STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1250 W Alder St • Union Gap, WA 98903-0009 • (509) 575-2490

October 11, 2019

Shane DeGross
BNSF Railway Company
605 Puyallup Avenue
Tacoma, WA 98421

RE: Ecology comments on draft Inundated Lands Initial Investigation Report:

- **Site Name:** BNSF Track Switching Facility aka Wishram Railyard
- **Site Address:** 500 Main St., Wishram, Klickitat County
- **FSID No.:** 1625461
- **CSID No.:** 230
- **Agreed Order:** DE 12897

Dear Shane DeGross:

Thank you for the submittal of the above-referenced draft report in accordance with Agreed Order DE 12897. Below are the Department of Ecology's (Ecology) comments on the draft report. Please review and incorporate edits for Ecology's review and final approval.

General Comments

Comment 1. The Sediment Management Standards (SMS) site identification process remains incomplete as Ecology stated in our comments to the draft Inundated Lands Initial Investigation Work Plan Addendum.

Comment 2. Ecology does not concur with your conclusion of no continuity between the upland non-aqueous phase liquid (NAPL) and the offshore NAPL for the following reasons:

- Lack of sufficient sampling density beneath the riprap.
- The unapproved modification of the final Nearshore Sediment RI Work Plan resulted in fewer core samples collected in the nearshore area.
- Limitations of the Dart survey at and near the riprap area.
    - Darts, D200 and D240, in the shoreward vicinity of MW-16 showed low-level responses (<10 %RE maximum but above background). With ultra violet optical screening tool (UVOST), any response off baseline may be indicative of NAPL.

  - Dart, F360, exhibited a very low-level response (consistent with background). However, the sediment sample showed visible evidence of NAPL.
  - Dart, E380, showed a low-level response with blue-green waveform however a sample was not collected at this location either by surface grab sampling or by core sampling.
  - Note that Dart, E380 showed a low-level response with blue-green waveform inconsistent with background. The laser-induced fluorescence (LIF) response was greatest at the deepest depth of sampling (~2.0 feet below surface). No confirmational sampling was performed at this location. However, F360, which is near E380, did show NAPL.

- Indications of NAPL in LIF logs, CR-02 and CR-03, at approximately 10 to 13 feet below grade.
  - Historical upland sources of diesel or middle distillate-range petroleum hydrocarbons in the near proximity of these locations include the 2,064-gallon Caloil tank and two diesel tanks (15,000 and 20,000 gallon).
- Indications of mixed NAPL organics in LIF logs, CR-04, CR-04_5, and CR-05, at approximately 6 to 8 feet below grade at the west (CR-4) and thinning to about 5.5 to 6.5 feet below grade at the east (CR-05).
  - Potential upland sources include the 2,064-gallon Caloil tank the Boiler Oil Feed AST, the Bunker C pipeline, the oil trough and the oil sump.
  - Blending of middle distillate and heavy oil may have occurred in the area adjacent upgradient of these locations to provide fuel for the powerhouse.
- The boring log for MWD-2 indicates NAPL (Figure 36). This boring was converted into a monitoring well location which is upgradient near MW-16.
- Dissolved-phase diesel range organics (DRO) at concentrations greater than 1,000 ug/L at MW-15 and MW-16. Research by Zemo (2009) and Shui et. al (1990) show that it is very likely that a nondissolved component exists if the dissolved-phase concentrations of diesel are greater than its effective solubility.
  - Dissolved-phase concentrations have varied from 4,760 to 12,360 ug/L combined DRO and ORO (oil range organics) at MW-15 and 5,200 to 36,270 ug/L combined DRO/ORO at MW-16.

  - Dissolved-phase concentrations have varied from 1,155 to 8,580 ug/L combined DRO/ORO at MW-17.

- The Nearshore Investigation Report shows NAPL present in sediments at locations, J260, G200, F360 and G260. Locations J260 and G260 are offshore from MW-16.
  - The offshore investigation shows NAPL shoreward of the oil trough, the powerhouse, the oil pipeline, the Caloil tank and the Boiler Oil Feed aboveground storage tank (AST).
- The top of the NAPL interval shown in the LIF logs appears to reside in the unsaturated zone or temporarily resides in that zone when the groundwater elevation (and lake level) drops. These conditions may allow NAPL to migrate in the air/NAPL-filled pore spaces and the air-filled pore spaces. It is only when saturated conditions exist that NAPL has to overcome pore entry pressure of the water-filled pores.

Adjust your conclusion based on these points.

Comment 3. This draft report deals primarily with the investigation of non-aqueous phase liquid (NAPL) in the sediments. The limited focus of the Initial Work Plan did not address the investigation of groundwater to surface water seeps along the shoreline where dissolved-phase impacts to surface water may exist. The draft Uplands Remedial Investigation report does describe the interpretation of the groundwater elevations through time as measured in the monitoring wells (hydraulic gradients). However, there is no information specific to groundwater to surface water seeps other than the temporal interpretation of the transducer data set that shows that discharges to the Columbia River are limited to a certain portion of a given year. Your interpretation also assumes that the 16-month monitoring period represents the typical pattern of water level fluctuation.

Ecology requires the further investigation of the groundwater to surface interaction.

Comment 4. Ecology makes specific comments concerning the body of the draft report that follows the table of contents. As such, comments that apply to those sections should also be reflected by corresponding changes on the Executive Summary page.

Note also that the comments previously provided by Ecology on the draft Inundated Lands Work Plan Addendum might have bearing on these current comments provided in review of the data collection and interpretation presented in this draft report. I did not attempt a thorough duplication of comments with regard to both of these documents.

In addition, some of my comments provided in Section 2, Initial Investigation Activities, may be more applicable to Section 3, Results. In that case, you may see a comment that refers to results but the comment appears in Section 2.

Comment 5. **Figure 1-2, Wishram Railyard Inundated Lands Study Area**: Please add a notation that some of the features described in the Legend may not appear on the figure. Please apply the changes requested in this comment to other figures in the document, as applicable.

Specific Comments

Comment 6. **Section 2.2.1, Dart Survey**: Please state whether the Dart solid phase extraction (SPE) media non-preferentially absorbs both low molecular and high molecular weight (short- and long-chain) polycyclic aromatic hydrocarbons (PAHs). This is significant because the non-selective sequestering of PAHs together with the use of the ultraviolet optical screening tool (UVOST) may result in the under-biased detection of PAHs due to the internal quenching of the fluorescence response. Indicate this in the report.

Also, specify in this section that benchtop UVOST was the type of LIF that was used to screen for the presence of separate-phase heavy oil petroleum hydrocarbons in the SPE media and by proxy, the sediments.

Comment 7. **Same section**: The Dart SPE media and UVOST were used to evaluate the aqueous-phase organics in MW-16 and the separate-phase organics in OHM-1. It is questionable whether the LIF logs generated from these two monitoring points are representative of what is present in the sediments.

In the sediments, the separate-phase petroleum hydrocarbons are not differentiated as you may see with the light non-aqueous phase liquid (LNAPL) that has collected in OHM-1, an upland well which penetrated through 30 to 40 feet thickness of submerged heavy oil as shown by LIF logs, TG-D04 and TG-D05.

Note that the 2013 Tar-specific Green Optical Screening Tool (TarGOST) Investigation report singles out the fluorescence signature at TG-D05 as representing a product type different than what is characteristic of "*pure heavy*" materials.

The analysis provided by Dakota Technologies suggests that the fluorescence response in TG-D05 log represents a mixture unlike the endpoints identified either as "diesel-like" or "light" or as "heavy oil-like" or "heavy". The comparison of fluid differentiated from a mixture versus a non-differentiated mixture is a spurious one. State this in the report.

Also questionable is the use of the logs generated at MW-16 and OHM-1 for calibration purposes, if at all used as such, for the reasons stated above. Likewise, the presence of naturally occurring organics containing PAHs may have interfered, either additive or subtractive, with the UVOST fluorescence response. Indicate that the Dart results are uncertain without proper calibration and sufficient confirmational sampling.

The considerations expressed in this comment and in Comment 6 cast doubt on the utility of using the Dart sampler and UVOST LIF as the first step in evaluation of the sediments for petroleum impacts. State this in the report.

Comment 8. **Same section**: The text states: "*Refusal with the pre-probing rod was generally interpreted to be a hard rocky or sandy layer*."

Please make a distinction in the text that hand pressure only was used to determine refusal as opposed to mechanical assistance by a weighted slide hammer or a percussion rotary hammer, unless these latter methods were used.

Comment 9. **Same section**: Have you assessed at all the potential role of oxygen quenching in the benchtop UV-LIF as a factor in possible reduction of the LIF response? I note that the Nearshore Sediment Remedial Investigation Work Plan did not specifically call for the evaluation of the benchtop fluorescence response under dysaerobic conditions, which may be more representative of natural conditions.

The question is whether the benchtop results emulate the natural, in-situ conditions, e.g., will one see a greater energy intensity measured as percentage of the reference emitter (%RE) if nitrogen gas is used to displace the oxygen to less than 20%, which may otherwise mimic in-situ conditions for the goal of obtaining a representative fluorescence response? State in the report the possible effect of oxygen quenching on the benchtop UV-LIF results.

State in the report whether you sampled the SPE media by analytical methods following collection of the Darts to evaluate the concentration of PAHs as a crosscheck or alternatively as calibration for the LIF response.

Comment 10. Section 2.2.2, Surface Sediment Grab Sampling: The text states: "*Within the study area, locations where Dart responses indicated the greatest potential for the presence of PAHs were targeted for surface sediment sampling.*"

My understanding is that with UVOST, any fluorescence response above the baseline (0% RE) should be taken into account if the method is functioning properly. Did you rescale any LIF logs to evaluate all of the responses above baseline?

I would especially point out log, F-300-DART. The waveform callout at approximately 2.1 feet below the top of the sediment elevation is notable in that the waveform closely resembles a gasoline or possibly a kerosene-like UVOST signature yet that callout only shows a fluorescence response of 3.6%RE.

Comment 11. Same section: The text states: "*At one study area and the background location, a bulk bioassay sample was collected…*"

Figure 2-2 identifies five collection locations for the surface sediment samples and Table 2-2 identifies the bioassay sample location as D420. However, as stated in Section 3.1.4, no bulk bioassay samples were collected.

I would have questioned the validity of the results if a bulk sample were collected at D420 for a bioassay. The LIF log for D420 shows a response that is similar to that shown in the log for the background sample with respect to a combination of criteria including the predominant peak, the fill color, and the waveform lifetimes. In contrast, the LIF logs for the remaining surface sediment sample locations (D150, D220, D240, D260) appear different in those same aspects shown in the background sample and in D420. The fill colors for the four logs are light blue to yellow-green, which indicates the relative dominance of the blue and green channel waveforms as opposed to the single dominance of the orange waveform. The waveform lifetimes also appear to be longer than those waveform lifetimes shown in the background sample and D420. These criteria would have called into question the selection of D420 as the location for the study area bioassay sample.

For comparison, the log for MW-16 has a yellow-green fill color for the dissolved phase organics. In addition, the portion of this particular log above the flagging tape shows an orange fill color similar to that representative of the background sample whether that response is an artifact or is not one.

Ecology asserts that the selection of the sample collection for bioassays should be properly informed by criteria such as described.

Comment 12. Section 2.3.2, Sediment Core Sampling: This draft section explains why the sediment core sampling deviated from Section 6.1.3 of the Ecology-approved work plan however; this rationale was not presented for Ecology decision input when BNSF took this action in the field. The work plan called for the collection of up to six confirmational sediment cores to confirm NAPL delineations gathered in the Dart survey and did not call for the contingency of core sampling beyond the initial study area that is explained in the draft Inundated Lands report. This is not necessarily an omission per the work plan in terms of the number of samples to be collected but it does represent an unapproved deviation. This unilateral action taken has jeopardized the legitimacy of this portion of the investigation.

Only one sediment core sample was collected per the work plan in the initial study area (sample D200). Examination of this LIF log shows that the highest %RE response is confined to approximately the upper eight inches at that location. Presumably, this location could have been sampled with a surface sediment grab sample (0 – 0.5 feet) while alternative Dart locations could have served for collection of sediment cores along the initial study area for more comprehensive coverage of the nearshore area. Dart locations that show greater than 10%RE that could have served as alternative core sampling locations are D280, E380 and F300.

The results of the deviation did return information that identified separate phase-impacted sediments outside of the initial study area. In that respect, I take no issue with that outcome. However, the emphasis on the nearshore area was again reduced since only one core sample was obtained in that area to characterize the chemical oxygen demand (COD) and the total organic carbon (TOC) for assessment of the ebullition potential.

I also point out that you identify NAPL observed in core sample, F360, but that the Dart response was negative for presence of petroleum hydrocarbons in that the LIF response appeared consistent with that shown in the background sample. See Table 2-3, Core Sample Summary. State this observation in the report.

With respect to the nearshore area, the results from D200 and F360 call into question the efficacy of using the Dart samplers and UVOST LIF as a first step to assess heavy petroleum hydrocarbons.

More importantly, my review as described above calls into question the adequacy of characterization per the work plan especially in terms of the assessment of petroleum-impacted locations along the nearshore and, to some extent, in the assessment of ebullition potential.

Comment 13. Section 2.3.3, NAPL Mobility Coring: I note that a Dart sampler was not emplaced in the two locations where the screening (visual, olfactory and photoionization detector (PID)) indicated NAPL (G200 and G260). This action, if taken, could have been informative in evaluating the Dart sampler and the benchtop UVOST setup from a SPE sample collected from a known NAPL location with in-situ heavy oil.

Prior to sectioning for laser-induced fluorescence frozen core analysis (LIFFCA), did anyone evaluate the core sample along its length to see if sedimentary features or structures could be observed? Possible pre-inundation depositional features that could be expected to be found in buried, relatively undisturbed or minimally reworked, sediments include stratification, graded bedding and cross bedding. These features may exert possible controls on transport due to variations in permeability. Discuss this in the report.

Variation in permeability predominantly in the horizontal plane or at an angle to the horizontal plane (non-vertical plane) may also have bearing on the NAPL mobility as opposed to evaluating only along the vertical axis (as was done with the LIFFCA pucks). Discuss this in the report.

Comment 14. Section 3.1.1, Dart Survey: Provide all of the raw LIF data for D240 as well as for the rest of the data set. The callouts at the lower part of this log appear to focus on the yellow green portion of the fill color as opposed to the light blue fill color that is predominant in the lower half of the log of the fluorescence response. Ecology has the proprietary optical screening tool (OST) software purchased from Dakota Technologies so that we can obtain additional callouts. In addition, the lifetimes of the waveforms appear to be longer in the upper part of the log compared to the callouts in the lower part.

Comment 15. Section 3.1.2, Stratigraphy and Visual Observations: Did anyone observe core sample, D200, for the presence of sedimentary features such as stratification, graded bedding and/or cross bedding? Some of these features could be expected if eolian and fluvial sedimentation were the predominant depositional processes of the former "beach" sand area (at least in the pre-inundation and not significantly reworked, deep part of the core). State this in the report.

Comment 15. Section 3.1.3, Petroleum-Related Constituents in Surface Sediment: The text states: "*…at core location D200, where the highest observed Dart fluorescence response was observed but where NAPL was not observed, a DRO concentration of 459 mg/kg was measured in the non-SGC sample.*"

The Sediment Management Standards (SMS) contains Table VI, Freshwater Sediment Cleanup Objectives and Cleanup Screening Levels Chemical Criteria, which lists the bulk petroleum hydrocarbons as separated into Total Petroleum Hydrocarbon (TPH)-Diesel and TPH-Residual. However, the benthic life may be affected by the cumulative effect of the combined total petroleum hydrocarbons resident in the impacted sediments. In that situation, a bioassay is applicable.

Per WAC 173-204-310(2), Ecology invokes the confirmatory designation procedure using bioassays as described in that subsection.

Comment 17. Same section: Regarding use of SGC, the following is stated in Ecology Publ. 97-602, Analytical Methods for Petroleum Hydrocarbons: "*It has been noted that some petroleum products, i.e. heavy fuel oils such as #6 fuel oil or Bunker C, may experience a concentration loss of between 10 and 20 percent when subjected to this cleanup technique. This loss appears to be primarily associated with the removal of petroleum compounds which contain sulfur. To account for this loss when analyzing samples that have been subjected to the cleanup procedure in preparation for heavy fuel oil determination, the analyst must use utilize (sic) standards which have undergone the cleanup technique to calibrate the GC.*"

Per this instruction, did the laboratory use the appropriate reference standards for comparison when quantifying the TPH concentration of the heavy oil after subjecting the sample to silica gel cleanup as a preparation method? State this in the report.

Comment 18. Same section: The text states: "*Based on this information, the nearshore area does not qualify as a sediment site under applicable standards.*"

Sufficient information was not collected to make the determination of whether the nearshore area should be incorporated as part of the offshore area that was designated as a sediment site. Consequently, this statement should be removed or modified to indicate it is based on existing information, which Ecology deems to be insufficient.

Comment 19. Section 3.1.4, Comparison of Sediment Sampling and Dart Results: Please provide the chromatograms for the analytical samples plotted in Figure 3-2. The TPH analysis may have incorporated the presence of naturally occurring organics into the quantification.

PAHs from natural organics may also have influenced the Dart sample results. For each LIF log, provide the classification plot provided by least squares analysis, if available.

Comment 20. **Same section**: The initial work plan (e.g., see Figure 6.-3) called for two comparisons, the Dart UVOST response to pore fluid saturation (PFS) and the core segment TarGOST response to PFS.

In contrast, the draft Initial Sediment Investigation only exhibits a graph of Dart fluorescence responses versus TPH concentration (Figure 3-2). Explain why there is a difference between the work plan and the report.

Did you assess any comparisons between any LIF response (UVOST or TarGOST) and the PFS? If so, include this information in the report. In lieu of that comparison, did you determine equivalent NAPL saturation based on the TPH mass concentration, e.g., using the Parker et. al, 1994 equation? If so, provide this information in the report.

Comment 21. **Same section**: I note that the cross-referenced data point for D420 shown in Figure 3-2 plots at a location supportive of a good fit between the DRO+ORO results and both the average and maximum Dart responses. However, the LIF log for that sample appears most similar to the response shown for the background sample. Indeed, the analytical result for that location shows non-detect for TPH. That raises the question of whether much of the Dart response is more indicative of the general presence of PAHs in the pore space attributable to natural organics as opposed to the presence of petroleum hydrocarbons and thus, the correlation is one simply between the presence of organics and UVOST response. On the other hand, a comparison of PFS to TarGOST response may provide a better indicator. Discuss this in the report.

In addition, the LIF classification plot, if available, may provide more insight into the origin of the PAHs, whether the source is pyrogenic, natural or even petrogenic. Are LIF classification plots available? If so, provide these plots in the report.

Comment 22. **Same section**: Is the average UVOST LIF response based on the entirety of signal from the baseline across the vertical sampling interval or is the average based on a threshold response, e.g., responses above 10%RE? State your answer in the report.

Comment 23. Section 3.2.1, Stratigraphy and Visual Observations: The text states: "*…remaining 4 locations (G200, G260, J260, and F360), a 2- to 3.5-foot interval of highly plastic disturbed silty sand with no apparent bedding structure and an abundance of organic debris, consisting of wood and roots, was observed approximately 0.5 foot to 2.5 feet bss.*"

The text also states that anthropogenic debris was encountered at 4.2 feet bss at G200. In contrast, at location J260, fine sand with laminations was encountered from 3.5 to 5.4 feet bss according to the sediment core log. Based on those observations, we should not expect that the sediments were draped uniformly over the bedrock but that the surface topography of the beach sediments was variable in places. State this in the report.

I also note that the presence of laminations is not indicated in Figure 3-4, cross-section A – A' unless you refer to that feature as being incorporated as part of the unit labeled as "*Sandy Silt w/ Organic Debris*." Sedimentary features such as laminations may affect the permeability and transport of contaminants. State in the report why you do not refer to the laminations as potentially having control on the transport of fluids.

Comment 24. Section 3.2.2, Petroleum-Related Constituents in Surface Sediment: The text states: "*At the remaining 3 core locations where NAPL was observed was greater than 2 feet bss and results from the overlying sediment were all below applicable SCOs.*"

Regardless of whether SMS sediment criteria were exceeded, sediment contamination that causes a sheen in surface waters or in groundwater that affects surface water above applicable cleanup standards constitutes a cross-media violation of water quality standards. Ecology expects that the petroleum-impacted sediments will have to be addressed to prevent formation of petroleum sheen triggered by ebullition or any other mechanisms.

Comment 25. Same section: The text states: "*Where EPH fractions were detected, between 70 and 80 percent of the detections consisted of both aliphatics and aromatics in the carbon range C21-C34. Again, this is consistent with the TPH results, as higher concentrations of TPH-ORO were observed relative to the TPH-DRO.*"

Ecology notes that a comparison between the TPH methods and the fractionation methods (VPH/EPH) is problematic due to the standard use of silica gel cleanup as part of the fractionation procedure for sample preparation. The differences in how integration is performed for each method may also introduce difficulty in comparing results from the TPH methods and the fractionation methods.

How do you account for proportional shifts in the carbon range fractions consequent of weathering processes on the composition of the petroleum masses throughout the site that may have contributed to that pattern? State your answer in the report. Ecology also notes that fractionation data is typically applied to human health criteria.

Is it instructive to distinguish, both vertically and laterally, the spatial distribution of TPH into a scheme similar to EPA's six toxicity fractions (aliphatic – low, medium, high and aromatic – low, medium, high) rather than generalizing as stated?

This approach makes sense since one would not necessarily separate out fraction ranges into diesel and heavy oil categories for in-situ petroleum. However, one would distinguish the fraction ranges as appropriate, for example, when one looks at the diesel-like mass near the current water table versus the petroleum mixture characteristic of the submerged NAPL near the sediment-surface water interface. This approach may not suffice for compliance purposes but it could have some utility for characterization and assessment purposes.

Comment 26. Section 3.2.3, Total Organic Carbon and Chemical Oxygen Demand in Surface and Subsurface Sediment: Table 3-4 lists TOC values for offshore sediment samples. The TOC value for D200 is not shown in that table since it represents a nearshore location. However, the analytical report in Appendix C does show that the TOC value for D200 in the initial study area is 4,580 mg/Kg. State in the report the depth of sample collection for TOC analysis at D200 and add the information about this location into Table 3-4. Change the title to Sediment Analytical Results

The depth of this sample collection is uncertain based on a review of the chain of custody. I note that no other samples were collected in the initial study area to determine the TOC values of the nearshore area. State this uncertainty in the report.

Comment 27. Same section: The text states: "*The higher TOC concentrations…were observed farther from shore at F360, G200, G260, and J260…*"

This statement does not fully provide the spatial context that describes the distribution of TOC values. Laterally, the area of highest TOC values are near G200, G260 and F360. Beyond these three locations, the TOC values tend to decrease generally with greater water depth. However, with the exception of D200, there does not appear to be enough TOC information to make a good comparison to the nearshore area. State this in the report.

I note also that a set of shallow and deep samples is not available for all of the eight sampling locations. Three of the four available sets of shallow versus deep samples suggest that the TOC values increase with sediment depth across the vertical sampling interval. State that the increase in TOC may also be related to some factor associated with sediment depth

Comment 28. Section 3.2.4, Nonaqueous Phase Liquid Mobility: The text states: "*NAPL density was assumed to be 0.96 g/cm^3 based on measurements of NAPL collected from upland wells in 2016.*"

The properties of the LNAPL collected from the upland wells will likely differ from the properties of that NAPL found in-situ in the sediments. If there is a density difference, is that difference negligible in the calculations? State this in the report.

Comment 29. Same section: In Figure 3-5, the ultraviolet response of the LIFFCA pucks may not be representative of the concentration of PAHs in the subsamples due to the artifactual nature of the internal quenching effect potentially induced by the high concentration of heavy molecular weight PAHs present as the pore fluid saturation (PFS) increases. In this situation, the TarGOST response is more instructive of the PFS of the heavy end petroleum hydrocarbons. State this distinction between the benchtop UV versus the TarGOST screening in the report.

Comment 30. Section 4.1, Sources and Chemicals of Interest: The text states: "*In some instances, sufficient NAPL was released to cause saturation of pore spaces in the soil allowing vertical migration of NAPL as a separate phase to the top of the present-day water table…or to the top of the historical water table…*"

This statement appears to emphasize the smear zone distribution of NAPL, which would be more characteristic of a release of a "diesel-like" product. In contrast, I note that the uplands TarGOST log for location, D-06 shows a fluorescence response that is approximately 70 feet thick and extends to a depth of about 85 feet below the current land surface. This suggests that the viscosity of the Bunker C or petroleum mixture released at the previous time(s) was considerably much lower than the viscosity of the weathered petroleum mixture present today.

It also suggests that the density and viscosity was such that the mass would have penetrated downwards due to NAPL head sufficient to overcome pore entry pressure in the saturated zone.

At location, D-05, the NAPL thickness is less (~40 feet) however, that petroleum mass appears to rest on the sloping bedrock surface assumed based on drilling refusal.

The SP& S letter dated November 20, 1950 documents an oil release that workers routed to a low area so again the viscosity must have been much lower, sufficient for the mass to flow readily. Even for a viscous mass, the effect of loading may be sufficient to mobilize the NAPL having a low fluid conductivity. State the distinctions mentioned in this comment in the report.

Comment 31. Same section and Section 4.3.1, Nonaqueous Phase Liquid: The text states: "*The extent of this NAPL does not extend to the current shoreline, and investigations within the inundated lands have not shown the presence of NAPl within nearshore areas.*"

"*The coring and Dart response data collected to date indicate NAPL is not present within the nearshore areas but is located within former upland areas (now inundated) between approximately 40 and 130 feet south of the current shoreline (Figure 3-2).*"

Ecology notes these interpretations are subjected to our criticisms here and elsewhere in these comments. An alternative explanation is that the route taken by the heavy oil mixture from the uplands to the former upland area (now inundated) at the time of release is narrower than could be captured by the sampling density provided by the Darts and the other investigation methods. State Ecology's objection and this alternative explanation in the report.

Comment 32. Section 4.3.2, Chemicals of concern and Section 4.5, Potential Exposure Pathways and Receptors: Per WAC 173-204-310(2), Ecology invokes the confirmatory designation procedure using bioassays as described in that subsection. See Comment 15. Ecology expects that you will perform a bioassay to override the chemical criteria.

Comment 33. Section 4.6, Inundated Lands Characterization Stage Conceptual Site Model: The first bullet of this section relates to a release or to composite releases identified in this phase of investigation. There may be older releases undiscovered deeper in the sedimentary deposits above the bedrock or in contact with the bedrock. State this in the report.

Comment 34. Appendix F, Calculated Estimates of Ebullition Potential, Section 2, Sediment Characteristics: Please see Comment 26 above.

Comment 35. Appendix A, Dart Response Logs: I note that the UVOST signature within the NAPL in OHM-1 closely resembles a diesel-like signature, especially the callout at 2.0 feet depth. The log also shows three other waveform callouts. Why do you show callouts above the NAPL? Is there water above the NAPL? Incorporate these answers into the report.

If these additional callouts represent dissolved-phase product, I note the resemblance in the callout pattern (relative peak heights) between OHM-1 and MW-16. Otherwise, the relative height of the blue channel and the lifetime of all of the channels differs between the two profiles. The third callout on E-380-DART most resembles the callout for MW-16.

The groundwater analytical results for MW-16 generally show greater concentration of diesel range organics over the residual oil range organics even in the samples prepared with silica gel cleanup.

The proportions of the dissolved-phase concentrations of groundwater samples collected from OHM-1 are more evenly divided between diesel range and residual oil range organics. I have not seen the analytical composition of the NAPL from OHM-1 but the UVOST LIF signature suggests that the LNAPL is predominantly diesel-like. State this in the report.

You can reach me at (509) 454-7836 if you have any questions regarding Ecology's comments.

Sincerely,

John Mefford

John Mefford, LHG
Cleanup Project Manager
Toxics Cleanup Program
Central Regional Office

cc: Allyson Bazan, AGO Ecology Division
Brooke Kuhl, BNSF Railway Company
Matt Wells, Tupper Mack Wells PLLC