APPENDIX D.6

CP-GW-2 (Interest Areas 200-UP and 200-ZP in 200-West, Central Plateau)
Evaluation Unit Summary Template

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PART I. EXECUTIVE SUMMARY

EU LOCATION

200-West

RELATED EUS

RC-GW-1 (300-F Plumes), RC-GW-2 (100-N Plume), RC-GW-3 (100-B/C/D/H/F/K Plumes), and CP-GW-1 (200-East Plumes), CP-LS-2 (Plutonium-contaminated Waste Sites), CP-LS-3 (U Plant Cribs and Ditches), CP-LS-4 (REDOX Cribs and Ditches), CP-LS-5 (U and S Ponds), CP-TF-1 (WMA T), CP-TF-2 (WMA S-SX), CP-TF-3 (WMA TX-TY), and CP-TF-4 (WMA U).

PRIMARY CONTAMINANTS, CONTAMINATED MEDIA AND WASTES

The CP-GW-2 Evaluation Unit (EU) is related to two Hanford groundwater interest areas (IA): 200-UP (including the 200-UP-1 CERCLA [Groundwater] Operable Unit (OU)) and 200-ZP (including the 200-ZP-1 CERCLA GW OU)[1]. The focus in this Appendix will on the selected groundwater IAs because available data has been arranged based on the IAs.

The primary contaminants (i.e., those with areas of concentration exceeding cleanup levels or water quality standards) for the 200-UP IA are carbon tetrachloride, chromium (hexavalent and total), nitrate, I-129, Tc-99, tritium (H-3), and uranium (DOE/RL-2016-09, Rev. 0, p. 11-2). All of these contaminants originated within 200-UP except for carbon tetrachloride, which migrated from 200-ZP. Within the 200-UP and 200-ZP interest areas, groundwater in the unconfined aquifer (Ringold unit E with base in the Ringold lower mud unit) has been directly impacted by past waste disposal operations; there are also a confined aquifer below the Ringold lower mud unit and among basalt flows (DOE/RL-2016-09, Rev. 0, p. 11-1 and 12-1).

The primary contaminants for the 200-ZP IA are carbon tetrachloride, chromium (hexavalent and total), I-129, nitrate, Tc-99, trichloroethene (TCE), and tritium (H-3) (DOE/RL-2016-09, Rev. 0, p. 12-3). Except for nitrate, the plumes for the other contaminants fall within that for the carbon tetrachloride. Within the 200-ZP interest area, groundwater is in an unconfined aquifer (Ringold unit E with base in the Ringold lower mud unit) directly impacted by past waste disposal operations. In those areas where the Ringold lower mud unit is missing, carbon tetrachloride has migrated below the mud unit into the confined aquifer (DOE/RL-2016-09, Rev. 0, p. 12-1).

BRIEF NARRATIVE DESCRIPTION

The CP-GW-2 EU is related to two Hanford interest areas: 200-UP and 200-ZP, which are related to the two corresponding CERCLA groundwater Operable Units (OUs), 200-UP-1 and 200-ZP-1, respectively.

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[1] An operable unit (OU) is a "discrete portion of the Hanford Site, [including] a group of land disposal sites placed together [based on geographic proximity, similarity of waste characteristics and site type, and the possibility for economies of scale] for the purposes of doing a Remedial Investigation/Feasibility Study (RI/FS) and subsequent cleanup actions" (from http://www.hanford.gov/files.cfm/ap-App-A.pdf). Because the Hanford groundwater OUs do not cover the entire Site, the staff informally defined "groundwater interest areas" including the GW OUs and intervening regions for scheduling, data review, and interpretation for the entire site (DOE/RL-2008-66, Rev. 0).

The 200-UP interest area, in the southern part of 200-West, includes the 200-UP-1 Groundwater OU and adjacent parts of the surrounding 600 Area; these areas are primarily associated with early operations at the REDOX and U Plants, with the exception of the Environmental Restoration Disposal Facility (ERDF) (DOE/RL-2016-09, Rev. 0, p. 11-1). The 200-UP-1 OU has an interim Record of Decision (ROD) (EPA 2012) and is being monitored (DOE/RL-2013-07) under requirements of the Atomic Energy Act of 1954 (AEA), Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and Resource Conservation and Recovery Act of 1976 (RCRA). A number of groundwater (GW) interim remedial actions have been conducted in 200-UP-1 (EPA 2012) as described in Part IV. The final ROD for the 200-UP-1 OU will be pursued when future groundwater impacts are adequately understood and studies to evaluate potential technologies to treat I-129 are completed (EPA 2012). In August 2015, the performance monitoring plan was released (DOE/RL-2015-14).

The 200-ZP interest area, in the northern and central parts of 200-West and nearby parts of 600 Area, includes the 200-ZP-1 groundwater OU and legacy source sites (cribs and trenches) primarily related to discharges of liquid wastes from the Plutonium Finishing Plant (PFP) (DOE/RL-2016-09, Rev. 0, p. 12-1). Remedial actions have been or are being taken to address groundwater contamination in the 200-ZP IA as described in Part IV.

SUMMARY TABLES OF RISKS AND POTENTIAL IMPACTS TO RECEPTORS

Table D.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 200-UP and 200-ZP interest areas; a Co-located Person (CP) is an individual located 100 meters from the physical boundaries of the 200-UP and 200-ZP interest areas; and Public is an individual located at the closest point on the Hanford Site boundary not subject to DOE access control. The nuclear-related risks to humans are based on unmitigated (unprotected or controlled conditions) dose exposures expressed in a range of from Not Discernible (ND) to High. The estimated mitigated exposure that takes engineered and administrative controls and protections into consideration, is shown in parentheses.

Groundwater and Columbia River

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[2]

No risk ratings are provided for Cultural Resources. Table D.6-1 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

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

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

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

Population or Resource		Evaluation Time Period	
		Active Cleanup (to 2064)	
		Current Condition: Monitoring	**From Cleanup Actions:** P&T / Monitoring
Human Health	Facility Worker	***Low to Medium*** (Low)	***Proposed Alternatives (range of actions): Low to Medium*** (Low)
	Co-located Person	***Low to Medium*** (Low)	***Proposed Alternatives (range of actions): Low to Medium*** (Low)
	Public	***Not Discernible (ND) to Low*** (ND to Low)	***Proposed Alternatives (range of actions): ND to Low*** (ND)
Environmental	Groundwater (Only existing plumes – Vadose zone threats evaluated in corresponding EUs)	200-UP IA: Low to Medium (NO3, Cr-VI, H-3, and I-129) 200-ZP IA: Low to Very High (CCl4) Overall: Very High (CCl4)	200-UP IA: ND to Medium (I-129) 200-ZP IA: ND to Very High (CCl4) Overall: Very High (CCl4)
	Columbia River	Benthic: Not Discernible Riparian: Not Discernible Free-flowing: Not Discernible **Overall**: Not Discernible	Benthic: Not Discernible Riparian: Not Discernible Free-flowing: Not Discernible **Overall**: Not Discernible
	Ecological Resources[(a)]	ND to Low	ND to Low
Social	Cultural Resources[(a)]	**Native American:** Direct: Known Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: Unknown **Manhattan/Cold War:** Direct: Unknown Indirect: Unknown	**Native American:** Direct: Known Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: Unknown **Manhattan/Cold War:** Direct: Unknown Indirect: Unknown

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

SUPPORT FOR RISK AND IMPACT RATINGS FOR EACH POPULATION OR RESOURCE

Human Health

Current

Facility workers are at risk when working in or around areas with contaminated soil. Exposure to such contaminants is limited because groundwater and contaminated soils are located below grade. However, during certain operations (e.g., P&T operations, drilling, and sampling), there may be the potential for exposure to hazardous and radioactive contaminants; however, the potential exposure would be very small.

Unmitigated Consequences: Facility Worker – Low to Medium, CP – Low to Medium; Public – ND to Low

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

Mitigated Consequences: Facility Worker – Low, CP – Low; Public – ND

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Cleanup alternatives have been selected for the 200-West Groundwater OUs (200-UP-1 and 200-ZP-1), which are related to the respective 200-West IAs, including pump-and-treat (P&T), monitored natural attenuation (MNA), and Institutional controls (ICs) to control access to residual contaminants in soil and groundwater as long as they exceed the cleanup levels (CULs). As such, impacts from potential remediation approaches will vary slightly, depending on the activity: P&T, MNA, and IC. Worker risks are thus rated as *Low* to *Medium*.

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

Mitigation: Refer to Current.

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

Environmental

Current

Groundwater: As illustrated in Table D.6-2, the saturated zone (SZ) GTM values for the 200-UP IA Group A and B primary contaminants range from *Low* for uranium, total chromium, and Tc-99 to *Medium* for hexavalent chromium and I-129. The nitrate and tritium plume areas (Group C) translate to *Medium* ratings. The saturated zone (SZ) GTM values for the 200-ZP Group A and B primary contaminants range from *Low* for hexavalent chromium, I-129, and Tc-99 to *Medium* for TCE to *Very High* for carbon tetrachloride. The tritium and nitrate plume areas (Group C) translate to *Medium* ratings based on current plume areas. Most of these contaminants are being treated using the 200-West P&T System. Thus the overall rating for the CP-GW-2 EU is *Very High* related to carbon tetrachloride in 200-ZP (which is currently being treated).

Columbia River: For 200-UP and 200-ZP, no plume currently intersects the Columbia River at concentrations exceeding the appropriate 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*. The large dilution effect of the Columbia River on the contamination from the seeps and groundwater upwellings results in *Not Discernible* ratings. Thus the overall rating for the Columbia River during the Current period is *Not Discernible*.

Ecological Resources: Groundwater wells on Central Plateau are in sensitive ecological areas. There is the potential for disturbance and invasion of exotic species in EU. Ecological resources at locations of new wells are evaluated prior to activities to assess potential impacts.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

Groundwater: During the Active Cleanup period (as described in Part V), most contaminants in the 200-UP and 200-ZP IAs have lower ratings than those for Current conditions, primarily due to treatment in the 200-West P&T facility. However, because of the large amount of carbon tetrachloride in groundwater and the time predicted for cleanup effectiveness (125 years), the rating of *Very High* is maintained for the Active Cleanup period to represent uncertainty in cleanup effectiveness and timing. Furthermore, because the remedial action for I-129 has not been selected for the 200-UP IA, the rating (*Medium*) was increased to *High*.

Columbia River: Based on the information in Part V, no radioactive or chemical contaminants are predicted to be discharged to the Columbia River in concentrations that would pose risk to benthic or riparian zone receptors during the Active Cleanup period. Similarly, because of the large dilution effect in the Columbia River, the free-flowing ratings are *Not Discernible* for all the Tank Farm EUs for all contaminants and evaluation periods.

Ecological Resources: Remediation could degrade habitats, disturb wildlife and affect animal behavior, and introduce exotic plant species.

Social – Cultural Resources

Current

There are unevaluated cultural resources located within this EU. Upland areas where characterization and monitoring activities take place may be culturally sensitive regions as well. Traditional cultural places are known to be located in the vicinity as well as National Register eligible archaeological sites associated with all 3 landscapes.

Risks and Potential Impacts from Selected or Potential Cleanup Approaches

There are unevaluated cultural resources located within this EU. Upland areas where characterization and monitoring activities take place may be culturally sensitive regions as well. Traditional cultural places in viewshed. Indirect effects are possible from capping.

Considerations for timing of the cleanup actions

Because remedial actions have not been defined for the 200-West Groundwater Operable Units in the 200-UP and 200-ZP Interest Areas, the ratings (Medium for 200-UP and Very High for 200-ZP) indicate the need for monitoring and treatment of groundwater in these areas. Without treatment existing contamination is likely to spread to contaminate additional groundwater resources.

Near-Term, Post-Cleanup Risks and Potential Impacts

Groundwater: During the Near-term, Post-Cleanup period (described in Table D.6-5), most of the ratings for contaminants are *ND* to account for expected treatment effectiveness. The noticeable exceptions are

carbon tetrachloride (*Medium* to reflect both the large inventory and treatment uncertainty) and I-129 (*High*) where the remedial action has yet to be selected.

Columbia River: As indicated in Part V, no radionuclides or chemicals from the 200-West Area are predicted to have concentrations exceeding screening values in this evaluation period. Thus the rating will not be modified and all ratings are *Not Discernible* as is the overall rating (Table D.6-5).

Ecological Resources: Permanent indirect effects to viewshed are possible from remediation activities. Permanent effects may be possible due to presence of contamination if monitored natural attenuation is the preferred remedial action. No other expected cultural resources impacts.

PART II. ADMINISTRATIVE INFORMATION

OU AND/OR TSDF DESIGNATION(S)

200-UP-1 and 200-ZP-1

COMMON NAME(S) FOR EU

200-UP and 200-ZP Interest Areas

KEY WORDS

200 Area, CP-GW-2, 200-UP-1, 200-ZP-1, Soils, Sediments, Central Plateau

REGULATORY STATUS

Regulatory basis: An interim action Record of Decision (ROD) was published in September 2012 (EPA 2012) that addressed all major contaminant plumes within the 200-UP-1 OU and superseded the prior interim action ROD issued in 1997 (EPA/ROD/R10-97/048). The selected remedy in the 2012 ROD includes a combination of:

- Groundwater extraction and treatment with MNA for all COCs, except iodine-129 and tritium;
- MNA for the entire tritium plume and parts of the nitrate and carbon tetrachloride plumes not captured by the groundwater extraction remedies[3];
- Hydraulic containment for iodine-129 while treatment technologies are investigated;
- Remedy performance monitoring; and
- Institutional Controls (ICs).

Groundwater contaminants in the 200-ZP-1 OU are being treated under a ROD (EPA 2008) where the selected remedy is a combination of: monitored natural attenuation (MNA), institutional controls (ICs), flow-path controls, and pump and treat (P&T). The 200 West P&T System began operations in 2012 and operated continuously through 2015. Groundwater is monitored to assess the effectiveness of the remedy (DOE/RL-2009-115).

[3] Soil vapor extraction (SVE) was effective at treating carbon tetrachloride in the 200-PW-1 OU overlying the 200-ZP-1 groundwater OU (removing approximately 80,000 kg of carbon tetrachloride). There is also a large groundwater plume currently being treated using the 200 West P&T System and an additional source of carbon tetrachloride in the vadose zone where SVE could be used. SVE operated between 1992 and 2012.

Applicable regulatory documentation

200-UP: Interim action Record of Decision (ROD) (EPA 2012) superseding the prior interim action ROD (EPA/ROD/R10-97/048). Remedial Design/Remedial Action Work Plan (DOE/RL-2013-07).

200-ZP: Record of Decision (ROD) (EPA 2008) and Performance Monitoring Plan (DOE/RL-2009-115, Rev. 0)

Applicable Consent Decree or TPA milestones

M-016-193 by 09/30/2017 Lead Agency: EPA

Milestone: Complete the remedial design investigation of the southeast chromium plume, including the installation of new wells and evaluation of groundwater monitoring data and install monitoring wells needed for remedy performance monitoring as defined in the 200-UP-1 RD/RA WP.

There are no milestones related to the 200-ZP-1 OU.

RISK REVIEW EVALUATION INFORMATION

Completed: Revised 20 February 2017

Evaluated by: K. G. Brown, E. LeBoeuf, H. Turner

Ratings/Impacts Reviewed by: D. Kosson, M. Gochfeld, J. Salisbury, A. Bunn

PART III. SUMMARY DESCRIPTION

CURRENT LAND USE

DOE Hanford Site for industrial use. All current land-use activities in the 200-West Area are *industrial* in nature (EPA 2012).

DESIGNATED FUTURE LAND USE

Industrial-Exclusive. All four land-use scenarios listed in the Comprehensive Land Use Plan (CLUP) indicate that the 200-West Area is denoted *Industrial-Exclusive* (DOE/EIS-0222-F). An industrial-exclusive area is "suitable and desirable for treatment, storage, and disposal of hazardous, dangerous, radioactive, and nonradioactive wastes" (DOE/EIS-0222-F).

PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

Not Applicable

High-Level Waste Tanks and Ancillary Equipment

Not Applicable

Groundwater Plumes

There are current plumes exceeding water quality standards (WQS)[4] in the 200-UP and 200-ZP IAs In the 200-UP interest area, Tc-99, uranium, tritium (H-3), I-129, nitrate, chromium, and carbon tetrachloride form extensive groundwater plumes (DOE/RL-2016-09, Rev. 0, p. 11-1); these contaminants (except for carbon tetrachloride from 200-ZP) originated from operations in the area. Limited amounts of other contaminants including chloroform, 1,4-dioxane, Sr-90, selenium-79, and trichloroethene (TCE) have been found in groundwater and are routinely sampled in selected wells; however, no plumes are associated with these contaminants. To summarize (DOE/RL-2016-09, Rev. 0):

- Tc-99 concentrations have been measured above the DWS (900 pCi/L) downgradient of WMA S-SX, the 216-U-1 and 216-U-2 cribs, and WMA U (DOE/RL-2016-09, Rev. 0, p. 11-6). The plume near WMA S-SX is attributed primarily to a 190,000-liter leak from tank SX-115 in 1965. Between 1966 and 1970, approximately 91,000 liters of waste was released from tank S-104 in an overfill event. A plume originated from 216-U-1 and 216-U-2 Cribs near U Plant. The WMA U area is also a source of Tc-99 groundwater contamination. The plume area has been fairly stable over the past decade (Figure D.6-1).
    - Maximum concentration: 51,400 pCi/L (299-W19-36) versus a DWS of 900 pCi/L
    - Areal extent of the plume: 0.3 km^2
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Uranium has been measured above the 30 µg/L DWS in two regions within 200-UP: downgradient of the 216-U-1 and 216-U-2 Cribs, which were the source of this plume, and near the 216-U-10 Pond, which received an estimated 2,100 kg of uranium (DOE/RL-2016-09, Rev. 0, p. 11-12). The plume area has been decreasing over the past decade (Figure D.6-1).

[4] In some interest areas, thresholds are the drinking water standards (DWS) and for others they are denoted cleanup levels, which are typically DWS or risk-based standards for cleanup. These thresholds are collectively denoted water quality standards (WQS) for the purpose of this Review.

    - Maximum concentration: 1,550 µg/L (299-W19-36) versus a DWS of 30 µg/L.
    - Areal extent of the plume: 0.3 km^2.
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Tritium in 200-UP primarily originated from disposal facilities associated with the REDOX Plant, which operated from 1952 until 1967 where a large plume from the REDOX Plant cribs extends 5 kilometers toward the east and northeast at concentrations above the 20,000 pCi/L DWS. Other sources include the 216-S-3, 216-S-21, and 216-S-25 Cribs. The plume area has been decreasing over the past few years (Figure D.6-1).
    - Maximum concentration: 271,000 pCi/L (699-36-66B) versus a DWS of 20,000 pCi/L.
    - Areal extent of the plume: 5.4 km^2.
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Iodine-129 plumes in 200-UP primarily originated from REDOX Plant waste sites with some contribution from U Plant resulting in two plumes, one from the 216-U-1 and 216-U-2 cribs and a second from the REDOX Plant waste sites that merge downgradient. The SX Tank Farm is the source of an additional small plume. The plume area was relatively stable over the past decade with a noticeable decrease between 2012 and 2013 and then a slight increase in 2014 and again in 2015 (Figure D.6-1).
    - Maximum concentration: 6.07 pCi/L (699-36-66B) versus a DWS of 1 pCi/L
    - Areal extent of the plume: 3.5 km^2
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Nitrate plumes in 200-UP originated from U Plant and REDOX Plant disposal facilities, with the U Plant sources more significant (DOE/RL-2016-09-32, Rev. 0, p. 11-25). WMA U is also a source of nitrate to the groundwater. The nitrate plume size has decreased in size in 2012 and has remain relatively stable since then (Figure D.6-1).
    - Maximum concentration: 3,190 mg/L (288-W19-43) versus a DWS (equivalent) of 45 mg/L
    - Areal extent of the plume: 5.7 km^2
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Chromium plumes are found in two 200-UP areas including two plumes near WMA S-SX, a larger plume in the 600 Area Concentrations, and also near the 216-S-20 Crib and 216-S-10 Pond and Ditch (DOE/RL-2016-09, Rev. 0, p. 11-27 through 11-30). Sources include an overfill event involving tank S-104, effluent disposal to the 216-S-20 Crib, and REDOX Plant ponds and ditches south of the 200 West Area. The total chromium plume decreased between 2010 and 2013 and has remained relatively stable since (Figure D.6-1).
    - Maximum concentration: 406 µg/L (299-W23-19) versus a "Model Toxics Control Act—Cleanup" (WAC 173-340) Method B groundwater cleanup level for hexavalent chromium of 48 µg/L and a DWS for total chromium of 100 µg/L
    - Areal extent of the plume: 5.7 km^2 (hexavalent) and 0.5 km^2 (total)
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Carbon tetrachloride is widespread within 200-UP where measured concentrations were greater than 10 times the cleanup level (3.4 µg/L) in 31 wells during 2015. Since the plume originated

from Plutonium Finishing Plant (PFP) waste disposal sites in 200-ZP, the carbon tetrachloride plume will be evaluated as part of 200-ZP (where both 200-UP and 200-ZP are part of this EU).

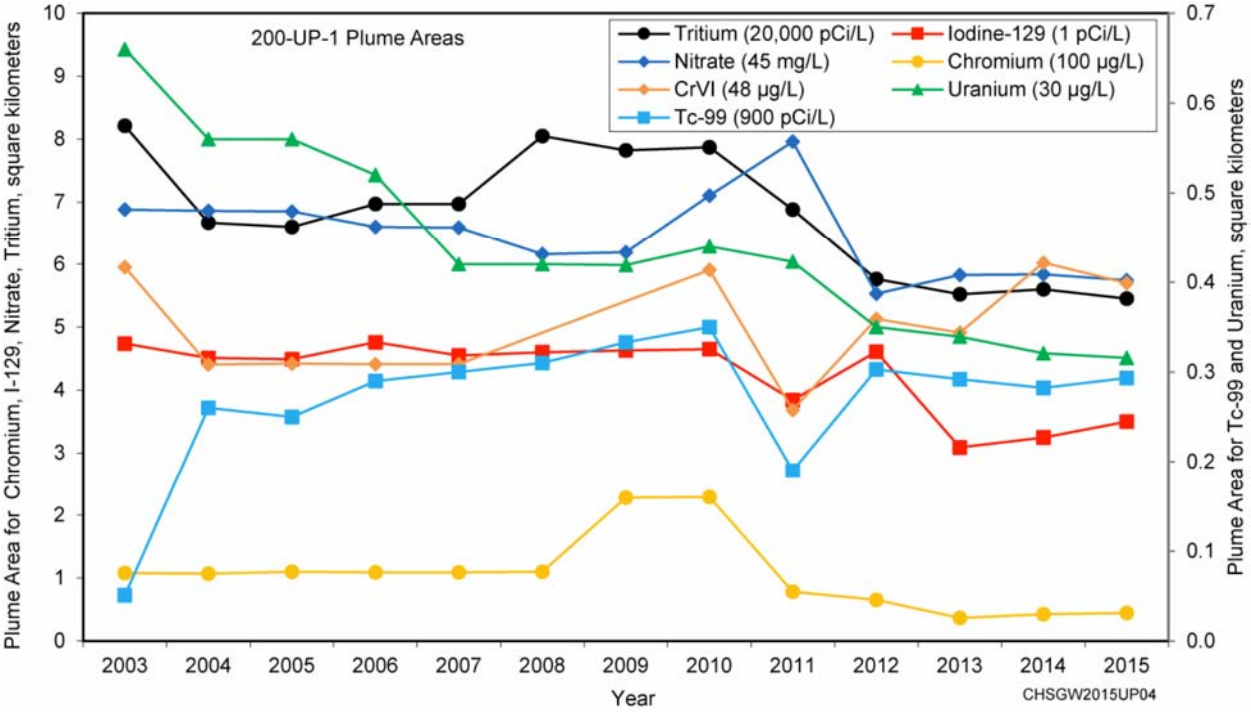

Figure D.6-1. 200-UP 2015 Plume Areas (DOE/RL-2016-09, Rev. 0, p. 11-8)

In the 200-ZP interest area, contaminants include carbon tetrachloride, chromium (total and hexavalent), I-129, nitrate, Tc-99, trichloroethene (TCE), and tritium where carbon tetrachloride is the main contaminant of concern (DOE/RL-2016-09, Rev. 0, p. 12-1). To summarize (DOE/RL-2016-09, Rev. 0):

- Carbon tetrachloride has been detected at concentrations exceeding the DWS (5 µg/L) and cleanup level (3.4 µg/L) under most of the 200-West Area (DOE/RL-2016-09, Rev. 0, p. 12-6). The primary source is from discharges of liquid waste from the Plutonium Finishing Plant (PFP) to the 216-Z-1A, 216-Z-9, and 216-Z-18 cribs and trenches. Concentrations of carbon tetrachloride are declining across 200-ZP as a result of capture by extraction wells and by natural attenuation processes where declines in both maximum concentration and in the number of wells exceeding 2,000 µg/L demonstrates the effectiveness of the remedial actions. At lower concentrations (5 µg/L), the 200 West Area plume footprint grew from 13 to 18 km^2 between 2014 and 2015 as a result of a reinterpretation based on sample data collected during drilling of new wells and a model update (ECF-200ZP1-16-0076). The plume area has been declining since 2011 (Figure D.6-2).
    - Maximum concentration: 1,980 µg/L (299-W11-87) versus a DWS of 5 µg/L and cleanup level of 3.4 µg/L
    - Areal extent of the plume: 18 km^2 (including that in 200-UP and for all depths in the unconfined aquifer)
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha

- Chromium concentrations have been measured above the final cleanup level (100 µg/L for total chromium and 48 µg/L for hexavalent chromium) beneath and downgradient of the single-shell tanks at WMA T and WMA TX-TY where sources include past leaks from single-shell tanks and from REDOX and PUREX plant operations (DOE/RL-2016-09, Rev. 0, p. 12-9). Chromium concentrations decreased in 200-ZP in most wells as a result of the 200 West P&T remedial actions where the aerial extent of the chromium plume exceeding 48 µg/L decreased from 0.52 km^2 in 2012 to 0.22 km^2 in 2013 then increased to 0.64 km^2 in 2015.
    - Maximum concentration: 198 µg/L (299-W11-43) and 278 µg/L (299-W11-13) versus a "Model Toxics Control Act—Cleanup" (WAC 173-340) Method B groundwater cleanup level for hexavalent chromium of 48 µg/L and a DWS for total chromium of 100 µg/L, respectively
    - Areal extent of the plume: 0.6 km^2 (hexavalent) and 0 km^2 (total)
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 h
- Iodine-129 concentrations exceed the 1 pCi/L DWS in three wells east and south of WMA T where sources include past leaks from single-shell tanks containing metal and liquid waste and from chemical processing at T Plant (DOE/RL-2016-09, Rev. 0, p. 12-12). The plume size decreased in 2010 and 2011 and appears to be relatively stable since then (Figure D.6-2).
    - Maximum concentration: 1.38 pCi/L (299-W5-2) versus a DWS of 1 pCi/L.
    - Areal extent of the plume: 0.09 km^2.
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Nitrate concentrations exceed the DWS (45 mg/L as nitrate) beneath much of 200-ZP where sources include liquid waste disposal from PFP processes to the cribs near WMA T and the 216-Z cribs and trenches (DOE/RL-2016-09, Rev. 0, p. 12-14). There are two high concentration plumes: one beneath WMA T and WMA TX-TY and another near the 216-Z cribs and trenches that merge extending from the 216-Z cribs and trenches to beyond the 200 West Area boundary. This combined plume is distributed throughout the entire thickness of the aquifer. The plume size peaked in 2012 and has decreased since then (Figure D.6-2).
    - Maximum concentration: 810 mg/L (299-W18-16) versus a DWS of 45 mg/L (equivalent)
    - Areal extent of the plume: 7.2 km^2
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- Technetium-99 exceeded the 900 pCi/L DWS in three monitoring wells and two extraction wells in 2015 where sources were releases from leaks in single-shell tanks and pipelines in WMA T and WMA TX-TY and liquid waste disposal from plutonium processing operations to cribs and trenches adjacent to the WMAs (DOE/RL-2016-09, Rev. 0, p. 12-16) There are two plumes, one centered at the north end of WMA TX-TY and the other beneath and east of WMA T. The Tc-99 plume total size is somewhat stable and slowly decreasing (Figure D.6-2).
    - Maximum concentration: 20,500 pCi/L (299-W14-13) versus a DWS of 900 pCi/L
    - Areal extent of the plume: 0.06 km^2
    - Shoreline impact: 0 m
    - Riparian zone intersected: 0 ha
- TCE is detected at levels above the cleanup standard (1 µg/L) throughout much of 200-ZP and is co-located with the carbon tetrachloride plume (i.e., found above cleanup level from the water table to the bottom of the aquifer) (DOE/RL-2016-09, Rev. 0, p. 12-18). No source information was provided; however, it will be assume that it has the same source as carbon tetrachloride

(liquid effluent discharges relating to PFP operations). Plume size increased between 2012 and 2015 because additional data were used to better define the plume size (Figure D.6-2).

- Maximum concentration: 12 µg/L (299-W11-90) versus a DWS of 5 µg/L and cleanup standard of 1 µg/L
- Areal extent of the plume: 1.13 km^2 at a DWS of 5 µg/L
- Shoreline impact: 0 m
- Riparian zone intersected: 0 ha

- Tritium concentrations exceeded the DWS at two locations: adjacent to WMA T and adjacent to the SALDS[5] (ongoing source) where additional sources are the liquid waste from plutonium processing to disposal facilities, including 216-T-25 Trench, and past leaks from tanks and pipelines adjacent to WMA TX-TY (DOE/RL-2016-09, Rev. 0, p. 12-18). The tritium plume area has been steadily decreasing over the past decade (Figure D.6-2).
  - Maximum concentrations: 60,200 pCi/L (699-48-77D) versus a DWS of 20,000 pCi/L.
  - Areal extent of the plume: 0.20 km^2
  - Shoreline impact: 0 m
  - Riparian zone intersected: 0 ha
- Uranium is not a contaminant of concern in the 200-ZP IA. It is not discussed in the (DOE/RL-2016-09, Rev. 0). It was last mentioned in the 2014 Hanford Site Groundwater Monitoring Report where it is stated that uranium is extracted from wells in the 200-UP IA (DOE/RL-2015-07, Rev. 0, p. 12-4). No information is provided on sources.

[5] Permitted discharges at SALDS are a continuing source of tritium to groundwater in 200-ZP (DOE/RL-2016-09, Rev. 0, p. 12-18).

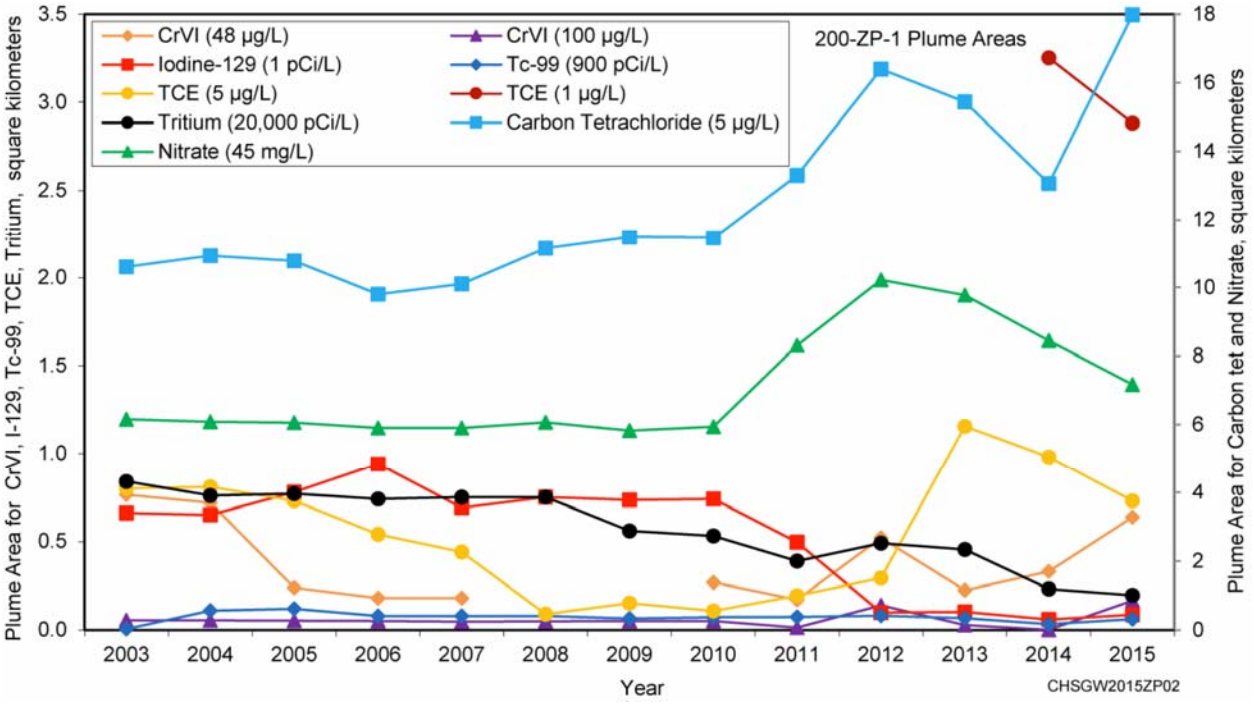

Figure D.6-2. 200-ZP 2015 Plume Areas (DOE/RL-2016-09, Rev. 0, p. 12-4)

Operating Facilities

Not Applicable

LOCATION AND LAYOUT MAPS

A series of maps are used to illustrate the location of the components within the CP-GW-2 EU relative to the Hanford Site. Figure D.6-3 shows the relationship among the various Evaluation Units studied in the Interim Report and the Hanford Site. Figure D.6-4 illustrates the extent of groundwater contamination in the Central Plateau. Figure D.6-5 shows a detailed view of the groundwater plumes in and near the 200-UP-1 and 200-ZP-1 Operable Units.

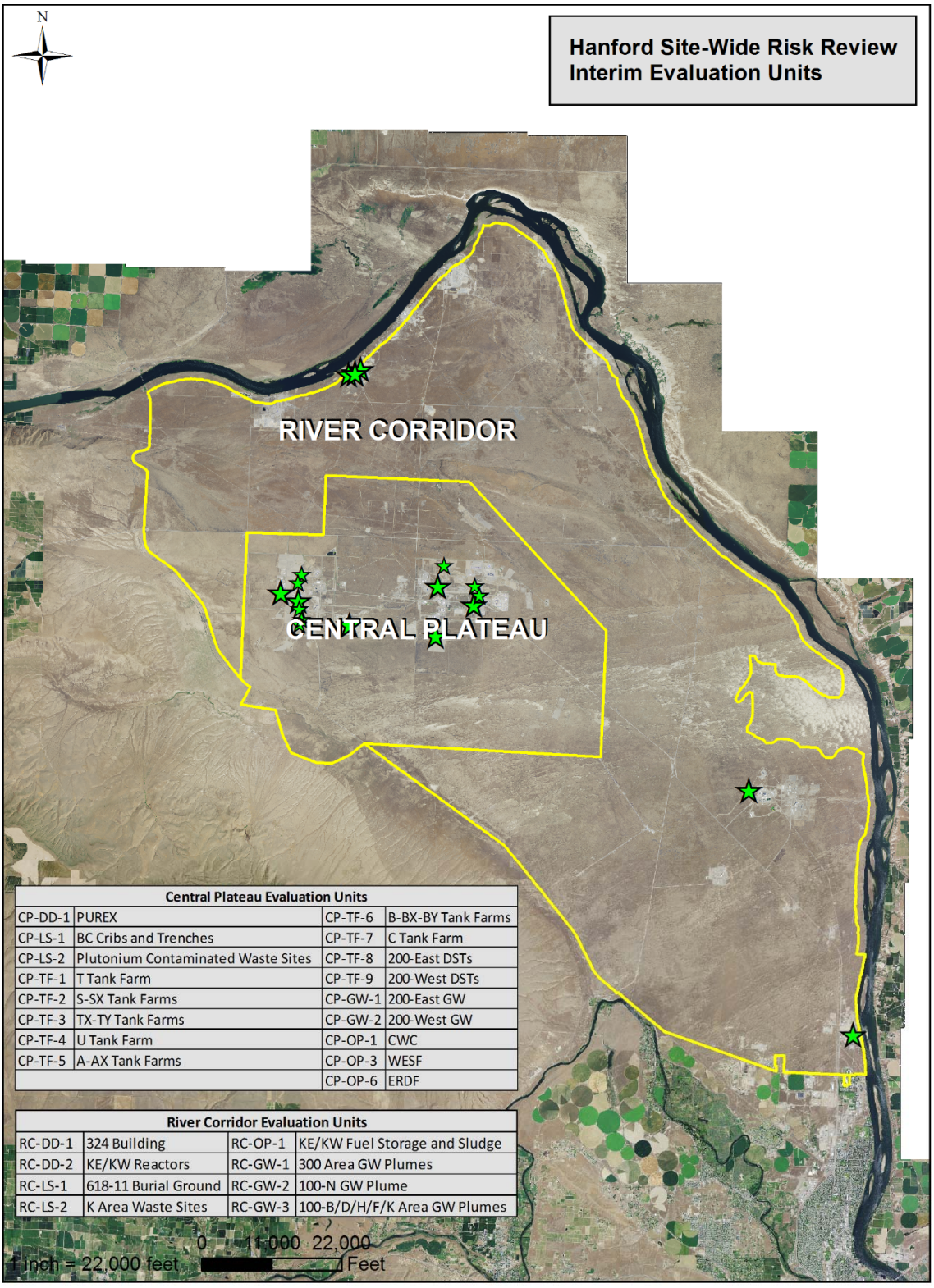

Figure D.6-3. Location of the Evaluation Units in Relation to the Hanford Site.

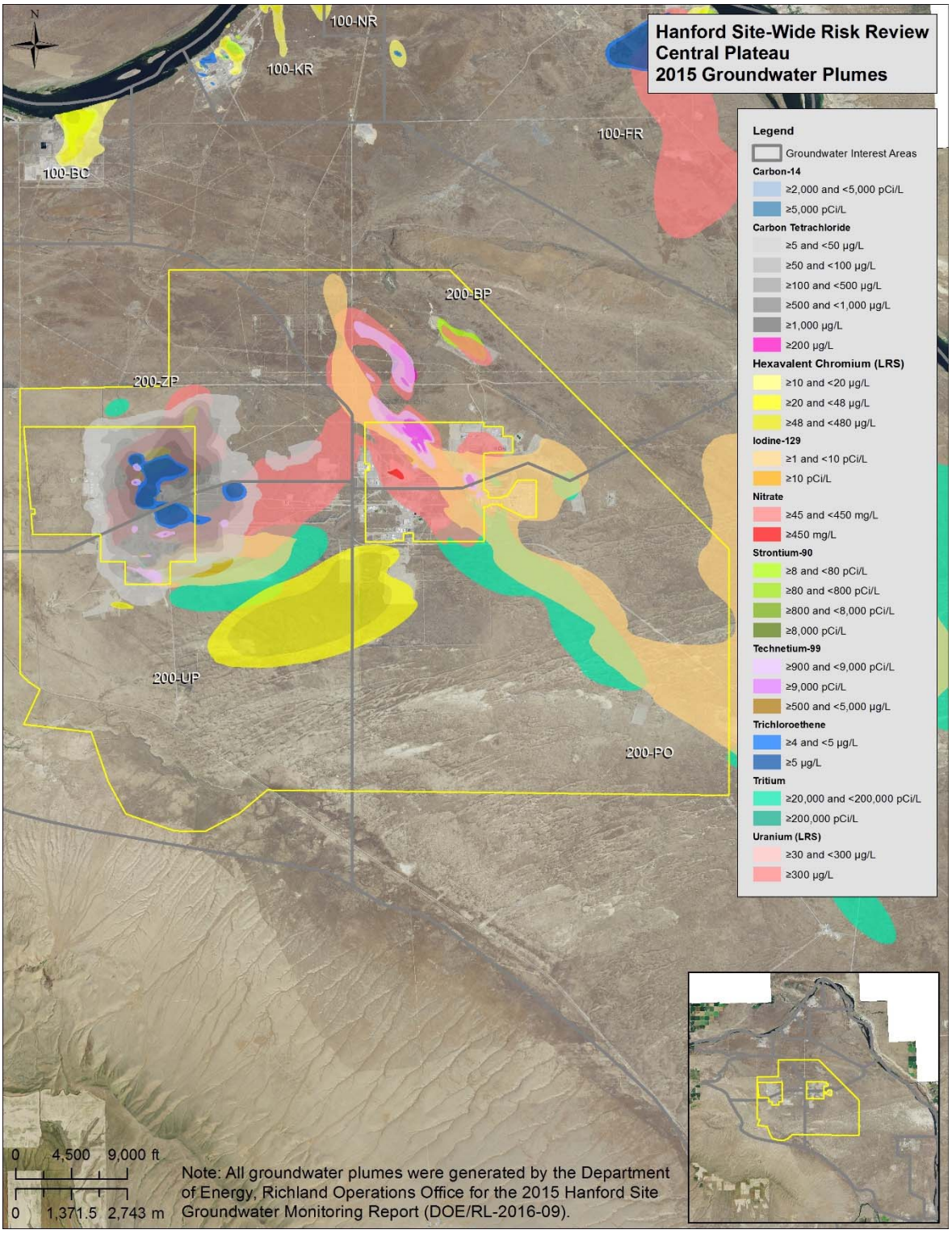

Figure D.6-4. Groundwater Contamination in the Hanford Central Plateau in 2015

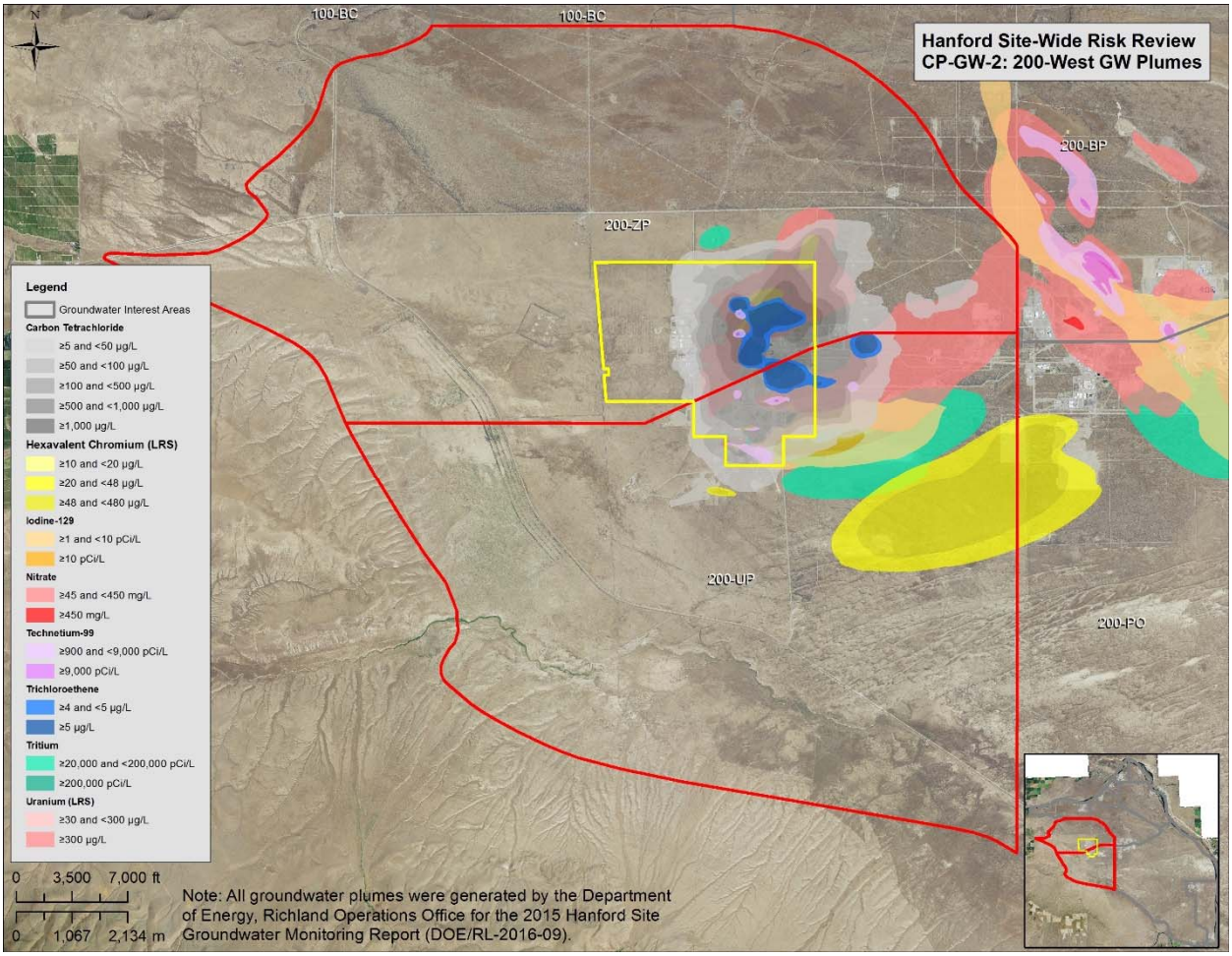

Figure D.6-5. Groundwater Plumes near the 200-UP and 200-ZP Interest Areas in 2015

PART IV. UNIT DESCRIPTION AND HISTORY

EU FORMER/CURRENT USE(S)

The CP-GW-2 EU is related to two Hanford interest areas: 200-UP and 200-ZP containing two CERCLA groundwater Operable Units (OUs), 200-UP-1 and 200-ZP-1, respectively.

The 200-UP interest area, which is in the southern part of 200-West, includes the 200-UP-1 Groundwater OU and adjacent parts of the surrounding 600 Area; these areas are primarily associated with early operations at the REDOX and U Plants, with the exception of the Environmental Restoration Disposal Facility (ERDF) (DOE/RL-2016-09, Rev. 0, p. 11-1). The 200-UP-1 OU has an interim Record of Decision (ROD) (EPA 2012) and is being monitored (DOE/RL-2013-07) under requirements of the Atomic Energy Act of 1954 (AEA), Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and Resource Conservation and Recovery Act of 1976 (RCRA). In August 2015, the performance monitoring plan was released (DOE/RL-2015-14). A number of groundwater (GW) interim remedial actions have been conducted in 200-UP including (EPA 2012 and DOE/RL-2016-09, Rev. 0):

- *216-U-1 Crib and 216-U-2 Crib Groundwater Interim Remedial Action (1985)*: An interim remedial action was designed to pump and treat groundwater below these cribs. Pumping started in June 1985 and continued until November 1985. The system removed 687 kg of uranium via ion exchange treatment.
- *200-UP-1 Groundwater OU Interim Remedial Action (1997, amended in 2009 & 2010)*: A pilot-scale treatability test consisting of a P&T system was constructed adjacent to the 216-U-17 Crib. Phase I operations commenced September 1995 and continued until February 1997. The test demonstrated that the ion exchange resin and granular activated carbon were effective at removing Tc-99, uranium, and carbon tetrachloride from groundwater. Based on the success of the treatability study, an interim action (i.e., groundwater extraction and treatment system) was implemented. Cleanup started in 1997 and met its remedial action objective of reducing highest concentrations to below 10 times the cleanup level of 48 µg/L for uranium and 10 times the maximum contaminant level of 900 pCi/L for Tc-99. This system removed 220.5 kg of uranium, 127 g (2.17 Curies) of Tc-99, 41 kg of carbon tetrachloride, and 49,000 kg of nitrate. The system was shut down in 2012.
- *WMA S-SX Groundwater Extraction System*: A groundwater extraction system for Tc-99 was constructed in 2011 and started operation in August 2012. The design consists of a three-well extraction system, aboveground pipelines, and a transfer building to pump extracted groundwater to the 200 West Groundwater Treatment Facility for treatment and reinjection. As of the 2013, the system has removed 128.6 g (2.18 Ci) of Tc-99, 36.1 kg of chromium, 22,600 kg of nitrate, and 39.5[6] kg of carbon tetrachloride since startup (DOE/RL-2016-09, Rev. 0, p. 11-42).
- The final ROD for the 200-UP-1 OU will be pursued when future groundwater impacts are adequately understood and potential technologies to treat I-129 are completed (EPA 2012).
- *U Plant Area Pump and Treat*: This remedy was designed primarily to remediate the uranium plume originating from the 216-U-1 and 216-U-2 Cribs near U Plant, but the system also removes technetium-99, nitrate, and carbon tetrachloride. During 2015, construction of the remedy was completed and the system began operation in September 2015. A total of 65.4 million L (17.3 million gal) of groundwater were pumped and 1.8 kg of uranium, 0.19 Ci of technetium-99, 22,300 kg of nitrate, and 5.3 kg of carbon tetrachloride were removed from the aquifer (DOE/RL-2016-09, Rev. 0, p. 11-37).
- *Iodine-129 Plume Hydraulic Control*: The 2012 interim action ROD (EPA 2012) requires hydraulic containment of the iodine-129 plume while treatment technologies are evaluated. The locations and flow rates for these wells were determined by groundwater flow modeling, and the resulting design was for three injection wells, and the three wells were drilled in 2015 and began operation in October 2015 (DOE/RL-2016-09, Rev. 0, p. 11-46).

The 200-ZP interest area, in the northern and central parts of 200-West and nearby parts of 600 Area, include the 200-ZP-1 groundwater OU and legacy source sites (cribs and trenches) primarily related to discharges of liquid wastes from the Plutonium Finishing Plant (PFP) (DOE/RL-2016-09, Rev. 0, p. 12-1).

[6] Due to a calculation error, the masses of carbon tetrachloride removed from the aquifer reported in the 2013 and 2014 annual reports (DOE/RL-2014-32, Hanford Site Groundwater Monitoring Report for 2013; DOE/RL-2015-07, Hanford Site Groundwater Monitoring Report for 2014) were overestimated. The corrected values for 2013 are 11.9 kg removed during the year and 14.2 kg removed since startup. The corrected values for 2014 are 12.9 kg removed during the year and 27.1 kg removed since startup.

The following actions have been or are being taken to address groundwater contamination in the 200-ZP IA:

- *200-ZP-1 OU Interim Remedial Action (1995)*: In 1996, a pump-and-treat system was started to reduce the mass of carbon tetrachloride (as well as secondary contaminants TCE and chloroform) in the groundwater primarily from waste sites south and east of the Plutonium Finishing Facility (DOE/RL-2012-03, Rev. 0). This action was completed and the interim P&T system was deactivated in May 2012 (with startup of the 200 West Area P&T facility). From 1996 through 2012, the system removed 13,911 kg of carbon tetrachloride, 15.7 kg of chromium, 84,693 kg of nitrate, 81.7 g (1.3 Ci) of Tc-99, and 1.0 kg of TCE (DOE/RL-2016-09, Rev. 0, p. ZP-25).
- *200-ZP-1 Record of Decision (2008)*: The 200-ZP-1 Record of Decision was issued in 2008 and selected P&T, MNA, and Institutional Controls (ICs) to remediate contaminated groundwater including impacting the direction of groundwater flow and further reducing the levels of carbon tetrachloride present and migrating towards the 200-UP-1 OU. The P&T system was started in 2012 and removed 9,264 kg of carbon tetrachloride, 249.91 kg of chromium, 0.000242 µCi of I-129, 844,113 kg of nitrate, 4.82 Ci of Tc-99, and 36.73 kg of TCE, and 8.25 kg of U[7] by 2015 (DOE/RL-2016-09, Rev. 0, p. 12-25).
- *200-PW-1 Interim Record of Decision (1992)*: Soil vapor extraction was implemented as an interim action in 1992 to remove carbon tetrachloride from the vadose zone in 200-PW-1 overlying the 200-ZP-1 groundwater (DOE/RL-2016-09, Rev. 0). The system has removed 80,107 kg of carbon tetrachloride to date; however, the mass removed each year has been decreasing (DOE/RL-2016-09, Rev. 0, p. ZP-28). The system did not operate in 2013, 2014, or 2015.

LEGACY SOURCE SITES

Not Applicable

HIGH-LEVEL WASTE TANKS

Not Applicable

GROUNDWATER PLUMES

Please see groundwater plume description in Part III above.

D&D OF INACTIVE FACILITIES

Not Applicable

OPERATING FACILITIES

Not Applicable

[7] Uranium is not a contaminant of concern for the 200-ZP-1 OU; it is including to track 200-UP-1 groundwater treated.

ECOLOGICAL RESOURCES SETTING

The 200-W groundwater plumes are located on the Central Plateau, and do not intercept the Columbia River. On the Central Plateau Site, the potential for terrestrial ecological receptors to interact directly with any of the groundwater plumes is unlikely because the depth of groundwater exceeds the depth of terrestrial plant roots and burrowing animals, arthropods, and birds. Locations of groundwater wells have currently been assessed for ecological resources, and the reviews will continue for future activities.

CULTURAL RESOURCES SETTING

The potential for cultural resources in the area of the groundwater plumes is high and likely to affect the Native American, Historic Pre-Hanford, and Manhattan Project/Cold War landscapes. A literature review of the setting for the 200-W Groundwater EU has not been completed. Current remedial actions for groundwater plumes have included evaluation of Section 106 of the National Historic Preservation Act. Future activities will also include Section 106 evaluations.

Consultation with Hanford Tribes (Confederated Bands of the Yakama Nation, Wanapum, Confederated Tribes of the Umatilla Indian Reservation, and the Nez Perce) and other groups who may have an interest in the areas (e.g. East Benton Historical Society, Prosser Cemetery Association, Franklin County Historical Society, the Reach, and the B-Reactor Museum Association) will be completed. Consultation with Hanford Tribes will be necessary to provide input on indirect effects to both recorded and potential unrecorded TCPs in the area and other cultural resource issues of concern.

PART V. WASTE AND CONTAMINATION INVENTORY

The method described in Chapter 6 of the Methodology Report (CRESP 2015) was used to approximate saturated zone inventories for the primary contaminants in the 200-UP and 200-ZP Interest Area.

CONTAMINATION WITHIN PRIMARY EU SOURCE COMPONENTS

Legacy Source Sites

Not Applicable.

High Level Waste Tanks and Ancillary Equipment

Not Applicable.

Vadose Zone Contamination

The potential impacts of remaining vadose zone inventory on groundwater is evaluated in the corresponding legacy source and tank waste and farms EUs. There are numerous sources for the groundwater plumes in the 200-UP and 200-ZP IAs as described in Part III, Primary EU Source Components. For example, the carbon tetrachloride plume, the largest in the CP-GW-2 EU, the originated from waste disposal sites associated with the Plutonium Finishing Plant (PFP) in 200-ZP (DOE/RL-2016-09, Rev. 0); these waste sites are associated with the CP-LS-2 (Plutonium Contaminated Waste Sites) EU. The vadose zone threats to the area groundwater are described in the corresponding Appendix.

Groundwater Plumes

The estimated inventory for the saturated zone contamination is provided in Table D.6-2 where the process is outlined in Chapter 6 of the Methodology Report (CRESP 2015). For the 200-UP and 200-ZP groundwater plumes (DOE/RL-2016-09, Rev. 0), the following information is provided:

- Maximum measured groundwater concentration in 2015 (DOE/RL-2016-09, Rev. 0);
- Upper 95% confidence limit (UCL) on the log-transformed 2015 groundwater and aquifer tube (AT) data from HEIS (http://ehs.hanford.gov/eda/) exceeding the WQS, where the AT can also be used if the plume is in contact with the Columbia River;
- Plume area in 2015 (exceeding the water quality standard (WQS), often the DWS or risk-based cleanup level) (DOE/RL-2016-09, Rev. 0);
- Assumed plume thickness, which as described in Chapter 6 of the Methodology Report (CRESP 2015) is the minimum of the thickness from Table 3 from the Hanford 200-UP-1 Operable Unit Interim Record of Decision or the unconfined aquifer thickness is used for the contaminant depth interval;
- Estimated plume pore volume and mass or activity in water (M^{SZ}) using the process described in Chapter 6 of the Methodology Report (CRESP 2015);
- The Groundwater Threat Metric (GTM) for the plume and corresponding rating.

As illustrated in Table D.6-2, the saturated zone (SZ) GTM values for the 200-UP IA Group A and B primary contaminants range from *Low* for uranium, total chromium, and Tc-99 to *Medium* for hexavalent chromium and I-129. The nitrate and tritium plume areas (Group C) translate to *Medium* ratings. These contaminants (except for I-129) have been treated and will be treated in the 200 West P&T System.

The saturated zone (SZ) GTM values (Table D.6-2) for the 200-ZP IA Group A and B primary contaminants range from *Low* for hexavalent chromium, I-129, and Tc-99 to *Medium* for TCE to *Very High* for carbon tetrachloride, which is being treated using the 200-West P&T System. The tritium and nitrate plume areas (Group C) both translate to *Medium* ratings. Thus the overall rating for the CP-GW-2 EU would be *Very High* related to carbon tetrachloride in 200-ZP. The carbon tetrachloride and other contaminants are being treated using the 200 West P&T System.

Impact of Cleanup, Recharge Rate, and Radioactive Decay on Groundwater Ratings

For this analysis, predicted impacts for a given plume at either the Core Zone Boundary for large plumes or the nearest "barrier" for smaller plumes from the TC&WM EIS groundwater screening analysis (DOE/EIS-0391 2012, Appendix O) are used to gauge potential impacts of recharge rate, transport, and radioactive decay on groundwater ratings. In the TC&WM EIS, a "barrier" represents the edge of the infiltration barrier to be constructed over disposal areas that are within 100 meters [110 yards] of facility fence lines (DOE/EIS-0391 2012). The Core Zone Boundary[8] is a rectangular region encompassing the entire area that would be directly affected by project facilities and thus represents the "fence line"

[8] Groundwater beneath the western portions of the northern and southern Boundary would be impacted by contaminants released at the S, T, and U Barriers. Because the western portion of the aquifer has relatively low groundwater flux, impacts would be relatively high. The eastern portion of the Boundary is in an area of high groundwater flux, and peak groundwater impacts along the eastern part of the Core Zone Boundary would be correspondingly lower (DOE/EIS-0391 2012, p. 2-209).

of projected tank closure operational facilities for each of the alternatives (DOE/EIS-0391 2012, p. 2-209). Despite potentially including sources other than those directly related to the 200-UP and 200-ZP OUs, the groundwater screening analysis was considered reasonable to assess rate of movement of contaminants through the Hanford subsurface for this Review. The S and U Barriers are proximate to 200-UP, and the T Barrier is proximate to 200-ZP.

The groundwater transport analysis (DOE/EIS-0391 2012, Appendix O) indicates that there may be large impacts resulting from radioactive decay and transport including that from emplacing the engineered surface barrier (and resulting reduction of infiltrating water) on the predicted peak groundwater concentrations at various barriers near the groundwater plumes. To summarize, the results for Central Plateau sources (DOE/EIS-0391 2012, Appendix O) include:

- Uranium (Group B) – There is a current plume in 200-UP IA but not in the 200-ZP IA (where uranium is not a contaminant of concern but is extracted from wells in the 200-UP IA). Peak predicted concentrations at the S, T, and U Barriers are 5 µg/L (CY 11,827), 9 µg/L (CY 11,840), and 8 µg/L (CY 11,816), respectively, for the No Action Alternative (DOE/EIS-0391 2012, p. O-59) and 0 to 1 µg/L (at the S, T, and U Barriers) for the Landfill Closure scenario (DOE/EIS-0391 2012, p. O-67) indicating uranium is relatively immobile, there are not major additional sources (considered in the TC&WM EIS screening evaluation), and that any residual effects would likely be localized. Thus the ratings for the 200-ZP IA would be *Not Discernible* for the Active Cleanup and Near-term, Post-Cleanup periods. The 200-UP-1 Interim ROD (EPA 2012) indicates that active cleanup (P&T) and monitored natural attenuation (MNA) are expected to reduce uranium concentrations to cleanup levels in 25 years (EPA 2012) (i.e., before the Active Cleanup period begins). Thus ratings for the Active Cleanup and Near-term, Post-Cleanup periods would be *Not Discernible* for the 200-UP IA.
- Nitrate (Group C) – There are current plumes in both 200-UP (where S and U Barriers are closest) and 200-ZP (where T Barrier is closest). Peak concentrations at the S and U Barriers (maximum of the two) and T Barrier are 37.9 mg/L (CY 3435) and 62 mg/L (CY 2056), respectively, for the No Action Alternative and 4.78 mg/L (CY 2051) and 62.1 mg/L (CY 2053), respectively, for Landfill Closure where the DWS (equivalent) is 45 mg/L. Since the T Barrier peak concentration (used here to indicate 200-ZP IA contaminant movement) exceeds the DWS during the Active Cleanup period (and would likely do so into the Near-term, Post-Cleanup period) with a plume area likely still exceeding 0.1 km^2, the groundwater rating for the 200-ZP IA nitrate would remain *Medium* for these evaluation periods, that is, without additional information. However, according to the 200-ZP-1 OU ROD (EPA 2008), planned active treatment is predicted to reduce the groundwater nitrate inventory by 95% during the cleanup period and to the cleanup level in 125 years; these predictions result in ratings of *Medium* and *Low* for the Active Cleanup and Near-term, Post-Cleanup periods, respectively. Since the predicted peak concentrations for 200-UP (both No Action and Landfill Scenario) are less than the threshold and the 200-UP-1 Interim ROD (EPA 2012) suggests that active cleanup and monitored natural attenuation will reduce nitrate concentrations to cleanup levels in 35 years (i.e., before the Active Cleanup period begins), the resulting 200-UP IA plume area would likely be insignificant during the Active Cleanup and Near-term, Post-Cleanup periods; the ratings for these periods would be *Not Discernible*.
- Chromium (Group A – hexavalent and Group B – total) – There is a total chromium plume in 200-UP and hexavalent chromium plumes in both 200-UP and 200-ZP. Peak chromium concentrations at the S and U Barriers (maximum of the two) and T Barrier are 541 µg/L (CY 3242) and 336 µg/L (CY 2036), respectively, for the No Action Alternative and 156 µg/L (CY 2050)

and 353 µg/L (CY 2045), respectively, for Landfill Closure where the DWS is 100 µg/L for total chromium and the cleanup limit is 48 µg/L for hexavalent chromium. Because both the No Action and Landfill scenarios exceed standards[9], the current ratings would not be modified based on the EIS screening results. However, the 200-UP-1 Interim ROD (EPA 2012) indicates that cleanup levels are predicted to be achieved for chromium (total and hexavalent) in 25 years (i.e., before the Active Cleanup period begins) resulting in ratings of *Not Discernible* for the Active Cleanup and Near-term, Post-Cleanup periods, respectively. The 200-ZP-1 ROD (EPA 2008) indicates that treatment is predicted to reduce the groundwater chromium inventory by 95+% during the cleanup period and to the cleanup level in 125 years resulting in ratings of *Low* for both the Active and Near-term, Post-Cleanup periods to account for uncertainty in treatment.

- Tritium (Group C) – There are current plumes in both 200-UP (S and U Barriers) and 200-ZP (T Barrier). Peak predicted concentrations at the S and U Barriers (maximum of the two) and T Barrier are 1,290 pCi/L (CY 2128) and 2,640 pCi/L (CY 2051), respectively, for the No Action Alternative and 32 pCi/L (CY 2050) and 2,870 pCi/L (CY 2050), respectively, for Landfill Closure where the DWS is 20,000 pCi/L. Since the tritium concentrations do not exceed the standard at any Barrier, any impacts are assumed to be localized. For the 200-ZP (with a current plume of 0.2 km^2) and considering ongoing activity at SALDS, it is considered that hot spots will persist to the Active Cleanup period that exceed the 20,000 pCi/L standard (since the maximum measured concentration is many times the standard, the half-life of tritium is 12.3 years, and there is no indication of removal of tritium) resulting in a continued *Medium* and a *Low* rating for the Active Cleanup and the Near-term, Post-Cleanup periods, respectively (considering radioactive decay). For the 200-UP IA with a much larger current plume (5.4 km^2), it is possible that the plume may exceed 0.1 km^2 when the Active Cleanup period begins but is likely to fall below 0.1 km^2 (and perhaps no plume) after cleanup. This results in a *Low* rating for the Active Cleanup period (MNA and radioactive decay) and an *ND* rating for the Near-term, Post-Cleanup period for the 200-UP IA (MNA and decay).
- Tc-99 (Group A) – There are current plumes in both 200-UP (S and U Barriers) and 200-ZP (T Barrier). Peak predicted concentrations at the S and U Barriers (maximum of the two) and T Barrier are 22,800 pCi/L (CY 3072) and 6,480 pCi/L (CY 2050), respectively, for the No Action Alternative and 1,510 pCi/L (CY 2051) and 6,600 pCi/L (CY 2051), respectively, for Landfill Closure where the DWS is 900 pCi/L. However, since peak concentrations for both IAs exceed the 900 pCi/L standard for the Landfill Closure scenario, there is no basis in the TC&WM EIS analysis to reduce the ratings below *Low* for either (based on this information alone). However, groundwater is being treated in both 200-UP and 200-ZP including removing Tc-99. The 200-ZP-1 ROD indicates that cleanup levels will be obtained in 125 years resulting in *Low* and *ND* ratings for the Active Cleanup and Near-term, Post-Cleanup periods, respectively. The interim 200-UP-1 ROD indicates the Tc-99 concentrations are projected to be below the 900 pCi/L standard by the end of the Active Cleanup period (i.e., a rating of ND). Thus the ratings are *ND-Low* for the Active Cleanup and *ND* for the Near-term, Post-Cleanup periods for 200-UP and 200-ZP.
- I-129 (Group A) – There are current plumes in both 200-UP (S and U Barriers) and 200-ZP (T Barrier). Peak predicted concentrations at the S and U Barriers (maximum of the two) and T

[9] Furthermore, the Landfill Closure scenario result for hexavalent chromium in 200-UP (*Medium* rating) would still result in a *Medium* rating unless the plume area would decrease by a factor of almost seven to reduce the rating. Thus the *Medium* rating is maintained for 200-UP hexavalent chromium.

Barrier are 29.1 pCi/L (CY 3136) and 26.1 pCi/L (CY 4560), respectively, for the No Action Alternative and 2.8 pCi/L (CY 2050) and 12.6 pCi/L (CY 2050), respectively, for Landfill Closure where the DWS is 1 pCi/L. However, since peak concentrations for both IAs exceed the 1 pCi/L standard for the Landfill Closure scenario, there is no basis in the TC&WM EIS analysis to reduce the ratings for either (based on this information alone). However, the 200-ZP-1 ROD indicates that 95% of the I-19 mass would be removed in 25 years and I-129 concentrations are projected to be below the cleanup level in 125 years resulting in a *Low* rating for the Active Cleanup and *ND* for the Near-term, Post-Cleanup period. For 200-UP, assuming effectiveness of the hydraulic control for I-129 required by the 2012 interim action ROD (EPA 2012), the rating would remain *Medium* for the Active and Near-term, Post-Cleanup periods.

- Carbon Tetrachloride (Group A) – The carbon tetrachloride plume is managed in the 200-ZP (source area) IA; there is a large, current plume emanating from 200-ZP. No values are reported at the S and U or T Barriers or Core Zone Boundary for carbon tetrachloride for either No Action or landfill Closure scenario, which indicates that either predicted peak fluxes were less than 1×10^{-8} g/yr (Appendix O, TC&WM EIS, p. O-2) or the relevant source sites were not included in the screening evaluation. The EIS screening results are assumed to not be informative for the analysis of the movement of carbon tetrachloride for this evaluation. The interim 200-UP-1 ROD indicates that it is expected to take 125 years of combined active P&T and MNA (i.e., after the Active Cleanup period) for the carbon tetrachloride concentrations to meet cleanup requirements. Thus the ratings for the Active Cleanup and Near-term, Post-Cleanup ratings for TCE would be *Very High* and *Medium*, respectively, to account for uncertainties including in treatment effectiveness. These ratings reflect the need for continued monitoring (as planned) during treatment.
- Trichloroethene (TCE) (Group B) – There is a TCE plume associated with 200-ZP. No values are reported at the S and U or T Barriers or Core Zone Boundary for carbon tetrachloride or TCE for either No Action or landfill Closure scenario, which indicates that either predicted peak fluxes were less than 1×10^{-8} g/yr (Appendix O, TC&WM EIS, p. O-2) or relevant source sites were not included in the screening evaluation. The 200-ZP-1 ROD (selected remedy) indicates that 95% of the TCE mass is expected to be removed within 25 years with the cleanup level being achieved in 125 years. Thus the Active Cleanup and Near-term, Post-Cleanup ratings for TCE would be *Low* and *ND*, respectively.

The results and ratings for the 200-UP and 200-ZP IAs are summarized in Table D.6-3

Columbia River

The process illustrated in Chapter 6 of the Methodology Report (CRESP 2015) is used to evaluate potential impacts to the Columbia River. Note that the evaluation of potential benthic and riparian impacts has a common thread up to the point when the shoreline impact (benthic) or riparian zone impact area is used to define ratings. Thus a common evaluation for the benthic and riparian zone is performed here. The results for threats to the Columbia River are summarized in Table D.6-4.

Benthic and Riparian Zone – Current Impacts

Based on the information in the 2015 Hanford Site Groundwater Monitoring Report (DOE/RL-2016-09 Rev. 0) and HEIS (http://ehs.hanford.gov/eda/), even though 200-UP and 200-ZP IA contaminants are in the saturated zone at concentrations exceeding thresholds, no plumes from the 200-UP and 200-ZP IAs

are currently intersecting the Columbia River at concentrations exceeding the WQS[10]. Thus current impacts to the Columbia River from the 200-UP and 200-ZP IAs would be rated as *Not Discernible*.

Benthic and Riparian Zone – Active Cleanup and Near-term, Post Cleanup for Current Plumes

Because the 200-UP and 200-ZP IA plumes originate from 200-West, it is considered unlikely that a plume might reach the Columbia River since the water travel time is greater than 50 years (and likely significantly more) from the 200 West Area to the 200 East Area and ~10 - 30 years from the 200 East Area to the Columbia River (Gephart 2003; PNNL-6415 Rev. 18), and significantly more time would likely be required to reach the river in sufficient quantity to exceed the WQS or appropriate aquatic screening values.[11] Any contaminants *predicted* to impact the Columbia River in sufficient amounts from the Central Plateau (e.g., as described in Appendix P in the TC&WM EIS (DOE/EIS-0391 2012)) would thus likely come from 200-East sources[12] and not the 200-UP and 200-ZP IAs. Thus the impacts to the Columbia River benthic and riparian ecology for the Active Cleanup and Near-term, Post Cleanup periods are rated as *Not Discernible*.

Benthic and Riparian Zone – Long-term

An ecological screening analysis was performed in the TC&WM EIS (DOE/EIS-0391 2012, Appendix P) to evaluate potential long-term impacts of radioactive and chemical contaminants (*from selected Central Plateau sources under a No Action Alternative[13]*) discharged with groundwater on aquatic and riparian receptors at the Columbia River. The screening results indicate that exposure to radioactive contaminants from peak groundwater discharge was below benchmarks (0.1-rad-per-day for wildlife receptors and 1-rad-per-day for benthic invertebrates and aquatic biota, including salmonids consistent with DOE Technical Standard DOE-STD-1153-2002[14]) (DOE/EIS-0391 2012, Appendix P, p. P-52), indicating there should be no expected adverse effects from radionuclides for Columbia River benthic and riparian receptors over the time period evaluated (10,000 years).[15]

The corresponding (No Action) evaluation in the TC&WM EIS for potential long-term impacts of chemical contaminants discharged with groundwater to the near-river ecology (benthic and riparian) indicate that chromium and nitrate (both of which have current plumes) would have expected Hazard Quotients

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[10] The only Central Plateau plume currently in contact with the Columbia River is tritium that was primarily discharged to the PUREX cribs and trenches (DOE/RL-2016-09 Rev. 0). There are plumes associated with River Corridor GW IAs that are also in contact with the Columbia River.

[11] Based on current and expected subsurface conditions, the only path from the 200 West Area to the Columbia River currently being considered is from 200 West to 200 East to the Columbia River (CRESP 2015).

[12] Note that TC&WM EIS predictions indicate possible impacts from chromium to the benthic and riparian zones within the next decade; however, actual well measurements for chromium and other contaminants show no likely impacts in the foreseeable future from 200-West or 200-East sources, including the next 150 years. Note there was a path north from 200-West to the Columbia River that is no longer considered reasonable due to changing hydrologic patterns across the Hanford Site.

[13] Despite including sources other than those directly related to the 200-UP-1 and 200-ZP-1 OUs, the analysis in the TC&WM EIS was considered a reasonable basis to assess the potential for impact of contaminants on the benthic and riparian zones. However, because the sources are not limited to GW OUs, the evaluation is not restricted to just the GW OU sources but instead those for many Central Plateau sources. Furthermore, the results can thus be divided by the 200-West and 200-East areas based on differences in travel times of water and contaminants to the Columbia River.

[14] The standard also indicates the screening values were used for riparian receptors.

[15] Because these expected impacts are likely to be small, the potential indirect impacts on the ecosystem are assumed to be correspondingly minor (DOE/EIS-0391 2012, Appendix P, p. P-52). Based on the results in the TC&WM EIS (Appendix P), the benchmark values in the DOE Technical Standard would have to be significantly lower in the future to change the evaluation results.

exceeding unity for aquatic and riparian receptors over the evaluation period in the TC&WM EIS. The results of the screening evaluation at the near-shore region under the No Action Alternative (DOE/EIS-0391 2012, Appendix O) indicate that the nitrate peak concentration (and discharge) occurred in the past and that future concentrations would appear to not exceed either the drinking water standard or ambient water quality criterion in the next 10,000 years. Furthermore, the potential impact of increased nitrate levels may depend on other factors (e.g., phosphorus). Thus, nitrate is considered to have a *Not Discernible* rating for the benthic and riparian ecology.

The EIS results of the screening evaluation at the near-shore region under the No Action Alternative (TC&WM EIS, Appendix O) indicate that the concentration could exceed the drinking water standard for total chromium (100 µg/L) and the EIS benchmark threshold[16] (as well as the ambient water quality criterion of 10 µg/L) for hexavalent chromium. The predicted concentrations are likely overestimated since all discharge is assumed to occur in a 40-m near-shore region. Furthermore, because of the long travel time of water from 200-West (200-ZP IA) to 200-East (then to the Columbia River) relative to that from 200-East to the Columbia River, it is likely that the 200-West sources would provide an insignificant contribution of the chromium predicted to reach the Columbia River exceeding screening values (unless this was assumed to occur via the now defunct northern path from 200-West to the Columbia River), which would likely lead to insignificant long-term impacts to the benthic and riparian ecology from 200-West sources, including those associated with the 200-UP and 200-ZP IAs.

Threats to the Columbia River Free-flowing Ecology

As described in Appendix E.2 and the Methodology Report (CRESP 2015), the large dilution effect of the Columbia River on the contamination from the seeps and groundwater upwellings results in *Not Discernible* ratings for the Active Cleanup and Near-term, Post Cleanup periods and insignificant long-term impacts to the free-flowing ecology for all contaminants.

Potential Impact of Cleanup and Recharge Rate on Threats to the Columbia River

The alternatives evaluation (No Action versus Landfill Closure) in the TC&WM EIS suggests that remedial actions (e.g., surface barrier emplacement that would decrease recharge in the areas near the Tank Farms) would appear to not have significant impacts on the long-term peak concentrations in the near-shore area (benthic and riparian receptors) of the Columbia River. These results are not due to ineffectiveness of the barrier but instead due to large amounts of contaminants already in the groundwater. Ratings are not changed based on the remedial actions assumed in the TC&WM EIS (DOE/EIS-0391 2012).

Facilities for D&D

Not Applicable

Operating Facilities

Not Applicable

[16] The benchmark value used for chromium (hexavalent) in the TC&WM EIS was the sensitive-species-test-effect concentration that affects 20 percent of a test population (EC_{20}) despite the fact that the less toxic trivalent form of chromium is more like to be present in oxygenated, aquatic environs (DOE/EIS-0391 2012, Appendix P, pp. P-52 to P-53).

Table D.6-2. Summary of the Evaluation of Current Threats to Groundwater as a Protected Resource from Saturated Zone (SZ) Contamination associated with the CP-GW-2 Evaluation Unit (200-UP and 200-ZP Interest Areas)

IA	PC	Grp	WQS[a]	Area (km^2)[b]	Thick-ness (m)[c]	Pore Vol. (Mm^3)	Max GW Conc	95th % GW UCL	Porosity[a]	K_d (mL/g)[b]	ρ (kg/L)[b]	R	SZ Total, M^{SZ} (kg or Ci)	SZ GTM (Mm^3)	SZ Rating[e]
200-UP	U	B	30 µg/L	0.3	15	1.03E+00	1550 µg/L	202 µg/L	0.23	0.8	1.84	7.40E+00	2.09E+02 kg	6.97E+00	Low*
	NO3	C	45 mg/L	5.7	24	3.15E+01	3190 mg/L	129 mg/L	0.23	0	1.84	1.00E+00	4.06E+06 kg	---	Medium*
	Cr	B	100 µg/L	0.5	24	2.76E+00	406 µg/L	208 µg/L	0.23	0	1.84	1.00E+00	5.74E+02 kg	5.74E+00	Low*
	Cr-VI	A	48 µg/L	5.7	24	3.15E+01	150 µg/L	108 µg/L	0.23	0	1.84	1.00E+00	3.39E+03 kg	7.06E+01	Medium*
	H-3	C	20000 pCi/L	5.4	30	3.73E+01	271000 pCi/L	85800 pCi/L	0.23	0	1.84	1.00E+00	3.20E+03 Ci	---	Medium
	Tc-99	A	900 pCi/L	0.3	20	1.38E+00	51400 pCi/L	5200 pCi/L	0.23	0	1.84	1.00E+00	7.18E+00 Ci	7.97E+00	Low*
	I-129	A	1 pCi/L	3.5	30	2.41E+01	6.07 pCi/L	3.08 pCi/L	0.23	0.2	1.84	2.60E+00	7.45E-02 Ci	7.45E+01	Medium
	CCl4	A	3.4 µg/L	---	---	---	612 µg/L[(f)]	---	0.23	0	1.84	1.00E+00	---	---	See below[(f)]*
200-ZP	CCl4	A	3.4 µg/L	18[(f)]	55	2.28E+02	1980 µg/L	209 µg/L[(f)]	0.23	0	1.84	1.00E+00	4.77E+04 kg	9.53E+03	Very High*
	Cr	B	100 µg/L	---	---	---	278 µg/L	184 µg/L	0.23	0	1.84	1.00E+00	---	---	---*
	Cr-VI	A	48 µg/L	0.6	24	3.31E+00	198 µg/L	83.6 µg/L	0.23	0	1.84	1.00E+00	2.77E+02 kg	5.77E+00	Low*
	I-129	A	1 pCi/L	0.09	30	6.21E-01	1.38 pCi/L	1.35 pCi/L	0.23	0.2	1.84	2.60E+00	8.37E-04 Ci	8.37E-01	Low
	NO3	C	45 mg/L	7.2	24	3.97E+01	810 mg/L	185 mg/L	0.23	0	1.84	1.00E+00	7.34E+06 kg	---	Medium*
	Tc-99	A	900 pCi/L	0.06	20	2.76E-01	20500 pCi/L	7320 pCi/L	0.23	0	1.84	1.00E+00	2.02E+00 Ci	2.25E+00	Low*
	TCE	B	5 µg/L	1.13	55	1.43E+01	12.0 µg/L	7.43 µg/L	0.23	0	1.84	1.00E+00	1.06E+02 kg	2.13E+01	Medium*
	H-3	C	20000 pCi/L	0.2	30	1.38E+00	60200 pCi/L	56800 pCi/L	0.23	0	1.84	1.00E+00	7.84E+01 Ci	---	Medium

a. The Water Quality Standard (WQS) is typically the drinking water standard (DWS). The exceptions are hexavalent chromium (Cr-VI) where the "Model Toxics Control Act—Cleanup" (WAC 173-340) Method B groundwater cleanup level of 48 µg/L is used and carbon tetrachloride (CCl_4) where a risk-based threshold of 3.4 µg/L is used instead of the DWS of 5 µg/L (although the DWS is used to estimate the GTM for CCl_4).

b. Plume area (DOE/RL-2016-09-32, Rev. 0).

c. The thicknesses for contaminants in the 200-UP IA is that from Table 3 from the Hanford 200-UP-1 OU Interim ROD (EPA 2012). As described in Chapter 6 of the Methodology Report (CRESP 2015), for those areas outside of the 200-UP IA, the minimum of the value from the Hanford 200-UP-1 OU Interim ROD (EPA 2012) or the unconfined aquifer thickness is used. For the 200-ZP IA, only TCE is not a plume in 200-UP, and the carbon tetrachloride thickness is used.

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

e. For Group C contaminants, rating is based on plume area (CRESP 2015). The Groundwater Threat Metric (GTM) rating based on Table 6-3, Methodology Report (CRESP 2015) for Group A and B contaminants. The 200-West P&T facility is operating, and contaminants with extraction amounts are indicated in the table with an asterisk (*) although other contaminants may be extracted. Very little I-129 has been captured in the system and thus it is not indicated as being treated. Soil vapor extraction has also been used to treat carbon tetrachloride (80,000 kg removed by 2012).

f. The CCL_4 plume covers areas in both the 200-UP and 200-ZP IAs. The area shown is for both IAs at 5 µg/L level. The plume was evaluated over both IAs and the results shown in the 200-ZP/CCl_4 row of the table. The maximum CCl_4 concentration was reported for CCL4 in 200-UP and 200-ZP separately. Measurements from both areas were used to estimate the 95% UCL.

Table D.6-3. Summary of the Evaluation of Future Threats to Groundwater as a Protected Resource from Saturated Zone (SZ) Contamination associated with the CP-GW-2 Evaluation Unit (200-UP and 200-ZP Interest Areas)

IA	PC	Group	WQS[a]	SZ Total, M^{SZ} (kg or Ci)	SZ GTM (Mm^3)	Current SZ Rating[b]	Plume in 50 yrs (No Action/ Closure)?[c]	Plume being treated?[d]	Treatment completed (yrs)[e]	Active Cleanup SZ Rating	Plume in 150 yrs (No Action/ Closure)?[c]	Near-term, Post-Cleanup SZ Rating
200-UP	U	B	30 µg/L	2.09E+02	6.97E+00	Low	No/No	Yes	25	ND	No/No	ND
	NO3	C	45 mg/L	4.06E+06	---	Medium	No/Yes	Yes	35	ND	No/Yes	ND
	Cr	B	100 µg/L	6.02E+02	6.02E+00	Low	Yes/Yes	Yes	25	ND	Yes/Yes	ND
	Cr-VI	A	48 µg/L	3.39E+03	7.06E+01	Medium	Yes/Yes	Yes	25	ND	Yes/Yes	ND
	H-3	C	20000 pCi/L	3.20E+03	---	Medium	No/No	No	25 (MNA)	Low	No/No	ND[f]
	Tc-99	A	900 pCi/L	7.18E+00	7.97E+00	Low	Yes/Yes	Yes	15	ND	Yes/Yes	ND
	I-129	A	1 pCi/L	7.45E-02	7.45E+01	Medium	Yes/Yes	No	---	Medium	Yes/Yes	Medium
	CCl4	A	3.4 µg/L	---	---	See below	Yes[g]	Yes	125	See below	No[g]	See below
200-ZP	CCl4	A	3.4 µg/L	4.77E+04	9.53E+03	Very High	Yes[g]	Yes	125	Very High	No[g]	Medium
	Cr	B	100 µg/L	---	---	---	Yes/Yes	Yes	125	---	Yes/Yes	---
	Cr-VI	A	48 µg/L	2.77E+02	5.77E+00	Low	Yes/Yes	Yes	125	Low	Yes/Yes	Low
	I-129	A	1 pCi/L	8.37E-04	8.37E-01	Low	Yes/Yes	No	125	Low	Yes/Yes	ND
	NO3	C	45 mg/L	7.34E+06	---	Medium	No/Yes	Yes	125	Medium	No/Yes	Low
	Tc-99	A	900 pCi/L	2.02E+00	2.25E+00	Low	Yes/Yes	Yes	125	Low	Yes/Yes	ND
	TCE	B	5 µg/L	1.06E+02	2.13E+01	Medium	Yes[g]	Yes	125	Low	No[g]	ND
	H-3	C	20000 pCi/L	7.84E+01	---	Medium	No/No	No	---	Medium	No/No	Low[f]

a. The Water Quality Standard (WQS) is typically the drinking water standard (DWS). The exceptions are hexavalent chromium (Cr-VI) where the "Model Toxics Control Act—Cleanup" (WAC 173-340) Method B groundwater cleanup level of 48 µg/L is used and carbon tetrachloride (CCl4) where a risk-based threshold of 3.4 µg/L is used instead of the DWS of 5 µg/L (although the DWS is used to estimate the GTM for CCl4).

b. Ratings provided in Figure D.6-2. For Group C contaminants, rating is based on plume area (CRESP 2015). The Groundwater Threat Metric (GTM) rating based on Table 6-3, Methodology Report (CRESP 2015) for Group A and B contaminants.

c. This evaluation is based on the TC&WM EIS screening results for the No Action and Landfill Closure scenarios using the peak concentrations and times at the most proximate "barriers" (DOE/EIS-0391 2012, Appendix O). The screening results for carbon tetrachloride are assumed to be not informative for this analysis.

d. The 200-West P&T facility has been operating since 2012, and contaminants currently being extracted are indicated although other contaminants may be extracted. Soil vapor extraction has also been used to treat carbon tetrachloride (i.e., 80,000 kg removed by 2012).

e. The 200-UP-1 Interim ROD (EPA 2012) indicates the time (in years) until the selected remedy achieves corresponding cleanup levels. The 200-ZP-1 ROD (EPA 2008) indicates that the selected remedy would remove a minimum of 95% of the mass of the contaminant and would achieve cleanup levels in 125 years.

f. Considering radioactive decay.

g. The screening results in the TC&WM EIS (DOE/EIS-0391 2012, Appendix O) are assumed to be uninformative; results are based on the appropriate ROD.

Table D.6-4. Summary of the Evaluation of Groundwater as Pathway to the Columbia River associated with the CP-GW-2 Evaluation Unit (200-UP and 200-ZP Interest Areas)

IA	PC	Group	WQS	BCG or AWQC[a]	Max GW Conc	95th % GW UCL	Max GW Conc / BCG or WQS	95th % GW UCL / BCG or WQS	Shoreline Impact (m)[b]	Riparian Area (ha)[c]	Benthic rating	Riparian rating	Overall rating[d]
200-UP	U	B	30 µg/L	5 µg/L	1550 µg/L	202 µg/L	3.10E+02	4.04E+01	---	---	---	---	ND*
	NO3	C	45 mg/L	7.1 mg/L	3190 mg/L	129 mg/L	1.01E+02	4.11E+00	---	---	---	---	ND*
	Cr	B	100 µg/L	55 µg/L	406 µg/L	208 µg/L	7.38E+00	3.78E+00	---	---	---	---	ND*
	Cr-VI	A	48 µg/L	10 µg/L	150 µg/L[(e)]	108 µg/L	1.50E+01	1.08E+01	---	---	---	---	ND*
	H-3	C	20000 pCi/L	2.65E+08 pCi/L	271000 pCi/L	85800 pCi/L	1.02E-03	3.24E-04	---	---	---	---	ND
	Tc-99	A	900 pCi/L	667000 pCi/L	51400 pCi/L	5200 pCi/L	7.71E-02	7.80E-03	---	---	---	---	ND*
	I-129	A	1 pCi/L	38500 pCi/L	6.07 pCi/L	3.08 pCi/L	1.58E-04	8.01E-05	---	---	---	---	ND
	CCl4	A	3.4 µg/L	9.8 µg/L	612 µg/L	---	2.02E+02	2.14E+01	---	---	---	---	ND*
200-ZP	CCl4	A	3.4 µg/L	9.8 µg/L	1980 µg/L	209 µg/L	2.02E+02	2.14E+01	---	---	---	---	ND*
	Cr	B	100 µg/L	55 µg/L	278 µg/L	184 µg/L	5.05E+00	3.35E+00	---	---	---	---	ND*
	Cr-VI	A	48 µg/L	10 µg/L	198 µg/L	83.6 µg/L	1.98E+01	8.36E+00	---	---	---	---	ND*
	I-129	A	1 pCi/L	38500 pCi/L	1.38 pCi/L	1.35 pCi/L	3.58E-05	3.50E-05	---	---	---	---	ND
	NO3	C	45 mg/L	7.1 mg/L	810 mg/L	185 mg/L	2.58E+01	5.88E+00	---	---	---	---	ND*
	Tc-99	A	900 pCi/L	667000 pCi/L	20500 pCi/L	7320 pCi/L	3.07E-02	1.10E-02	---	---	---	---	ND*
	TCE	B	5 µg/L	47 µg/L	12.0 µg/L	7.43 µg/L	2.55E-01	1.58E-01	---	---	---	---	ND*
	H-3	C	20000 pCi/L	2.65E+08 pCi/L	60200 pCi/L	56800 pCi/L	2.27E-04	2.14E-04	---	---	---	---	ND

a. Biota Concentration Guide (BCG) from RESRAD-BIOTA v1.8 (consistent with DOE Technical Standard DOE-STD-1153-2002) for radionuclides. For chemicals, the Ambient Water Quality Criterion (AWQC) (Table 6-1 in DOE/RL-2010-117, Rev. 0) or Tier II Screening Concentration Value (SVC) (http://rais.ornl.gov/documents/tm96r2.pdf) used when AQWC not available.

b. Shoreline impact (m) (DOE/RL-2016-09, Rev. 0)

c. The intersection area between the groundwater plume and the riparian zone was provided by PNNL based on the 2015 Hanford Site Groundwater Monitoring Report (DOE/RL-2016-09-32, Rev. 0).

d. No plumes are currently in contact with the Columbia River resulting in a ND rating. The 200-West P&T facility has been operating since 2012, and contaminants currently being extracted are indicated (*) although other contaminants may be extracted. Soil vapor extraction has also been used to treat carbon tetrachloride (i.e., 80,000 kg removed by 2012).

e. The maximum value for Cr-VI in the 200-UP IA was calculated from the data obtained from HEIS (http://ehs.hanford.gov/eda/).

PART VI. POTENTIAL RISK/IMPACT PATHWAYS AND EVENTS

CURRENT CONCEPTUAL MODEL

Large and small contaminant plumes in the 200-West Area comprising the CP-GW-2 EU pose a current and continuing risk to protected natural resources in the area including groundwater. However, since there is prohibition on the use of groundwater through the Active and Near-term, Post-Cleanup periods, there is no risk to humans. Furthermore, the risks to benthic, riparian zone, and free-flowing ecology are minimal as previously described in Part V.

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?*

There is remedial work being done in the 200-West Area, including monitoring and pump-and-treat activities; thus risk to workers would tend to be related to standard industrial risks ("slips, trips, and falls") and those related to monitoring activities including sampling and well drilling.

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

Not applicable.

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

Not applicable.

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?*

There is a deep vadose zone beneath the 200-West Area through which contaminants must travel to reach groundwater and then to off-site areas (e.g., Columbia River) where receptors could be exposed. Restrictions on use of site groundwater also represent a barrier to exposure. Because of relatively long travel times, natural attenuation of the radionuclides with relatively short half-lives (when compared to travel times) is also a barrier. Furthermore, the large flow in the Columbia River would tend to dilute any contaminants to which receptors might be exposed via the surface water pathway.

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

The thick vadose zone under the Central Plateau and generally arid climate result in natural infiltration rates of between less than detection to more than 100 mm/yr (RPP-13033). Present conditions (e.g., bare ground and coarse sand and gravel surfaces) in the 200-West Area are conducive to higher infiltration rates than would be expected on undisturbed ground within the 200 Areas. Thus the vadose zone is currently acting as both a barrier and, in some areas, a secondary source for tank waste contaminants. Episodic groundwater recharge may occur following periods of high precipitation, especially if combined with topographic depressions, highly permeable surface deposits such as gravel, and where the land is denuded of vegetation (RPP-13033), which would also increase infiltration

through the vadose zone[17]. The vadose zone and groundwater have been contaminated from Central Plateau sources; however, the travel times from these areas to potential receptors has been sufficiently long that no off-site receptors are known to have been exposed to these wastes other than tritium.

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

The primary pathway and primary impacted protected resource are both groundwater. Since there is a restriction on use of groundwater, there are no human receptors; the ecological receptors are those (benthic, riparian zone, and free-flowing) near where the groundwater enters the Columbia River. The groundwater also serves as a potential, long-term future pathway (e.g., I-129 and nitrate) for impact to the Columbia River (a protected natural resource) from the CP-GW-2.

There are complete pathways for the exposure of ecological receptors to vadose zone contaminants in the legacy source areas. There will also be other possible pathways (ingestion, external radiation and dermal, inhalation) from residual wastes to human and ecological receptors after institutional controls are lifted.

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

The relatively long residence times in Hanford groundwater are consistent with recharge conditions for a semi-arid site; however, there is variation in expected residence times (PNNL-6415 Rev. 18, p. 4-72). Groundwater travel time from 200-West to 200-East (50+ years) and then from 200 East to the Columbia River is (~10-30 years) limits impacts to the River to very mobile contaminants over very long time frames. Travel times from the 200 Areas to the Columbia River are expected to decrease because of the reduced hydraulic gradient from the discontinued wastewater recharge in the 200 Areas.

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

Large and small contaminant plumes in the 200-West Area comprising the CP-GW-2 EU pose a current and continuing risk to protected natural resources in the area including groundwater and the Columbia River in the very long-term. However, since there is prohibition on the use of groundwater through the Active and Near-term, Post-Cleanup periods, there is no risk to humans. Furthermore, the risks to benthic, riparian zone, and free-flowing ecology are minimal as previously described in Part V.

POPULATIONS AND RESOURCES CURRENTLY AT RISK OR POTENTIALLY IMPACTED

Facility workers are at risk when working in or around areas with contaminated soils. Exposure to such contaminants is limited because groundwater and contaminated soils are located below grade. However, during certain operations (e.g., drilling, sampling, removal, treatment, and disposal), there may be the potential for exposure to hazardous and radioactive contaminants; however, the potential exposure would be very small. Similarly, co-located persons would be expected to have similar to reduced exposure to facility workers, while the public would be expected to have significantly reduced exposure. As noted above, The Department of Energy and contractor site-specific safety and health planning that includes work control, fire protection, training, occupational safety and industrial hygiene, emergency preparedness and response, and management and organization—which are fully integrated with nuclear safety and radiological protection—have proven to be effective in reducing industrial accidents at the Hanford site to well below that in private industry. Further, the safety and health

[17] Because the waste tanks divert water, there are areas of low moisture content and regions of higher moisture denoted an "umbrella effect" (RPP-23752). Similar effects can be seen in cribs. It is assumed that the potential impact of the variation in moisture is captured by the range of recharge rates evaluated in this Review.

program must effectively ensure that ongoing task-specific hazard analyses are conducted so that the selection of appropriate PPE can be made and modified as conditions warrant. Task-specific hazard analyses must lead to the development of written work planning documents and standard operating procedures (SOPs) [DOE uses the term work planning documents in addition to procedures] that specify the controls necessary to safely perform each task, to include continuous employee exposure monitoring. Last, ICs will be used to control access to residual contaminants in soil and groundwater as long as they exceed the cleanup levels (CULs). As such, mitigation actions will generally lead to reduced risks.

Facility Worker

Risks are thus rated as *Low to Medium*, with mitigated risk reduced to *Low*.

Co-Located Person

Risks are rated as *Low*; mitigated risk is also rated as *Low*.

Public

Risks are located as *Not Discernible* to *Low*; mitigated risk is rated as *Not Discernible*.

Groundwater

As illustrated in Table D.6-2, the saturated zone (SZ) GTM values for the 200-UP Group A and B primary contaminants range from *Low* for uranium, total chromium, and Tc-99 to *Medium* for hexavalent chromium and I-129. The nitrate and tritium plume areas (Group C) translate to *Medium* since both areas are greater than 0.1 km^2. The saturated zone (SZ) GTM values for the 200-ZP Group A and B primary contaminants range from *Low* for hexavalent chromium, I-129, and Tc-99 to *Medium* for TCE to *Very High* for carbon tetrachloride, which is being treated using the 200-West P&T System. The tritium and nitrate plume areas (Group C) both translate to *Medium* ratings, respectively, based on current plume areas. Thus the overall rating for the CP-GW-2 EU would be *Very High* related to carbon tetrachloride in 200-ZP (which is being treated).

Columbia River

As described in Part V, no plumes currently intersect the Columbia River, thus current ratings for all contaminants for the benthic, riparian, and free-flowing ecology are *Not Discernible*.

Ecological Resources

Remediation actions taken to reduce the contaminated groundwater plumes may have indirect effects on terrestrial ecological resources. Subsurface remediation actions such as pump and treat activities or development of subsurface chemical barriers to contaminant transport may indirectly affect ecological resources through several mechanisms:

- Injection and pumping wells might alter the hydrology in the vadose zone, and change soil water availability for plants.
- Injection of barrier constituents might alter soil chemistry and nutrient availability depending on rate or distance of migration of those constituents and whether the constituents interact with soils within the rooting zone
- Well pad and road construction may disturb the surface, degrade available habitat, and impact ecological resources/receptors

- Pedestrian and vehicle traffic during construction, maintenance, monitoring, and decommission of subsurface barrier systems may degrade habitats, disturb wildlife and affect animal behavior, and introduce exotic plant species.

Use of plants to accomplish phytoremediation would incur both direct and indirect effects to ecological receptors within the area of the EU used for treatment. Direct effects include surface disturbance and habitat removal associated with preparation and planting of the phytoremediation species to be used. As with subsurface treatment activities, pedestrian and vehicle traffic during construction, maintenance, monitoring, and decommission may degrade habitats, disturb wildlife and affect animal behavior, and introduce exotic plant species.

Cultural Resources

The potential for cultural resources in the area of the groundwater plumes is high and likely to affect the Native American, Historic Pre-Hanford, and Manhattan Project/Cold War landscapes. A literature review of the setting for the 200-W Groundwater EU has not been completed. Current remedial actions for groundwater plumes have included evaluation of Section 106 of the National Historic Preservation Act. Future activities will also include Section 106 evaluations.

CLEANUP APPROACHES AND END-STATE CONCEPTUAL MODEL

The 200-UP interest area, which is in the southern part of 200-West, includes the 200-UP-1 Groundwater OU and adjacent parts of the surrounding 600 Area; these areas are primarily associated with early operations at the REDOX and U Plants, with the exception of the Environmental Restoration Disposal Facility (ERDF) (DOE/RL-2016-09, Rev. 0, p. 11-1). The 200-UP-1 OU has an interim Record of Decision (ROD) (EPA 2012) and is being monitored (DOE/RL-2013-07) under requirements of the Atomic Energy Act of 1954 (AEA), Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and Resource Conservation and Recovery Act of 1976 (RCRA). A number of groundwater (GW) interim remedial actions, including pump and treat and groundwater extraction have been conducted in 200-UP including (EPA 2012). The final ROD for the 200-UP-1 OU will be pursued when future groundwater impacts are adequately understood and potential technologies to treat I-129 are completed (EPA 2012). In August 2015, the performance monitoring plan was released (DOE/RL-2015-14).

The 200-ZP interest area, in the northern and central parts of 200-West and nearby parts of 600 Area, include the 200-ZP-1 groundwater OU and legacy source sites (cribs and trenches) primarily related to discharges of liquid wastes from the Plutonium Finishing Plant (PFP) (DOE/RL-2016-09, Rev. 0, p. 12-1). Remedial actions have been or are being taken to address groundwater contamination in the 200-ZP IA including P&T, MNA, and Institutional Controls (ICs).

Contaminant Inventory Remaining at the Conclusion of Planned Active Cleanup Period

Remedial actions have been defined (primarily P&T, MNA, and ICs) for both the 200-UP and 200-ZP IAs; however, some of the actions are predicted to require more time than the 50-year Active Cleanup period to return groundwater to a state that allows most beneficial use (as drinking water). Thus it is assumed that certain mobile contaminants with large current plumes (e.g., tritium, TCE, and carbon tetrachloride) will continue to have plumes above cleanup standards after the Active Cleanup period. Furthermore, the remedial action for I-129 in the 200-UP-1 OU has not been selected so its plume is assumed to not be impacted by current treatment in 200-West.

Risks and Potential Impacts Associated with Cleanup

Ecological Resources: Personnel, cars, trucks, heavy equipment and drill rigs, as well as heavy, wide hoses, 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). 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, truck, heavy equipment, and drill rigs may have direct impact on cultural resources in the riparian areas and in upland areas where there is soil/ground or alteration to the landscape. Assuming heavy equipment locations, new roads 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 and drilling 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 roads located on TCP, direct effects include visual, auditory and vibrational alterations to landscape/setting. Heavy equipment and drilling 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. The use of heavy, wide hoses could have direct effects to archaeological resources including artifact scattering or breakage as well as disturbance of surface sediments, if the areas have not been previously cleared. Construction of staging areas 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 staging areas and other containment system locations 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 staging areas and other containment systems, and/or soil removal activities 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, containment systems 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 including 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, truck, heavy equipment, and drill rigs 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. New roads alter the 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 remediation activities, 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.

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

The range of remediation alternatives for Groundwater OUs within CP-GW-2 include (i) pump and treat; (ii) remove, treat, and dispose; (iii) monitored natural attenuation (MNA); and (iv) Institutional controls (ICs) to control access to residual contaminants in soil and groundwater as long as they exceed the cleanup levels (CULs). As such, impacts from potential remediation approaches will vary, depending on the activity.

Facility Worker

Risks are thus rated as *Low to Medium*, with mitigated risk reduced to *Low*.

Co-Located Person

Risks are rated as *Low*; mitigated risk is also rated as *Low*.

Public

Risks are located as *Not Discernible* to *Low*; mitigated risk is rated as *Not Discernible*.

Groundwater

As described in Part V, cleanup (primarily), recharge, and decay will have significant impacts on groundwater ratings during the Active Cleanup period. To summarize, ratings for most contaminants are lower during this period than for Current conditions with two notable exceptions. The rating for carbon tetrachloride is rated *Low-Very High* to reflect both the large inventory in groundwater and uncertainty in treatment effectiveness (predicted to require 125 years). Furthermore, since no remedial action has been selected for I-129 in the 200-UP IA, this rating was not modified (also based on predictions in the TC&WM EIS).

Columbia River

Please see Part V for a discussion of the impact of treatment, recharge, and decay on groundwater ratings. All ratings are *Not Discernible* for these potential impacts and do not change as a function of recharge or decay.

Ecological Resources

Personnel, car, pick-up truck, truck traffic as well as heavy equipment, drill rigs, and new facilities in the non-target and remediated areas will likely lead to permanent effects in areas of heavy equipment use, drill rigs and construction areas. Effects on the ecological resources are likely to include exotic/alien species, differences in native species structure, and soil invertebrate changes in areas of high activity (compaction). During remediation, radionuclides or other contaminants released or spilled on the surface could have long-term effects if the contamination remained, and plants did not recolonize or thrive. Such disruptions could affect the associated animal and plant communities.

Cultural Resources

Personnel, truck, heavy equipment, and drill rigs may have direct impact on cultural resources in the riparian areas and in upland areas where there is soil/ground or alteration to the landscape. Assuming heavy equipment locations, new roads 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 and drilling 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 roads located on TCP, direct effects include visual, auditory and vibrational alterations to landscape/setting. Heavy equipment and drilling 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. The use of heavy, wide hoses could have direct effects to archaeological resources including artifact scattering or breakage as well as disturbance of surface sediments, if the areas have not been previously cleared. Construction of staging areas 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 staging areas and other containment system locations 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 staging areas and other containment systems, and/or soil removal activities 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, containment systems 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 including 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, truck, heavy equipment, and drill rigs 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. New roads alter the 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 remediation activities, 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

Despite on-going treatment, some contaminant plumes (e.g., I-129) in the 200-West Area may continue to increase in size (Figure D.6-1 and Figure D.6-2) and impact additional groundwater. A remedial decision for I-129 in 200-UP-1 is needed.

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

Please see Part V for a discussion of the impact of cleanup, recharge, and decay on groundwater and Columbia River ratings in the Near-term, Post-Cleanup period. For potential impacts to groundwater, the ratings for the 200-West GW OUs tend to be *ND* to reflect presumed treatment effectiveness. Notable exceptions are carbon tetrachloride (*Medium* rating) to reflect the large contaminant inventory in groundwater and uncertainties in treatment effectiveness and I-129 (*High* rating) in 200-UP since no remedial decision has been made.

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

Table D.6-5. Summary of Populations and Resources at Risk or Potentially Impacted after Cleanup

Population or Resource		Risk/Impact Rating	Comments
Human	Facility Worker	Low (Low)	Only workers at risk or impacted would be working on monitoring and sampling.
	Co-located Person	Low to Not Discernible (Not Discernible)	Following completion of active cleanup activities, groundwater concentrations should be below AWQS.
	Public	Not Discernible (Not Discernible)	Following completion of active cleanup activities, groundwater concentrations should be below AWQS.
Environmental	Groundwater (Only existing plumes – Vadose zone threats evaluated in corresponding EUs)	200-UP IA: ND to Medium (I-129) 200-ZP IA: ND to Medium (CCl_4) Overall: Medium (I-129)	As discussed in Part V (and summarized in Table D.6-3), there are significant impacts to future groundwater threats from transport (recharge), radioactive decay, and cleanup (200-W P&T) on contaminants. The risk driver (*Medium*) is I-129 in 200-UP where monitoring is continuing until a remedial action is defined.
	Columbia River	Benthic: Not Discernible Riparian: Not Discernible Free-flowing: Not Discernible **Overall**: Not Discernible	TC&WM EIS screening results indicate that exposure to radioactive and chemical contaminants from peak groundwater discharge below benchmarks for both benthic and riparian receptors (Part V). Dilution factor of greater than 100 million between River and upwellings.
	Ecological Resources[(a)]	ND to Low	Contamination remaining in areas for monitored natural attenuation may still result in uptake in biota, but is not likely to cause an effect to the biota. Continued long-term monitoring activities may disrupt riparian and terrestrial habitats. Re-vegetation in EU will result in additional level 3 resources, and potentially creation of level 4 resources potentially at risk

Population or Resource		Risk/Impact Rating	Comments
			because of disturbance, especially from invasive species.
Social	Cultural Resources[(a)]	**Native American:** Direct: Known Indirect: Known **Historic Pre-Hanford:** Direct: Unknown Indirect: Unknown **Manhattan/Cold War**: Direct: Unknown Indirect: Unknown	Permanent indirect effects to viewshed are possible from remediation activities. Permanent effects may be possible due to presence of contamination if monitored natural attenuation is the preferred remedial action. No other expected cultural resources impacts.

a. 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

Because of the large carbon tetrachloride plume that may take 125 years or more to treat and the fact that remedial actions have not been defined for the I-129 in the 200-UP-1 OU, the corresponding ratings (*Medium-High*, respectively) indicate the need for continued monitoring and treatment of groundwater in these areas.

PART VII. SUPPLEMENTAL INFORMATION AND CONSIDERATIONS

The final Record of Decision (ROD) was signed for the 200-ZP-1 OU in 2008 (EPA 2008). An interim ROD was signed in 2012 for the 200-UP-1 OU (EPA 2012); the final remedy selection for I-129 in the 200-UP-1 OU is pending additional characterization and analysis.

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