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DEPARTMENT OF ECOLOGY
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March 15, 2021 21-NWP-044

Brian A. Harkins, Deputy Assistant Manager
Tank Farms Division
Office of River Protection
United States Department of Energy
PO Box 450, MSIN: H6-60
Richland, Washington 99352

Re: Transmittal of Department of Ecology's Comments for *Preliminary Performance Assessment of Waste Management Area A-AX*, *Hanford Site, Washington*, RPP-ENV-61497, Revision 0, and *Analysis of Post-Closure Groundwater Impacts from Hazardous Chemicals in Residual Wastes in Tanks and Ancillary Equipment at Waste Management Area A-AX at the Hanford Site, Southeast Washington*, RPP-ENV-62206, Revision 0

References: See page 2

Dear Brian A. Harkins:

The Department of Ecology (Ecology) is submitting our preliminary review comments for the above referenced documents. We refer to our comments as preliminary because the documents were prepared early in the retrieval process, and document RPP-ENV-61497 was titled as a preliminary document. We request "preliminary" also be included as part of the title of document RPP-ENV-62206.

Significant work remains on retrieval and characterization of the tank farm vadose zone, tanks, and ancillary equipment residuals for incorporation into the Appendix I Performance Assessment (IPA). Ecology will provide comments on associated documents submitted to us during the retrieval and closure process, including the final IPA. Ecology expects and commits to a collaborative comment resolution process for these documents.

Because the complete IPA represents the final documentation of key data needed to support Ecology's closure decisions, Ecology considers it to be a Tri-Party Agreement Primary Document. We recognize this issue is being discussed in the context of holistic negotiations. However, unless and until a different agreement is reached, we will continue to follow the process described in Appendix I, and we expect full and adequate resolution of our comments.

One of the lessons learned from the Waste Management Area (WMA) C Performance Assessment (PA) was the lack of clarity resulting from fragmenting the PA into multiple documents. This same fragmented approach has been adopted for WMA A-AX. This fragmentation impedes integration of risk, at relevant time and space domains, from various source terms at a WMA.

In Letter 18-NWP-176 (Reference 1), Ecology provided an outline indicating how the above information should be included in a single document along with the information provided in the submissions attached to Letter 20-TF-0091 (Reference 2). Ecology emphasizes our need for the combined document.

If you have questions or concerns, please contact me at jeff.lyon@ecy.wa.gov or (509) 372-7914, or Beth Rochette, Toxicologist, at beth.rochette@ecy.wa.gov or (509-372-7922.

Sincerely,

Digitally signed by Lyon, Jeffery (ECY)
Date: 2021.03.15 14:22:13 -07'00'

Jeffery J. Lyon
Tank Systems Operation & Closure Project Manager
Nuclear Waste Program

br/aa
Enclosures (3)

References:

1. Letter 18-NWP-176, dated November 8, 2018, "Structure of the Appendix I Performance Assessment (IPA) for Waste Management Area (WMA) A/AX"
2. Letter 20-TF-0091, dated September 29, 2020, "The U.S. Department of Energy, Office of River Protection, Transmittal of RPP-ENV-61497, Preliminary Performance Assessment of Waste Management Area A-AX, Hanford Site, Washington, Revision 0, and RPP-ENV-62206, Analysis of Post-Closure Groundwater Impacts from Hazardous Chemicals in Residual Wastes in Tanks and Ancillary Equipment at Waste Management Area A-AX at the Hanford Site, Southeast Washington, Revision 0"

cc electronic w/enc:

David Einan, EPA
Christopher Kemp, USDOE-ORP
Rod Lobos, USDOE-ORP
Brian Vance, USDOE-ORP
Doug Shoop, USDOE
Jon Perry, HMIS
Marcel Bergeron, WRPS
Paul Rutland, WRPS
Mason Murphy, CTUIR
Jack Bell, NPT
Rex Buck, Jr., Wanapum
Laurene Contreras, YN
ERWM Staff, YN
Susan Leckband, HAB
David Reeploeg, Hanford Communities
Max Woods, ODOE
Scott Van Verst, WDOH
Jim Alzheimer, Ecology
Damon Delistraty, Ecology
Dib Goswami, Ecology
Theresa Howell, Ecology
Jeff Lyon, Ecology
Nina Menard, Ecology
John Price, Ecology
Beth Rochette, Ecology
Kyle Rucker, Ecology
Maria Skorska, Ecology
Jerry Yokel, Ecology
Environmental Portal
Hanford Administrative Record
Hanford Facility Operating Record
HMIS Correspondence Control
USDOE-ORP Correspondence Control
WRPS Correspondence Control

Review Comment Record

Document: RPP-ENV-61497, Rev. 00, Preliminary Performance Assessment of Waste Management Area A-AX at the Hanford Site, Washington

Ecology Comments

Date: March, 2021

Reviewer: DD, DG, JWL, BR, SVV, JWY

DOG1. General: Ecology has prepared comments for RPP-ENV-62206, Rev. 0, Analysis of Post-Closure Groundwater Impacts from Hazardous Chemicals in Residual Wastes in Tanks and Ancillary Equipment at Waste Management Area A-AX at the Hanford Site, Southeast Washington, in addition to the comments for this document. Some of the general comments for that document also apply to this document. They will not be repeated here, however. Ecology requests that they be considered when this document is revised. BR

DOG2. General: Please clarify in the Executive Summary that this document evaluates groundwater impacts (via leaching) of waste contaminants in tank residuals and ancillary equipment without considering current groundwater contamination. DD

DOG3. General: Comparison between A-AX and TC-WM EIS (ref: Section 1.5.2; Page 1-39): The text states that "although the mathematical models for the fate and transport of residual wastes in WMA A-AX may differ between the WMA A-AX PA and the TC & WM EIS, the conceptual models are consistent with each other. The results published in WMA A-AX do not isolate sources in WMA A-AX and therefore direct comparisons between the two models have not been performed." In the past it has been observed different results using different mathematical models in the same conceptual models. Therefore, a direct comparison is necessary between the TC-WM EIS and the WMA A-AX. DG

DOG4. Executive Summary, p. ES-5, lines 16-40; Section 6.2.1, p. 6-77, Table 6-10: Please clarify if sensitivity cases are limited to the effect of single parameter changes on peak groundwater concentration/time (e.g., p 6-2, lines 40-41). If so, note that these analyses (which change one factor at a time) are useful in isolating the effect of a single parameter on the output but do not address the effect of interactions among multiple parameters on groundwater concentration over time. DD

DOG5. General: Because of the lack of characterization data for WMA A-AX residual wastes, the A-AX PA relies primarily on the extensive testing and analyses done for WMA C residual wastes. This is necessary as of 2019 because, unlike the WMA C PA, the initial WMA A-AX PA is deliberately being completed before any tanks in the WMA have been retrieved; thus, characterization of tank-specific residuals will not be possible until future updates to the PA.

This makes it difficult for Ecology to have confidence in the results when this uncertainty is hard to quantify at this time. JWY

DOG6. General: There is variability in each waste stream inventory concentration. It is not clear of what the variability is in the calculation of potential intruder impacts. The WMA C WIR had a discussion that provided a comparison of the Class C limits based on the WMA C PA 12 inventory estimates and the Class C limits based on the BBI inventory estimates updated with 13 post-retrieval samples for the five SSTs. JWY

DOG7. General: What is impact of A-AX to VLAW? WIR for WMAC shows its impact. In sum, this Draft WIR Evaluation demonstrates that the stabilized residuals, waste tanks, and 40 ancillary structures (including integral equipment) at the time of WMA C closure will meet 41 DOE M 435.1-1 criteria, are incidental to the reprocessing of SNF, are not HLW, and may be managed as LLW. JWY

DOG8. General: Section 9.3 Future Work, puts this version of the PA in perspective as one document of many used for decision making. Along with the PA maintenance plan, the 435.1 composite analysis, closure plan, monitoring plan, new field data and annual reports represent a suite of information that needs to be made for final closure of the facility. Reviewers would be well informed to read sections 9.2 and 9.3 prior to review. JWY

DOES1. Executive Summary, p. ES-7, para 4 (no line numbers): Define “non-negligible inventories.” DD

DOES2. Executive Summary, p. ES-7, last para (no line numbers); p. ES-8, Figure ES-5; Section 3.1, p 3-3, Figure 3-1: Please state whether or not the exposure pathways/receptors specified (i.e., groundwater, air, inadvertent intruder) are the only pathways/receptors explicitly required by DOE Order 435.1. Regardless of the DOE Order 435.1 requirement, acknowledge that there are other exposure pathways/receptors that have been omitted in Figures ES-5 and 3-1. For example, in conjunction with the human intruder scenario, terrestrial eco receptors could be exposed to contaminated soil brought to the surface after drilling activities (e.g., drill cuttings). Also, please add an arrow connecting the source term directly with contaminated soil media (as in Figures 7-2 to 7-5) to depict the intruder pathway (drill cuttings brought to surface soils, i.e., direct contaminant transfer to surface soils, neither via groundwater nor via air). DD

DOES3. Executive Summary, p. ES-8, last para (no line numbers); Section 3.1, p. 3-2, lines 2-5: Text (p ES-8) states, “The surface water pathway is not a possible exposure pathway for the disposal facility because surface water is not present near WMA A-AX, ….” Although surface water is not near WMA A-AX, transport of WMA A-AX contaminants from groundwater to river water/sediments could expose human and terrestrial/aquatic eco receptors to contaminants derived from tank residual waste (as WMA A-AX overlies the 200-PO-1 groundwater OU which abuts the river). DD

DOES4. Executive Summary, ..p ES-10, Table ES-1; Section 5.3, p 5-14, lines 25: Re the "Atmospheric (40 CFR, Subpart H)" performance objective, explain "Screened out" in more detail in Table ES-1 (via a footnote). It appears that footnote "d" is incorrectly placed in the last two lines of the table (12.3 pCi/L and 1.6E-3 pCi/L), since these values far exceed 1E-10 pCi/L (per the footnote). DD

DO1-1. Section 1.6.6.3, p. 1-48: What is the uncertainty of using the *WMA C Single –Shell Tank Waste Management Area C Pipeline Feasibility Evaluation (RPP-PLAN -47559)* for the WMA A-AX waste management area for evaluating human intrusion? JWY

DO2-1. Section 2.1.8. p. 2-100, lines 1-4: Text cites NCRP Report No. 93 for an estimate of background radiation dose in the U.S. (365 mrem/y). NCRP Report No. 160 (2009) updates NCRP Report No. 93 (1987). A key finding of the more recent NCRP Report No. 160 is that although the naturally occurring amounts of radiation have changed little, there has been a dramatic increase in the amount of radiation from medical imaging procedures, resulting in an increase in background radiation dose to the general public in the U.S. (620 mrem/y). NCRP Report No. 160 updates NCRP Report No. 93. Please revise the background radiation dose estimate (620 mrem/y), according to NCRP Report No. 160. DD

DO2-2. Section 2.1.9 (or elsewhere in Section 2.0) - The 200-E-286-Ditch should be discussed along with its association with well corrosion. At least three wells were lost at WMA A-AX due to well corrosion. At the three corroded and decommissioned wells, the corrosion occurred above the water table at (or slightly above) a fine-grained geologic unit (the Cold Creek silt-dominated unit [CCUz]). This unit creates perching conditions for groundwater (percolating downward between the surface and the water table) and greatly increases lateral spreading. The most likely source of the corrosion is chloride-bearing effluent from the 200 East Area powerhouse (284-E Powerhouse) that was discharged to an unlined ditch (200-E-286 Ditch) that traversed the southwest end of what later became the 241-A Tank Farm (Figure 1-2). This ditch was active from 1946 to 1953. The CCUz fine-grained unit and the increased amount of lateral spreading of the chloride-bearing waste water are the subject of the next three comments. JWL

DO2-3. Section 2.2.2.1.2, General: The description implies that inventory estimates have a significantly high degree of uncertainty or are essentially unknown, so that one is left to wonder the usefulness of risk estimate results and how they can guide decision making. Also, three significant figures in the inventory estimate Tables seems inconsistent with the precision to which these values are known. SVV

DO2-4. Section 2.2.2.1.2, p. 2-144: Under Waste Inventory Assumptions, item b): clarify if 360 cubic feet is 'per tank'. SVV

DO2-5. Section 2.2.2.1.2, p. 2-145: Under Waste Inventory Assumptions, item f): as described, the concentration estimates for ancillary equipment are highly uncertain, and therefore the analysis uses the average SST concentrations instead, with a rationale that the actual

concentrations are likely less than the average SST values. This appears to be an arbitrary substitution for something that is essentially unknown, and does not appear to be defensible. Further, item f) discusses concentrations, but does not address how total ancillary equipment inventory is estimated. SVV

DO2-6. Section 2.2.2.1.2, p. 2-146, Line 2: Text states, "Also, uranium is treated as a radionuclide and not a chemical for this analysis." As such, clarify why U is included in Table 2-8a. DD

DO3-1. Section 3.1, p. 3-2: Text notes that surface water pathway is omitted. Even though the Columbia River is 11 km away, groundwater plumes from 200 Area contaminants are currently approaching or reaching the river. Clarify why the Columbia River is not a surface water pathway for this PA, when it is reasonable to think that if contaminants reach the point of exposure well, that they will also reach the Columbia River within the 1,000-year time period. SVV

DO3-2. Section 3.1, p. 3-2: Text notes air pathway is negligible since the few radionuclides that can partition into gas phase are present in small quantities. However, groundwater can be brought to the surface for use as irrigation, which can contaminate soil and then enter the air via resuspension. I note later that this pathway is shown in Figure 3-1, so the text discussion should include this 'air' pathway that is shown in the figure. SVV

DO3-3. Section 3.1, p. 3-2: Text describes that the nominal case (for dose calculations) is more conservative than a best estimate. It seems more intuitive that a nominal case would be the best estimate. Why is the nominal case based on assumptions that are less likely valid than a best estimate case? Clarify if a 'best estimate' calculation is carried out, and if it is not, explain why. SVV

DO3-4. Section 3.1, p. 3-2: Text explains that 'bounding case' dose calculations are (at least sometimes) based on conditions not considered credible, so that one is left to wonder as to their usefulness in decision making. Clarify why bounding case calculations are not based on credible conditions. SVV

DO3-5. Section 3.2.2.1.6, p. 3-45: Explain the reasoning for the assumption that the entire inventory of a tank is instantly available for release and transport at some point in time (as opposed to a slow degradation of barriers which intuitively seems more likely). SVV

DO3-6. Section 3.2.2.2, p 3-48, Lines 30-31: Clarify that although CH_4, TH, and I_2 are less likely to be redeposited on the ground surface (and available for ingestion), these gaseous forms may be inhaled. DD

DO3-7. Section 3.2.2.2, p 3-48, footnote "4": Re radon, looks like footnote "4" should refer to Section 3.2.2.3 (not 3.2.2.2). DD

DO3-8. Section 3.2.2.4, p 3-54, Table 3-3; p 3-55, Figure 3-16. A recent review of plant rooting depths at Hanford has shown that depths>300 cm are credible, based on observations at other locations (Foxx et al, 1984), effect of plant age on root depth (Klepper et al, 1985; McConnell and Smith, 1977; Clements and Young, 2001), and various sampling limitations (Waugh et al, 1994) (https://setac.onlinelibrary.wiley.com/doi/full/10.1002/ieam.4044). For example, rooting depths up to 914 cm have been reported for sagebrush at Los Alamos, NM (Foxx et al, 1984). Please incorporate this information, re the likelihood of a biotic pathway to transport radionuclides into the shallow zone (0-15 ft) with potential for human and ecological exposure. DD

DO3-9. Section 3.2.3, p. 3-56: The PA uses 25 mrem/y as a performance objective. While making no judgement on this value, the Hanford Site generally uses inconsistent performance objectives. Sometimes it is 15 mrem/year, sometimes 25, other times a risk-based objective of 1E-4, other times MTCA. Clarify how this PA's performance objective fits into the overall scheme of Hanford's objectives, and explain why Hanford does not use a consistent set of performance objectives. SVV

DO4-1. Section 4.2.4. Figures 4-21 through 4-26, p. 4-67 – 4-72: According to the text, contaminant groundwater concentrations are attenuated between the fence line and100 m PoCal because contamination from tank sources enters the aquifer with a relatively small footprint and is affected by transverse dispersion, diluting the contamination. The difference in attenuation factors between the two farms is a reflection of the differences in the Darcy flow". The huge attenuation huge attenuation cannot be explained by the above phenomenon (also see figure 5-9). More discussions are required. DG

DO4-2. Section 4.2.7, p. 4-81, lines 2-4: Text states, "The contaminated water is the only source of exposure; dose from exposure to contaminated air was calculated separately and has been screened out using the approach described in Section 4.2.5." Refer to Section 5.3 for modeling rationale for "screened out" (as used here). DD

DO5-1. Section 5.1.2, p. 5-4, text and Figure 5-2: The figure indicates that entire inventory of I-129 in the pipelines releases to the vadose zone in about ten years, and this release starts immediately after closure. Therefore, it would seem these same release rates would be occurring at the present time, as the difference between year 2020 and 2050 seems insignificant in terms of available release mechanisms? In other words, what is preventing those same release rates from happening now? Please discus this. Further, if releases are occurring now, measuring release rates could be used to validate release mechanism models. SVV

DO5-2. Section 5.2.1, Tables 5-1 and 5-2: It would be useful to include the peak total concentration from both tank farms and the EPA MCL concentrations in these tables. Further, why is there no equivalent table for U-238? SVV

DO5-3. Section 5.3, general: It could be useful to state the air emission standards (mrem/year) here for reference. Further, when quoting dose results in the text, units of mrem/year (rather than mrem) would be clearer. SVV

DO5-4. Section 5.3, p. 5-12, lines 21-27: As described in Section 3.2.2.2 (and from an exposure potential), clarify here in Section 5.3 that the more relevant form of H-3 is tritiated water (TOH) vapor (not H_2 gas) with plant uptake and the more relevant form of I-129 is hydrogen iodide (HI) (not I_2 gas) with redeposition to the ground surface. DD

DO5-5. Section 5.4.1, p 5-18, Table 5-7. Please add the radon flux performance objective (20 pCi/m^2/sec) to this table as a footnote. DD

DO5-6. Section 5.5.1, p. 5-19: Define 'groundwater dose conversion factor'.

DO6-1. Section 6.1.4.2, p. 6-12: The uncertainty in residual inventory estimates is likely to be large, and likely to be a significant contributor to overall uncertainty. Yet, due to the preliminary state of retrieval and lack of data, this component of uncertainty is not considered. Discuss how the omission of this uncertainty component will impact the uncertainty analysis. SVV

DO6-2. Section 6.1.6.1, p. 6-32: Discuss the reason for assuming the peak total dose is normally distributed. Discuss how the 95% confidence interval might change if the distribution is not normal. SVV

DO6-3. Section 6.1.6.1, p. 6-33, Table 6-8: In Section 5, the nominal case dose assessment for the total contributions in A Farm results in a median peak dose of 0.3 mrem/y (considering out to 10,000 years). Here, in Table 6-8, the results of the uncertainty analysis show a range of peak dose from essentially zero to about 3 mrem/y, with a standard deviation of about 0.3 mrem/y. Given the lack of sample and other data, and uncertainties in model parameter values and how systems will behave over thousands of years, it seems improbable that the range of possible dose outcomes only spans 3 mrem/y. It appears to imply a level of knowledge that seems improbable. Is this analysis saying that the uncertainty in dose is so small that values greater than 10 mrem/y (and comparable to the dose limit) are not possible, especially since uncertainty in residual tank inventory appears to not be included in the analysis? SVV

DO6-4. Section 6.1.7, p. 6-70: The text should mention that uncertainty in residual tank inventory is not included in the uncertainty analysis. SVV

DO6-5. Section 6.2.3, p. 6-85: Inventory sensitivity case 1 is intended to represent the maximum possible inventory based on current knowledge of the waste. But it appears there is very little 'knowledge' of waste, as there is very little sample data, and rather the 'knowledge' of waste is based on modeling estimates which likely have a high degree of uncertainty. Discuss the uncertainty in the current BBI and HTWOS based estimates and how this would propagate to the sensitivity case 1 results. SVV

DO7-1. Section 7.0, p 7-1, Lines 39-40: Text states, “Table 7-2 presents parameters common to all intruder scenarios.” Table 7-2 presents BBI (not parameters). Please fix. DD

DO7-2. Section 7.0, p. 7-2, Table 7-1: Explain why meat consumption is omitted from the Chronic Rural Pasture exposure, for example from livestock on the pasture. SVV

DO7-3. Section 7.0, p. 7-2, and p, 7-31, Table 7-7: Intrusion calculations are carried out at 100 years for drilling through the pipelines, but earlier in the document, it was described that pipeline inventories are essentially unknown, and are based on an average of estimated tank waste inventories (which seems arbitrary). The results of this intrusion scenario appear to be arbitrary since the source term, which contributes to the concentration of drill cuttings, is not known. Discuss the level of knowledge of the source term for this scenario, and how it contributes to uncertainty. SVV

DO7-4. Section 7.4.1, p. 7-31, Table 7-7: Please specify the retrieval status (pre vs. post-retrieval) and inventory source (HTWOS vs. BBI) for tanks in this table (in relation to information provided in Sections 1.8 and 2.2.2.1.2). DD

DO7-5. Section 7.4.2.1. p. 7-38. The Intruder Analysis indicates that further analysis of pipeline residuals may be warranted. The pipeline inventory is highly uncertain. JWY

DO7-6. Section 7.4.2.2 Figure 7-20 (a-d), 7-21 (a-d), p. 7-48 – 7-49: The inclusion of the average values on Figure 7-20(a-d) and Figure 7-21(a-d) only provide a qualitative indication of the model’s representation of the vadose zone moisture profile. Since we have plenty of moisture data, a quantitative and statistical (including multiple realizations) approaches would provide better understanding of the vadose zone flow and transport. DG

DO9-1. Section 9.1.3, p 9-3, lines 12-13. Please provide Ecology with the DOE-0431 memorandum. JWY

DO9-2. Section 9.1.5, p. 9-5, Table 9-3: Noting that the 5th - 95th percentile range of the mean probabilistic analysis dose, 0.14 - 0.92 mrem/y seems incredulously small relative to the lack of knowledge associated with this analysis. It implies a level of knowledge that appears improbable. SVV

DO9-3. Section 9.1.5, p. 9-5, Table 9-3 and lines 34-37 through lines 1-6, p. 9-6: It seems implausible that regulatory performance objectives will be met over the entire duration to 10,000 years. A summation of all uncertainties would need to be calculated before coming to this gross conclusion. JWY

DO9-4. Section 9.3, p. 9-6, line 42: Text states, “The current PA is based on inventory estimates prior to retrieval from WMA A-AX.” However, clarify that the base case (INV0) assumes and

evaluates projected inventory after retrieval, except tanks 241-A-104 and 241-A-105 which are assumed not to be retrieved. DD

DOA1. Section A.8.2, p. A-16: Use of the information and studies of WMA C may not be appropriate for a similar evaluation at WMA A-AX. The CCUz silt unit at WMA A-AX is not present at WMA C. The two sites are not comparable in terms of heterogeneity. The CCUz at WMA A-AX is up to 35-ft thick over the waste management area. There is nothing comparable at WMA C and potential for lateral spreading of contaminants in the vadose zone is greater. JWL

DOA2. Section A.8.2, page A-16: This assumption does not take into account the thicker and more extensive CCUz unit at WMA A-AX. Conclusions that were made on the basis of data from WMA C that does not have a thick aquitard (or at times an aquiclude) may not be appropriate. Lateral spreading may be much more pronounced than assumed from studies at WMA C. JWL

DOA3. Section A.8.6, p. A-18: "Lateral spreading in the vadose zone is minimal" may not be a valid assumption. See comments 1, 2, and 3. Furthermore, the corrosion of the 3 wells at WMA (that had to be replaced) occurred at the level of the CCUz in each well, most likely due to chloride spreading from the 200-E-286 Ditch. Corrosion is still occurring at WMA A-AX wells and has spread at least as far as 299-E27-14. Well 288-E27-14 is more than 200 meters from the location of the former location of the 200-E-286 Ditch. So, we know that lateral spreading at WMA A-AX has not been limited to 100 meters (or the boundary of the WMA). JWL

Review Comment Record

Ecology Comments

Document: RPP-ENV-62206, Rev. 0, Analysis of Post-Closure Groundwater Impacts from Hazardous Chemicals in Residual Wastes in Tanks and Ancillary Equipment at Waste Management Area A-AX at the Hanford Site, Southeast Washington

Date: March, 2021

Reviewers: DD, DG, TH, JWL, BR, MBS, JWY

HCRG1. General: Nature and scope of this TPA document. It is clear from the scope of this document, this PA document should not be treated as a secondary document. It is a "primary" TPA document as this document is supposed to involve a lot of decision making (ref.1.1.2, page 1-9, etc.) which justifies this document as primary not as preliminary document. For example, it stated that "The primary purposes of the preliminary PA are to 1) establish an efficient modeling framework; 2) provide an initial evaluation of impacts to groundwater, air, and inadvertent intruder from estimated tank residual waste prior to retrieval of waste from SSTs; 3) support other HFFACO Appendix I retrieval documents requiring risk assessments (TWRWPs [HFFACO Appendix I Section 2.1.3] and RDRs [HFFACO Appendix I Section 2.1.7]); and 4) support decisions on whether or not to forego the use of a third tank retrieval technology. Etc. Etc. which justify to treat this document as primary. However, Ecology's comments, should be considered as preliminary since it didn't address the intended purpose of a number of decision making description/analysis. Ecology will have more thorough analysis of this document as we move through our discussion of these preliminary comments and other associated documents as per appendix I and related topics such as the past leak analysis, modeling issues of calibration, uncertainty analysis, risk assessments, etc. DG

HCRG2. General: p. 1-32, Section 1.4.2, Closure: A critical component of the closure decision is using the corrective action process to document in the Tier 2 (WMA specific) closure plan, based on the RFI/CMS and Appendix I performance assessment, that not all contaminated soils can be practicably removed or decontaminated in order to replace the clean closure requirements in WAC 173-303-640(8)(a) and WAC 173-303-610(2)(b) with the landfill closure requirements in WAC 173-303-665(6) and WAC 173-303-645. USDOE will need to remove any additional waste from ancillary equipment or remediate contaminated soil if those actions are required to demonstrate compliance with the applicable closure performance standard. TH
HCRG3. General: One of the lessons learned from the WMA-C PA was the problem of fragmenting the PA into multiple documents. This same fragmented approach has been adopted for WMA-A-AX. Acknowledging complexities of predicting exposures to human and ecological receptors over 10000 years from multiple source terms, this administrative fragmentation impedes proper integration of risk (at relevant time and space domains) from various source terms (e.g., tank residuals vs. past leaks present in soil). Fragmentation also inefficiently repeats common information (i.e., much of the text in several sections, e.g., site

and facility characteristics, implementation of models). This issue should be re-visited for future WMA PAs. DD, MBS

HCGR4. General: Ecology requests PA calculations and graphs that show the sum of impacts of all contaminants (including radionuclides) on groundwater, over the time period from closure through the 10,000 year time period, from all WMA A-AX source terms combined, in particular including contamination in the vadose zone from past leaks, residuals in pipelines and ancillary equipment, and tank residuals. MBS

HCRG5. General: Ecology requests tables and/or and graphs that show contaminant concentrations (all hazardous contaminants), total cancer risks (nonradioactive carcinogens plus radionuclides), and chemical hazard indices, in groundwater over the time period from closure through 10,000 y. We request this for all WMA A-AX source terms combined, including contamination in the vadose zone from past leaks, residuals in pipelines and ancillary equipment, and tank residuals. BR

HCRG6. General: p. 1-46: For the purposes of this volume of the PA, it assumes the A-104 and A-105 will not be retrieved. While for the purposes of a PA that could make sense, Ecology disagrees with that assumption in terms of the retrieval requirements for A Farm (reference CD if needed). Include an analysis where retrieval of waste is consistent with Appendix H goals. TH

HCRG7. General: The performance assessment includes waste sites that are in CERCLA operable units. Please include text to describe the interface between this performance assessment and the decision making for those CERCLA OUs. For example, the 241-A-151 Diversion Box and the 241-A-302A catch tank are also included in the Part B DST permit application and the 200-CP-1 RI/FS work plan and the information provided in those documents does not align with the information provided in the PA. TH

HCRG8. General. Ecology will use the requirements in WAC 173-340-700 through -760, including WAC 173-340-720 and-730 values for groundwater and surface water, and possibly other defensible lines of evidence to evaluate releases from this RCRA TSD (past and future) to environmental media and determine the need for action in those media. See WAC 173-303-64620(4)(g). BR

HCRG9. General. Need for a DQO process with participation of stakeholders, tribal nation: Similar to the C tank Farm and the TC-WMA EIS, the a formal DQO process involving stakeholders, tribal nations is required to get input on the following:

- An accepted scoping of the document with safety functions
- Specific sensitivity case analysis
- Acceptance of the FEPs
- Risk assessment scenarios. DG

HCGR10. General: A-AX Tank Farm PA vs C Tank Farm: It is a major change in the approach used for this PA compared to C Tank Farm. The following points are noted to address and concur by the regulators and the USDOE:

- It took both the agencies to go through a thorough DQO process for 3 years involving stakeholders, tribal nations and the public to come up with an acceptable process of analysis to address a number of important issues. Ecology, believes most of the issues/problems are more or less same and some need more rigorous process to analyze how to move forward. A detailed DQO process is therefore required to be followed.
- No computational process should be avoided just because "those process models were computationally intensive, often taking hundreds of hours to evaluate a complete suite of sources for multiple radionuclides.". Ecology made a number of comments and well as discussions were held to address these issues. Those comments are not highlighted here but communicated in many ways through letters, workshops, please look at those
- Need a detailed comparison with the TC-WM EIS. There are big differences of the approaches used which need to be evaluated/compared before moving forward.

Other issues will come when we engage our discussions in these issues. The current approach is not acceptable without complete understanding of a number of these issues. DG

HCRG11. General: Closure Steps: As per the document/executive summary, 3 closure steps are identified (ref. P ES-1, last paragraph):

- SST waste retrieval,
- filling the tanks with grout for stabilization, and
- surface cover barrier placement.

The closure steps should include any corrective actions for soil as well as groundwater and associated activities. Explain how it will be addressed. DG

HCRG12. General: (ref. p. ES-5; 4th bullet): Provide a general description what is meant by the "bounding" inventories?" How you addressed the uncertainties in defining the bounding conditions not only on inventories, but also all other aspects of uncertainties (e.g. modeling: System vs process, parametric, etc.). Also, it is not clear how a single modeling framework of abstracted system level model can integrate all aspects/components of the PA in spite of their limitations that are often characterized by coarser numerical discretization, lower dimensionality. Appropriate technical discussion should be reflected in several applicable chapters dealing with these issues. DG

HCRG13. General. Some support documents only recently became available for our reference (ex. RPP-RPT-60101). We may have significant future comments that stem from the support documents that were not available until late in our review (or after our review). BR

HCRG14. General: Ecology requests that the 17 WHO dioxin-like polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) be evaluated in groundwater, due to detects of several PCDD/PCDF congeners in groundwater underlying WMA A-AX. DD and BR

HCRG15. General: Please clarify in the Executive Summary that this document evaluates groundwater impacts (via leaching) of waste contaminants in tank residuals and ancillary equipment without considering current groundwater contamination. DD

HCRES1. p. ES-1. Please include text provided by Ecology explaining how this preliminary document is considered a primary TPA document for review, as well as comment resolution, to meet TPA requirements. DG

HCRES2. p. ES-1, Paragraph 2: "This impacts analysis is required by the State of Washington for closing U.S. Department of Energy (DOE)-operated facilities that will manage hazardous chemical and dangerous waste generated during departmental activities as low-level waste." Please explain the use of the term "as low-level waste" in this context. Is the analysis to make a low-level waste management decision included in this volume of the PA? TH

HCRES3. p. ES-1, Paragraph 4: "Closure of the individual SSTs and WMA A-AX in its entirety occurs in three major steps: 1) SST waste retrieval, 2) filling the tanks with grout for stabilization, and 3) surface cover barrier placement." Please include "removal or remedial actions" as a major step, as there may be remedial or removal actions required for soils and ancillary equipment to maximize protection of human health and the environment. TH

HCRES4. P. ES-5, Lines 39-42. Note that in addition to sensitivity analyses (i.e., base case vs. alternative cases, mainly related to waste mobility), please add that assumed receptor exposure (e.g., scenarios, pathways, parameters) also contributes uncertainty to post-closure performance of WMA A-AX (e.g., residential tap water scenario [groundwater ingestion/inhalation] vs. agricultural scenario [including irrigated crop food ingestion]). DD

HCRES5. p. ES-7, Line 43. Because this document applies only to nonrad chemicals, delete external exposure. DD

HCRES6. P. ES-8, Figure ES-5; Section 3.1, p 3-2, Figure 3-1. These figures describe an EPA tap water scenario and MTCA groundwater pathway, although they exclude direct contact risk from ancillary equipment above 15 ft depth (e.g., pipelines) for human and ecological receptors. This exposure pathway from ancillary equipment should be evaluated for human ingestion, inhalation, and dermal contact, as well as protection of groundwater via leaching and direct contact exposure to ecological receptors (e.g., plants, soil biota, birds, mammals). Humans and wildlife may also be exposed via contaminated food consumption in this shallow zone (<15 ft depth). In addition, it should be acknowledged that a human intrusion scenario could transport residual tank waste to the surface, where human and ecological receptors could be exposed. Clarify how the tap water (resident) scenario meets RCRA closure requirements, given that this scenario is not specified in RCRA. Include all relevant exposure pathways which address

RCRA. In particular, the Dangerous Waste (DW) Regulations (which conform with RCRA and implement RCRA in Washington) require CULs for environmental media (e.g., soil, groundwater, surface water, air), based on MTCA Method B (unrestricted land use), to meet closure performance standards (WAC 173-303-610[2][b][i]). Re groundwater, evaluations of both direct ingestion (WAC 173-340-720) and soil protective of groundwater (WAC 173-340-747) are required. DD

HCRES7. P. ES-8, Lines 16-18; Section 3.1, p 3-1, Lines 40-44. Although surface water is not present near WMA A-AX, groundwater flows into the river. Therefore, please clarify that groundwater below WMA A-AX must protect surface water and river sediment, because WMA A-AX lies directly over 200-PO-1 which, in turn, flows into the Columbia River. DD

HCRES8. p. ES-8, Paragraph 1: "The surface water pathway is not a possible exposure pathway for the disposal facility because surface water is not present near WMA A-AX, and is too limited on the Hanford Site Central Plateau in quantity to be used domestically." Please clarify whether the groundwater underlying A-AX abuts surface water. TH

HCRES9. p. ES-8, Paragraph 3: "To evaluate protection of water resources, peak predicted hazardous chemical and dangerous waste constituent concentrations in groundwater are compared to available Federal and State drinking water standards." Please modify the end of this sentence to state "Federal drinking water standards and state groundwater cleanup levels". TH

HCRES10. p. ES-8 and ES-9. For the hazardous waste concentration limits in groundwater (and tap water) two standards are cited, MTCA in WAC 173-340-720 (p. ES-8, line 8) and drinking water (MCLs) in WAC 246-290-310 (p. ES-9, line 40). The appropriate standard is for groundwater under MTCA Method B in WAC 173-340-720. However, the MCLs are cited in 11 other places in the document. They include the following:

- p. 1-39, Table 1-3
- p. 5-3, Section 5-2, paragraph 2
- p. 5-9, Table 5-1
- p. 5-10, Table 5-2
- p. 8-1, Section 8.0, second bullet
- p. 8-2, Section 8.1, second bullet on line 11, line 16, and line 29
- p. 8-4, Section 8.1.2, line 13
- p. 8-6, Tables 8-3 and 8-4. JWL

HCRES11. P. ES-10, Table ES-1; Section 5.2, p 5-9 to 5-10, Tables 5-1 and 5-2. MTCA groundwater CULs (WAC 173-340-720) are missing in these tables (as implied by the MTCA groundwater pathway shown in Figures ES-5 and 3-1). Please include relevant MTCA groundwater ingestion CULs in these tables. Re Table ES-1, the MCL for nitrite (as nitrite) is 3.3 mg/L (not 5 mg/L), and the groundwater concentration for F at the fence line for A Tank Farm (1.94E-1 mg/L) appears incorrect (given the much lower 100 m downgradient concentration and corresponding data in Table 5-1). Please revise. DD

HCRES12. P. ES-11 and ES-12, Tables ES-2 and ES-3, footnotes a & b; Section 8.1.1, p 8-4 to 8-5, Tables 8-1 and 8-2, footnote. In the absence of Cr+6 speciation, all of total Cr in groundwater should be assumed to be Cr^{+6} (as noted in footnote b). The inhalation RfC for Cr^{+6} mists/aerosols (IRIS, 8E-6 mg/m^3), as well as the IUR for Cr^{+6} (MTCA/CLARC and EPA/RSL tables, 8.4E-2 [ug/m^3]$^{-1}$) should be used to estimate respective noncancer HQ and cancer risk from inhalation (e.g., exposure to aerosol particles while showering). The oral RfD for Cr^{+6} (MTCA/CLARC and IRIS, 3E-3 mg/kg/d) and oral CSF for Cr^{+6} (EPA/RSL tables, NJDEP, and CalEPA, 0.5 [mg/kg/d]$^{-1}$) should be used to estimate respective noncancer HQ and cancer risk from groundwater ingestion. The oral CSF for Cr^{+6} is a valid EPA Tier 3 tox value (OSWER 9285.7-53 [see p 14-15 and p B-8 to B-12 at: https://semspub.epa.gov/work/HQ/163525.pdf]). Other web references for the oral CSF for Cr+6 include EPA/RSL tables (https://semspub.epa.gov/work/HQ/200043.pdf), CalEPA (https://oehha.ca.gov/chemicals/chromium-hexavalent), and NJDEP (https://oehha.ca.gov/media/downloads/water/comment/112509nj.pdf). The NJDEP study by Alan Stern (https://www.ncbi.nlm.nih.gov/pubmed/20843510) is based on an NTP (2008) chronic bioassay with rats and mice (https://ntp.niehs.nih.gov/ntp/htdocs/lt_rpts/tr546.pdf). DD

HCRES13. P. ES-13, Table ES-4; Section 3.1, p 3-3, Lines 1-10; Section 6.2.2, p 6-13, Table 6-3; Section 8.2, p 8-8, Table 8-5. Please define base case in Table ES-4 (via a footnote) as a scenario where safety functions behave as expected and anticipated retrieval and closure actions occur as planned. Re INF1, INF2, and INF3 cases for AX tank farm in Table ES-4 (and Table 8-5), concentration and year data appear to be in error (are different than in Table 6-3 which appears more consistent with INF cases). DD

HCR1-1. Section 1.0, General. This document does not include a Preface that explains how it fits into the Appendix I Performance Assessment. A preface of this sort was included in the RCRA Closure Analysis of Waste Management Area C document (RPP-ENV-58806). Please add a Preface section to this document. BR

HCR1-2. Section 1.0, p. 1-3, paragraph 3, lines 40-46: "In order to provide both DOE and Ecology information necessary to make a decision on the length of post-closure care time, this impacts analysis contains a long-term evaluation of contaminants remaining in the tanks and ancillary equipment because it may take hundreds to thousands of years for these contaminants to leach from the tank sources and travel through the vadose zone and unconfined aquifer to reach a potential receptor. Impacts from existing contamination in the soil within WMA A-AX will be evaluated in a future Analysis of Past Leaks and a future Risk Assessment for Soil (Figure 1-3)." Ecology disagrees with the submittal of multiple volumes of a PA and requests that USDOE submit a single PA for approval as a primary document so that all impacts can be evaluated. Ecology also understands this issue is being discussed in Holistic Negotiations and will accept text that reflects the resolution reached in that forum. TH

HCR1-3. Section 1.1, p. 1-7 and 1-8: "Closure decisions for dangerous / hazardous chemicals in the Hanford Site SST system soils will be made through the RCRA corrective action process. The

RCRA corrective action component of the IPA will contain 1) a baseline risk assessment of the contaminated soil and vadose zone sediments and 2) an analysis of past leaks." All 4 "volumes" of the Appendix I PA are critical for the closure decision for the SST soils and ancillary equipment, including the DOE O 435.1 component of the PA. TH

HCR1-4. Section 1.1.1, p. 1-9, lines 5 through 22. The document states "While there is no guidance in WAC 173-303-610, WAC 173-303-640, or WAC 173-303-665(6) as to what a long-term impacts analysis should contain.." However, there is significant guidance regarding Ecology's expectations for environmental risk assessments for soil, water, air and ecological pathways in WAC 173-340 sections 700-760, which are referenced in WAC 173-303-646, corrective action (see sections -645(11) and -64620). There have been releases from these tank farms. Releases will require corrective action under WAC 173-303-646. Therefore, see WAC 173-340 sections 700-760 for guidance and regulations related to long-term risk analyses. BR

HCR1-5. Section 1.1.1, p. 1-9, Second Paragraph, lines 24-26: "WAC 173-303-665(2)(b) does not apply to tank systems, but because WMA A-AX does not have a liner and/or leachate collection system, it is being brought forward to assist in determining what information/data Ecology might need to support closure decisions." It is inaccurate to state that WAC 173-303-665(2)(b) does not apply to tank systems. It is more accurate to state that WAC 173-303-665 does not include clear requirements for tank systems closing as a landfill. TH

HCR1-6. Section 1.2, p. 1-16, lines 21 -36. The text states "Past leak events are not addressed in this analysis. However, these events will be addressed in a risk assessment for soil and an analysis of past leaks (Figure 1-3), which will both support the WMA A-AX RFI/CMS." Ecology expects all source terms, including past releases, to be included in the WMA A-AX Appendix I PA, to be consistent with Section 2.5 of Appendix I of the Hanford Tri-Party Agreement. This section states "As each WMA proceeds toward closure, its respective PA will be updated to address all pertinent new results and findings – and will, as a minimum, incorporate the following results as they become available: actual volumes of tank waste residuals left after retrieval, <u>results of leak investigations</u>, new geologic and ancillary equipment waste characterization information, and the results of new barrier and tank residual stabilization and fill performance studies and tests." BR

HCR1-6. Section 1.2, p. 1-17, lines 2-5, and footnote 9: "Together with WMA A-AX, these DST farms form the "A Complex" of tank farms which, given their proximity, are expected to be closed with a common surface barrier or a set of essentially continuous surface barriers" The footnote states that interim barrier may be used for individual tank farms. Please include the statement that a surface barrier is required, and must meet or exceed the performance of a RCRA Subtitle C barrier at the time of closure. TH

HCR1-7. Section 1.3.2, p. 1-18, lines 36-38: "Since the closure cover is not expected to be built for 30 years, the final cover design will occur in the future and calculations can be used to inform the final design requirements." Please reference applicable TPA milestone series

requiring 90% cover design and applicable schedule dates, or reference the WMA A-AX Tier 2 closure plan which will include the compliance schedule for placement of the final barrier. TH

HCR1-8. Section 1.3.3 and Section 1.6.1, p. 1-20 and p. 1-40, Table 1-1 and Table 1-4, Exposure point. The exposure point given here is assumed to be 100 m downgradient at the point of highest exposure. Ecology uses exposure points that correspond to points of compliance in our regulations: see WAC 173-340-720(6)(b) "The standard point of compliance shall be established throughout the site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site." Also see WAC 173-303-645(6)(a) "The point of compliance is a vertical surface located at the hydraulically down-gradient limit of the waste management area that extends down to the uppermost aquifer underlying the regulated units." Since this document is intended to address Dangerous Waste/RCRA requirements, risk calculations are expected to address the state's points of compliance, in addition to or rather than the assumed exposure point for DOE O 435.1. BR

HCR1-9. Section 1.6.1, p. 1-39, Table 1-3. The state follows WAC 173-303 standards, which are not limited to MCLs for groundwater. See the requirements in WAC 173-303-64620(4). There have been releases from this tank farm so corrective action will be required and would be required if the tanks release in the future. Also, there are many more constituents given in the BBI database and all need to be considered in this report, until data from the tanks (and vadose zone) are available. Furthermore, we emphasize that the EPA tap water scenario given in Figure 3-1, Section 3.2.3, Section 4.2.5, Section 8.1.1, and throughout the document is an additional line of evidence to Ecology, but it alone does not meet the requirements in WAC 173-303 for closure. We will use WAC 173-340 scenarios and associated calculations during the closure process for making decisions in accordance with our regulations. Specific values from Ecology's regulations, for the constituents in Table 1-3, are:

Chemical	WAC 173-340-720 Eqn 720-1, 720-2 (μg/L)	WAC 173-340-730 Section (3) (μg/L)	MCL (μg/L) (lowest of state and federal)	90th percentile background (DOE/RL-96-61) when limiting (μg/L)
Al	1.6E04	None	None	Below -720 value
Cr (VI)[a]	4.8E01	1E01	1E02 total Cr	Below -730 value
F	9.6E02	None	4E03	1.05E03
Fe	1.1E04	1E03	None	Below -730 value
Hg	None	1.2E-02	2E00	Below -730 value
Mn	7.5E02	5E01	None	Below -730 value
Ni	3.2E02	136	1E02	Below MCL
Nitrate-N	2.6E04	1E04	1E04	Below -730 value
Nitrite-N	1.6E03	None	1E03	Below -730 value
Pb	1.5E01	2.1E00	1.5E01	Below -730 value
Sr	9.6E03	None	None	Below -720 value
Utotal	3.2E00	None	3E01	9.85E00

[a]Cr^{+6} (4.8E1 μg/L) with oral RfD=3E-3 mg/kg/d; 0.2 μg/L with NJDEP/CalEPA oral CSF=0.5 $[mg/kg/d]^{-1}$)
BR, DD

HCR2-1. Section 2.1.1.2.2, p. 2-8, lines 42-44: "This evaluation addresses releases from residual waste left in the SSTs, pipelines, and ancillary equipment; therefore, evaluation of these UPRs is outside the scope of the current impacts analysis and will be addressed through the RCRA Corrective Action process." Are the UPRs planned for inclusion in the RFI/CMS? If so, please state that here, and clarify that the PA will be updated after that analysis is completed. TH

HCR2-2. Section 2.1.5.4.3, p. 2-81 – 2-97 Groundwater near A-AX has a number of contaminants over levels of concern for groundwater and/or surface water in the past 10 years:

Well	Nonradiological Contaminants	GW limit exceeded	SW limit exceeded	Years
299-E25-2	Arsenic	Method B	Various	2008, 2018
	Dibenz[a,h]anthracene	Method B	Various	2016
	Heptachlorodibenzofuran		Various	2016
	Hexachlorobenzo-p-dioxin	Method B	Various	2016, 2017, 2019
	Ideno(1,2,3-cd)pyrene	Method B	Various	2016
	Nitrate-N	Method B, MCL		2012-present
	Pentachlorodibenzofurans		Various	2016
	Pentachlorodibenzo-p-dioxin	Method B	Various	2016
	Selenium		Aquatic	2019
	Tetrachlorodibenzofurans		Various	2016
	Tetrachlorodibenzo-p-dioxins	Method B	Various	2016, 2017, 2019
299-E25-40	Arsenic	Method B, MCL	Various	2013 – 2018
	Chromium	MCL		2017
	Cyanide	Method B		2019
	Hexachlorobenzo-p-dioxin		Various	2016 – 2019
	Nitrate-N	Method B, MCL		2011 – 2019
	Pentachlorodibenzo-p-dioxin		Various	2016
	Tetrachlorodibenzofurans		Various	2019

299-E25-41	Arsenic Heptachlorodibenzofuran Hexachlorobenzo-p-dioxin Methylene chloride Nitrate-N Pentachlorodibenzo-p-dioxin Tetrachlorodibenzo-p-dioxins	Method B MCL Method B, MCL 	Various Various Various Various Various	1990s – 2019 2016 2016 2016 2006 – 2019 2016 2016
299-E25-93	Arsenic Hexachlorobenzo-p-dioxin Nitrate-N Pentachlorodibenzo-p-dioxin Tetrachlorodibenzofurans Tetrachlorodibenzo-p-dioxins	Method B Method B, MCL 	Various Various Various Various Various	2013 – 2019 2016, 2019 2003 – 2019 2019 2016, 2019 2019
299-E25-94	Aroclor-1260 Arsenic Cyanide Heptachlorodibenzofuran Hexachlorobenzo-p-dioxin Iron Nitrate-N Pentachlorodibenzofurans Pentachlorodibenzo-p-dioxin Selenium Tetrachlorodibenzofurans Tetrachlorodibenzo-p-dioxins	Method B Method B Method B Method B, MCL Method B 	 Various Various Various Aquatic CWA 304 fresh water Various Various Aquatic WAC 173-201A Various Various	2019 2013, 2018 2018, 2019 2016, 2018 2016, 2017 2014 2004 – 2019 2016 2019 2016, 2017 2016 2016, 2017

Many of these contaminants are not considered in the BBI dataset, and inventory values are not available. However, as retrieval data are obtained, it will be necessary to look at all of the contaminants and determine if WMA A-AX releases have contributed to the

contamination in nearby groundwater. [Note: Details about the assumptions and exact dates can be provided]. BR

HCR2-3. Section 2.1.8 (or elsewhere in Section 2.0). The 200-E-286-Ditch should be discussed along with its association with well corrosion. At least three wells were lost at WMA A-AX due to well corrosion. At the three corroded and decommissioned wells, the corrosion occurred above the water table at (or slightly above) a fine-grained geologic unit (the Cold Creek silt-dominated unit [CCUz]). This unit creates perching conditions for groundwater (percolating downward between the surface and the water table) and greatly increases lateral spreading. The most likely source of the corrosion is chloride-bearing effluent from the 200 East Area powerhouse (284-E Powerhouse) that was discharged to an unlined ditch (200-E-286 Ditch) that traversed the southwest end of what later became the 241-A Tank Farm (Figure 1-2). This ditch was active from 1946 to 1953. The CCUz fine-grained unit and the increased amount of lateral spreading of the chloride-bearing waste water are the subject of the next three comments. JWL
HCR3-1. Section 3.2, p. 3-11, 3rd paragraph, and p. 3-12 second paragraph. – Use of the "Ecology Advocacy Model" and fine-grained model of WMA C to evaluate transport of contaminants to the water table at WMA C may not be appropriate for a similar evaluation at WMA A-AX. The CCUz silt unit at WMA A-AX is not present at WMA C. The two sites are not comparable in terms of heterogeneity. The CCUz at WMA A-AX is up to 35-ft thick over the waste management area. There is nothing comparable at WMA C and potential for lateral spreading of contaminants in the vadose zone. JWL

HCR3-2. Section 3.2.2.1.2, p. 3-37 – 3-41, and throughout the document. Recharge assumptions.

- The text on lines 12 – 14 of p. 3-38 refer to the water balance equation on line 7 of p. 3-38, and state "By directly measuring or estimating the parameters on the right hand side under controlled conditions, the recharge can be calculated." Please state which parameters are measured, and which are estimated. Please provide any equations used to estimate the estimated parameters.
- RPP-RPT-60885, Appendix A gives the following assumption: Section A.1.3 states "The design life of the cover is 500 years in the nominal case, following which the infiltration through the cover returns to the site-wide average infiltration rate for undisturbed soil." This assumption cannot be ensured. Lack of human disturbance for 500 years can never be guaranteed.
- Another assumption is given in Section 4.2.2.2: "The transition period from the young revegetated shrub steppe to the mature shrub steppe community is assumed to require 30 years, which is the assumption included in PNNL-14702." Wildfire alters vegetation succession, and therefore infiltration rates. For example, the Hanford site had 302 wildfires in the years 1990-2010 (USDOE, 2011)). Lesica, et al. (2007, Recovery of big sagebrush following fire in Southwest Montana, Rangeland Ecol. Manage. 60:261-269) found that Wyoming big sagebrush had only 2% recovery in 23 years after fires on plot studies in southwest Montana, and modeling suggested that full recovery for Wyoming big sagebrush after fires would be <u>greater than 30 years "and probably much more."</u> Wyoming big sagebrush is the major subspecies of big sagebrush at Hanford (PNNL-

13688). Invasive species (e.g., cheatgrass, a common invasive species after fire, which results in a higher recharge rates at least 5 times greater than that of native shrub-steppe (Gee, GW, MJ Fayer, ML Rockhold, and MD Campbell. 1992. Variations in recharge at the Hanford Site, Northwest Science, 66(4):237-249). It has been found that shrub steppe vegetation does not easily re-establish after cheatgrass invasion (Norton, JB, TA Monaco, JM Norton, DA Johnson, TA Jones. 2004. Soil morphology and organic matter dynamics under cheatgrass and sagebrush-steppe plant communities. J. of Arid Environments 57:445-466).

- The following assumptions from Section A.1.3 "Impacts resulting from plausible climate change that may occur during the evaluation period do not adversely impact the performance of the surface or vadose zone as a barrier." And "Net infiltration through the thick, heterogeneous vadose zone in the 200 Areas dampens the effect of discrete events, and therefore episodic precipitation events can be replaced by an average annual recharge rate." are questionable. [Section A.2.2 has a related assumption, that there will not be significant climate change based on estimates of past climates in the area]. Climate change could result in extreme summer droughts that destroy the vegetation and/or lead to increasing fire frequency which would favor invasives like cheatgrass rather than deeply-rooted shrubs. This would potentially result in decreased water removal during dry seasons, and would not prevent winter precipitation from going below the root zone. Climate change may result in dune migration through the tank farm, changing the water use efficiency of the vegetation due to burial. Climate change could result in greater winter precipitation, reduced evapotranspiration as a result of more effective precipitation and deeper percolation from events, which would result in overall higher annual recharge amounts.
- Another assumption, from Section A.2.1 is "It is assumed that the natural shrub-steppe ecology established prior to site operations is re-established in the footprint of the WMA (i.e., the top of the surface barrier) and surrounding area during the post-closure period. Justification: Once operational activities on the site cease, ecological forces will reestablish a native vegetation that has adapted to the regional climate. Unfortunately, invasives, such as cheatgrass, are well adapted to the regional climate and are strongly competitive with the natural shrub-steppe ecology.
  Due to the above concerns, Ecology requests a sensitivity evaluation with 100 mm/y recharge until 2050, 0.5 mm/y for 100 y after barrier placement, and 22 mm/y thereafter to represent a surface that has been burned and occupied by invasives such as cheatgrass (PNNL-14702, Rev.1, Table 4.15). The long-term value of 22 mm/y would be roughly half of the WAC 173-340-747(5)(f)(ii)(A) default value for eastern Washington: 25% of annual precipitation (25% of 173 mm/y is approximately 43 mm/y). Please provide this sensitivity analysis in Section 8.2, and ultimately in the Past Leaks portion of the WMA A-AX IPA. While it might be reasoned that the sensitivity case with an unvegetated gravel surface is more extreme than this, the cheatgrass case should be given more weight with the current closure assumptions, unless a decision is made to leave the tank farm surface unvegetated with gravel. BR

HCR3-3. Section 3.2.2.1.6, p. 3-44: Summary of Assumptions for Groundwater Pathway as outlined in the following bullet items are not always true and needs further discussions clarifications with examples and references**.**

- "The inclusion of moisture-dependent anisotropy functions allows the homogeneous HSUs to adequately approximate the effects of heterogeneity". *Please note that both Ecology and USDOE used alternative conceptual model to address multiple aspects in the C-Tank Farm PA*
- "The hydrostratigraphy of the vadose zone is adequately represented by the delineation ofequivalent homogeneous units for evaluating bulk (or mean) flow and contaminant transport". *It is not clear from the field data (e.g. heterogeneity and moisture profile, etc.) that one can conclude the above statement without more analysis.*
- "Vadose zone hydraulic property values up scaled from small- and micro-scale (sample) measurements apply to the field scale for the equivalent homogeneous units". *Detail sensitivity analysis with multiple realizations approach should be evaluated before moving forward with this single concept.*
- *"The inclusion of moisture-dependent anisotropy functions allows the homogeneous HSUs to adequately approximate the effects of heterogeneity" may not necessarily address of flow and transport required for complete analysis not only for the residuals but also for the past leaks. Ecology has provided a number of comments on this subject during the C-Tank Farm PA analysis.* DG

HCR3-4. Section 3.2.3, p. 3-49, lines 4-9. For the tap water scenario that Ecology may use as a line of evidence in addition to WAC 173-340-720, the exposure pathways given here do not include immersion in tap water, which was given for WMA C, in RPP-ENV-58806, Section 7.2.3, p. 7-39. This document should be corrected to be consistent with the WMA C document. BR

HCR4-1. Section 4.1.1.1, p. 4-2, lines 14-19: According to the text "the EHM model representation does capture the mean or the bulk flow characteristics of the vadose zone moisture plumes (RPP-RPT-60101; Simulating field-scale moisture flow using a combined power-averaging and tensorial connectivity-tortuosity approach" [Zhang and Khaleel 2010]; and "Estimation of effective unsaturated hydraulic conductivity tensor using spatial moments of observed moisture plume" [Yeh et al. 2005])." Ecology expects USDOE to take similar C-Tank Farm approach to address small scale heterogeneity based on geology, hydrogeologic charateristics (e.g. moisture content, etc.). DG

HCR4-2. Section 4.2. 1.2, p. 4-8: Specifically what is the needed characterization? What is uncertainty of using WMA-C data for residual waste? JWY

HCR4-3. Section 4.2.3.5, Figure 4-15, p. 4-60: This figure shows plenty of variation in the points of calculation and flow velocity distribution in the WMA A-AX three-dimensional process model. Please include an explanation for this in the text. DG

HCR4-4. Sections 4.2.3.7 and 4.2.3.8, p. 4-57. Is the 100m value which is used to calculate the risk based on the comingled nitrate value? JWY

HCR4-5. Section 4.2.4, p. 4-72, Depending on where the POC is it looks like comingling of down gradient A with AX could affect the concentration especially for Tc-99 as shown on figure 4-17. Please discuss. JWY

HCR4-6. Section 4.2.5, p 4-73, Lines 22-23. Text states, "Given this research, it is highly unlikely that a high percentage of the total chromium inventory impacting groundwater is in the hexavalent form." If incorrect, describe how this assumption may have significant consequences, given the applicability of an IUR for Cr^{+6} (0.084 $[ug/m^3]^{-1}$), as well as an oral CSF for Cr^{+6} (0.5 $[mg/kg/d]^{-1}$), in an EPA tap water scenario (e.g., inhalation while showering, ingestion of groundwater). DD

HCR4-7. Section 4.2.5.1.1, p. 4-74, Table 4-14. Ecology will assume that the chromium in water is hexavalent chromium in the absence of speciation data for chromium in water. Please add hexavalent chromium to Table 4-14. BR

HCR4-8. Section 4.2.5.1.1, p 4-74, Table 4-14. Note that the oral RfD shown for Cr (1.5 mg/kg/d) is for Cr^{+3}. Please also list oral RfD for Cr^{+6} (3E-3 mg/kg/d) and inhalation RfC for Cr^{+6} (8E-6 mg/m3 for mists/aerosols, 1E-4 mg/m^3 for particulates). In addition, list the IUR for Cr^{+6} (8.4E-2 $[ug/m^3]^{-1}$) and oral CSF for Cr^{+6} (0.5 $[mg/kg/d]^{-1}$). Also, EPA/OSRTI and MTCA/CLARC have adopted a revised oral RfD for U (2E-4 mg/kg-d) (https://semspub.epa.gov/work/HQ/196808.pdf). Please list this revised oral RfD for U, and use it for toxicity calculations. DD

HCR5-1. Section 5.1, p. 5-2, lines 1-7. The text states "Chemicals in the pipeline/ancillary equipment, with no grout and concrete barriers, are released through advection and diffusion. The advective release is controlled by the recharge rates in the tank farms. The recharge rate in the first 500 years after closure is 0.5 mm/y to account for the surface barrier." However, the current recharge rate is estimated at about 100 mm/y, and advection associated with the pipeline residuals to is likely to be occurring now. Please add text to justify assuming that release only occurs after a barrier, currently not present, degrades in 500 y. Further, if releases are occurring now, measuring release rates could be used to validate release mechanism models. BR, SVV

HCR5-2. Section 5.2, p.5-4: Based on table 5-1 values the only concentrations that look certain are the Nitrate and Nitrite values show for 100-1000 year time frame. What is the uncertainty in these values when used in concentration ratios? JWY

HCR5-3. Section 5.2, p. 5-9 – 5-10, Tables 5-1 and 5-2, and throughout the document: Ecology will use WAC 173-340-720 to set groundwater standards. State and federal laws are all considered in this regulation. Specific values are given in a prior comment on Table 1-3 for the contaminants in Tables 5-1 and 5-2. BR

HCR5-4. Section 5.2, p 5-9 and 5-10, Tables 5-1 and 5-2: Cr^{+6} (4.8E1 ug/L with oral RfD=3E-3 mg/kg/d; 0.2 ug/L with NJDEP/CalEPA oral CSF=0.5 $[mg/kg/d]^{-1}$). In addition, provide references for Kd values in sand. The Kd for Cr (0 mL/g) appears to be the Hanford Kd value for Cr^{+6}, while the MCL for Cr (0.1 mg/L) is for total Cr. In the absence of Cr speciation data, Cr should be assumed to be Cr^{+6} for risk evaluation. DD

HCR5-4. Section 5.2.1, p 5-12, Line 1: Specify that Kd=0 mL/g for Cr+6 (not "chromium"). DD

HCR5-6. Section 5.3.1, p 5-24, Lines 28-34. Cancer risks presented here should specify an inhalation pathway (assuming that is the case). In addition, please specify ingestion cancer risks, using the oral CSF for Cr^{+6} (0.5 $[mg/kg/d]^{-1}$). DD

HCR5-7. Sections 5.3.3 and 5.3.4, p 5-39, Lines 4-10. Although text states, "…there is no hazard from the inhalation pathway," total Cr should be assumed to be Cr^{+6} (due to absence of Cr speciation data) which results in hazard and risk from inhalation. That is, the inhalation RfC for Cr^{+6} mists/aerosols (8E-6 mg/m^3), as well as the IUR for Cr^{+6} (8.4E-2 $[ug/m^3]^{-1}$), should be used to estimate respective noncancer HQ and cancer risk from inhalation (e.g., showering pathway, https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=525385&Lab=NHSRC; https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0168051&type=printable; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2874882/pdf/nihms68723.pdf). In addition, the oral RfD for Cr^{+6} (3E-3 mg/kg/d) and oral CSF for Cr^{+6} (0.5 $[mg/kg/d]^{-1}$) should be used to estimate respective noncancer HQ and cancer risk from groundwater ingestion. DD

HCR6-1. Section 6.0, p 6-1, Lines 21-30. Text states, "A probabilistic analysis of the base case to show the effects of parameter uncertainty on the performance of the system for hazardous chemicals was not performed in this analysis because it is not specifically required." Text goes on to say that this analysis was performed for rads in the DOE O 435.1 PA. Therefore, describe rationale for omitting this analysis for nonrads, while including it for rads (in terms of information value, rather than regulatory requirement). DD

HCR6-2. Section 6.2, p 6-5, Lines 21-23. Text states, "The sensitivity analyses quantify the ranges of calculated groundwater concentration outcomes due to single-parameter or multiple-parameter changes that represent an underlying shift in the conceptual model." However, these sensitivity cases (Table 6-1) appear limited to the effect of single parameter changes on peak groundwater concentration/time. As such, these analyses (which change one factor at a time) are useful in isolating the effect of a single parameter on the output but cannot detect interactions among multiple parameters which may be critical to understanding the system. DD

HCR6-3. Section 6.2.1 p. 6-7 3rd bullet. What does "extraneous analysis" mean in this context? JWY

HCR6-4. Section 6.2.7, p 6-32, Lines 19-22. The Kd for Pb at Hanford should be 30 mL/g (Ames and Serne, 1991, PNL-7660, cited in ECF-Hanford-10-0442, Rev 1). DD

HCR8-1. Section 8.1.1.1, p 8-3, footnote 1. Cancer risks presented here should specify an inhalation pathway (assuming that is the case). In addition, please specify ingestion cancer risks, using the oral CSF for Cr+6 (0.5 [mg/kg/d]-1). DD

HCR8-2. Section 8.1.1, p 8-4 to 8-5, Tables 8-1 and 8-2. The table footnotes (indicated by *) should specify both oral and inhalation and pathways for HI for Cr+6 (assuming that is the case). DD

HCR8-3. Section 8.1.1.2, p 8-3, Lines 32-39. Contrary to text, U does appear to contribute to HI at peak yr (10000 yrs after closure) at both tank farms (Tables 8-1 and 8-2). Please correct text. DD

HCR8-4. Section 8.1.2, p 8-4, Lines 5-13. Clarify why radionuclides are discussed here in this document on hazardous chemicals (nonrads). DD

HCR8-5. Section 8.1.2, p 8-6, Tables 8-3 and 8-4. The MCL for nitrite (as nitrite) is 3.3 mg/L (not 4.5 mg/L). Please correct. DD

HCR8-6. Section 8.2, p 8-5, Lines 15-17. Text states, "Sensitivity analyses are generally intended to evaluate the effects of scenario and conceptual model uncertainties on the groundwater concentrations at the PoCals used in the impacts analysis." As used here (Table 8-5), sensitivity analyses appear to evaluate effects of parameter uncertainty (parameter changes), not model uncertainty (e.g., alternative transport models). Please clarify. DD

HCR8-7. Section 8.2, p 8-10, Lines 3-5. Sensitivity analysis (Table 8-5) does not appear to evaluate simultaneous changes in multiple parameters (e.g., varying both INF and INV together) on groundwater concentration/peak arrival times. As such, please acknowledge that parameter interactions are not evaluated, highlighting an additional source of parameter uncertainty. DD

HCR8-8. Section 8.3, p. 8-10. The document states "Consequently, it can be concluded the retrieval process may be driven by considerations other than post-closure behavior of WMA A-AX." Ecology will need an estimate of risks for all source terms, including the nontank sources in the vadose zone, prior to making closure decisions. BR

HCRA-1. Appendix A, General: The following contaminants that are associated with pipelines, which are within 15 ft of the ground surface, exceed levels of concern for soil. Since the pipelines will not be grouted, they will decompose over time, and the contaminants inside will become part of the soil. In the table below, estimated concentrations inside the pipelines have been compared to WAC 173-340 direct contact and ecological protection levels of concern for soil. The concentrations in the pipelines were calculated as described in Section 6.1 of RPP-RPT-58293, Rev. 1, using summed inventory values for A-farm and AX-farm from Appendix A of RPP-RPT-58293, Rev.1, and averages based on the number of tanks in each farm.

Contaminant	Tank Farm	Exceeded Direct Contact	Exceeded Ecological Protection

Aluminum	A	Yes, Method B	Yes – Plant value
Chromium	A	No	Yes – Wildlife value
Iron	A	Yes, Method B	No
Manganese	A	Yes, Method B	Yes – Plant value
Nickel	A	Yes, Method B	Yes – Plant value
Uranium (total)	A	Yes, Method B+C	Yes – Plant value
Aluminum	A-AX	Yes, Method B	Yes – Plant value
Chromium	A-AX	No	Yes – Wildlife value
Iron	A-AX	Yes, Method B	No
Manganese	A-AX	Yes, Method B	Yes – Plant value
Nickel	A-AX	Yes, Method B	Yes – Plant value
Uranium (total)	A-AX	Yes, Method B+C	Yes – Plant value

BR

HCRA-2. Section A.8.2, p. A-15, lines 19-23. This assumption does not take into account the thicker and more extensive CCUz unit at WMA A-AX. Conclusions that were made on the basis of data from WMA C that does not have a thick aquitard (or at times an aquiclude) may not be appropriate. Lateral spreading may be much more pronounced than assumed from studies at WMA C. JWL

HCRA-3. Section A.8.6, p. A-17. “Lateral dispersion in the vadose zone is minimal” may not be a valid assumption. See previous comments for sections 2.1.8, 3.2, and A.8.2. Furthermore, the corrosion of the 3 wells at WMA (that had to be replaced) occurred at the level of the CCUz in each well, most likely due to chloride spreading from the 200-E-286 Ditch. Corrosion is still occurring at WMA A-AX wells and has spread at least as far as 299-E27-14. Well 288-E27-14 is more than 200 meters from the location of the former location of the 200-E-286 Ditch. So, we know that lateral spreading at WMA A-AX has not been limited to 100 meters (or the boundary of the WMA). JWL

Technical Comments on WMA A-AX Preliminary Performance Assessment

Prepared For:

Washington Department of Ecology
3100 Port of Benton Blvd.,
Richland, WA 99354

March 5, 2021

Prepared By:

Tetra Tech, Inc.
415 Oak St.
Kansas City, Missouri 64106
(816) 412-1741

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General Comments on RPP-ENV-62206, Rev. 0

1. This document relies heavily on the WMA C PA due to its proximity to WMA A-AX and the amount of data acquired and analyses conducted at that location, which makes sense. However, several analyses do not occur at WMA A-AX because they were performed at WMA C and indicated insignificant impacts on concentrations and dose at point of compliance (e.g., heterogeneity in vadose zone). These assumptions may be invalid or not applicable at WMA A-AX. For example, the Cold Creek silt (CCUz) is laterally extensive beneath WMA A-AX and not present underneath WMA C.

Specific Comments on RPP-ENV-62206, Rev. 0

Executive Summary

1. Table ES-1, Page ES-10: Concentration of fluoride at the Fence Line for 241-A Tank Farm is incorrect. This value should be 8.09E-04 milligrams per liter (mg/L) from Table 5-1 or Table 8-3. Correct this value.

2. Table ES-1, Page ES-10: Maximum Contaminant Levels (MCLs) listed from WAC 246-290-310 reference an older version. A newer version of WAC 246-290-310 was certified on October 25, 2019. Update fluoride and nitrite MCLs to 1.0 and 2.0 mg/L, respectively. Also, update globally (a) text that references the MCL values (i.e., Line 18 of page ES-11), and (b) other tables such as Tables 8-3 and 8-4.

Chapter 2

1. Section 2.1.5.4.2, Figure 2-28: Figure 2-28 shows the hydrogeologic units present at the water table in 1998, at the start of "active remediation," a term not explained and not discussed in terms of its significance. Even though the location of WMA A-AX is not shown on the figure, its location appears to be where the formation at the water table is the Hanford formation, at least in 1998. This depiction is at odds with the conceptual site model presented throughout the Preliminary Assessment (PA), which indicates the predominant hydrostratigraphy unit (HSU) at the water table is the coarse-grained member of the Cold Creek Unit (CCUg). All figures provided in the PA should be revised to support the current conceptual site model.

2. Section 2.1.5.4.3, Figure 2-35: This figure illustrates the range of saturated hydraulic conductivity values estimated from slug tests, pumping tests, and model calibration for the Hanford formation. The Hanford formation is present in the unsaturated zone at WMA A-AX, not in the saturated zone. The discussion of the unconfined aquifer system at WMA A-AX should be supported with data that pertain to the geologic formations that constitute the aquifer at WMA A-AX (e.g., the large-scale pumping test at WMA B-BX-BY in the CCUg or saturated hydraulic conductivity data of the CCUg from the most recent version of the Central Plateau Groundwater Model [CPGWM]).

Chapter 3

1. Section 3.3, Page 3-50, Line 37: Explain further why uncertainty analysis was not conducted for this impacts analysis. Not clear is whether this sentence refers to the process model, system model, or both models.

Chapter 4

1. Section 4.1, Page 4-1, Line 40: The text should be revised to add another bullet for "Evaluating parameter uncertainty in the performance of the WMA A-AX system." This was specified as a principal use of the system-level model on Page 3-50.

2. Section 4.2.2.4, Figure 4.2: Figure 4-2 would be more useful if extents of geologic formations at the current water table would be overlain on it. This would support designation of the location of the high hydraulic conductivity zone and show correspondence between the calibrated CPGWM and the conceptual site model. Also, listing HSUs next to hydraulic conductivities in the legend would be helpful. It is not clear what is represented by zero m/d hydraulic conductivity in the legend, this needs to be resolved.

3. Section 4.2.3.9, Page 4-65, Lines 3 through 21: This paragraph discusses use of a "dimensional adjustment factor" in GoldSim to account for lateral dispersion in the saturated zone. It is not clear, why the plume function was not used in GoldSim. The GoldSim plume function has both transverse dispersivity and vertical dispersivity input arguments. Use of the plume function is recommended versus assigning a dimensional adjustment factor. In addition to the transverse dispersivity value discussion, provision of vertical dispersivity values would be necessary, along with sensitivity analyses on the transverse and vertical dispersivities.

4. Section 4.2.3.9, General: The basis for the dimensional adjustment factor (DAF) is not well supported. The DAF likely affects concentrations at the compliance point greater than any other parameter if the text is properly understood. The text states need for the DAF because the GoldSim aquifer element is a streamtube that does not account for lateral spreading. The DAF allows reduction of concentrations in the 1D model to account for lateral spreading for which the transverse dispersivity parameter in the 3D process model normally would account. The text (page 4-61, line 1) states "the dimensional adjustment factor modifies the outflow rate of the aquifer to account for the lateral spreading and flow heterogeneities in the 3-D process model.

   The text also states, "The ratio of concentrations from the process model and the system model was 3.5:1. Therefore, a dimensional adjustment factor of 3.5 was added to the flow rate in the second aquifer element." This is the equivalent of more than tripling an already-high horizontal hydraulic conductivity (i.e., 18,200 meters per day [m/d]) in order to account for effects of transverse dispersivity, which was assigned a value of 1.05 m in the process model.

   If the switch to the GoldSim plume function is not implemented, support the DAF discussion with a discussion indicating physical underpinning to this factor rather than implying it as a lumped parameter (which could mask poor conceptualization or mis-application of either the 3-D or 1-D models). This is particularly important because neither model is calibrated to or benchmarked against field data. Revise this section to better support use of the DAF or change the GoldSim model to use the plume function and describe that function.

Chapter 5

1. Section 5.2.1, Page 5-11, Lines 6-8: The text states that uranium concentrations are still rising at the end of the 10,000-year simulation. It is not clear if a simulation was conducted for "peak

seeking" out to 100,000 years to determine the peak uranium groundwater concentration. If not, then the text should be revised to justify not including this simulation.

2. Section 5.2.1, Page 5-11, Line 36: The text states "the flattening of the concentration time series for chromium from tank sources indicates the dissolved concentration limit of 2,000 µg/L within the waste form has been reached." Figures 5-5 and 5-6, which depict concentration of chromium in groundwater from all sources in WMA A-AX, show the majority of the tank sources have flattening curves at concentration of $2E^{-6}$ mg/L, which equals 0.002 micrograms per liter (µg/L) rather than 2,000 µg/L. Resolve the contradiction between the text and the figures.

3. Figures 5-5 and 5-6, Pages 5-13 and 5-14: The two figures are supposed to show concentrations in groundwater emanating from each tank source at the A and AX tank farms. However, it appears that all tank sources at the A Farm indicate exactly the same trend, as do all tank sources at the AX Farm. The figures are misleading because the trends for Tanks A101 through A105 cannot be seen, as they are overprinted beneath the Tank A106 trend. Trends at individual sources at the AX Farm are visible only because the AX Farm trends are represented by broken, rather than solid, lines. Thus, the figures are not effective at supporting the discussion of chromium concentration trends in Section 5.2.1. Modify or replace the current figures with figures that support the discussion.

4. Section 5.3.2, Page 5-25, Line 30: The text states that "of the 18 chemicals modeled, only 5 have a non-zero HQ at any time in the 10,000-year time frame." Specification previously in the document is for only 12 potential chemicals of concern (PCOC) because only 12 chemicals have non-zero inventory at WMA A-AX. The text should explain what are the other six chemicals to which the above-cited statement alludes, and do they have zero inventory.

Chapter 6

1. Section 6.1, Uncertainty Analysis, Pages 6-1 through 6-5: An uncertainty analysis of radionuclide fate and transport is in Section 6.1. This analysis applies to radionuclides, rather than hazardous chemicals, which is the topic of this document. It was also conducted on a base case simulation that was run by application of the process model, which is not used in analysis of fate and transport of hazardous chemicals. Thus, the discussion is not relevant to the analysis pertaining to hazardous chemicals. Uncertainty analysis regarding hazardous chemicals should be included in this document.

2. Section 6.1, Page 6-2, Line 11: The text lists types of parameters included in the uncertainty analysis. Notably missing are the unsaturated zone flow parameters, including moisture content and unsaturated zone hydraulic conductivity. Explain why these parameters were not evaluated in the uncertainty analysis.

3. Section 6.1, Figure 6-2: Not clear is what the dashed line labeled "deterministic" represents. Explain the meaning of this trend line in the text or on the graph.

4. Section 6.2, Page 6-5, Line 26: The text states that "it is also emphasized that these sensitivity analyses have been augmented by probabilistic uncertainty analyses that specifically evaluate

parameter uncertainties." The uncertainty analyses discussed in Section 6.1 do not address parameter uncertainty with regard to fate and transport of hazardous chemicals.

5. Section 6.2.2, Page 6-10, Line 19: The text states that "INF1 was selected to evaluate post-design behavior more consistent with the surface barrier performance that is more representative of the conclusions in PNNL-13033, namely that normal weathering of the surface barrier will likely not cause a significant increase in infiltration." The conclusions section of PNNL-13033 does not discuss effects of weathering on the Hanford prototype barrier. Support selection of INF1 with a pertinent discussion or analysis.

6. Section 6.2.2, Page 6-11, Lines 39-43: The text explains the relationship between the graph of total groundwater concentration in the different surface barrier sensitivity cases at 100 m beyond the fence line (Figure 6-3) to fence line concentrations, as follows "the concentration at the A Farm line will be at most 40% higher than the displayed results, depending on whether the impact to groundwater is driven more by tank residuals, in which case the fence line concentrations will be 40% higher than displayed, or residuals in pipelines and ancillary equipment, in which case the fence line concentrations will be 2% higher than displayed."

   This statement is related to the concept that the only process acting on contaminants between the PoCals is dilution. The statement reappears at least 10 more times in this section, rendering the text much longer than necessary. Suggestions are to rewrite the statement to more clearly express the underlying relationship of concentrations at the two PoCals, and to present the amended statement only once in the introductory section to improve clarity and readability of the section.

7. Section 7.0, Page 7-3, Bullets 2 and 3: Bullets 2 and 3 intend to present key observations about safety functions gleaned from the impacts analyses. Bullet 2 states that the unsaturated zone is a safety function that delays transport times to time lengths exceeding 1,000 years. However, the analyses presented in Sections 5 and 6 did not evaluate any vadose zone properties, so the basis for the 1,000-year delay is not explored in the impacts analysis. Similarly, the key saturated zone transport parameters hydraulic conductivity and hydraulic gradient were not evaluated in this document. The assessment should be revised to contain an evaluation of the vadose zone parameters in the impact analysis to support the statement the vadose zone is a safety function of 1,000 years.

Appendix A

1. A.7.7, Page A-14: The source for pipelines is assumed to occur uniformly throughout two areas (11,032 and 6640 square meters [m^2]). This assumption spreads out the source term for the pipelines and is not conservative. Moreover, this study does not evaluate that source area assumption. Recommendation is to evaluate focused sources within the release footprint.

2. A.7.8, Page A-15: Uranium solubility is evaluated in the uncertainty analysis, but chromium solubility is not. It is not clear why chromium solubility is not evaluated via uncertainty analysis. We acknowledge the statement in the Cantrell (2013) paper that maximum observed concentration of chromium was 2,000 µg/L in tank 241-C-202; however, because the A and AX

tanks have not been tested, it is appropriate to evaluate this constraint regarding chromium solubility in an uncertainty analysis.

3. A.8.2, Page A-16: Heterogeneity was not evaluated in this study because results at WMA-C showed concentrations to be less conservative. The assessment should evaluate heterogeneity at A-AX via sensitivity or uncertainty analysis, given its differing vadose zone geology, unless a justification can be provided.

Specific Comments on RPP-ENV-61497, Rev. 0

Chapter 4

1. Section 4.1.2.1, Page 4-4: This section (Description of GoldSim) would be a good place to include a diagram or key that identifies the various element icons featured in the figures throughout Section 4 for readers not familiar with GoldSim.

2. Section 4.2.2.4, Pages 4-31 through 4-38: Orientation of the grid at an angle of 45 degrees to orientation of tank rows (aligned to cardinal directions) introduces additional processing/post-processing steps, creating opportunities for error in calculations of contaminant concentrations at points of calculation (PoCals).

   Figure 4-3 shows the "zig-zag" relationship between model cell faces and the PoCal locations, and Table 4-8 provides the additional spatial calculations necessary to modify PoCal calculations because of misalignment between the grid and the PoCals. The text states that "the segments zigzag northward from the south because the orientation of the model grid, rotated 45 degrees from azimuth, is intended to parallel the direction of incoming flow, but the flow direction in the aquifer includes some curvature in the vicinity of WMA A-AX." The incoming flow direction shown on Figure 4-2 appears to be better aligned with a grid oriented to cardinal directions than the rotated grid shown on the figure. Similarly, Figure 2-54 shows the averaged water table map in 2014 with groundwater flow more toward the south than southeast at WMA A-AX. Necessity of these additional post-processing steps is questionable because of the very low hydraulic gradient (0.5 centimeter across the model domain) and curvature of the flow field. Flow lines should be included on Figure 4-3, as on Figures 4-15 through 4-17, to clearly make the case for rotation of the grid.

3. Section 4.2.2.9, Page 4-44, Line 20 through Page 4-45, Line 28: These paragraphs suggest that comparison of model results to the spatial distribution of moisture content data is inappropriate. Instead, the comparison is modeled moisture content profile to the average value of moisture content (presumably developed from the data distribution) assigned to an HSU, which does not vary with depth. The underlying reason for presenting one average value to represent the entire moisture content profile in Figures 4-7 and 4-8 is that "the data represent several different locations in WMA A-AX where the data were collected in 2014," and "the data exhibited considerable variability, ranging from close to zero to as high as 43.2 percent by volume." In other words, moisture content data vary significantly.

A key question underlying the abstraction approach is appropriateness of assuming an equivalent homogeneous medium (EHM) approach and using a single value to represent a parameter that likely varies with depth. This discussion does not address that question adequately. This section should present the data set and its variability in space and time in order to support or reject the hypothesis that the EHM approach does not oversimplify model results. This hypothesis should be tested with the process model before concluding the system model will accurately replicate behavior of the actual system to be modeled. At a minimum, the sensitivity analysis should test a "worst-case" scenario using a moisture content value representative of the high end of the observed data distribution.

4. Section 4.2.3.3, Page 4-50, Line 38: The text indicates that the system model discretization scheme for the vadose zone featured finer discretization near the HSU contacts "to produce improved numerical results near the interface." Not clear is whether the text refers to element thickness or number of cells. One suspects the former, because Table 4-11 indicates that the H2_Middle element (the only element not bounded by an HSU contact) consists of 100 cells to represent 50 m of vadose zone for a cell thickness of 0.5 m. The remaining elements range from 1.5 to 8.25 m in thickness, and none is subdivided. Clarify the meaning of "finer discretization."

5. Section 4.2.3.9, Page 4-56, Line 7: The text states that "the saturated zone has been modeled as a 1-D transport pathway oriented along the primary flow direction." However, Figures 4-15 through 4-17 show that this is clearly not the case for most of the model domain. The flow lines cross the upgradient boundary at an angle of approximately 45 degrees, which increases to approximately 70 degrees from normal where the plume passes through the PoCals (as seen on Figures 4-16 and 4-17 that show the PoCals aligned on their downgradient column boundaries). Accurately characterize the relationship of the grid to the flow lines.

Chapter 6

1. Section 6.1.6, Page 6-31, Lines 10-12: Two metrics, peak of the mean and mean of the peaks, are introduced, but unclear is whether this document provides values of these. Metrics such as peak mean dose and mean peak dose appear in this chapter, but not clear is whether these are peak of the mean or mean of the peaks doses. Clarify what the peak doses presented in this section represent.

2. Section 6.1.6.2.1, Figures 6-11 through 6-17: Not clear is whether the total dose is calculated at the fence line or 100 m beyond the fence line. Clarify this in the text or on the figures.

References

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