



To: Quinault Indian Nation

- From: Natural Systems Design, Inc. and Saturna Watershed Sciences
- Date: October 28, 2020
- **Re:** Critical Review of Proposed Chehalis River Basin Flood Damage Reduction Project NEPA DEIS: Geology Discipline Report Review

EXECUTIVE SUMMARY

A qualified technical team of geologists and geomorphologists reviewed the National Environmental Policy Act (NEPA) Draft Environmental Impact Statement (DEIS). The team also reviewed related documents prepared to support the proposed Flood Retention Expandable (FRE) facility and airport levee improvements project (proposed project), which are being reviewed by the U.S. Army Corps of Engineers under NEPA. The team was composed of Tim Abbe PhD, PEG, PHG of Natural Systems Designs and Paul Pittman PEG of Saturna Watershed Sciences.

The team reviewed the DEIS, as well as the Geology Discipline Report (Appendix H), the Selection and Description of Alternatives (Appendix D), and Impact Levels (Appendix E). The team concluded that the following critical assumptions, omissions, and errors are present in the NEPA DEIS and associated discipline reports, resulting in a gross underestimation of the potential for impacts if the proposed project is approved for construction and operation:

- The proposed project action is a significant project; therefore, the highest level of analysis is expected. However, the analysis is generally qualitative, with significant omissions. It is our opinion that the analysis does not meet the standards typical for a project of this scope, scale, and intensity.
- This is a project DEIS, not a programmatic/plan-level DEIS; therefore, project specific details for all project related actions need to be included so that extent, magnitude and consequence of the potential impacts can be disclosed and quantified for use by regulatory decision-makers. This project DEIS does not meet that standard for all actions and impacts.
- This project was determined by the lead agency to have high potential for significant impacts, hence the preparation of an EIS. Deferring proposed mitigation to some future point via the Clean Water Act Section 404 permitting process omits the function of NEPA, which is to ensure that significant impacts are mitigated to the greatest extent feasible. The NEPA DEIS does not provide a Mitigation Plan suitable for evaluation under this review and thus regulatory decision makers have no basis on which to determine if it is possible to adequately mitigate for the proposed impacts to the Chehalis River and its associated floodplain habitats and species.
- Alternatives need to be developed adequately and equitably, such that they can be compared and vetted to a high level for a project of this magnitude. Cost-benefits and impacts for all alternatives identified need to be sufficiently robust to truly evaluate the alternatives and make a meaningful selection process. This NEPA DEIS does not provide a defendable alternatives analysis.
- The NEPA DEIS evaluated impacts over a time scale of 50-years. It is not clear if the proposed project will continue beyond 50-years or if it would be removed at that time. Given the fact that large dams are intended to last far longer than 50-years and there is no commitment to remove the project in 50-years, the evaluation time period of 50-years is arbitrary and misleading since it minimizes impacts that occur

over a longer time period. Cumulative environmental impacts will increase with time, maintenance costs will rise considerably with the age of the project and flood reduction benefits will diminish significantly after 50 years based on climate predictions. If there is no plan to remove the project, it should be considered permanent and needs to be evaluated as such. If it is a temporary structure, there must be a commitment it will be removed, and the removal action and associated impacts and proposed mitigation be described.

- The FRE design allows for a future expansion the proposed project. However, that future expansion and its impacts, while stated in the definition of the proposed project (I.e. the Flood Reduction Expandable facility), are not disclosed, or evaluated. The future phase of this project needs to be included in the impact analysis.
- The analyses supporting the NEPA DEIS rely on unsupported and erroneous information and omit potential impacts, thus providing inaccurate and biased results to decision makers in the DEIS document.

Comments specific to the Geology Discipline Report (Appendix H) and supporting technical analyses are:

- Referral to the proposed project as a "temporary reservoir" is factually incorrect and misleading. The reservoir is a permanent feature on the landscape. The pool will be periodically filled and drained over the life of the project and using the word "temporary" is clearly used repeatedly in the DEIS to minimize impacts. "Temporary" is synonymous with "short-term" or something that lasts only a limited time and is not permanent. Yet the DEIS refers to long-term impacts, such as first sentence on page 31 of Appendix H: "Over the long-term, there would be potential for a high impact from increased erosion in the flood retention facility project area."
- An increase in landslides within the reservoir from operation of the FRE facility is acknowledged in the text (pages 31 and 35, Appendix H). This impact, however, is not adequately described nor evaluated, and it is not presented in the impact inventory table. This is an omission.
- Large displacement waves initiated by landslides are only considered in the analysis if the triggering mechanism is seismic. Landslides initiated by drawdown at full or activated reservoir conditions or other potential triggering mechanisms are not considered in the hazard and impact analysis. This is an omission.
- No geologic hazards occurring downstream were identified or evaluated; however, downstream geologic hazards, such as dam overtopping, will result from this project and the risk is potentially high. Federal and state guidelines require this analysis. Some geologic hazards, such as dam overtopping or dam failure, have a high and potentially unmitigable risk. Failure to consider and disclose this potential impact misinforms public hazards and risks for FRE operations and underrepresents potential habitat impacts. This is an omission.
- The document falsely states the proposed project "will result in less riverbank erosion and a medium beneficial impact" (last paragraph, page 31, Appendix H). This statement has no supporting evidence and conflicts with analysis presented in Appendix I (Geomorphology) that clearly states that bank erosion and channel migration occur at peak flows far less than those that will be reduced by the project. Erosion and sediment transport are natural processes in alluvial rivers and critical to habitat formation. This is particularly important for the Chehalis downstream of the proposed project since it has experienced significant historic incision and confinement. The only way for an incised channel to reestablish a new floodplain and the benefits to habitat and flood conveyance is through bank erosion. Thus, even if the project did reduce erosion it would be an adverse impact, not beneficial impact.
- The maximum conditions considered in the impact analysis was the "catastrophic" event, or 100-year event. The probability of a 100-year event occurring in any given year is 1%. Assuming no change in

hydrology over the 50-year period the project is evaluated, the probability of a 100-yr flood increases to 39% and over 100-years, it increases to 63%. But it is well established that hydrologic changes are occurring as a result of the warming climate and the magnitude and frequency of flood peaks will increase. So, the probabilities of a 100-year flood will increase as will events larger than the 100-year event. National and international dam safety design standards require the use of the probable maximum flood (PMF), yet no analysis of the PMF or its impacts were presented in the DEIS. Failure to disclosure of this hazard potential and the downstream impacts **is an omission**.

- The lack of sufficient detail in the proposed quarry plans and the failure to disclose and evaluate potential impacts constitutes a significant omission and error. This error is propagated in the geologic impact analyses, sediment transport impact analyses and habitat impact analyses. The standards for environmental review of new surface mines proximate to salmon-bearing waters are high. The level of disclosure and analysis is inadequate and incomplete and is therefore **an omission**.
- The Pe Ell waterline replacement is represented in graphics submitted with the project's public notice (Sheet 20 of 22 dated 7/30/2020) but is not disclosed in the NEPA DEIS analysis despite its crossing landslide areas, steep terrain, and channel migration zones. This project element and its potentially high impacts to Pe Ell are not disclosed or evaluated. This constitutes an omission.
- Landslides and landslide potential are underrepresented in the supporting technical analyses and thereby underestimate sediment delivered by landslides and the resulting impact analyses; actual sediment volumes will be much higher (potentially as high as 16 million cubic yards). This serious error is propagated in the sediment transport impact analyses (Appendix I) and thus in all analyses of reservoir and downstream habitat impact analyses. The potential implications of landslides are also not considered in the FRE Operations Plan. See NEPA Ecosystems Addendum for additional analysis of the flaws in the sediment transport model and analysis and implications for species and habitats.
- Most of the proposed reservoir pool lies within an area highly susceptible to slope instability. The proposed drawdown rate, stated as 10 feet/day, far exceeds the hydraulic conductivity of geologic materials and thus is highly likely to trigger erosion and landsliding and is not consistent with the best available science and international design standards for large dams (see SEPA Geology Technical Memo). This error is propagated in the sediment transport impact analyses and habitat impact analyses and is not considered in the FRE Operations Plan. This error would result in unsafe conditions which threaten public safety as well as adversely impacting water quality, habitat, and fish survival. Other variables and assumptions used in landslide stability modeling are inconsistent with proposed operations and appear to have bias favoring the project. There is no mention of these uncertainties with the analysis in the NEPA DEIS.
- The proposed drawdown rates will significantly increase the probability of landslide occurrence and may initiate larger, deep-seated landslides <u>beyond those that were mapped and considered in the analysis</u>. Landslides could dam the Chehalis River or major tributaries which could then result in a dam break flood, something **omitted in the analysis**. These landslides could impact public safety, dam facility operations, forest roads, upslope timber production, habitat conditions and water quality within the reservoir, river and downstream. The proposed drawdown rates far exceed recommendations in the scientific literature and present an **error in the analysis**.
- The loss of topsoil and vegetation in the reservoir will decrease the function and benefit they provide for preventing erosion and enhancing slope stability. Therefore, an increased occurrence of landslides is anticipated from project operations. This condition was underrepresented in the technical analysis and is an error. This error is propagated in the sediment transport impact analyses and habitat impact analyses. See the NEPA Ecosystems Addendum for additional analysis of the flaws in the sediment transport model and analysis and implications for species and habitats.

Appendix H notes that much of the Chehalis valley floodplain is composed of fine-grained alluvium that is at high risk of liquefaction during a strong earthquake. The report describes alluvium in the upper Chehalis in vicinity of the proposed reservoir as coarse-grained that is unlikely to liquify. But the report does not discuss fact that the large volume of fine sediment that will accumulate in the reservoir will be subject to liquefaction and enter the reservoir pool or river. This is an omission.

In conclusion, many of the same technical issues, errors, and omissions identified in the review of the State Environmental Policy Act (SEPA) DEIS and supporting documents also occur in the NEPA DEIS. Therefore, we incorporate herein by reference the following SEPA Technical Memorandum which provides detailed explanations of the basis for these conclusions:

Earth Discipline Report – Geology Technical Analyses Review (SEPA Geology Technical Memo) (NSD 2020a)

Additional addenda to the SEPA technical memoranda have been prepared in response to the NEPA DEIS which are incorporated herein by reference as follows:

 Critical Review of Proposed Chehalis River Basin Flood Damage Reduction Project NEPA DEIS: Addendum to Cascade of FRE Ecosystems Effects Technical Memo (NEPA Ecosystems Addendum) (NSD 2020b)

INTRODUCTION

An expandable flood retention (FRE) facility and airport levee improvements have been proposed as an alternative to accomplish flood damage reduction on the Chehalis River, Washington. Several alternative concepts were proposed, but the FRE facility has been advanced for environmental review under NEPA.

The DEIS and supporting documents prepared for the NEPA review state the following as parameters for the impact assessments:

- The FRE is designed for a 100-year hydrologic event, such as the 1996 flood, but is not designed for larger floods, such as the 2007 flood, which would overtop the structure.
- > The design life of the FRE is approximately 50 years (through 2080).
- The DEIS reported that the FRE dam structure is expected to impound water during at least 33% of the years through 2080.
- > The 100-year reservoir pool elevation is 627 feet (mean sea level).
- FRE reservoir has a maximum capacity of 65,000 acre-ft and hydraulic head of approximately 202 feet (100-year event).
- The reservoir would be partially to fully inundated episodically, most likely during the winter rainy season, and the reservoir is estimated to be inundated approximately 2% of the time under current climate conditions.
- The inundation period of the reservoir will be of variable duration, but the DEIS states that full reservoir drawdown would be up to 35 days for single reservoir pool filling events.
- The proposed reservoir pool drawdown rate is stated as 10 feet/day (5 inches/hour), which is 100-1,000 times the stated hydraulic conductivity of hillslope materials.
- > The DEIS states that erosion and landslides influenced by the reservoir would increase.

ANALYSIS

The following documents were reviewed:

- Geology Discipline Report (Appendix H)
- Selection and Description of Alternatives (Appendix D)
- Impact Levels (Appendix E)
- Supporting technical analyses, specifically:
 - Shannon & Wilson, Inc., 2015. Landslide Reconnaissance Evaluation of the Chehalis Dam Reservoir. Report prepared by Shannon & Wilson, Inc., Seattle, WA, for Chehalis Basin Workgroup, September 22.
 - Shannon & Wilson, Inc. 2017a. Technical Memorandum Phase 2 Chehalis Dam Landslide Evaluation Chehalis Dam Basin Workgroup, Pe Ell, Washington. Report Prepared by Shannon and Wilson, Seattle, WA, 21-1-21897-021, for Chehalis Basin Workgroup, June 29.
 - Shannon & Wilson, Inc. 2017b. Technical Memorandum Chehalis Basin Strategy: Reducing Flood Damage and Enhancing Aquatic Species Project Phase 2 Chehalis Dam Site Characterization Landslide Stability Improvement Evaluation, Pe Ell, Washington. Report Prepared by Shannon and Wilson, Seattle, WA, 21-1-21897-021, for Chehalis Basin Workgroup, June 28.
 - Shannon & Wilson, Inc., 2019. Chehalis Basin Strategy: Phase 3 Landslide Evaluation. Report prepared by Shannon & Wilson, Inc., Seattle, WA, 21-1-21897-021, for Chehalis Basin Workgroup, May 10, 2019.

These documents provide the basis for evaluation of design, impacts and mitigation. Additional peer-reviewed science literature, regulations, and government agency guidelines were also referenced.

Findings

We conclude that the NEPA DEIS, Geology Discipline Report, Alternatives, and Impact Analysis relied on incomplete or erroneous technical analyses which result in misinformation and false conclusions being reviewed by the regulatory decision makers through the NEPA process. We have thoroughly documented these same errors and omissions from the SEPA DEIS and related discipline reports in the *SEPA Geology Technical Memo* (attached) prepared during the SEPA comment period; that analysis is incorporated herein by reference. A summary of our findings is presented below.

Alternatives Analysis

Under the NEPA review, significant impacts to elements of the environment must be considered for the range of viable alternatives considered. Viable alternatives must be presented substantively and equitably for comparative purposes with the preferred project alternative. Risks and uncertainties need to be disclosed. Direct, indirect, and cumulative impacts need to be considered. If significant impacts are anticipated, mitigation needs to be proposed. The DEIS does not meet these NEPA standards.

Insufficient Analysis of Scale, Intensity and Duration of Operational Impacts

The public safety and ecological impacts from the proposed operations are grossly understated and underrepresented in the DEIS. These impacts will persist for the life of the project and beyond. It is possible that the impacts resulting from the proposed FRE project may be so great that fish populations in the Chehalis River would be irreparably damaged, if not potentially lost all together (e.g. spring Chinook); if design assumptions are incorrect or inadequately designed, significant loss of human life and communities may result. The analyses presented in the DEIS are not sufficient to address these issues with sufficient confidence for

regulatory agencies to authorize the proposed project for construction based on the disclosed scale and intensity of impacts or the mitigation as vaguely proposed.

Referencing Previous Studies and Best Available Science

The Shannon and Wilson (2017a, 2017b, 2019) reports cited in the Geology Discipline Report (Appendix H) failed to reference previous studies and mapping within the project area, or to reference applicable studies pertinent to support the conclusions in their analyses. The technical analyses should have included a review of previous studies, relevant information and citations to support their conclusions. As a result, significant information was omitted from their analyses. Reference pages 6 through 9 in the *SEPA Geology Technical Memo*.

Applicable Guidance, Standards and Codes

For dam construction, the following federal guidelines and standards should have referenced and integrated into the DEIS analysis to support planning, analysis and considerations for dam design:

- United States Bureau of Reclamation (USBR) & Army Corps of Engineers (USACE) Best Practices in Dam and Levee Safety Risk Analysis (2019) and USACE Safety of Dams – Policy and Procedures (2011)
- Interagency Committee on Dam Safety (ICODS) approved guidance documents FEMA P-1025 (Federal Guidelines for Dam Safety Risk Management), FEMA P-64 (Emergency Action Planning for Dam Owners), FEMA P-946 (Inundation Mapping of Flood Risks Associated with Dam Incident Failures), FEMA P-94 (Selecting and Accommodating Inflow Design Floods for Dams), FEMA P-65 (Earthquake Analyses and Design of Dams), and FEMA P-93 (Federal Guidelines for Dam Safety).

There was no reference to the use of these documents in the planning, analysis, and consideration of design in the DEIS. As a result, significant information was omitted from the DEIS.

Landslide Mapping

Review of the landslide mapping by Shannon and Wilson identified omissions of many significant landslides and other mass wasting processes that could impact the FRE facility design, FRE operations, ecological impacts, and impacts to public safety.

- The DEIS acknowledges that reservoir operations would increase landslides and erosion, but doesn't consider the potential for landslides omitted in the technical analyses. This would result in:
 - More fine sediment inputs to the river from hillslopes and landslides that will impact water quality.
 - Increased potential for landslide hazards, including landslide-initiated displacement waves that can overtop the dam.
 - The DEIS fails to assess impacts from landslide-generated displacement waves and seiche wave impacts on reservoir shoreline erosion and wave-overtopping of the FRE facility and resulting public safety.

These omissions and errors result in an underrepresentation of impacts. Reference pages 14 through 19 in the SEPA Geology Technical Memo.

Soil and Rock Hydraulic Conductivity and Slope Stability with Reservoir Operations

Landslide stability within the reservoir is affected by changing reservoir level, which controls the following factors: hydrodynamic pressure; hydrostatic pressure; uplift force, and physical and mechanical properties of soil and rock, including hydraulic conductivity (Wang et al. 2012). Both shallow landslides and some deep-seated landslides can be triggered by positive pore-fluid pressures generated at the soil-bedrock interface during reservoir fluctuations.

- FRE reservoir drawdown is two to three orders of magnitude faster than the hydraulic conductivity of hillslope soils within the reservoir, which would likely trigger widespread mass wasting (deep-seated landslides, shallow landslides, debris flows). There is no consistency between the technical analyses and proposed FRE Operations Plan on drawdown rate in the DEIS, nor is there adequate evaluation on ecological systems or public safety impacts that may result from widespread slope instability.
 - Slope instability in the reservoir would result in downstream impacts to public safety, project operations, and ecological systems.

The technical analyses used to evaluate these potential impacts were in error or omitted. Reference pages 19 through 26 in the SEPA Geology Technical Memo.

Soil Erosion

Hillslope vegetation has a significant effect on erosion and shallow landsliding (Schmidt et al. 2001; Shaw and Vaugeois 1999). After timber harvest, hillslopes are at an elevated risk of slope instability until the new trees have established substantial rooting, which takes 14-20 years (Schmidt et al. 2001). The proposed project will permanently remove conifers from the reservoir area even on high risk slopes where cutting would be prohibited under Washington State forest practice guidelines. Increases in soil water content by rain and reservoir inundation increase the probability of erosion and landslides even with mature vegetation. The proposed project will increase the frequency and magnitude of soil saturation as well as eliminating the soil cohesion provided by tree roots.

- The NEPA DEIS acknowledges that reservoir operations would increase landslides and erosion. This would result in:
 - Increase of fine sediment inputs to the river from hillslopes and landslides that will impact water quality (elevated turbidity). Increases will occur even when reservoir pool is not filled due to rain on bare slopes and the formation of gullies. Drawdown of the reservoir pool will substantially increase these inputs. Fine sediment will likely remain in suspension far downstream of the dam.
 - Fine sediment deposition in the river will impact spawning habitat and increase the mortality of salmonid eggs.
 - Landslides reaching the river would directly impact fish habitat and passage.
 - Large landslides could trigger large displacement waves in the reservoir pool that would erode slopes impacted by wave run-up (thus impacting much more area than where slide occurs). Waves could also damage the proposed facilities.
 - Landslides in reservoir area could temporarily impound the Chehalis or major tributaries such as Crimm Creek. Landslide dams are subject to catastrophic failure and dam burst floods that could damage the dam or plug the tunnels beneath the dam.

Increased landsliding and erosion impacts were underestimated in the NEPA DEIS because they relied on information from technical analyses that underrepresented impacts, this is an error with significant ramifications to the geomorphic model, its conclusions, and the assessment of impacts to downstream waters, wetlands, and species. Reference pages 27 through 29 in the SEPA Geology Technical Memo and the NEPA Ecosystems Addendum.

Landslide Dams and Dam-Break Floods

Technical analyses briefly discuss the potential for the Chehalis River to be dammed by a landslide within the reservoir and potential damage to the proposed FRE structure; however, the potential impact of large waves and dam-break floods resulting from large landslides were not evaluated in the DEIS.

- The DEIS fails to acknowledge that landslides can dam and impound stream channels that could potentially impact the FRE's conduit and operations as well as negatively impact ecological systems.
 - A river-damming landslide would result in impacts to operational conditions, potentially clogging the outlet structure, potential damage to the outlet structure, and impacts to downstream habitat conditions.

Given the potentially catastrophic impacts of landslide dams, this represents **a significant omission**. Reference pages 29 through 38 in the *SEPA Geology Technical Memo*.

Quarry Impact Analyses

Three quarries are proposed as a component of the proposed project. However, neither proposed plans nor detailed descriptions of existing conditions or impacts of developing these three proposed quarries were presented in the NEPA DEIS or supporting documents.

The NEPA DEIS fails to provide site plans, volume estimates, proposed footprints, or supporting technical analyses (e.g. vibration, slope stability, stormwater management, etc.) or meaningful analysis for any of the three quarries proposed on steep slopes and adjacent to Type-S waters; nor was there a consideration of potential impacts.

This significant omission from the NEPA DEIS fails the requirements for a full and complete project to be disclosed and analyzed so that all impacts are evaluated so the regulatory decision-makers can make fully informed permit decisions.

Pe Ell Water Line Relocation

A water line relocation for Pe Ell is implied as a component of the proposed project but is not specifically identified in the NEPA DEIS, nor are the impacts of this component analyzed. No proposed plans nor detailed descriptions for the water line relocation were presented in the NEPA DEIS or supporting documents. Supporting graphics submitted with the project's public notice (Sheet 20 of 22 dated 7/30/2020) identify the water line relocation. It crosses many geologically hazardous areas, including landslides, steep slopes, and channel migration zones. The excavation, installation, and operation of a municipal water line in these hazardous areas has probable impacts to wetlands and waters, and aquatic species and their associated habitats and compensatory mitigation would be anticipated.

The DEIS fails to provide site plans, project description, construction methods, alternatives analysis, impact analysis, mitigation, and supporting technical analyses or meaningful analysis for impacts to wetlands and waters.

This significant omission from the NEPA DEIS fails the requirements for a full and complete project to be disclosed and analyzed so that all impacts are evaluated so the regulatory decision-makers can make fully informed permit decisions.

CONCLUSIONS

Our review concludes that the NEPA DEIS relies on **technical analyses that have significant data gaps, errors, and omissions**. These data gaps, errors and omissions are propagated in the NEPA DEIS. It is our opinion that the NEPA DEIS and supporting technical analyses:

- Fail to accurately identify, quantify, disclose, or clearly communicate all hazards, impacts, risks, and uncertainties associated with the FRE and proposed operations.
- Fail to provide comprehensive identification of <u>all</u> landslide occurrences or landslide potential within the reservoir; the presence of unstable slopes prone to instability with reservoir operations has significant uncertainties and potentially significant impacts beyond those which have been reported.
- Fail to communicate the risk to public safety and ecological systems from landslide-generated displacement waves or FRE dam failure.
- Do not fully assess or communicate landslide dam and dam-break flood risks to FRE operations, public safety, or ecological systems.
- Have not fully integrated applicable federal guidance documents, assessment standards, and relevant codes to fully inform decision makers.
- Fail to provide equal and substantive analysis of alternatives.
- Fail to provide substantive mitigation plans adequate for evaluation, nor does it establish criteria, targets, or objectives that the mitigation plans would need to achieve.

Therefore, the NEPA DEIS is incomplete, inherently flawed and misinforms decision-makers. The NEPA DEIS 1) fails to fully consider, quantify, disclose and analyze all impacts; 2) fails to provide mitigation plans to be evaluated by decision makers, 3) fails to offer substantive analysis of alternatives, and 4) consistently underrepresents impacts to public safety and aquatic resources and their habitats from this proposed project. In our opinion, these impacts are unmitigable.

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