Confederated Tribes and Bands
of the Yakama Nation ERWM

Established by the
Treaty of June 9, 1855

January 11, 2018

Laura Buelow, Ph.D.
Acting Unit Manager
U.S. Environmental Protection Agency
Hanford Project Office
825 Jadwin Ave., Ste 210
Richland, WA 99352
buelow.laura@epa.gov

Subject: Review of the *Remedial Investigation/Feasibility Study and Proposed Plan for the 100-BC-1, BC-2 and BC-5 Operable Units, DOE/RL-2010-96 and DOE/RL-2016-43, Draft A*.

Dear Ms. Buelow:

The Confederated Tribes and Bands of the Yakama Nation (Yakama Nation) appreciate the opportunity to review and provide comments on the above referenced documents.

As you are aware, the Hanford Reach is a culturally resource-rich area of immense significance to the Yakama Nation. Since time immemorial, the Yakama people have and continue to rely on our aboriginal territory throughout the Columbia River Basin to hunt, fish, and gather. These practices and the areas that support these activities are part of our way of life and our culture.

The cleanup and restoration of the Hanford site is vital to our culture, our health and the future of our Tribe. The Yakama Nation's priorities for the cleanup and closure of the Hanford Site must include:

1. Compliance with Yakama Nation Treaty Rights, including full access to Treaty resources by Yakama members within its aboriginal territory, which includes the Hanford Site.
2. Full and unimpeded access to traditional cultural properties, traditional use areas and sacred sites.
3. Official recognition that tribal members living near the Hanford site are the most vulnerable people to environmental contaminants, as underscored by EPA's Columbia River Fish Contaminant Survey.
4. Compliance with Yakama Nation's exposure scenario to ensure that all resources (surface waters, geologic resources, groundwater, air, and biological resources such as plants, fish, and wildlife) at the Hanford Site and including the Columbia River are safe for tribal use.

The Yakama Nation supports cleanup actions that are complete, permanent, and are based on proven technology. We do not support remedial actions that leave large quantities of long-lived radionuclides or dangerous waste in place and rely on long-term stewardship or institutional controls to address future potential exposure scenarios. Long-term stewardship and institutional controls will not be effective for wastes that remain dangerous for hundreds or thousands of years. Assuming that contaminants remain in place implies that a Long-Term Stewardship

Program Plan must be implemented which will remain effective longer than most human institutions have ever existed.

We look forward to discussing our priorities for cleanup and our concerns regarding the current cleanup plans for Hanford with you further.

Sincerely,

Marlene George

Marlene George, Projects Coordinator
Yakama Nation ERWM

cc: Doug Shoop, Acting Manager, US Department of Energy
Administrative Record

Attachment 1: YN Comments on the 100-BC Area Proposed Plan & Remedial Investigation / Feasibility Study/Proposed Plan

Attachment 2: Additional Groundwater Comments: DOE/RL-2010-96, DRAFT A, Remedial Investigation/Feasibility Study for the 100-BC-1, 100-BC-2, and 100-BC-5 Operable Units

Attachment # 1: YN Comments on the 100-BC Area Proposed Plan & Remedial Investigation / Feasibility Study:

Protection of Yakama Nation Treaty Rights, Land Use, and Institutional Controls: Ensuring Treaty compliance is a critical intergovernmental concern. By and through this document, USDOE supports the participation of Yakama Nation in activities related to remediation and restoration of resources affected by Hanford and implements its trust responsibility and enforceable obligations to the Yakama Nation. A total of 37 waste sites were selected in the Preferred Alternative for application of institutional controls. Institutional controls such as those included in the Preferred Alternative are not consistent with Hanford uses protected by Yakama Nation Treaty Rights. Furthermore, institutional controls will not prevent exposure by aquatic receptors or many terrestrial receptors, such as birds and small mammals. EPA concurs with the criticism that the RIFS and Proposed Plans fail to acknowledge that the Hanford Reach National Monument is expected to have additional lands added in this area. This would impact the reasonableness of assumptions regarding exposure and resource impact.

The impact of failing to remediate deep contamination sites or groundwater on the ability to expand the National Monument is a significant impact which must be addressed. If there are any RCRA permits to be issued in the future, and the CERCLA documents fail to address this, the Yakama Nation will be able to raise the need for new SEPA consideration of this impact (as well as impacts on Tribal and public ability to utilize shorelines of statewide significance).

a. YN requests a determined path for a more cooperative relationship amongst YN & the TPA agencies in the development of RI/FS/PP documents to allow the YN to effectively participate in decisions regarding future cleanup activities.
b. Along the Columbia River and its shoreline areas, porewater and aquifer sampling data continue to exceedances of water quality cleanup standards. It is the belief of the YN ERWM that a Federal interagency committee composed of the Department of Interior, the EPA, and USDOE should convene to define mutually the terms and conditions of habitability for native people of the Columbia River Basin (including residual contamination standards) and to establish an agreement with the Yakama Nation.
c. The Treaty of 1855, which reserves specific rights and resources for the Yakama Nation (this includes the right to practice in full subsistence activities in Yakama usual and accustomed use areas) should be acknowledged as an ARAR or a "must comply" standard for cleanup decisions. All future Interim and Final Record(s) of Decision(s) should be in harmony with Treaty rights of the Yakama Nation.
d. Institutional Controls:
    i. Within the timeframes that are realistically applicable to this scenario (estimated to be approximately 200 years but in reality, thousands of years due to reactor sites not covered under this ROD) institutional controls will almost inevitably fail and allow some exposure to human health and the environment. DOE's use of institutional controls as a means of preventing, without fail, exposure to residual contamination in the subsurface and groundwater remains both troubling and ultimately unproven. The Nuclear Regulatory Commission adamantly favors

Institutional Controls for only 100 years. Future land use as currently designated, does not recognize YN Tribal (or any Tribal scenario) use or and how the preferred alternative will be protective of that use.

Waste sites with radiological contamination exceeding human health direct contact cleanup levels, particularly in the shallow subsurface, should be remediated using a remove, treat, and dispose (RTD) approach rather than application of institutional controls.

ii. The impact of failing to remediate deep contamination sites or groundwater on the ability to expand the National Monument is a significant impact which must be addressed. If there are any RCRA permits to be issued in the future, and the CERCLA documents fail to address this, the Yakama Nation will be able to raise the need for new SEPA consideration of this impact (as well as impacts on Tribal and public ability to utilize shorelines of statewide significance).

The Plans must consider the impact of proposed alternatives with long remediation time spans and long periods of institutional controls on the expansion of the Hanford Reach National Monument.

e. Regarding the use of institutional controls at DOE waste sites, the National Research Council pointed out: "While there is typically a tacit recognition that engineered barriers and waste stabilization approaches have limited periods of effectiveness, these technologies are frequently employed with inadequate understanding of, or attention to, the factors that are critical to their success. These include the need for well-conceived plans for performance monitoring that identify and correct potential failures and plans for maintenance and repair, including possible total system replacement" (NRC, 2000). This level of planning, both technical and financial, does not appear to have been included in the cleanup planning. YN ERWM requests this level of detail be included in the Proposed Plan and ROD. (Cost estimates need revision to include these elements.)

f. The CLUP was a Federal undertaking that determined what type of activities could occur within the Hanford landscape, yet traditional cultural properties (TCP) were never addressed. Areas designated for industrial use, research and development, and conservation mining could have significant impacts on the landscape, and adversely affect a TCP should one be present. Furthermore, the final CLUP did not include any suggestions, or address any concerns provided by the Yakama Nation.

   i. Also, the use of ICs for extended time periods is inconsistent with the CLUP. CLUP is designated for 50 years operational and 100 years for ICs. Beyond that time period, the site could be used for any and all types of land use; including irrigation. There is nothing in place to review and confirm performance of these ICs.

g. YN requests DOE follow recommendations in EPA guidance document for identifying and addressing effects decision will have on cultural resources (including the use of ICs in culturally significant areas and traditional use areas) and evaluate NPCE documents and map areas of effect from these projects to determine affects to CRs. YN believes

accomplishment of these actions are needed to provide the necessary information to support a defensible remedy selection

Cultural Resources

100-B/C Areas RI/FS state that cultural surveys are routinely conducted to protect sensitive areas. The use of the word "routine" is misleading. National Historic Preservation Act (NHPA) Section 110 surveys have not been conducted to fully understand the nature and extent of the cultural resources present. A traditional cultural property (TCP) study has not been conducted to determine if TCPs are present; therefore, such resources are not being taken into consideration in determining potential adverse effects. Site wide undertakings and decisions such as clean up levels, restoration, vegetation management, land use plans, and the use of barriers and institutional controls need to take into consideration their effects on significant cultural sites and TCPs. It is the obligation of DOE under the NHPA Section 110 to inventory and evaluate properties to determine eligibility under the agency's jurisdiction.

There is the assumption of, and over-reliance on, the use of Institutional Controls to ensure protectiveness rather than pursuing the primary cleanup objective, which is protectiveness of the environment and human health through selection of remedies that employ treatment technologies that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants. The philosophy underlying the cleanup of Hanford should be guided explicitly by the goal of allowing Native Peoples to safely live the lifestyle to which they are entitled and utilize cultural resources such as TCP and traditional use areas. This way of thinking will be particularly important when considering how to incorporate non-quantitative elements into the Preferred Alternative, such as the spiritual or cultural value of a site.

Decisions such as clean up levels, restoration, vegetation management, land use plans, and the use of barriers and institutional controls need to take into consideration their effects on significant cultural sites and TCPs. The Yakama Nation has previously expressed deep concern over leaving in place large quantities of hazardous radiological and chemical wastes on the site with the long-term use of institutional controls as protective measures.

Regarding the use of institutional controls at DOE waste sites, the National Research Council pointed out: "While there is typically a tacit recognition that engineered barriers and waste stabilization approaches have limited periods of effectiveness, these technologies are frequently employed with inadequate understanding of, or attention to, the factors that are critical to their success. These include the need for well-conceived plans for performance monitoring that identify and correct potential failures and plans for maintenance and repair, including possible total system replacement." (NRC, 2000). This level of planning, both technical and financial does not appear to have been included in the analysis of alternatives. YN ERWM requests this level of detail be included in the Proposed Plan and ROD rather than statements that it will be in the Remedial Design/Remedial Action Work Plan. All potential cost estimates must be identified within the remedy selected for each waste site. It is assumed that ICs will be maintained for 5 years beyond the time that the cleanup goals are initially achieved. YN ERWM requests that DOE verify that cost estimates for each alternative are correct.

The YN ERWM expects a discussion of the culturally sensitive areas with reference to both historic and pre-contact Native American use within the Proposed Plan. Implied agreement with implementation of a ROD change rather than a Memorandum of Agreement (MOA) or outlining actions within the ROD is misleading. The YN ERWM requests consultation with DOE on this issue. Use of institutional controls must be addressed in light of, and with appropriate deference to, significant cultural sites and Yakama Nation treaty rights, which guarantee use of the land for specific purposes that are considered inseparable from the traditional Yakama way of life. Furthermore:

a. Currently, there are several projects and major decisions that will be made that affect the entire Hanford Site, yet a comprehensive TCP study has not been performed. Site wide undertakings and decisions such as clean up levels, restoration, vegetation management, land use plans, the use of barriers and institutional controls need to take into consideration their effects on TCPs and traditional use areas. It is the obligation of DOE under the NHPA, Section 110, to inventory and evaluate properties to determine eligibility under the agency's jurisdiction.
b. Cultural resources have not been adequately addressed in any of the 100-B/C documents (RI/FS and Proposed Plan). Please refer to the EPA document, CERCLA Compliance with Other Laws Manual: Part II[1] (hereafter referred to EPA Guidance), where it details how to be in compliance with the NHPA during the CERCLA process. Section 4.1.3 clearly states that efforts should be made to identify cultural resources. Generally DOE carries out these efforts during the NHPA Section 106 process for each project, however between 2003 and 2011, many projects were carried out under the "no potential to cause effect" classification in the 100-B/C Areas. These projects were completed without proper Tribal consultation, and did not have a full Section 106 cultural review. Recently, an artifact was discovered in a spoils pile in the 100-B Area, which gives evidence to the fact that the 100-B Area lacked appropriate cultural review prior to the onset of many projects.
c. As outlined in the EPA Guidance Section 4, once cultural properties are identified, it needs to be determined if they are eligible and if the proposed actions will have an adverse effect on the eligible properties. Further, the EPA Guidance states that any **adverse effects to eligible properties must be mitigated, and "this mitigation plan should be included in an MOA signed by the consulting parties** (page 4-10)." EPA Guidance 4.1.4.2 states that the "remedial design process should provide for scheduling and funding of the development and implementation of a detailed cultural resources mitigation plan."
d. The EPA Guidance 4.1.5 (page 4-11) details proper documentation: "Compliance with the NHPA requirements should be documented in the RI/FS report, describing, as appropriate, the determination of whether cultural resources are or are not present; the result**s of the Cultural Resource Survey (CRS) process and recommendations on the eligibility of the identified cultural resources for the National Regis**ter; the impact, if any, on such resources; and the associated mitigation measures to

[1] EPA, 1989. CERCLA Compliance with Other laws Manual: Part II. Clean Act and Other Environmental Statues and State Requirements, EPA/540/G-89/009, OSWER Directive 9234. 1-02, August.

minimize potential "no adverse" or "adverse" effects. When cultural resources are present, the ROD should identify the NHPA as an ARAR. For each alternative, the ROD should identify whether the alternative will comply with substantive NHPA requirements. **For the selected remedy, the ROD should also include a brief statement describing what compliance with NHPA entails, e.g. that there will be no impact on cultural resources or what mitigation measures will be required."**

e. The 40 CFR 300.435(b)(2) states: "During the course of the RD/RA, the lead agency shall be responsible for ensuring that all federal and state requirements that are identified in the ROD as applicable or relevant and appropriate requirements for the action are met."

f. It is evident that the RI/FS and Proposed Plan documents do not meet EPA guidelines. DOE has not performed the necessary tasks to determine effects to cultural resources, **in consultation with the YN ERWM to determine effective avoidance, minimization, and/or mitigation measures.** The **final ROD must reflect compliance with NHPA**, which will be impossible with current data.

g. YN ERWM requests EPA and DOE to complete the necessary task of "**describing what compliance with NHPA will entail" and if necessary based on proper field evaluation complete a necessary MOA to mitigate for any adverse effects to the newly discovered TCPs, in consultation with YN ERWM.**

h. There has been no attempt to identify new cultural properties or traditional cultural properties in many years, as mandated under NHPA Section 110. The Hanford Cultural Resource Management Plan outlined a process for identifying one TCP per year; however this has not been done. DOE has not been meeting their Section 110 obligation of identifying cultural properties on the Hanford site. There are known TCPs that have not been evaluated, including:

   - White Bluffs
   - Coyote Rapids
   - Columbia River
   - Wahluke Slope
   - Other potential TCPs in the Hanford area.

   Cultural properties are only being addressed through the NHPA Section 106 process, on a project by project basis, which is entirely ineffective. This piecemeal method does not allow for a comprehensive holistic landscape study and does not allow for proper consultation with YN ERWM. None of the Alternatives were evaluated against the nine balancing criteria based on effects to a TCP. The YN ERWM Program requests that this be done.

i. It is unclear as to what is in place to ensure compliance with the Antiquities Act of 1906. Under the Antiquities Act of 1906, the Hanford Reach National Monument (HRNM) was created by Proclamation 7319 in 2000. The Proclamation lists the resources that are to be protected including: riparian, aquatic and upland shrub-steppe habitats, native plant and animal species, as well as archaeological, historic and sacred sites throughout the monument. While the majority of the HRNM is managed by the U.S. Fish and Wildlife Service (USFWS), the river corridor lands underlying the Hanford reactors and operational areas are managed by DOE. These lands contain high levels

of contamination and significant cultural resources.

j. It is recognized in the Proclamation that DOE has the responsibility to clean up hazardous substances and the restoration of natural resources. The Proclamation further states, "As Department of Energy and US Fish and Wildlife Service determine that lands within the monument managed by the Department of Energy become suitable for management by the US Fish and Wildlife Service, the US Fish and Wildlife Service will assume management by agreement with the Department of Energy." Clearly it was the intent of the President that the HRNM land would be cleaned, restored and then managed by the USFWS.

   The entire HRNM would then be managed according to the mission of the USFWS guided by the HRNM Comprehensive Conservation Plan (CCP), which states that a primary purpose to "protect and restore biological, cultural, geological and paleontological resources." Areas in the River Corridor 100 Areas are some of the most contaminated, and it remains the obligation of DOE to clean and restore these areas within the HRNM and areas that could affect the HRNM in consultation with the Department of Interior. Anything other than complete cleanup and restoration of the HRNM would be in direct conflict with the Antiquities Act, Proclamation 7319, and the HRNM CCP.

k. Full compliance with government-to-government requirements are not fulfilled by the vague statements found in the Proposed Plan (page 8): "DOE and EPA invited the Tribal Nations to formal consultation on the proposed River Corridor clean up actions, including this one. DOE has worked with Tribal nations during the RI/FS process". The Tri-Parties take a proactive approach to soliciting input from tribal governments on Tri-Party Agreement (Ecology et al., 1989) policies and issues. Specifically, the Tri-Parties conduct periodic briefings for the affected tribal governments. DOE routinely provides copies of Tri-Party Agreement (Ecology et al., 1989) documents concurrently to tribal governments, Ecology, and EPA." The Proposed Plan and decision documents do not adequately explain how cleanup meets the National Historic Preservation Act consultation process, including, for example, the specific and concrete steps for how cleanup in the cultural areas will proceed in a manner that prevents disturbances (e.g., specific soil sampling designs to protect artifacts).

The preferred alternative should be consistent with the USDOE's American Indian Policy (144.1), DOE policy Management of Cultural Resources (141.1), with the federal trust responsibility, and with the terms of the Treaty of 1855. YN believes the preferred alternative is lacking this consistency.

Surveying and designating Traditional Cultural Properties must occur prior to developing a cleanup plan and alternatives which proposes to restrict Tribal use of land and resources for hundreds of years. Decisions which propose to leave residual contamination in soil at sites which may overlap with Traditional Cultural Properties (TCPs) should not be made until such surveys are conducted and the lack of TCPs is confirmed.

Human Health Risks and Cleanup Levels:

The various risk assessments discussed in the RI consistently found significant risks to both human health and the environment, yet most of these are not carried forward to development of PRGs or remedial alternatives. Risks exceeding allowable thresholds are consistently explained away or minimized through discussions of uncertainties. However, these risk thresholds are not particularly conservative in most cases (e.g., the of 1×10^{-4} risk for radionuclides) and were set by EPA with the awareness that there would be uncertainties in deriving risk-based values corresponding to the thresholds. The existence of uncertainty is not sufficient reason to ignore risks that exceed the thresholds, yet this is consistently done to minimize the area and the number of constituents of concern (COCs) that need to be addressed by the remedial alternatives.

The Yakama Nation Exposure Scenario was developed to describe a traditional subsistence lifestyle, including dietary patterns and seasonal activities. The lifestyle may result in exposure to radioactive and hazardous chemical contamination, now and in the future, from Hanford. The project resulted in a conceptual site model that was developed to illustrate potential exposure pathways from Hanford Site contaminant releases to not just soil and groundwater, but also plants (shoots, roots, leafy material, and berries), fish, and other animals such as wild game. Not only do these resources provide food and medicines, but also material for tools, shelter, and accessories. The scenario isn't just for information and comparison, but it compiles information specific to the Yakama Nation to be considered in evaluating potential risk from contamination and to support appropriate cleanup decisions. Exposure parameters were estimated for inhalation, dermal contact, and ingestion of air, soil, water, fish, meat, vegetables, fruit, and milk, and reflect a current and anticipated subsistence lifestyle.

The Yakama Nation has commented on previously that Tribal uses that result in risks in the 1×10^{-2} or 1×10^{-3} range are not included in the reasonable maximum exposure scenario (RME) used to develop PRGs, and are included only in the discussion of uncertainties. This continues to be of concern; however, a similar pattern of minimization of risk applies throughout a variety of other exposure pathways and receptors.

Section 6.1.1.1 states that food production pathways, such as produce, beef, and milk ingestion in the subsistence farmer scenario, were not used to develop PRGs. Although risks through these pathways frequently exceeded 1×10^{-4} for mercury, arsenic, other metals, and some radionuclides, these COCs were not identified to be addressed in the remedial alternatives due to "uncertainties and conservativism in plant uptake equations." Although these pathways are appropriate to a farming scenario, they would also apply to hunting or gathering of plants for subsistence or other uses.

Section 6.4.2 presents risks associated with angler and tribal use of riparian areas throughout the river corridor, including ingestion of fish. All risks above target risk levels are explained as being based on over-conservative risk models or assumptions, and not considered further. The previous ecological risk assessments have also been updated in Chapter 7 and concentrations compared to updated PRGs. As for previous Operable Units in the River Corridor, no risks were considered significant, and were largely dismissed based on uncertain PRGs or small areas of exceedance compared to home ranges. Only hexavalent chromium in groundwater was retained for further evaluation.

In summary, the RI eliminates from consideration Tribal cultural and subsistence uses, agricultural scenarios, public uses of riparian areas and risks to anglers, and all terrestrial and aquatic ecological risks other than hexavalent chromium in groundwater – essentially all

scenarios of importance to the Yakama Nation and other potential users of the shoreline area – even though in all cases risks were calculated that exceeded regulatory thresholds under both MTCA and CERCLA. As a result, only six waste sites and groundwater were retained for action in the FS. Development and evaluation of the remedial alternatives presented can only be considered incomplete due to failure to address all of these important exposure pathways and COCs.

The Yakama Nation expects and requests that our scenario will be used to evaluate risk comprehensively for Hanford, incorporating all sources, radiological and chemical contaminants, exposure pathways, and natural resource uses. Tribal exposures; ingestion of produce, meat, fish, and milk through farming and hunting/gathering; and recreational shoreline exposure pathways should be fully considered as part of the development of PRG values, RMEs, and remedial alternatives. Development of remedial alternatives should be protective of all exposure scenarios and COCs identified through the risk assessment exceeding maximum acceptable risk levels under MTCA or CERCLA, even if there uncertainty associated with the calculation of risk.

a. There remains unacceptable risk to the YN tribal members from both chemical and radiological contaminants. Tribal risk information from the Remedial Investigation/Feasibility Study indicates unacceptable ranges of over the allowed risk for cancer/ noncancerous health effects. Native American scenarios indicate Tribal risks are greater than the EPA upper target risk threshold of 1×10^{-4} and HI of 1.
b. The tribal exposure scenarios are treated as uncertainties rather than being included among the selected current and future reasonable land use scenarios. Existing tribal treaty rights clearly support explicit inclusion of tribal exposure scenarios in setting Preliminary Remediation Goals (PRGs), particularly when less-protective scenarios are included. All potential impacts to treaty-reserved rights and resources should be thoroughly evaluated and considered in a revised RI/FS and Proposed Plan and supporting documents, including use of the Yakama Nation Risk Scenario as the basis for setting cleanup levels. YN ERWM program requests DOE include (for clarification) in RI/FS/PP how many sites would fail if the YN ERWM risk scenario were applied.
    i. The Remedial Action Objectives and Preliminary Remediation Goals are stated to be based in part on MTCA as an ARAR for cleanup standards for nonradioactive hazardous substances and the CERCLA NCP risk range for radionuclides (see prior discussion regarding the lack of support for not recognizing MTCA as an ARAR for all carcinogens, including radionuclides).However, the RAOs and PRGs are not based on the "reasonable maximum exposure scenario," which is a clear standard under MTCA. [WAC 173-340-708]
c. Along the Columbia River and its shoreline areas, porewater and aquifer sampling data continue to exceedances of water quality cleanup standards. It is the belief of the YN ERWM that a Federal interagency committee composed of the Department of Interior, the EPA, and USDOE should convene to define mutually the terms and conditions of habitability for native people of the Columbia River Basin (including residual contamination standards) and to establish an agreement with the Yakama Nation.
d. Much of the risk assessments are based on the RCBRA and other supporting documents. See following excerpts (and risk values) from the RCBRA (River Corridor Baseline Risk Assessment Volume II, Part 1: Human Health Risk Assessment August 2011), the 100-BC RI/FS.

i. Volume II, Part 1: Human Health Risk Assessment August 2011pg 7-34: For the Nonresident Tribal scenarios, the total cancer risk estimates exceed 10^{-4} and HIs exceed 1.0 for all ROD areas, mostly due to exposures that are associated with ingestion of plants assumed to be gathered from the Hanford Site. A large proportion of Nonresident Tribal cancer risk and HI is related to arsenic soil concentrations that are approximately equivalent to levels in areas unaffected by Hanford Site activities. When cancer risk estimates are calculated without the contribution of arsenic, the total cancer risk estimates still exceed 10^{-4} for all six ROD areas. The key risk drivers other than arsenic are technetium-99, carbon-14, strontium-90, benzo(a)pyrene, and Aroclor-1254, predominantly by the plant and game ingestion pathways.

ii. Because the Native American resident scenarios include very high food ingestion rates, strontium-90 continues to play a significant role in food-related exposures at year 2075. By year 2150, however, Native American resident cancer risks above 1×10^{-4} are also dominated by arsenic exposure from ingestion of garden produce. Average arsenic concentrations at remediated waste sites range between 1.1 and 17.3 parts per million. Some of these arsenic concentrations exceed the Hanford Site background value of 6.5 parts per million (DOE/RL-92-24). However, all of the RME values for arsenic are less than the IAROD cleanup value of 20 parts per million, which is based on the MTCA Method A unrestricted cleanup level. YN does not support the proposed cleanup value for arsenic.

iii. Table G-135: Yakama Nation Exposure Scenario Summary of Risk Estimates from use of groundwater as a potential drinking water source indicates tribal member total cumulative excess lifetime cancer risk (i.e. sum of both total non-radionuclides and total radionuclides-ELCR) to be ~3 in 1000 (2.4X10-3) which is greater than the EPA upper target risk threshold of 1X10-4 (1 in 10,000). The Hazard Index (non-cancer causing) is 5.9, which is greater than the 2007 MTCA (WAC 173-340-720) target HI of 1.0.

iv. Table G-138: Yakama Nation Exposure Scenario Summary of Risk Estimates from use of groundwater in a sweat lodge indicates highest tribal member ELCR) ~2 in 10 (1.3X10-1) which is a thousand times greater than the EPA upper target risk threshold of 1X10-4 (1 in 10,000). The highest Hazard Index-HI for tribal members is 54, which is greater than the 2007 MTCA (WAC 173-340-720) target HI of 1.0.

v. Table G-143: Comparison of Risk Estimates and Hazard Indices for the CUTIR, Yakama Nation, and EPA Tap Water Risk Assessments indicates total ELCR risk to the general public to be ~6 in 10,000 (5.8X10-4) which is also greater that the EPA target threshold. The HI is 2.1, again greater than the MTCA target of 1.0. Clearly the remedy isn't protective; thus the need for exceedingly long period of ICs.

vi. Risks to the YN Tribal members should <u>also</u> be calculated and included in the Alternative selection decision-making process using the YN risk scenario post 100 years of remedy selection.

e. Reasonable Maximum Exposure (RME) Modeling: YN requests clarification on how the RME modeling proposed in this plan & the methods to develop it are consistent with WAC 173-340-702(14) and WAC 173-340-747 criteria.

f. Alternate Hexavalent Chromium site-specific risk-based concentration of 46.6 ug/L : YN does not agree with use of this approach and request re-evaluation of ecological risks. It is highly uncertain to claim that cladocerans are present in the Hanford Reach "solely and exclusively because they are washed through the site by stream flow from

a still-water site." For example, in reference to the Hanford Reach, Becker (1984, Aquatic Bioenvironmental Studies: The Hanford Experience 1944-84," Elsevier, NY) notes, "…common in the river drift along with zooplankton were Daphnia sp., rotifers, and insects." The issue of residency is uncertain and largely irrelevant, since it is documented that cladocerans are present in the Hanford Reach and merit protection. Furthermore, EPA's deletion process (EPA-823-R-13-001) "allows deletion of nonresident tested species if and only if they are not appropriate surrogates of resident untested species-based on taxonomy." It can be argued that cladocerans are indeed "appropriate surrogates of resident untested species-based on taxonomy" and should not be deleted. For example, Daphnia is widely used as a surrogate species in ecotox testing worldwide. Therefore, it is inappropriate to delete these data, especially since cladocerans appear to the be the most sensitive biota in the data set used to develop a site-specific CUL for Cr+6 in the Hanford Reach. The regulatory pathway taken by USDOE is based on EPA guidance and does not address state regulations. YN believes chronic freshwater AWQC for Cr+6 (10 ug/L) would apply per WAC 173-201A-240 for DOE to be in compliance with this ARAR.

i. Waste site 116-B-14-1 is a major continuing source of Carbon-14 adjacent to the river shore, was it included in the riparian/nearshore evaluation? If not, clarify why.

g. Ecological Risks:

i. Exposure of ecological resources via seeps is considered inconsequential; discounting the risks to aquatic resources.[2]

ii. The results of the River Corridor Baseline Risk Assessment (RCBRA) are inconsistently used to justify finding that there is no risk in soils and risks from only hexavalent chromium and strontium 90 in groundwater. Specifically, if a chemical was found to be present in the 100-B/C area at levels of concern but not in the RCBRA, which encompasses a broader area, it was eliminated. However, if a chemical was found to be of concern in the RCBRA, but not through Area-specific evaluations, it was also eliminated. One or the other evaluation should have been used consistently, or in a defined weight-of-evidence approach, to identify chemicals of concern. A review of this process is requested.

iii. Scientific management decision point (SMDP)reasons. A review of this process is requested.

a. Both aquatic and terrestrial bioassays were conducted in the RCBRA, but toxicity results were discounted if they could not be correlated with specific chemicals of concern at the site. However, it is seldom the case that bioassay results can be effectively correlated with individual chemicals other than through complex toxicity identification evaluation (TIE) procedures or collection of many more paired data points than were obtained for the area evaluated. SMS and MTCA regulations do not require identification of the chemical(s) causing toxicity; the toxicity itself can be interpreted as evidence of an unacceptable impact.

b. Due to the difficulty of identifying appropriate numeric screening levels for plants and other trophic levels, field-based surveys should also be used to identify potential chemical impacts, such as evaluating the extent of stressed

[2] The riverbanks along the Hanford Reach, part of a National Monument, is characterized by a diverse riparian and upland land environments. Its riverine habitats provides spawning, rearing, and migratory locations for salmonids and other fish species (USFWS, 2008). Critical habitat has been designated for upper and mid-Columbia River steelhead, upper Columbia River Chinook, and bull trout (NOAA, 2010; USFWS, 2010).

vegetation or the species richness of plant communities in comparison to baseline.

h. The approach used in risk characterization did not account for the possibility that constituents act synergistically or antagonistically. More discussion is requested.
i. More discussion is requested on all potential geologic and climatic scenarios that could cause a release of the soil and water contaminants in the future resulting in environmental and human health exposures (including site worker exposure).
j. More discussion is requested on identification of all potential ways that the proposed remaining contamination could be transported to the surface, including erosion, via plants, animals, insects. For instance, the Columbia could alter its course over the years and remove some or all of the cover soil.
k. There is the assumption of, and over-reliance on, the use of Institutional Controls to ensure protectiveness rather the primary objective which is protectiveness of the environment and human health through selection of remedies that employ treatment technologies that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants. While cleanup decisions may ultimately be defined by management boundaries, the YN believes risk assessment should be based upon actual human behaviors.

ARARs: The Preferred Alternative is not protective does not fully meet and/or identify and apply all ARARs.

a. The most important and protective state standard which USDOE refuses to consider as an ARAR is arguably the state cleanup standard for all carcinogens in Washington's hazardous substance environmental cleanup law, MTCA (the Model Toxics Control Act, RCW Chapter 70.105D). While the USDOE's practice has been to apply MTCA risk requirements only to nonradiological contaminants, Both CERCLA and MTCA define radionuclides as hazardous substances. More protective state standards are required to be applied as ARARs pursuant to CERCLA. Although MTCA does not include cleanup levels for individually named radionuclides, it clearly states that "radionuclides are hazardous substances under the act." [Washington Administrative Code (WAC) 173-340-200]. Radionuclides are carcinogens, and MTCA defines the maximum allowable incremental cancer risk level for individual carcinogens as $1x10^{-6}$. It defines the maximum allowable incremental lifetime cancer risk level for multiple carcinogens and multiple exposure pathways as $1x10^{-5}$.This standard requires that all cleanups result in a level of protection from residual carcinogen exposure which is generally ten times more protective than the lower end of CERCLA's allowable cleanup cancer risk range. MTCA's inclusion of both chemicals and radionuclides in assessing cancer risks is consistent with U.S. Environmental Protection Agency (USEPA) guidance on establishing cleanup levels for CERCLA sites with radioactive contamination (USEPA, 1997). That guidance states that:
    1. The USEPA is aware of "no technical, policy, or legal rationale for treating radiation risks differently from other risks addressed under CERCLA."
    2. The USEPA uses a consistent methodology for assessing cancer risks at CERCLA sites no matter the type of contamination.
    3. The USEPA classifies radionuclides as known carcinogens.
    4. Cancer risks for radionuclides should generally be estimated using the slope factor approach.
    5. Cancer risks from radiological and non-radiological contaminants should be summed to provide risk estimates for persons exposed to both types of carcinogenic contaminants.

Radiation exposure risk from the National Academy of Sciences (BEIR VII Report, 2005), from which acceptable risk levels are supposed to be updated, indicates 15 millirem of annual exposure is projected to cause a lifetime cancer risk of 8 fatal cancers in adults for every 10,000 exposed adults (women are more susceptible to cancer from the same dose) – this is 8 times the CERCLA maximum risk level and 80 times the state MTCA level. Furthermore, EPA's National Remedy Review Board issued a review of the 100-D and H Areas Plans on March 27, 2015. The EPA Remedy Review Board explicitly reaffirmed that the applicable "appropriate and relevant" standard for Hanford cleanup may not exceed the 12 millirem dose for cleanup levels; CERCLA NCP and Guidance bar use of dose based cleanup levels, and requires choice of a remedy based on cleanup levels (or PRGs) resulting in a cancer risk: "meeting the 10-4 to 10-6 cancer risk range. This policy was reaffirmed in the June 13, 2014 updated version of OSWER Directive No. 9285.6-20, 'Radiation Risk Assessment at CERCLA Sites: Q and A'.

Calculation of radionuclide PRGs based on use of a risk ELCRs of a 1 in 10,000 risk is in opposition the EPA guidance which states the point of departure for risk is 1 in a million. The allowable target risk range is $1X10^{-4}$ to $1X10^{-6}$ but DOE continues to drive cleanup with the lowest level rather than initially striving to meet the highest standard of 1 in a million ($1X10^{-6}$).The Preferred Alternative presents as acceptable a radionuclide risk level for cancer morbidity that is set at 1×10^{-4} excess cancers. Based on the requirements of MTCA and CERCLA regulations, YN requests the radiological and nonradiological cancer risks should be combined and compared to the standard that Washington State has determined is protective of human health. This standard has an upper limit of lifetime risk for combined carcinogens of $1x10^{-5}$.

b. The cleanup level utilizing the maximum combined carcinogen risk standard as an ARAR must be applied to proposed plans via use of the reasonable maximum exposure scenario. The reasonable maximum exposure scenario is also an applicable standard which must be the basis for unit specific cleanup levels which meet the exposure standards for total carcinogens and toxicity (hazard index).

Exposure scenarios selected to develop preliminary remediation goals and reasonable maximum exposure scenarios fail to include tribal uses or recognize exercising of treaty rights;

- Reasonable maximum exposure scenarios are "the highest exposure that is reasonably expected to occur at a site under current and potential future site use." WAC 173-340-708(3)(b),
- Tribal uses as guaranteed by the Treaties of 1855 and the federal NHPA are potential future uses of the site and resources, and will result in far higher exposures than the rural resident or monument worker resident scenarios on which proposed cleanup levels and remediation goals are based.
- Regardless of whether USDOE accepts individual assumptions about exposure from the Yakama Nation Exposure Scenario, the Plans are required to reflect tribal exposure scenarios in the setting of cleanup levels as the Reasonable maximum exposure scenario (RMES).

The Yakama Nation requests and urges that the Plans be revised to meet the applicable standards for total carcinogen risk (1x10-5) as applied to each site and overall exposure under the reasonably foreseeable exposure scenario of the Yakama Nation use of areas and resources pursuant to the treaty o 1855 and as guaranteed by the NHPA.

c. The Washington State Sediment Management Standards (SMS) (Section 204 of Chapter 173 of the Washington Administrative Code [WAC 173-204]) have not been identified as ARARs for the Columbia River shoreline. YN requests the sediments along the shoreline of the Columbia River should be identified as a contaminated medium and PRGs established for them.
   i. Freshwater SMS standards were updated in September 2013 and it is Ecology's policy that these standards apply as ARARs if the Record of Decision has not yet been completed. EPA and DOE should ensure that the Proposed Plan takes into account the numerical chemical and biological criteria in interpreting existing sediment chemistry and bioassay results and in setting PRGs for Columbia River sediments in the 100-BC Area and the River Corridor in general.
d. Shoreline of Statewide Significance standards: The Columbia River shorelines, from the high-water mark to 200 feet inland, have been designated as a "shoreline of statewide significance" pursuant to RCW 90.58.030(2)(f). This is clearly a location significant ARAR. Adoption of plans which restrict access are not consistent with this designation. Clarify why this standard was not considered.
e. YN requests all sites with the status of 'no further action' and requiring IC for deep soil zones be evaluated against current MTCA 2007 standards while not backsliding from previously more stringent IROD cleanup values. The YN requests DOE include a table within the PP to include the cleanup numbers that were generated for each Interim closed/closed waste site in the RI/FS and compared to MTCA 2007 clean up numbers.
   i. The Comprehensive Environmental Response, Compensation, and Liability Act also requires 1×10^{-6} as the point of departure within the allowable risk range. The higher allowable risk level for radionuclides would allow for the closure of a number of previously remediated waste sites that could require additional remediation under more stringent cleanup standards.
f. While the USDOE's practice has been to apply MTCA risk requirements only to nonradiological contaminants, MTCA defines radionuclides as hazardous substances. Although MTCA does not include cleanup levels for individually named radionuclides, it clearly states that "radionuclides are hazardous substances under the act." [Washington Administrative Code (WAC) 173-340-200]. Radionuclides are carcinogens, and MTCA defines the maximum allowable incremental cancer risk level for individual carcinogens as $1x10\text{-}^{6}$. It defines the maximum allowable incremental lifetime cancer risk level for multiple carcinogens and multiple exposure pathways as $1x10\text{-}^{5}$and this should be DOE's cleanup goal for combinations of contaminants.
g. <u>YN request the following for cleanup standards for soils</u> will satisfy the most stringent (lowest) of: [i.e. WAC 173-340-700] specifically:
   i. Direct contact consistent with WAC 173-340-740(3)
   ii. Soil concentrations to protect groundwater: derived using WAC 173-340-747(4) and WAC 173-340-740 (5) to evaluate hexavalent chromium using the site-specific Kd value of 0 mL/g supporting a 0.19mg/kg [soil protective of groundwater];
   iii. Protection of ecological receptors achieved through one of the following methods:
      1. Excavation of contaminated soil to a minimum of 15 feet below ground surface, or
      2. Excavation of contaminated soil such that residual soil concentrations do not exceed ecological screening levels listed in WAC 173-340-900 (Table 749-3, or

3. A site-specific demonstration that remedial standards eliminate threats to ecological receptors.

h. Table 8-2. Potential Federal and Washington State ARARs and TBCs for 100-BC should be edited to define the following as ARARs, not just TBCs: "Terrestrial Ecological Evaluation Procedures" (WAC 173-340-7490), "Site-Specific Terrestrial Ecological Evaluation Procedures" (WAC 173-340-7493), "Priority Contaminants of Ecological Concern" (WAC 173-340-7494)

Groundwater:

a. The Proposed Plan for cleanup of the 100-BC Area and the associated RI/FS Report does not support an adequate cleanup of the area groundwater or soils. The Preferred Alternative proposes concentrations of hexavalent chromium in the groundwater above drinking water standard for 70 years and exceedances of surface water standards for over a 100 years is considered a reasonable timeframe.

   YN does not share this viewpoint. The Preferred Alternative should incorporate active remediation to achieve cleanup levels within a reasonable timeframe, with a target of 10 years or less wherever technically practicable.

b. DOE acknowledged that the model significantly simplifies the physical system being simulated to discretize groundwater transport and other processes into solvable equations. Furthermore, available data does not extend over a comparable past period to that required for groundwater to reach cleanup levels in the future, resulting in considerable uncertainty in predictions of future vadose and groundwater transport over long periods of time. Therefore, the RI/FS Report did not present the model results as absolute predictions and cautioned they should not be considered as such. Rather they should be interpreted as order-of-magnitude estimates of simplified 100-BC vadose zone and groundwater contaminant behavior used to inform decision making when selecting cleanup actions. Furthermore, residual sources to groundwater have not been clearly identified and delineated with quantitative data. Cleanup verification packages that were relied upon for evaluation of many waste sites do not include sampling below the depth of remediation. The dearth of characterization data, particularly for sources to groundwater, results in significant uncertainty. This uncertainty should be recognized and applied to the estimated timeline for achieving cleanup standards to realistically evaluated proposed remedial actions.

   YN requests timeframes for achieving cleanup levels be revised to account for model uncertainty to allow for a more detailed evaluation of the alternative. YN requests additional characterization of the deep vadose zone and groundwater to identify and characterize source areas to groundwater.

Groundwater Source material:

a. The preferred alternative does not include active remediation of strontium-90 or hexavalent chromium source material. Strontium-90 contamination at the 118-B-1, 118-B-3, 118-C-1, and 118-C-4 waste sites exhibit activities of 1.35 to 11.8 pCi/g immediately above the water table. The observed concentrations of strontium-90 in groundwater continue to exceed those predicted if the plume were attenuating by radioactive decay (discounting discharge of contaminated groundwater to the Columbia River indicating an ongoing source of strontium-90 to groundwater is in the subsurface. Based on the information presented in the RIFS Report, the source9s)

remain poorly characterized, as are associated contributions of strontium-90 to groundwater.

b. DOE groundwater modeling results estimated a minimum of 70 years for the strontium-90 plume and 15 years for the hexavalent chromium plume to attenuate below cleanup levels. However, the RI/FS Report (Section 5.5.3) acknowledged that significant but essentially unquantifiable uncertainty was associated with these results. The RIFS Report continued:
The models used in this analysis are ultimately simplifications of reality, and some difference in forecasted versus actual results is likely; models are best considered as tools to inform decisions rather than absolute predictions.

   Therefore, modeled outcomes should be evaluated as rough order of magnitude estimates to inform decision making while accounting for potential uncertainty and planning for possibly unfavorable changes in environmental conditions.

   YN requests additional characterization of strontium-90 and hexavalent chromium source areas to groundwater should be performed. Concentrated sources to groundwater, and sources that continue to contribute contaminants to groundwater under the native vegetation infiltration scenario, should be bounded with analytical data and removed using mature remedial technology as part of the preferred alternative.

Columbia River shoreline and surface water impacts:

a. Groundwater samples collected from aquifer tubes and monitoring wells proximate to the Columbia River shoreline report strontium-90 concentrations as high as 43 pCi/l. Inland concentrations reported in the RI/FS Report are similar. The cleanup level for strontium-90 in groundwater is 8 pCi/l. The Proposed Plan (p. 21) stated that discharge of strontium-90 contaminated groundwater does not pose a risk to human or ecological receptors based on concentrations of strontium-90 being "rapidly reduced upon mixing with overlying surface water" and referenced higher biota concentration guidelines of 278 pCi/L and 53,900 pCi/l for fish and aquatic organisms identified in DOE guidance *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (DOE-STD-1153-2002).

   Groundwater samples collected from aquifer tubes, hyporheic sampling points, and monitoring wells proximate to the Columbia River shoreline contained hexavalent chromium concentrations as high as 43 µg/l, exceeding the Surface Water Action Level of 10 µg/L, documenting a complete pathway for ecologic exposure (RIFS, p. 7-87). The DOE further evaluated ecologic exposure to hexavalent chromium and developed a site-specific risk-based concentration of 46.6 µg/L to "take into account relevant differences between the sensitivities of the aquatic organisms in the national data set and the sensitivities of organisms that occur within a specific site (in this case the Hanford Reach)." The regulatory status of this approach and the site-specific value used to modify national Ambient Water Quality Criteria (AWQC) is not clear. Nor is its application in the 100-BC Operable Unit, which appears to justify discharge of contaminated groundwater rather than pursuing upgradient treatment.

   The approach presented in the Proposed Plan to allow ongoing discharge of hexavalent chromium and strontium-90 to the Columbia River does not meet the requirements of the Washington State SMS or Water Quality Standards, including

identification of a dilution zone or sediment impact zone, or explicit identification of points of compliance.

YN requests all remedial alternatives should be reviewed for compliance with Washington State SMS and Water Quality Standards compliance and updated or revised as needed to comply with these requirements. Application of monitored natural attenuation and/or discharge of contaminated groundwater into the Columbia River should meet all regulatory guidelines at the appropriate point of compliance along the shoreline. Groundwater should meet AWQC at the point of discharge to surface water through active remediation to upgradient sources a necessary.

b. Groundwater is to be restored to its most beneficial use, which is drinking water standards (i.e. Method B, unrestricted land-use values). YN requests all PRGs should be calculated based on unrestricted land-use (at the very minimum.)
c. Groundwater is not generally considered a primary source, yet the YN ERWM Program is concerned that any remedy reviews will not include appropriate sampling actions or technological systems review to confirm performance or to consider missing source area contaminants (i.e. reactors/fuel basin plumes). YN requests DOE clarify how and demonstrate (using travel times, etc) that contamination from these COCs will be prevented downstream and/or from reaching the river in exceedances of the DWS, MCLs, AWQS and SMS (Sediment Management Standards).
d. At the time 100-BC was operating, the activities in the Central Plateau formed GW plumes of rad contamination-long-lived, which flowed northward towards gable Mt/Gabel Mt Gap. Eventually these plumes will reach the 100-BC Areas and contaminate this GW. Nothing in this plan accounts for this source of contamination or will address it. What is the contingency plan to address this predictable event. YN requests DOE identify all the current and projected contaminant discharges to the Columbia River that have or will occur during the proposed 187 years soil and 70 years for groundwater cleanup attenuation periods.

Monitored Natural Attenuation:

a. The Preferred Alternative employs monitored natural attenuation extensively for remediation of groundwater. However, the RIFS Report indicates groundwater source material remains in place 100-BC groundwater monitoring data for contaminants such as hexavalent chromium and strontium-90 do not clearly exhibit declining trends and the aerial extent of plumes based on groundwater monitoring data appears stable (DOE/RL-2016-67 R.0). The observed conditions are not appropriate for, or conducive to, monitored natural attenuation. Concentrations of hexavalent chromium in 100-BC groundwater are comparable to the larger plumes in the 100-D and 100-H areas that are currently undergoing active remediation. Similarly, strontium-90 concentrations in 100-BC groundwater exceed those observed in the 100-H area and are within the range observed at 100-N; both of these areas were selected for interim remedial actions.

   Multiple characteristics of the 100-BC area support active and relatively aggressive remediation to achieve cleanup levels with a high degree of certainty in a reasonable timeframe, including:

   i. The extended timeline to reach cleanup levels using monitored natural attenuation identified in the Proposed Plan;
   ii. Uncertainty associated with characterization of groundwater source material and the deep vadose zone; and

iii. Uncertain funding for ongoing institutional controls and groundwater monitoring over the lengthy timeframes proposed, and the risk associated with leaving high concentrations of contaminants of concern in soil and groundwater over these timeframes.

YN requests the RI/FS/PP for the 100-BC Area include an explanation of the MNA lines of evidence that support how radioactive decay will address the strontium plume consistent with OSWER Directive No. 9200.4-17P, April 1999, etc. YN requests a containment alternative for groundwater be considered to prevent negative impacts to the river from strontium-90 during the decay period.

b. Response did not provide lines of evidence to support MNA and indicate no need to provide a containment alternative. However, remediation of known and potential groundwater contaminant sources is a key element of a MNA-based remedy. Remediation of waste sites in 100-BC is claimed complete. However, as discussed in Chapter 5, Section 5.6.2, it is inferred, based on observations of plume behavior in groundwater, that continuing sources of Cr(VI) remain in the vicinity of 100-C-7:1 and 116-B-11 while strontium-90 is distributed over a broader area (Figure 5-15 in the main text of this RI/FS). These sources, which are believed to lie in the periodically rewetted zone (PRZ), are low-level sources that result in Cr(VI) concentrations persisting above the 10 µg/L surface water quality PRG for up to 60 years at the shoreline. This is a significant assumption that Cr(VI) remains located at these sites. Please discuss with more details within the RI/FS.

Analysis of Alternatives:

YN Major Concerns Alternative #2: the Preferred Alternative: The Preferred Alternative leaves vast amounts of long-lived radiological contamination in the ground that will continue to threaten human health and the environment for thousands, if not millions of years, at the 11 waste sites listed for MNA with ICs. Our review of the RI/FS showed that if DOE had excavated 9 of these waste sites deeper (another 15 feet) the majority of contamination would have been removed and the need for ICs eliminated. In order to greatly reduce contamination at 100-BC Area DOE needs to conduct additional cleanup actions for the B and C Reactors and at already cleaned up waste sites where DOE has left large quantities of contamination in place in the deep soils (greater than 15 feet bgs). Evaluation of performance of alternatives relative to Remedial Action Objectives 1 and 2 in the Proposed Plan should recognize that reductions in vadose source terms, as well as reductions in groundwater plume concentration and extent, result in concomitant reductions to contaminated groundwater and associated potential exposure thereof. Similarly, greater preference should be given to remedial actions that are permanent at the time of completion, and do not require ongoing maintenance of institutional controls and memory into the distant future.

The following identify concerns with Alternative #2.

a. No remedial actions for Sr-90. Using monitored natural attenuation (MNA) for 70 years does not seem prudent. The Columbia River is a discharge boundary for the aquifer system, and the unconfined aquifer is in direct communication with the river along the shoreline of 100-B/C. By their inter-connectedness, to ensure continuity of the Hanford site groundwater remediation efforts, treatment of Strontium-90 should also be included in the 100-B/C ROD GW remediation plan. YN believes additional measures should be taken to reach compliance with the DWS of 8 pCi/L for Strontium-90 (see WAC173-201A-250(1)(B)).

b. We disagree with the statement on Page 10-22, lines 5 through 12in the RI/FS (and within the Proposed Plan, pg.13) representing the conclusion that alarmingly high concentrations for strontium-90 in near-shore seeps and river aquifer tubes (53 pCi/L and 49 pCi/L) are acceptable and these do not pose a threat to riparian animals drinking from and fish/aquatic organisms in the Columbia River.[3]
c. We believe samples collected from aquifer tubes and shallow monitoring wells do indicate threats to these vulnerable receptors and that a more robust cleanup is necessary. Comparisons to BCG calculated values (e.g., 278 pCi/Liter and 53, 900 pCi/Liter) should not be the only criteria considered. BCGs for radionuclides are higher than published DWS. YN requests consideration/application of MTCA Table 720-1 Radium 226& 228 and Radium 226 values (i.e. 5pCi/liter; 3pCi/liter) when evaluating any radionuclide impacts to riparian animals and fish and aquatic receptors in the near-shore and Columbia River.
d. Clearly the discussions within these documents (and other reports; aquifer tube samples) supports the need to define the Columbia River adjacent to the Hanford site boundaries as an Operable Unit. YN disagrees with the statement 'the 100-BC boundary at the Columbia River is the ordinary low water mark, which is characterized by the presence of the "green line" of algae delineating the permanently inundated portion of the river channel.' DOE facilities (and CERCLA work-scope) at the BC area (as well as along the entire river corridor) clearly demonstrate extension of boundaries beyond and into the Columbia River. YN reiterates its position that the River should be a designated operable unit subject to remediation under CERCLA.
    i. Natural seeps are observed along the shoreline, in the riparian zone, associated with early summer drop of River water levels. These represent secondary contaminant sources to the riparian zone, yet not of the Alternatives address remediation of this complete pathway.
e. Any contamination that is mobilized as part of the proposed remedial actions should be contained, containerized, and disposed of according to the applicable legal requirements.
f. YN ERWM does not believe the Preferred Alternative as a remedy for the both soils and groundwater meets the selection criteria, in particular in its ability to demonstrate no adverse impacts to drinking water supplies, other ground waters, surface waters, ecosystems, sediments, air, or other environmental resources including wetlands in 100-BC areas (e.g. 'rare riparian plants in the 100-BC Area' [DOE/RL-96-32]). We believe it is inconsistent with anticipated (and feasible) future land and groundwater use; and does not represent to the maximum extent possible a permanent solution.
g. B Reactor: B Reactor is not structurally sound enough to maintain its integrity for the duration of the preferred alternative or the applied ICs. DOE needs to conduct a study on B Reactor building life – when it will be structurally unable to safely allow visitors and needs to be demolished. There is no way this reactor building is going to stand for 30,000 years. In the interim, DOE needs to conduct an engineering study on stabilizing this waste site and possible partial or complete removal of contaminants (while the reactor building still stands). The engineering study to look at what actions would be done to stabilize the side of the 105-B Building where the FSB is located – that would allow for soil removal. This study should also include

[3] "Groundwater with strontium-90 concentrations above the proposed 8 pCi/L cleanup level that upwells through the river bottom does not pose a threat to recreational users because there is limited potential for direct contact and, if present, concentrations are rapidly reduced upon mixing with the overlying surface water. Groundwater discharges with strontium-90 contamination do not pose a threat to aquatic receptors in the near-shore area or within the Columbia River because all strontium-90 concentrations are well below the BCG value of 278 pCi/L for riparian animals drinking from near-shore seeps and 53,900 pCi/L for fish and aquatic organisms in the Columbia River (DOE-STD-1153-2002)."

how USDOE will revise the B/C reactor area plan to include a summarized risk from all carcinogens.

h. C Reactor: There are below grade structures, (tunnels, fuel storage basin), connect to or adjacent to the C Reactor Building (105-C) that will not be removed until the reactor core and building are demolished and disposed of on the Central Plateau, starting in 2068. These structures and fuel basin are to remain in place until the year 2254 per DOE's Proposed Plan. DOE needs to add information to the RI/FS, PP and final ROD that soil contamination at waste site 118-C-3:2 will be removed (shallow and deep) when C Reactor is demolished.

YN's Preferred Alternative: YN proposes a modified Alternative 6 and request the following additional cleanup actions to be included.

a. Waste Site 116-C-5 Retention Basin. This waste site has already undergone remediation RTD of top 15 feet of contaminated soil, leaving deep contamination of Am-241, Cs-137, Pu-238, Pu-239/240 and Sr-90 in place. DOE needs to implement additional RTD for this waste site to remove another 16 feet of contaminated soil eliminating the need for ICs until the year 2137. This action will protect the river by ensuring no contamination reaches groundwater for the river.
b. 116-B-11 Retention Basin Site. This waste site has already undergone remediation RTD of the top 16 feet of contaminated soil, leaving deeper contamination of CrVI, Cs-137 and Sr-90 in place. DOE needs to implement additional RTD for this waste site to remove another 15 feet of contaminated soil eliminating the need for ICs until the year 2247. This action is to protect the groundwater and river from future contamination.
c. 118-C-1 Solid Waste Burial Ground. This site has already undergone remediation RTD of the top 17 feet of contaminated soil, leaving deeper contamination in place of C-14, Cs-137, Ni-63 and Sr-90. DOE needs to implement additional RTD for this waste site to remove C-14 and other radionuclides to a cleanup level that eliminates the need for ICs until the year 8698.
d. 100-B-14:1 Process Sewer. This sub-site has already undergone remediation RTD of the top 15 feet of contaminated soil, leaving deeper contamination of C-14 and Cs-137. DOE needs to implement additional RTD for this waste site to remove C-14 and other radionuclides to a cleanup level that eliminates ICs until the year 12110.
e. 116-B-4 French Drain. This waste site has already undergone remediation RTD of the top 15 feet of contamination, leaving deeper contamination in place of Cs-137 and Pu-239/240. DOE needs to implement additional RTD to remove the radionuclides to a cleanup level that eliminates ICs until the year 2152.
f. 116-C-2A Pluto Crib, 116-C-2B Pump Station, and 116-C-2C Sand Filter. These waste sites have already undergone remediation RTD of the top 30 feet of contamination, leaving deeper contamination of Am-241, Cs-137, Pu-238, Pu-239/240, and Sr-90. DOE needs to implement additional RTD to remove the radionuclides to a cleanup level that eliminates ICs until the year 2228.
g. Waste Site 100-B-34 Radioactive Process Sewer. Alternative 6 will remove the shallow contamination from this waste site, but leave deeper contamination on the eastern segment of Sr-90. DOE needs to fully cleanup this waste site including the deep contamination to eliminate ICs until the year 2055.

YN provides the following information and requests edits to Table 10-8 in support of this determination.
Table 10-8: Comparative Evaluation of Alternatives: Requested adjustments:
General: Delete qualifying text within Short Term Effectiveness criteria column.

Specific:

a. Current designation of long-term effectiveness and permanence of Alternative 2 is inconsistent with Table 10-1 criteria and should be considered 'fair' [i.e. two stars]. While Alternatives 2, 3, and 5 have similar actions for MNA ICs, RTD for waste sites and MNA with ICs for GW; Alternatives 3 & 5 include actions [i.e. P & T for GW & Cr(IV) source treatment] which provide additional effectiveness and permanence not offered by Alternative 2. Alternative 6 far better more fully meets this definition than the other alternatives (i.e., The NCP (40 CFR 300) defines effectiveness as the "degree to which an alternative reduces toxicity, mobility, or volume through treatment; minimizes residual risk; affords long-term protection; complies with ARARs; minimizes short-term impacts; and how quickly it achieves protection.").
b. Current designation of short-term effectiveness should be adjusted upward for Alternatives 4 and 6, (considered to perform well [i.e. three stars]) and downward to a designation of 'fair' for Alternatives 2, 3, and 5 due to groundwater IC time frames and length of MNA for Alternatives 2,3, and 4. Use of ICs for beyond 100 years is not supported by science. There is the potential for unacceptable exposure from deep soil excavation and drilling activities during the extended time frame [187 years].
c. Current designation of implementability across the table to designate as considered to perform well [i.e. three stars]. It seems as though you've confuse implementability with cost.
d. Use of ICs for unrealistic time frame of ~200 years (e.g., the following sites)
   i. B reactor Fuel Storage Basin (118-B-8:4) and associated waste sites : no remediation until Reactor is remediated ~70yrs-2203 but ICs anticipated thru to 32,021;
   ii. 100-B-14-1:below 15ft contamination: ICs indicated for 12,110 yrs-located below the 116-B-11 Ret Basin near the river shore, and contaminated with Carbon-14; 118-C-1: deep level: ICs indicated for 8698 yrs.
g. The Preferred Alternative (or Proposed Plan) does not include the required description of the contingency measures that will be implemented should the monitoring show that natural attenuation is unable to achieve the cleanup goals. Conditions that would trigger the contingency should also be specified (e.g., continued plume migration or contaminant levels are well above levels predicted for a specified time) (EPA 540-R-98-03 1) (EPA; Directive 9234.2-25).
h. Site specific ICs needs should be more clearly defined, and upon what authority they would be enforced/maintained over the long-term including interactions with the National Park Service.
i. Clarification of what is considered "passive treatment" and weight applied in consideration of evaluation of the criteria 'Reduction of TMV through Treatment' is needed. EPA generally considers passive treatment as being like the 100-N area apatite barrier, where the groundwater comes to the treatment, rather than being actively pumped to somewhere else to be treated. Radioactive decay would be related to monitored attenuation. Please clarify.
j. Need identification of the various taxonomic groups included (e.g. plants/birds) in the evaluation of strontium-90 concentration impacts in evaluation of near-shore and River impacts. Include discussion of the conceptual site model used. Clarify if RESRAD-BIOTA was used.

General Comments:

a. While YN recognizes there has been some effort made by DOE to restore the natural contours of the landscape, it should be recognized the contours of the landscape have

not been completely restored to pre-Hanford conditions. Many areas in the B/C area are flat due to remedial activities and have not been re-contoured. The statement in the Proposed Plan is misleading.

b. Fall Chinook Salmon. There is no risk information on Fall Chinook Salmon that spawn downstream (close to) 100-B/C Area. As stated in the PP (page 22) "The primary concern for aquatic biota residing in river water or the river bottom substrate is exposure to COCs present in groundwater upwelling through the riverbed gravel, cobbles, and sand (Chinook Salmon spawni**ng areas). The in**formation continues by stating the groundwater discharge from 100-BC Area will have no effect on bull trout, spring-run Chinook salmon, or steelhead trout. There is no mention of Fall Chinook salmon. DOE needs to reevaluate contaminated groundwater impacts on Fall Chinook salmon.

c. Daughter Products. Transuranic radionuclides decay into other elements that are usually radioactive with half-lives longer than the original radionuclide. Pu-238 (half-life 88 years) decays into U-234 (half-life 245,000 years) which in turn decays into Th-230 (half-life 75,400 years). Pu-239 (half-life 24,000 years) decays into U-235 (half-life 710,000,000 years). Pu-240 (half-life 6,537 years) decays into U-236 (half-life 23,400,000 years) which decays into Th-232 (half-life 14 billion years). It takes 10 half-lives for a radionuclide to decay into a daughter product. The RI/FS did not take into account daughter products because uranium and thorium are natural radioactive elements of the earth. There is uranium and thorium in the earth soils BUT the uranium and thorium in the 100-BC Area was placed there by DOE not nature.

d. 1,000 Year Compliance Period. DOE continues to use a 1,000 year compliance period for contamination left in place at Hanford. This compliance period was originally suggested in a NRC Rulemaking effort – that was stopped. By federal law DOE (or the US government) is responsible for radiological contamination until it no longer poses a threat to human health and the environment – if it's one day or a million years. There are three waste sites (100-B-14:1, 118-B-8:4 and 118-C-1) that will have ICs longer than 1,000 years. DOE cost planning for long-term waste sites to the years 8698, 12110 or 32021 have not been done – DOE needs to provide this type of information that may impact their decision on leaving it in place. Remember ICs are only good if there is a US Government funding the monitoring.

e. Long-Term Radiological Contamination Hazard – Future Us. DOE hazard assessment for human health only addresses a **r**esidential farmer and family, never a city or community constructed on the waste sites. For C-14, plutonium, and uranium their half-lives are in the thousands and millions of years. DOE needs to conduct an assessment of a city or community being constructed at the waste site areas 5,000 years in the future – when ICs no longer exist and Hanford information is gone.

f. WAC 173-340-720(4)(b)(ii) (2007) indicates that WAC 173-340 Method B for potable groundwater applies for the protection of surface water beneficial uses, and references WAC 173-340-730; in this way, water quality standards are incorporated in WAC 173-340-720. WAC 173-340-730(3)(b)(i) also gives the relationship of water quality standards and WAC 173-340. We believe the aquatic water quality criteria do apply to the ground water because the property abuts the surface water and should be applied at 100-BC. (see Table 8- Proposed Plan)

g. The YN ERWM Program requests EPA use of the new RfD value (0.0006) for Uranium by EPA's Office of Drinking Water as the basis of the Maximum Contaminant Level for drinking water is noted in the Tri-Party approved comment resolution document attached to DOE letter (13-AMRP-0041) to EPA and Ecology,

11/21/2012. YN disagree with the use of 30ug/L as the MCL currently set for the Hanford site. We request uranium be evaluated in the FS.

h. The pump-and-treat alternatives all appear to be solely aimed at chromium reduction. The pump-and–treat alternatives fail to address any type of treatment of non-chromium contaminants, and don't plan for how these co-extracted contaminants will be treated and reduced before reinjection. The YN ERWM program requests clarification within the RI/FS/PP and preferred alternative of specific treatments for these co-extracted contaminants of concern.
i. The B & C Reactor is or should be considered a source of primary threats to the environment. Any discussion of remedy must include discussion of path forward for remediation of the B Reactor fuel basin as well as final disposition of the Reactors.
j. Were the 132-B-1, 132-B-3, 132-B-4, 132-B-5, 132-C-1, and 132-C-3 sites (reactor footprint sites evaluated using ARCL methodology) and all the extensive underground piping and other buried structures
fully characterized and included in the risk and remediation plans? If not describe the full extent of uncharacterized structures and areas related to the B/C reactor areas. Table 4-23 references reports but this information contained should be summarized in the RI/FS.
k. The lowest soil RAG for Cr(VI) under the interim action RODs was set at 2 mg/kg. Table 7 in the Proposed Plan still identifies this as the proposed soil cleanup level protective of groundwater and surface water. YN believes the distribution coefficient value was used incorrectly derived and should be set at 0.0, supporting Hexavalent Chromium=0.19 mg/kg. The subsequent remedy timelines should be re-evaluated.
l. YN requests EPA use of the new RfD value (0.0006) for Uranium by EPS's Office of Drinking Waster as the basis of the Maximum Contaminant Level for drinking water as noted in the Tri-Party resolution document attached to DOE letter (13-AMRP-0041) to EPA and Ecology 11/21/2012. Table 5-7:
    i. Footnote (e) : "The soil screening level and preliminary remediation goal for Cr(VI) are set to 6.0 mg/kg based on the evaluation in ECF-Hanford-11-0165, Evaluation of Hexavalent Chromium Leach Test Data Conducted on Vadose Zone Sediment Samples from the 100 Area; this value is not dependent on waste site size." YN requests clarification of relevance of use of this level for the 100-BC area.
    ii. Detection limits should be below the cleanup level (see value assigned to arsenic. Suggest review).
m. Table 6: Edit to reflect Sr-90 value as =0.35pCi/L. [4]
n. Remedial Action Objectives (RAOs): YN asks that all RAOs have a definitive task or standard to be met. We believe the purpose of TAOs to not only explain and address site risks but to include specific details of actions to be taken to achieve the objective. RAOs are the measurement tools for evaluation the success of the ROD remedy during the CERCLA 5 year review process. Without a specific action, the metrics for the measurement of success are filled with subjectivity and uncertainty. E.g., Prevent COCs migrating and/or leaching through the soil that will result in groundwater concentrations exceeding federal and state standards and risk-based thresholds for protection of surface water and groundwater by treatment of the contaminated soils or RTD.
o. Clarification and inclusion of more information is requested for cost analysis of required well-conceived plans for performance monitoring that identify and correct

[4] Nez Perce Tribe July 15, 2010 letter to Matt McCormick regarding DOE/RL-2009-54 Rev 0; Proposed Plan for Amendment of 100-NR-1/NR-2 Interim Action Record of Decision.

potential failures and plans for maintenance and repair, including possible total system replacement (NRC, 2000). This level of planning, both technical and financial does not appear to have been included in the Proposed Plan or the analysis of alternatives.

p. The RI/FS/PP provides the foundation for the ROD to defer the specific components for each waste site and groundwater plumes to the remedial design/remedial action work plan. Design elements for alternative selection should be described in sufficient detail in the Proposed Plan so that the public can evaluate and comment on the proposal (EPA 540-R-98-031). All associated costs should also be included. Clarification is requested.

q. It appears that none of the alternatives were evaluated against the nine balancing criteria based on what happens with transition to long-term stewardship prior to completion of the remediation under the ROD. Was a cost benefit analysis of remedy costs including long-term stewardship costs performed? Clarification is requested.

r. Orchard Lands: YN requests more discussion within the RI/FS/PP of the relationship between the Orchard Land OU and the CERCLA work at 100-BC and how overlapping of contamination is being dealt with. YN supports chasing waste site contamination following the observational approach.

s. **General: Evaluation of Alternatives:** The evaluation of alternatives presented in the Proposed Plan found that the preferred alternative (alternative 2) was the highest ranked alternative for only two criteria: cost and implementability. Both rankings were conferred due to the extensive use of monitored natural attenuation and institutional controls, which require primarily administrative action.

   However, alternatives 4, 5, and 6 were ranked more highly than alternative 2 for both long-term protectiveness and reduction in toxicity, mobility, and volume. Alternative 3 was the highest ranked alternative for short-term effectiveness, followed by alternatives 2 and 5. Alternatives 4 and 6 were given the lowest possible ranking (1 out of 5), primarily due to anticipated worker exposure during active remediation, although similar remedial actions are underway at other locations along the River Corridor and have been routinely conducted throughout Hanford for the past 20 years or more. Additionally, evaluation of both short- and long-term effectiveness and permanence assumed equal performance for all alternatives with respect to restoration of groundwater, since no alternative includes active remediation of strontium-90. This logic ignores the more rapid reductions in the extent of the hexavalent chromium plume and associated discharge of contaminated groundwater to the Columbia River that would occur under alternatives 3 through 6.

   Similarly, alternatives 2 through six are ranked equally with regard to reduction in toxicity, mobility, and volume. This equivalency between alternatives has been assigned on the basis that removal of contaminated media from the River Corridor for disposal in ERDF does not result in direct treatment of COCs. Such logic ignores reduction in mobility associated with removal of COCs from the vadose and periodically rewetted zones, and associated reduction in the volume of contaminated groundwater achieved through removal of source material and contaminated groundwater.

   Finally, evaluation of permanence does not appear have considered the uncertainty associated with, and potential failure of, institutional controls that extend into the distant future. Preference for administrative action implicitly assumes ongoing administrative control, maintenance, and funding for institutional controls over the

period of time required to reach cleanup levels. In the case of alternative 2, up to approximately 30,000 years at waste site 118-B-8:4 and well over 100 years at many other sites. Such assumptions are not realistic when considered in the context of typical human life spans, let alone electoral and federal budgetary cycles and/or government agency reorganizations or restructuring.

Based on the evidence presented, and flaws in reasoning applied to the evaluation of alternatives, selection of alternative 2 as the preferred alternative is not justified. Preference appears to have been given primarily to consideration of cost. The evaluation of implementability primarily recognizes that administrative actions can be easily accomplished in a short period of time, while discounting the successful, routine, verifiable and permanent application of mature technology such as RTD and pump-and-treat at other locations throughout Hanford.

YN requests the evaluation of alternatives be redone. Greater consideration should be given to:

i. The reductions in the volume of contaminated groundwater achieved through active remediation;
ii. Reduced mobility of contaminants that are removed from the River Corridor vadose zone;
iii. The verifiable performance and permanence of active remediation; and
iv. Proven efficacy of mature remedial technologies.

Evaluation of performance of alternatives relative to Remedial Action Objectives 1 and 2 in the Proposed Plan should recognize that reductions in vadose source terms, as well as reductions in groundwater plume concentration and extent, result in concomitant reductions to contaminated groundwater and associated potential exposure thereof. Similarly, greater preference should be given to remedial actions that are permanent at the time of completion, and do not require ongoing maintenance of institutional controls and memory into the distant future.

YN Addendum #1: Additional Groundwater Comments: DOE/RL-2010-96, DRAFT A, Remedial Investigation/Feasibility Study for the 100-BC-1, 100-BC-2, and 100-BC-5 Operable Units

Specific comments:

1. Throughout document: (1) Relate all elevations to NAVD88; (2) Change “groundwater fate and transport” to “groundwater contaminant fate and transport”.
2. Page 2-3, line 28–29: Edit to “Boreholes C7843 (116-C-5) and C7846 (100-B-5) were completed as temporary wells 199-B3-52 and 199-B4-15, respectively”.
3. Page 3-5, line 9: Change "Flow volumes" to "Flow rates".
4. Page 3-5, line 12: Add "water surface" before "elevation of the river".
5. Page 3-11, lines 10 to 11: Change "the low hydraulic conductivity of the RUM forms an effective aquitard beneath Ringold unit E" to "the RUM with low hydraulic conductivity forms an effective aquitard beneath Ringold unit E".
6. Page 3-12 and 3-13, Figures 3-5 and 3-6: (1) Delete "Scale: 1:14,000"; (2) Show the axis lines.
7. Page 3-15, Figure 3-7: Is there a contour layer for the elevation of the top of Ringold Formation Unit E?
8. Page 3-21, lines 11 to 12: Delete "because the contact between the Hanford formation and Ringold Formation is deeper".
9. Page 3-21, lines 34 to 35: contradict with lines 22 to 23 in the same page.
10. Page 3-22, 3-23, Figures 3-10 and 3-11: (1) Change contour intervals from 4s and 9s to 0s and 5s; (2) If groundwater level was used to calculate the thickness of unconfined aquifer, the date of groundwater level measurement should be noted.
11. Page 3-24, Table 3-2: (1) Show one or two significant digit(s) for the Minimum Porosity of Ringold Formation; (2) "Physical Property" column, add "Saturated" before "Vertical K"; (3) How did you obtain the "vertical hydraulic conductivity"? (4) Double-check the *K* values for RUM Silt and RUM Sand and Gravel.
12. Page 3-24, Porosity equation: keep "Bulk Density" together.
13. Page 3-27, lines 15 to 18: Are these hydraulic conductivity values measured or fitted?
14. Page 3-28, lines 15 to 16: Change "Wells screened in Ringold unit E had hydraulic conductivity ranging" to "The estimated hydraulic conductivity of Ringold unit E ranged".
15. Page 3-28, line 17: (1) Change "in a well screened at" to "found for"; (2) Delete "two wells screened in the".
16. Page 3-41, Figure 3-21: Show the Title for Y-axis.
17. Page 3-57, line 24: Add “of effects” after “evaluation”.
18. Page 5-18, Table 5-4, Note g: Add “for vertical value” before “;”.
19. Page 5-19, line 12: Add “set” after “parameter”.
20. Page 5-45, line 3: Change “A simple calculation was then employed to compute unit-length SSL and PRG values by scaling” to “The unit-length SSL and PRG values were then calculated by scaling”.
21. Page 5-45, lines 9 and 11, Equations (5a) and (5b): Units on the right-hand side of the equations do not match those on the left-hand side.

22. Page 5-46, lines 27–28, Change “These evaluations were based on results of leaching studies conducted on soil samples from a large number (about 200) of leach studies for vadose zone soils across the River Corridor” to “These evaluations were based on results of leaching tests (about 200) conducted on vadose zone soil samples from the 100 Area”.
23. Page 5-47, line 24: Change the second “(5c)” to “(5d)”; Add definition for “PRG_{EVAL}”.
24. Page 5-47, line 27: Add “≡” before “representative length”.
25. Page 5-58, Table 5-11: Change the title of column 6 from “Waste Site Decision Unit-Length” to “Representative Length”.
26. Page 5-59, line 25: Add “water” after “surface”.
27. Page 5-64, lines 14 and 16: Delete “maps of”.
28. Page 5-64, line 21 to page 5-65, line 12: Can you present the river stage used for both calibration and prediction periods?
29. Page 5-66, line 22, “Tritium does not require modeling because concentrations have declined beneath DWSs”: Conflict with Page 5-59, lines 10–21.
30. Page 5-67, line 26: Add “contaminant” before “concentration trends”.
31. Page 5-68, line 31: Add “contaminant” before “transport”.
32. Page 5-69, line 23: Add “contaminant” after “soil”.
33. Page 5-70, lines 4–7: Is it possible that the hydraulic part of the model is better characterized than the contaminant part, based on the observation data, and is more reliable?
34. Page 5-70, lines 9–18: Can you present the revised loading curve for each Cr(VI) source?
35. Page 5-71, line 3: Change “Columbia River RI Report” to “Field Summary Report” for consistency.
36. Page 5-75, line 7: Change “The broad location of source strengths and locations” to “The broad range of source strengths and locations”.
37. Page 5-75, lines 28–31: Present simulated Cr(VI) cross sections A-A’ and B-B’ in the same scale as Figures 4-55 and 4-56.
38. Page 5-80, Figure 5-20: (1) Change the line for 48 µg/L to Dash-Dot style.
39. Page 5-80, Figure 5-21, and 5-82, Figure 5-25: Why does the simulated length of impacted shoreline fluctuate for Cr(VI) and not for Sr-90?
40. Page 5-84, Table 5-16: Contradict with Table 5-15 for Tritium.