertaken on the feasibility of demolishing the U Canyon walls down to the deck level, and that the safest method of taking down these huge thick concrete walls would be to use explosives to weaken the walls and structure, and then to use heavy machinery to collapse the canyon walls and roof onto the deck. It is believed that these same methods will be used to D&D the PUREX plant and adjacent buildings, assuming that the results at U Plant continue to be satisfactory.

The PUREX Storage Tunnels will be managed as a RCRA storage unit until closure can be coordinated with the final closure plan for the PUREX Plant. There are several D&D options for the rail cars and equipment in the two tunnels, ranging from retrieving each rail car unit and disposing of it as part of the main building D&D, to leaving the railcars in place and injecting grout and backfilling the storage tunnels. An RI/FS Work Plan is scheduled to be submitted for review in September 2015. No firm date for D&D of the buildings or tunnels has been established.

In July 2016, DOE proposed to demolish and remove tanks TK-P4 and TK-40, along with remaining tanks, piping, and ancillary structures in the PUREX 203A and 211A storage areas. The 203A acid storage area and the 211A chemical storage area are located north of the PUREX canyon building (see #1 and #5 on Figure F.4-4). Tank TK-P4 is located in the southeast corner of the 203A acid storage area, and tank TK-40 is located in the northeast corner of the 211A chemical storage area. Tanks TK-P4 and TK-40, which stored process chemicals during PUREX facility operations, were drained, flushed, and deactivated in 1998 to meet RCRA clean closure requirements. The secondary containment walls and floor in the storage areas will be demolished, and soil beneath the RCRA unit boundary for both tanks will be excavated up to a depth of 3 ft below the containment structure. Debris and soil will be loaded into roll-on/roll-off containers for treatment, if required, and disposal at ERDF. This proposed removal action is needed to facilitate access to the PUREX canyon building in support of future remedial and site closure actions.

Contaminant Inventory Remaining at the Conclusion of Planned Active Cleanup Period

The contaminant inventory within the demolished and buried PUREX Plant and tunnels will likely be the same as their starting points, although one option may be to move some or all of the contaminated rail cars and equipment out of the tunnels and into the canyon before final D&D. However, risk to human health, ecological receptors, or natural resources will be minimized by containment and institutional controls to eliminate potential pathways of exposure to the contaminants. This would be accomplished through waste encapsulation in grout, use of the substantial concrete canyon structure for entombment of waste, and the construction of an engineered barrier over the remaining grouted structure.

Risks and Potential Impacts Associated with Cleanup

The radioactive material inventory remaining at the end of deactivation was primarily in the form of contaminated equipment and surfaces, dust and debris, located below the deck in the process cells, with some remaining plutonium and oxide dust stabilized in gloveboxes in N Cell. No workers are expected to enter the process cells, except for possible further decontamination and disposition of the gloveboxes. A fixative would be applied to all equipment located on the deck before being moved into the cells and all workers would wear protective gear. Such workers will be required to have extensive training on hazardous waste and radiologic safety, and will wear proper protective suits and respirators, radiation monitoring badges, and will undergo regular biomonitoring.

Movement of equipment on the deck and into the cells may require size reduction and will require lifting and movement with overhead or portable cranes. Although experienced skill craft workers will be responsible for these operations and special precautions will be taken, there is always the potential for an industrial type accident or injury within these confined spaces. It should be noted that there were no accidents or injuries during the U Canyon D&D work.

Radiological, chemical and industrial related risks during D&D of the two tunnels should be low if the rail cars and equipment are grouted in place and the tunnel walls used as a permanent cover, since no workers will come into contact with the contaminants. A decision to bring the contaminated equipment inside the canyon to be made part of the Plant D&D would create potential industrial type accident risks as well as potential exposure to the contaminated equipment.

Populations and Resources at Risk or Potentially Impacted During or as a Consequence of Cleanup Actions

Facility Worker

Protection of workers from physical, chemical, and radiological hazards would be achieved by mitigating hazards, extensive planning, use of mock ups, and worker training and protection (see attached *Hanford Site Hazards Guide* and CH2MHill Safety Reference Documents at http://chprc.hanford.gov/page.cfm/CHPRCSafetyReferenceDocuments).

Co-Located Person

Protection of workers and other individuals located 100 meters from the PUREX boundary from physical, chemical, and radiological hazards would be achieved by mitigating hazards, extensive planning, use of mock ups, and worker training. Also see references in Worker section above.

Public

Surveillance and maintenance activities will continue throughout the D&D process to monitor radiological conditions, check safety related items, provide for facility-security controls and ensure there is no public access to the PUREX site by unauthorized personnel or the public.

Groundwater

Protection of groundwater will be achieved by waste encapsulation of contaminants in grout, use of the substantial concrete structure for entombment of waste, and the construction of an engineered barrier over the remaining grouted structure.

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 uranium or Sr-90 plume would be expected in the next 150 years due to transport and decay (Sr-90) considerations. Thus the *Low* rating would apply after the Active Cleanup is completed to account for uncertainties.

Columbia River

Based on an analysis similar to the one discussed in Appendix E.6 (A-AX Tank and Waste Farms) Section 6.6, the Columbia River rating for this EU is ND.

Ecological Resources

Impacts on ecological resources are provided for the selected cleanup strategy as well as the "Full Removal and Disposal" alternative that was considered.

Construction of a barrier: Personnel, cars, trucks, heavy equipment and drill rigs on roads through non-target areas or remediation site carry seeds or propagules on tires, injure or kill vegetation or animals, make paths, cause greater compaction of soil, displace animals and disrupt behavior/reproductive success. Also seeds and propagules can be dispersed from soil from truck or blowing from heavy equipment. Often permanent or long-term compaction can result in the destruction of soil invertebrates. Compaction can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area. Compaction of soils may permanently destroy areas of the site with intense activity. Construction of new buildings can cause permanent destruction of plants and animals, and of the on-site ecosystem larger than the footprint of the building. Effects will radiate from the building, and post-remediation effects depend on the degree of use (e.g., personnel and truck traffic, type of truck traffic and heavy equipment activity). Irrigation for re-vegetation 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. Soil removal can cause complete destruction of existing ecosystem, all of the above effects on adjacent sites, but these effects are potentially more severe because of blowing soil (and seeds) and the potential for exposure of dormant seeds. In the re-vegetation stage, there is the potential for invasion of exotic species, changing the species diversity of native communities. 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. Caps and other containment systems can disrupt local resources and drainage; often non-native plants are used on caps (which can become exotic/alien adjacent to the containment site).

Removal of waste to ERDF: Trucks, heavy equipment and drill rigs on roads through non-target areas or remediation site carry seeds or propagules on tires, injure or kill vegetation or animals, make paths, cause greater compaction of soil, displace animals and disrupt behavior/reproductive success. Also seeds and propagules can be dispersed from soil from truck or blowing from heavy equipment. Often permanent or long-term compaction can result in the destruction of soil invertebrates. Compaction can decrease plant growth in those areas, decrease abundance and diversity of soil invertebrates, and prevent fossorial snakes or mammals from using the area. Compaction of soils may permanently destroy areas of the site with intense activity. Drilling can cause destruction of soil invertebrates at greater depths, and has the potential to bring up dormant seeds from deeper soil layers. Drilling can cause disruption of ground-living small mammals and hibernation sites of snakes and other animals. Construction of new buildings can cause permanent destruction of plants and animals, and of the on-site ecosystem larger than the footprint of the building. Effects will radiate from the building, and post-remediation effects depend on the degree of use (e.g., personnel and truck traffic, type of truck traffic and heavy equipment activity). 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. Soil removal can cause complete destruction of existing ecosystem, all of the above effects on adjacent sites, but these effects are potentially more severe because of blowing soil (and seeds) and the potential for exposure of dormant seeds. In the re-vegetation stage, there is the potential for invasion of exotic species, changing the species diversity of native communities. 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.

Cultural Resources

Personnel, car, and truck traffic on paved roads as well as use of heavy equipment will not have any direct impact on archaeological resources because there is no disturbance to soil/ground or alteration to the landscape. Assuming heavy equipment locations and staging areas have been cleared for cultural resources, then it is assumed adverse effects would have been resolved and/or mitigated. If heavy equipment locations and staging areas have not been cleared, this could result in artifact breakage and scattering, compaction and disturbance to the soil surface and immediate subsurface, thereby compromising stratigraphic integrity of an archaeological site. TCPs may be directly affected if personnel are on roads located on TCP and if personnel are unaware of cultural resource sensitivity, appropriate behaviors and protocols. For traffic on paved roads located on TCP, direct effects include visual, auditory and vibrational alterations to landscape/setting. Heavy equipment may cause direct effects to TCPs including destruction of culturally important plants, physical attributes of the TCP and introduction of noise and vibrations also altering the setting. These actions may interfere with traditional uses of TCP.

Construction of buildings, staging areas, caps and other containment systems, and/or soil removal activities are assumed to have been cleared for cultural resources and any adverse effects would be resolved and/or mitigated. If building locations and staging areas have not been reviewed for cultural resources this could result in compaction and disturbance to the soil surface and throughout the subsurface leading to permanent adverse effects to the surface and subsurface integrity of an archaeological site by destroying the stratigraphic relationships of the soil, archaeological artifacts and features as well as all proximal information associated with archaeological artifacts and features. Construction of buildings and staging areas can have direct effects to TCPs including destroying physical attributes of TCP, destruction of culturally important plants, alteration of the setting and introduction of noise and vibrations also altering the setting. These actions may interfere with traditional uses of TCP. In some instances, the waste site is considered an archaeological site and/or pockets of undisturbed soils and potentially intact archaeological material are present. In these instances, effects could include preservation of artifacts in-situ if any information had already been gleaned from archeological site testing prior to capping. Otherwise, capping could result in compaction and compression of artifacts by destroying the stratigraphic relationships of the soil, archaeological artifacts and features as well as all proximal information associated with archaeological artifacts and features. Direct effects to TCPs include permanent alteration of physical setting and design of TCP, permanent viewshed impacts and possibly permanent interference with traditional use of TCP. Revegetation activities may cause direct effects to TCPs include physical alteration to or restoration of TCP depending on how the area is recontoured and what plants are selected for revegetation. Contamination remaining in situ may have direct effects including permanent physical alteration of TCP, and lead to permanent intrusion in long-term use and access to TCP.

Indirect effects from personnel, car, and truck traffic on paved roads as well as use of heavy equipment may lead to the introduction of invasive plant species or removal of culturally important plants that alters the landscape/setting for roads located within the viewshed and noise-scape of TCP. Existing road causes no alteration to viewshed or noise-scape. Presence of vehicles may result in visual, auditory and vibrational alterations to landscape/setting. Remediation actions may lead to visual alteration of landscape/setting. Introduction of noise alters landscape/setting. Introduction of equipment and buildings may interfere with traditional uses of TCP. During construction, indirect effects could result in temporary auditory, visual and vibrational effects. Revegetation could lead to indirect effects from visual alterations to setting depending on how the area is recontoured and what plants are selected for revegetation. Remaining contamination could lead to indirect effects from permanent intrusion, which could limit the use and access to TCP.

ADDITIONAL RISKS AND POTENTIAL IMPACTS IF CLEANUP IS DELAYED

The main PUREX building is being maintained in a safe low-maintenance condition and is surround by barbed wire fencing to prevent public or inadvertent access, and the two tunnels are sealed and the stored equipment is not currently accessible. Since the facility was placed into the S&M, a new roof was placed over the canyon and aqueous makeup areas. According to a 2014 DSA report, conditions in the facility have been relatively stable since deactivation with minor exceptions, and it is anticipated that these conditions can be maintained for a long period of time if cleanup is delayed.

PUREX Tunnel 1 was constructed in 1956. Except for a 103-foot section one wall that is composed of 3-foot thick reinforced concrete, the remaining walls and roof of the 358-foot long tunnel were constructed using 12 inch by 14 inch creosoted No. 1 Douglas Fir timbers, arranged side by side with the 12-inch side exposed. The last evaluation of the structural integrity of the tunnel was made in May 1991 by Los Alamos Technical Associates (LATA). It concluded that there was very low probability of any degradation of the timbers due to decay or insect attack, but that there was ongoing degradation occurring from continued exposure to the gamma radiation from equipment being stored there. It estimated that the strength of the timbers would be 60% of their original strength in 2001. Applying the same formulas used in that analysis to the year 2014 would indicate that the timbers are currently at about 55% of their original strength. This study indicates that standard factor of safety will be reached at 47.5% of original value. It is estimated this could occur sometime about 2040. However, the recent collapse of a 20-foot section of Tunnel #1 would indicate that degradation and weakening of the timbers is occurring faster. A follow-on engineering evaluation of the second tunnel found that it was also at risk of early failure. The wood structure of tunnel #1 also offers the potential for a fire that would release its entire 21,200 Ci radiological inventory to the environment.

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

Populations and Resources at Risk or Potentially Impacted After Cleanup Actions (from residual contaminant inventory or long-term activities)

Table F.6-8. Populations and Resources at Risk

Population or Resource		Risk/Impact Rating	Comments
Human	Facility Worker	Not Discernible (ND)	Other than periodic inspections of the final burial area, no workers will be present.
	Co-located Person	ND	None
	Public	ND-Low	Public access will be prevented by physical barriers and institutional controls
Environmental	Groundwater (A&B) from vadose zone[(a)]	Low	Current ratings in Table F.6-7. 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 and decay (Sr-90) considerations. The *Low* rating would apply to these after the Active Cleanup period is completed to account for uncertainties.
	Columbia River from vadose zone[(a)]	ND	Based on an analysis similar to the one discussed in Appendix E.6 (A-AX Tank and Waste Farms) Section 6.6, the Columbia River rating for this EU is ND.
	Ecological Resources[(b)]	ND-Low	Remote chance of penetration of roots into contaminated site, allowing exposure to residual contamination.
Social	Cultural Resources[(b)]	**Native American:** Direct: Unknown Indirect: Known **Historic Pre-Hanford:** Direct: None Indirect: None **Manhattan/Cold War**: Direct: None Indirect: None	Permanent indirect effects to viewshed are possible from capping. No other expected cultural resources impacts.

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 PUREX 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

Risk to human health, ecological receptors, or natural resources will be minimized by containment and institutional controls to eliminate potential pathways of exposure to the contaminants. This would be accomplished through waste encapsulation in grout, use of the substantial concrete canyon structure for entombment of waste, and the construction of an engineered barrier over the remaining grouted structure. This will be designed to deter even the intrusion of future "industrial archaeologists".

BIBLIOGRAPHY

AMG, PNNL, *Hanford Site-Wide Risk Review,* Project Data Sheet, PUREX, September 4, 2014

Bechtel Hanford, *Plutonium-Uranium Extraction Plant (PUREX) Hazard Assessment, BHI-01358 Rev. 1*, for U.S. Department of Energy, Richland Operations Office, Office of Environmental Restoration, July 2001

CH2MHill Plateau Remediation Company, *Plutonium-Uranium Extraction Facility Documented Safety Analysis, CP-14977 Revision 7*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, September 25, 2014

CH2MHill Plateau Remediation Company, *Criticality Safety Evaluation Report CSER-03-002, HNF-14579, Revision 1*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, April 17, 2014

CH2MHill Plateau Remediation Company, PUREX Emergency Planning Hazards Assessment, CP-13467, Revision 3, EDC-12-001459, for U.S. Department of Energy, Assistant Secretary for Environmental Management, June 6, 2013 ***[Official Use Only document]***

CH2MHill Plateau Remediation Company, *U Plant Documented Safety Analysis, HNF-13829, Revision 5*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, February 22, 2013

CH2MHill Plateau Remediation Company, *U Plant Documented Safety Analysis, HNF-13829, Revision 4*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, December 13, 2010 ***[Official Use Only document]***

CH2M, PUREX Tunnel 2 Engineering Evaluation, Project Number: 693839.BS, June 2017

CRESP 2015a. *Methodology for the Hanford Site-Wide Risk Review Project*, Consortium for Risk Evaluation with Stakeholder Participation (CRESP), Nashville, Tennessee. Available at: http://www.cresp.org/hanford/.

DOE/RL-97-56 1998, Hanford Site Manhattan Project and Cold War Era Historic District Treatment Plan, DOE/RL-97-56, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE/RL-2016-09, Rev. 0, *Hanford Site Groundwater Monitoring Report for 2015, Rev 0*, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Available at: http://higrv.hanford.gov/Hanford_Reports_2015/Hanford_GW_Report/

E. N. Dodd III, *Plutonium-Uranium Extraction (PUREX) Facility Storage Tunnel Hazard Analysis, HNF-SD-CP-HIE-002, Rev. 0*, B&W Hanford Company, April 24, 1997

E. N. Dodd III, *PUREX Deactivated End-State Hazard Analysis, HNF-SD-CP-HIE-004, Rev. 0*, B&W Hanford Company, March 9, 1999

Federal Facility Agreement and Consent Order Change Control Form, Change Number M-85-12-02, Revise interim milestones in the M-085 series (canyon s/associated waste sites and Tier 2 Facilities) to incorporate lessons learned from U Plant, November 26, 2012

Flour, *Project Experience Report, Canyon Disposition Initiative (221-U Facility)*, for U.S. Department of Energy, Assistant Secretary for Environmental Management, January 2008

Peter M. Knollmeyer, James E. Mecca (Department of Energy, Richland Operations Office) and Ricardo Martinez (Project Enhancement Corporation), *Transition of Facilities at Hanford to a Stable, Low Cost State*, Waste Management 2000 Conference, February 27-March 2, 2000, Tucson, AZ

Los Alamos Technical Associates Inc., *An Evaluation of the Structural Integrity of PUREX Storage Tunnel #1*, for Westinghouse Hanford Company, May 1991

RPP-26744, Rev. 0, Corbin RA, BC Simpson, MJ Anderson, WF Danielson, JG Field, TE Jones, and CT Kincaid. 2005. Hanford Soil Inventory Model, Revision 1. RPP-26744, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

US Department of Energy, *PUREX Facility Preclosure Work Plan, DOE/RL-95-78, Revision 1*, Richland, WA, April 1997

US Department of Energy, *Hanford Facility Dangerous Waste Permit Application, PUREX Storage Tunnels, DOE/RL-90-24, Revision 4*, Richland, WA, April 1997

US Department of Energy, *Dangerous Waste Permit Application Part A Form, WA7890008967, Part III, Operating Unit 2, PUREX Storage Tunnels, Revision 6*, Richland, WA, July 11, 2005

US Department of Energy, *Surveillance and Maintenance Plan for the Plutonium-Uranium Extraction (PUREX) Facility, DOE/RL-98-35 Revision 3*, Richland, WA, January 2008

US Department of Energy, *Dangerous Waste Permit Application Part A Form, WA7890008967, Part V, Closure Unit Group 25, PUREX, Revision 0*, Richland, WA, January 20, 2011

US Department of Energy, *Dangerous Waste Permit Application Part A Form, WA7890008967, Part V, Closure Unit Group 25, PUREX, Addendum B, Waste Analysis Plan Draft*, Richland, WA, January 20, 2011

US Department of Energy, *Closure Plan for the PUREX Tanks TK-P4 and TK-40*, DOE/RL-2015-72, Revision 0, Richland, WA, May 2016.

Westinghouse Hanford Company, *A Brief History of the PUREX and UO3 Facilities, WHC-MR-0437*, for the US Department of Energy, Office of Environmental Restoration and Waste Management, November 1993

Westinghouse Hanford Company, *PUREX Plant Deactivation Mission Analysis Report, WHC-SD-CP-MAR-002, Revision 0*, March 30, 1995