



# Chehalis River Basin Flood Control Zone District

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Chehalis River Basin Flood Damage Reduction Project  
c/o Anchor QEA  
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Filed Electronically

**RE: Chehalis River Basin Flood Control Zone District Comments on the U.S. Army Corps of Engineers Draft Environmental Impact Statement for the Proposed Flood Damage Reduction Project – Submitted to the U.S. Army Corps of Engineers Seattle District Regulatory Branch**

On September 18, 2020, the U.S. Army Corps of Engineers (Corps) issued a Draft Environmental Impact Statement (DEIS) for the Chehalis River Basin Flood Damage Reduction Project (Project) in compliance with the National Environmental Policy Act (NEPA) of 1969, as amended (40 Code of Federal Regulations [CFR] 1500-1508; 33 CFR 325 Appendix B). The Chehalis River Basin Flood Control Zone District (the District) submits the following comments, which reflect the District's review of the analysis and findings of the NEPA DEIS and include requests for refining the analysis in a forthcoming NEPA Final Environmental Impact Statement (FEIS).

The District acknowledges the substantial and diligent effort of the Corps' staff in the preparation of the NEPA DEIS. This project is critical for the health, safety and well-being of residents and businesses in the Chehalis Basin, as well as for the sustaining the regional economy. In the recent past, flooding has caused major physical damage, substantial transportation delays, and significant economic loss in the Chehalis Basin. The District is committed to reducing the risks associated with flooding, including preserving life and preventing damage to property while conserving the natural resources of the Chehalis Basin. As the proponent of the proposed project the District must make critical decisions regarding engaging in permitting, final design, construction, and operation of the project. When making these decisions, the District will need to rely on the Corps' NEPA DEIS, and eventually a Final EIS to inform ourselves concerning the benefits and environmental effects of the Project.

Prior to the release of the Corps' NEPA DEIS, the Washington Department of Ecology (Ecology) released a separate and independent DEIS on February 28, 2020, in compliance with the Washington State Environmental Policy Act (SEPA) as directed by the Washington State Governor's Office. With two DEISs having been prepared and issued by different regulatory agencies under different state and federal

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environmental review statutes different results and comparison between the two DEISs is inevitable. While recognizing that agency decision-making and permitting must ultimately rely on the EIS prepared by the appropriate level of government (state or federal), in the public interest and for the credibility of the participating institutions, it is important that there be some form of consensus developed regarding the conclusions of the two different documents. The District's review has found that in several areas the reasons for disparity between the findings of the SEPA DEIS and the NEPA DEIS are not apparent in other areas different assumptions about the design, construction and operation of the project have been made. While this comment letter is to address the NEPA DEIS prepared by the Corp we nevertheless feel bound to provide some comment of the disparities between the two documents in the hope that as the FEISs are prepared, these disparities can be resolved.

In the time between the release of Ecology's SEPA DEIS and the Corps' NEPA DEIS, additional information has been developed to inform the assumptions about several of the project components, the most important of which are the temporary inundation area operational scenarios, as well as many avoidance, minimization, and mitigation measures that the District intends to pursue. This additional information does not change in any way the project configuration or description of its operation. The following additional information has been developed since the SEPA DEIS was issued:

- (1) FRE Facility Temporary Reservoir Inundation and Vegetation Analysis Clarification (HDR 2020) provided with the District's comments to Ecology's DEIS and also included as Appendix D to the Biological Assessment and the Essential Fish Habitat Assessment recently submitted to the Corps (September 18, 2020).
- (2) Aquatic and Terrestrial Mitigation Opportunities Assessment report (Kleinschmidt 2020a) included as Attachment 4 of the Department of Army Section 404 Permit Application (submitted to the Corps on September 4, 2020).
- (3) Wetland Mitigation Opportunities Assessment (Kleinschmidt 2020b) submitted to the Corps as Attachment 3 of the Department of Army Section 404 Permit Application.

Further, to support an application for the discharge of fill material into Waters of the U.S., pursuant to the requirements of Section 404 of the Clean Water Act, administered by the Corps, the District has submitted the following information to the Corps:

- (1) Department of Army Section 404 Permit Application (DAPA), submitted September 4, 2020.
- (2) Draft Biological Assessment (BA) and Essential Fish Habitat (EFH) Assessment, submitted September 18, 2020.

The NEPA DEIS has incorporated some, but not all, of the updated information provided. Most notably the NEPA DEIS did not include the mitigation actions described in the Kleinschmidt 2020a mitigation opportunities report. The District recognizes that Corps was unable to include the information noted above in the NEPA DEIS due to time constraints; however, the District requests that during preparation of the FEIS, the Corps consider the updated inundation analysis (HDR 2020) and the avoidance, minimization, and mitigation measures provided in the DAPA and Draft BA/EFH documents, and the Aquatic and Terrestrial Mitigation Opportunities Assessment report (Kleinschmidt 2020a). Further, the District is committed to developing a comprehensive mitigation program and looks forward to providing updated mitigation measures to be included in the FEIS in response to the Corps statement in the NEPA DEIS (page 265) that:

“[t]he Final EIS will present updated potential mitigation measures. These measures will be based on continued evaluation by the Corps, coordination with the Applicant, consultation with tribes and resource agencies, and comments received on this Draft EIS.”

After review of the NEPA DEIS, the District generally supports the Corps’ conclusions and analysis and is encouraged by the findings that while the Project may cause negative environmental impacts, there would also be beneficial impacts from implementation of the proposed project through the reduction of flood risk to the communities and natural resources of the Chehalis Basin. The District understands that if the process proceeds into permitting that the negative environmental impacts will need to be avoided, minimized or mitigated to the extent practicable. The District recognizes that the NEPA DEIS provides a more robust analysis in many resource areas than the SEPA DEIS and has been able to incorporate more accurate or refined assumptions regarding construction and operation of the flood retention expandable (FRE) facility.

The District’s comments on the NEPA DEIS provided herein have been divided into four sections.

- **Section 1** – Comments on the Structure and Content of the DEIS
- **Section 2** - Comments on Assumptions for Inundation Frequency/Duration, and Vegetation Management and their Relationship to Findings on Water Quality and Impacts to Aquatic Species
- **Section 3** - Comments on Key Distinctions between NEPA DEIS and SEPA DEIS
- **Section 4** - Corrections or Clarifications of Project Features, Assumptions, and Items of Material Interest in the NEPA DEIS

As a companion to the specific comments on the DEIS, the District also submits an updated Conceptual Vegetation Management Plan (VMP; Attachment 1). This plan replaces the initial preliminary conceptual vegetation management plan that was part of the programmatic EIS effort of 2017 (Anchor QEA 2016). This updated VMP provides a pre-construction selective tree harvest plan and an operations phase adaptive management plan that the District has developed to avoid and minimize impacts associated with loss of vegetation in the temporary inundation area identified by the Corps. The updated VMP includes more detailed mapping of vegetation communities within the temporary storage reservoir inundation area and a June 2020 site reconnaissance. It also incorporates the previously prepared inundation analysis (HDR 2020) to refine assumptions regarding expected inundation duration. One objective of the updated Conceptual Vegetation Management Plan is to manage vegetation in the temporary reservoir to provide more shading of water courses within the temporary storage reservoir than what was assumed in the impact analysis performed in either the NEPA DEIS or the SEPA DEIS. It is anticipated that the updated Conceptual VMP will be used for future stakeholder and agency coordination efforts.

## **1- Comments on the Structure and Content of the NEPA DEIS**

### **The two-stage assessment of numerous project alternatives provides a substantive basis for DEIS Alternatives Analysis.**

NEPA requires that other reasonable alternatives to the proposed project that meet the projects purpose and need must be analyzed. The District appreciates the rigor with which the Corps undertook this responsibility. To assess alternatives, the NEPA DEIS begins with 61 flood damage reduction alternatives (individually and in combination) and applies a set of clearly defined criteria to screen those alternatives. After an extensive screening and evaluation process, the Corps found that one alternative, a different form of the proposed FRE configuration, passed the alternatives screening analysis and this alternative is evaluated in detail in the NEPA DEIS (see Appendix D of the NEPA DEIS). The NEPA DEIS also

includes a detailed analysis of the No Action Alternative using the same impact criteria used to evaluate the proposed project. In contrast, the SEPA DEIS does not describe the methodology or provide an evaluation of other alternatives to meet the project purpose and need. The District appreciates the Corps attention to providing a substantive basis for an alternatives analysis in the NEPA DEIS, and requests that the FEIS and forthcoming Record of Decision (ROD) reflect the outcome of the alternatives analysis and the proposed project's fulfillment of the purpose and need.

***The No Action Alternative is analyzed in detail providing an appropriate basis for the comparison with the proposed Project and reasonable alternatives.***

As required by NEPA, the DEIS provides a detailed evaluation of the impacts of the No Action Alternative (not implementing the Project). Uniquely in this case the No Action Alternative has very significant consequences; it is not a benign continuation of the status quo. These include potential loss of life, major damage, regional transportation disruption and economic loss from the major and catastrophic floods that will continue to occur with regularity in the future. These effects will be felt within the 100-year flood plain which encompasses Chehalis, Centralia, Adna, Pe Ell, Grand Mound, Oakville, Montesano, Cosmopolis, Aberdeen and Hoquiam and the rural portions of the Chehalis River Basin. The primary "benefit" of the project—clearly identified in the NEPA DEIS—is the reduction of damage from these floods. In contrast, the SEPA DEIS does not provide a detailed evaluation of the No Action Alternative. The District, in coordination with the Office of Chehalis Basin (OCB) is committed to finding a solution to the flood risk in the Chehalis Basin. Given the substantial damage and destruction past floods have caused, and future floods are likely to cause, the District appreciates the Corps effort to characterizing the benefits of the project from reducing flood risk in the Chehalis Basin. This allows a clear comparison of the impacts/benefits of implementing the Project versus not taking that action. The District requests the FEIS and forthcoming ROD continue to reflect the benefits of the project, and that the Corps decision making process reflect the urgency of the issue at hand.

***The NEPA DEIS includes a detailed side-by-side comparison of the proposed project and the alternatives.***

The NEPA DEIS includes a side-by-side comparison of the proposed project and the alternatives including the No Action Alternative. This allows decision-makers and the public to quickly understand and evaluate the differences between the project and the alternatives—a comparison that is critical to decision-making. In contrast, the SEPA DEIS does not provide this direct side-by-side comparison. The District commends the Corps for providing a clear and thorough analysis of alternatives which correctly details the impacts and benefits of the proposed project and alternatives, in meeting the purpose and need of reducing flood risk in the Chehalis Basin. The District requests that the FEIS and forthcoming ROD reflect this alternatives analysis.

***The NEPA DEIS recognizes that over and above the potential impact of the Project the changing climate will also affect environmental resources of the Chehalis basin.***

Both the SEPA and NEPA DEISs highlight the effects to aquatic resources of future climate change. In the SEPA DEIS these effects were comingled with the effects of the Project causing many readers to believe that the scientific analysis concluded that the Project would be the most significant contributor to declines in the salmon populations in the Chehalis River Basin. However, 87% of the negative impact on salmon populations, which the SEPA DEIS projected to be limited to upstream of Rainbow Falls were found to be related to climate change; FRE impacts accounting for the remaining 13% and this level of impact was prior to giving consideration to avoidance, minimization and mitigation measures. In contrast



the NEPA DEIS did not directly incorporate climate change effects with Project impacts; the effects of the Project are identified separately making future decision-making more supportable. The NEPA DEIS has correctly incorporated narrative describing the likely effect of climate change over and above the direct and indirect effects of the Project. The District believes that climate change is a critical issue that must always be considered and endorses the Corps approach of separately describing how climate change may contribute to additional future impacts to resources.

**Use of percentage values obscures the context of critical expected effects.**

In a number of instances, the Corps has chosen to report potential impacts as a percent change from existing conditions to the detriment of clearly understanding the importance of an impact. An example may be found in Section 4.5.3.3 where the modeling results for changes in salmon and steelhead abundance and diversity are reported on Table 4.5-2 (Page 127). The results are reported for the Project area, the 100-year flood plain and the Chehalis Basin as a whole. Presumably these percentages were derived from modeled predictions of the actual number of fish affected. The table shows high percentage reductions of abundance (40% – 78%) in the project area, but very small changes (ranging from 0.1% loss to potentially a 1.3 % increase) at the basin level. What is lost in this presentation is that while the percentage of fish affected in the project area may appear high, the actual numbers of fish predicted to be lost are relatively few. Moreover, at the basin wide level the small number of fish lost is not significant. This contextual relationship would be easily seen on Table 4.5-2 if the actual abundance values were included with the percentage change values. Providing this important type of context information should be considered for all descriptions of impacts in the DEIS where percentages are used. In this example, the District does not discount the actual effect of the potential loss of a few fish in the project area but including the actual predicted abundance values ensures that the FEIS will accurately reflect the potential basin-wide impacts which are not significant. The District has committed to addressing those impacts but that loss needs to be properly understood within the overall basin resource.

## **2- Comments on Assumptions for Inundation Frequency/Duration, and Vegetation Management and their Relationship to Findings on Water Quality and Impacts to Aquatic Species**

Both the NEPA DEIS and the SEPA DEIS report modeled increases in water temperature as a result of FRE construction and operation. Predicted increases in water temperature in turn affect the suitability of aquatic habitat to support primarily salmonid species in the project footprint and in the immediate downstream reaches of the Chehalis River and is one of the key issues for the Project for most stakeholders.

In the NEPA DEIS, increased water temperature is linked to changes in vegetation within the temporary storage reservoir. Depending on the frequency and duration of FRE operation some of the existing vegetation within the temporary storage reservoir is expected to die-off reducing shading of tributary streams and the river within the reservoir. The loss of shading without mitigation may then lead to increased water temperatures. The District believes that the computer based modelling analysis of this complex issue has incorporated assumptions about the frequency, extent and duration of inundation, the existing vegetation and the resulting future succession of vegetation that have resulted in an over-estimate of the increase in water temperature and resulting effect on aquatic species habitat.

The SEPA EIS, completed earlier in 2020 provided the first attempt at analyzing these impacts. As a result of that process the District provided extensive comments on the assumptions used and provided those comments to both the Department of Ecology and the Corps who were still preparing the NEPA DEIS. Recognizing the importance of this issue the District has continued to provide information that allows for refinement of the analysis and a better estimate of the impacts that may occur. The District believes that the modelling analysis must be refined in the following four areas:

1. The frequency and flow level of events that trigger operation of the FRE – the size of the flood event governs how much water is stored and how long it will take to empty the reservoir.
2. How long vegetation at various elevations within the temporary storage reservoir would be inundated. Vegetation at higher elevations will be inundated for a much shorter time period than those at lower elevations.
3. Pre-construction plan for removal of trees likely to die as a result of inundation.
4. Plan for replacement of trees with suitable flood tolerant vegetation to restore shading, habitat and to stabilize slopes.

The District earlier provided or provides as part of this comment letter information related to each of these above listed elements as discussed below. The District requests that the water quality and related aquatic species impact be reanalyzed when preparing the NEPA FEIS. The specific refinements requested by the District are described in the following sections.

**Refine NEPA DEIS assumptions for the temporary inundation area operational scenarios based on the Inundation Analysis (HDR 2020)**

HDR's (2020) inundation analysis demonstrated that during various FRE operational events, areas upstream of the FRE facility will experience a range of inundations, as expressed in water surface elevation (WSEL) and total acres inundated. To determine the maximum extent of the temporary inundation area during FRE facility operations, HDR (2020) modeled the resulting pool from WSEL 425 feet up to WSEL 620 feet, using the maximum WSEL for the 2007 flood event of record. The inundation analysis identified three discrete phases of temporary inundation pool drawdown, or evacuation based on WSEL, drawdown rate and function including:

1. Initial Temporary Reservoir Evacuation (event maximum inundation pool to WSEL 528 feet)
2. Debris Management Evacuation (WSEL 528–500 feet)
3. Final Temporary Reservoir Evacuation (WSEL 500–425 feet)

This analysis is a refinement to the assumption of maximum temporary reservoir inundation that formed the basis of Ecology's SEPA DEIS impact determinations, and is a further refinement to the assumptions for temporary reservoir inundation presented in the NEPA DEIS. To determine the maximum reservoir WSELs occurring with each of the flood events noted in the SEPA DEIS, HDR (2020) obtained the regulated and unregulated flood hydrographs from the SEPA DEIS and added notations to the hydrograph plots to clarify key drawdown stages. Based on proposed flood retention and drawdown operations, and using hydrographs reflecting flood events equivalent to the 10-, 20-, 100-, and 500-year flood events, HDR (2020) simulated inundation zones and durations for representative floods. HDR also prepared figures depicting the inundation zones and modeled durations for each of the following historic flood events that would have triggered FRE facility operations: 1996, 2007, and 2009. A complete set of inundation maps was included in the DAPA and the BA/EFH submittals to the Corps. The District requests that the Corps include the updated inundation analysis in the assumptions of the FEIS and

subsequent impact analyses on water quality, aquatic species and habitat, wetlands, and terrestrial species and habitats impacts.

**Refine NEPA DEIS assumptions regarding the temporary inundation.**

The NEPA DEIS analysis relies primarily on temporary inundation area and temporary reservoir evacuation zones provided in Anchor QEA's 2016 VMP to assess operational impacts to vegetation. These assumptions inaccurately represent the extent and duration of inundation in the temporary inundation area (see HDR 2020). This has led to an overstatement of impacts on water quality parameters, aquatic species and habitats, wetlands and water bodies, and terrestrial species and habitats, where such impacts are a function of the fate of vegetation in the temporary inundation area.

The updated inundation analysis (HDR 2020) provided by the District to the Corps describes the frequency and duration of inundation for expected FRE facility operations. This analysis provides assumptions for modeling analysis that are more detailed than those used in the NEPA DEIS.

A primary goal of the Conceptual VMP is to minimize the extent of tree clearing and vegetation removal in the temporary inundation area, while balancing the need to reduce the amount of woody material that would be generated within the area during a flood event that triggers FRE facility operation. The inundation analysis provides the basis for pre-construction clearing by identifying the modelled size of the temporary inundation areas that would be created under different expected flood events.

The District requests that the Corps consider the refined analysis of inundation zones described in HDR 2020 and their likely inundation duration when preparing the FEIS.

**Refine NEPA DEIS assumptions regarding affected vegetation communities within the temporary storage reservoir**

The District has provided, in HDR 2020 a detailed description and mapping of current vegetation communities present within the temporary storage reservoir inundation area and areas immediately adjacent. These data were integrated from multiple sources, including a limited field survey as described in HDR 2020. The District requests that the refined vegetation data incorporated in HDR 2020 be used in further analysis of water quality impacts by the Corps during preparation of the FEIS. Upon request, the District will provide these data on electronic media in a format suitable for Corps use.

**Refine NEPA DEIS assumptions regarding vegetation management within the temporary storage reservoir inundation area for refined water quality analysis**

The NEPA DEIS water quality analysis applies a refined approach in its assumptions of the inundation zones and vegetation clearing requirements in comparison to the SEPA DEIS water quality analysis. The NEPA DEIS assumptions are consistent with the approach presented in the Anchor QEA 2016 Proposed Flood Retention Facility Pre-construction Vegetation Management Plan. The NEPA DEIS does not assume that the full temporary inundation area would require vegetation clearing as was assumed in the SEPA DEIS water quality analysis. The District believes that these assumptions should be further refined to more clearly assess the contribution of vegetation management through shading effects on water quality.

The Districts Conceptual VMP includes a pre-construction vegetation treatment plan that optimizes the selective removal of trees susceptible to inundation mortality while retaining/replacing vegetation to

minimize loss of shading and retaining stable slopes. This plan, which would be implemented during the Project construction phase, provides the basis for refining the vegetation community coverage and shading assumptions used in the NEPA DEIS water quality modelling analysis. For example, the inundation analysis referenced above assess inundation level and duration for 5 different flood events and allows for refining the area within which no initial tree removal and loss of shading can reasonably be assumed based on the existing vegetation communities. The NEPA DEIS also assumes that, following initial tree removal, replanting of flood-tolerant native shrubs and trees would be performed in areas susceptible to increased risk of landslides and erosion. To further refine this assumption, the Conceptual VMP provides a list of flood tolerant plants that can be replanted to replace vegetation lost as a result of inundation.

The Conceptual VMP also proposes the implementation of an Adaptive Management Plan for vegetation managements to ensure the long term sustainability of vegetation cover within the temporary storage reservoir and the avoidance and minimization of water quality impacts and impacts to upland terrestrial habitat and associated wildlife.

The District requests that the Corps reanalyze water quality impacts, particularly water temperature and turbidity using updated and refined inputs to the water quality modelling analysis based on the inundation analysis report (HDR 2020) and the Conceptual Vegetation Management Plan submitted by the District.

**Refine assumptions for operational impacts to sediment load to the Chehalis River.**

In the analysis of operational impacts to sediment load to the Chehalis River upstream of the FRE facility, the NEPA DEIS indicates that a low to medium increase in sediment load is anticipated due to increased risk of erosion and landslides over time because of flooding at the base of the slopes from impoundment events (Geomorphology Appendix I (Table ES-1)). Although the Conceptual VMP is biologically focused and does not explicitly include objectives related to sedimentation or erosion, the plan includes measures that may minimize erosion, including a refined approach to selective tree harvest in the temporary inundation area based on vegetation responses to inundation in the three areas of reservoir evacuation. Proposed BMPs such as leaving roots and stumps of harvested trees may also minimize risk of slope instability and erosion and should be recognized during preparation of the Final EIS. Furthermore, the proposed Adaptive Management Plan will be developed and implemented in coordination with agencies and stakeholders, with the objective of maintaining riparian functions in the temporary reservoir area including stream bank stability. The District requests that the Corps consider these elements in their analysis of sediment load during flood inundation, review the modeling applications relative to these elements, and review the subsequent effects on turbidity that are described in Appendix G: Water Quality and Quantity Report.

**Refine assumptions for impacts to geomorphology and related aquatic habitat to include mitigation program actions for placing large woody material in downstream reaches.**

In the analysis of construction and operational impacts to large woody material (LWM) to the Chehalis River upstream and downstream of the FRE facility, the NEPA DEIS indicates that medium to high impacts to LWM are likely from decreased recruitment and transport of LWM from the temporary reservoir inundation area to downstream reaches above and below RM 75 (Geomorphology Appendix I (Table ES-1)). Subsequent impacts on fish and aquatic habitat from the reduction in LWM transport downstream are further documented in Appendix K, Discipline Report for Aquatic Species and Habitat.

The importance of LWM to creating aquatic habitat complexity and overall increases in biological diversity in the Chehalis River is a focus of the *Aquatic and Terrestrial Mitigation Opportunities*

*Assessment* report (Kleinschmidt 2020a). To offset the loss of LWM downstream of the proposed FRE facility, the District has proposed to implement wood loading mitigation actions in the mainstem Chehalis River and numerous tributaries. These mitigation actions are intended to compensate for impacts from FRE construction and operations. For example, the District proposes to:

- Enhance instream habitat in 17 miles of stream and river channel by placement of 50 wood loading structures with substrate enhancement (assume 3 structures per mile for 17 miles).
- 35 of the wood loading structures would each include 300 ft of large wood placement, 200 feet of wood toe, 50 ft. of boulder weir, and 1 beaver dam analog.
- 15 of the wood loading structures would be gravel retention jams each covering 900 linear ft of channel

The District is committed to working with stakeholders to develop appropriate measures for a comprehensive mitigation program which will include actions for offsetting the Project's impacts to aquatic habitat such as the placement of LWM. The District requests that the Final EIS at a minimum consider the measures detailed in the *Aquatic and Terrestrial Mitigation Opportunities Assessment* report (Kleinschmidt 2020a), in their analysis of impacts to geomorphology, and related aquatic habitat conditions below the FRE facility. The District intends to continue work on refining mitigation actions and will coordinate directly with the Corps as additional refinements are made.

**Refine assumptions used in the fish population models, based on updated information from the District**

The District appreciates the complex effort to characterize the projects impacts to fish populations through the development and use of fish population models – Ecosystem Diagnostic Tool (EDT), and integrated with NOAA's Life Cycle Model. The use of models provides agencies, the public, and decision makers an important tool for forecasting the potential impacts of the Project on resources such as anadromous salmonids in the Chehalis Basin. However, although models provide context to decision making regarding a proposed action, models are inherently a simplified representation of complex systems, and must rely on subjective interpretation of error bounds for their results. When model results are relied upon as fact, this can lead to a misunderstanding of the application of the models in the decision making process. The District requests that the Corps more appropriately qualify the results of the fish population modeling to make clear that impact findings are not a known outcome of the proposed project, but an estimate of potential outcomes.

Furthermore, the District has undertaken a substantial effort to better inform assumptions regarding the Project's impacts (see Conceptual VMP), and then to develop a comprehensive mitigation program to offset potential impacts to fish and aquatic resources (see Kleinschmidt 2020a). The District requests that these refinements be included in the FEIS analysis. For example, in Attachment E Geomorphology Ratings Table, to Appendix A Salmonid Modeling Report, of Appendix K Discipline Report for Aquatic Species and Habitat, the following assumption was made regarding LWD:

“Change in LWD is based on assumption that all LWD from upstream of the FRE facility will be removed from system since no specific information has been provided on what happens to LWD collected in impoundment.”

This assumption is directly related to how debris will be handled during flood retention events. As described in the Biological Assessment and Essential Fish Habitat Assessment (see Section 5.6 pg. 5-13) debris would be cut up and disposed of, and wood suitable for instream mitigation actions would be sorted and trucked out of the reservoir area. The District is committed to developing mitigation

opportunities and will continue to pursue reasonable solutions such as using collected LWM for habitat enhancement purposes.

In addition to revising the way in which the results of the fish population models are presented, the District requests that the Corps review the Conceptual VMP in addition to the *Aquatic and Terrestrial Mitigation Opportunities Assessment* report (Kleinschmidt 2020a), and the Biological Assessment and Essential Fish Habitat Assessment, and appropriately refine related assumptions, for use in the EDT and integrated Life Cycle model.

### **3- Comments on Areas for Improved Consistency between the NEPA DEIS and the SEPA DEIS**

Two separate DEISs have been issued assessing the environmental impacts and evaluating alternatives to the Project. One prepared by the state's Department of Ecology and the second by the Corps. These separate documents were prepared subject to their own statutory and regulatory requirements, are based on different assumptions, utilize different methods of analysis and reach divergent conclusions. It will be helpful to evaluation of the Project by the public, tribes, regulatory agencies and the District that these separate documents evaluate the project as consistently as possible. It is important that the uncertainty presented by the differences in the two documents be resolved for the District, the Office of the Chehalis Basin Board and the Corps when making difficult decisions concerning the Project. The District believes that an effort must be made during the preparation of the Final EISs to resolve these differences in order to reconcile the two documents to the extent possible. The following comments represent areas where the District believes productive efforts may be productively made to usefully rationalize the separate documents.

#### **The NEPA DEIS finds that there would be beneficial impacts from implementing the proposed project.**

The NEPA DEIS finds that there would be a beneficial impact from the proposed project through reduction of the frequency, severity, and duration of flooding. As noted throughout the NEPA DEIS, there are numerous beneficial impacts from the project, including that the reduction in flooding would reduce the number of structures inundated; decrease scouring downstream of the facility; reduce impacts on environmental justice populations; decrease impacts to recreational resources downstream ; and increase slope stability downstream of the FRE facility due to peak flow reduction. The District appreciates that these benefits are acknowledged in the NEPA DEIS where they were not explicitly acknowledged in the SEPA DEIS. Clearly understanding the benefits of the Project and being able to balance them against the its potential impacts is critical to all stakeholders including to the Office of the Chehalis Basin Board when evaluating if this Project fits within a basin-wide flood damage reduction and aquatic species enhancement strategy.

#### **The NEPA DEIS provides thorough accounting of impacts across resource areas.**

The NEPA DEIS impact analysis assesses whether the potential impacts would be adverse or beneficial and for adverse impacts whether they would be low, medium, or high. Conversely, Ecology's SEPA DEIS reviews similar types of potential environmental impacts in most cases simply as either significant or non-significant. The District supports the NEPA DEIS use of evaluation criteria that are quantitative or qualitative and use of a more refined scale to explain the relative level of impact on each resource. The

additional level of detail provided in the NEPA DEIS provides critical information for the District to use in the development of its avoidance, minimization, and mitigation plans and in future decision-making about the project.

**Potential for Mitigation incorporated into impact determinations in the NEPA DEIS.**

The NEPA DEIS incorporates the feasibility of mitigation into the impact analysis and provides a detailed description of the mitigation measures proposed by the District to date (see Chapter 7 of the NEPA DEIS). For example, if avoidance, minimization, or mitigation is likely—such as implementing a Storm Water Pollution Prevention Plan (SWPPP) during construction to limit erosion—the Corps has determined that the impact of storm water runoff and sedimentation is low. For the same evaluation in the SEPA DEIS, the impact is determined to be significant and unavoidable unless mitigation is feasible. The SEPA DEIS omits any discussion of the fact that implementation of a SWPPP is an industry standard effective mitigation and minimization measure and would be required as part of the permitting process for the project. In a number of resource areas the NEPA DEIS recognizes that reasonable, proven minimization and mitigation measures are available and would likely be implemented resulting in a more realistic assessment of impacts which the District will use when developing further avoidance, minimization and mitigation measures.

**The NEPA DEIS includes an analysis of basin-wide impacts to salmonid species.**

Impacts on aquatic species and habitats from construction and operation of the FRE facility reported in the NEPA DEIS focus on the river reaches directly above and below the proposed FRE facility, similar to the analysis provided in the SEPA DEIS. However, the NEPA DEIS also evaluates impacts to fish species and habitats at the basin-wide level and finds that, when considering the entire Chehalis River Basin, impacts on most salmonid species abundance are predicted to be low, with the exception of Spring Chinook (Section 4.5.3.3 of the NEPA DEIS). The SEPA DEIS does not provide a basin-wide analysis, resulting in an overstatement of the Project's overall impacts. The District supports the inclusion of the basin-wide analysis in the NEPA DEIS, which provides the public and decision-makers a context for evaluating the effects of the proposed project on salmonid populations in the Chehalis River Basin.

While the basin-wide findings provide a critical context for project area impacts, the District takes seriously the effects of the proposed project on important habitat viability parameters such as spatial structure and diversity for salmonid species, specifically Spring Chinook habitat above Crim Creek. To offset potential Project impacts the District has identified specific mitigation actions and assessed the potential for enhancements to salmonid habitat upstream of the proposed FRE facility site, including tributaries that would be partially inundated during FRE facility operations. The Mitigation Opportunities Assessment Report (Kleinschmidt 2020a) describes several actions that target tributaries including Alder Creek, Big Creek, Rock Creek, and Thrash Creek. The mitigation actions also target main stem reaches of the Chehalis River and east and west forks. Habitat enhancements, including hyporheic exchange actions intended to promote thermal exchange with cooler ground water, may benefit rearing juvenile salmonids. These actions are expected to expand the amount of suitable spawning reaches currently available to anadromous fish and ultimately increase the spatial structure of populations that occupy them. Wood loading in small streams, riparian restoration, and substrate improvements is similarly expected to enhance habitats and expand suitable spawning areas to increase spatial structure. The District appreciates the Corps' attention to considering the mitigation options that the District is committed to pursuing in

collaboration with Chehalis Basin stakeholders and through the subsequent permitting process. The District's plan is to continue work on developing its a mitigation program. The District requests that the FEIS reflect the most current information it provides to the Corps for its analysis of the project's impacts on aquatic species and habitats, and related resource areas (water quality, surface water hydrology, wetlands, geomorphology, and geology).

**Analysis of greenhouse gas emissions in the NEPA DEIS correctly assumes that the District has committed to not burning removed woody material.**

There are notable differences in the construction emissions of carbon dioxide equivalent emissions (CO<sub>2e</sub>) between the NEPA DEIS and SEPA DEIS. The NEPA DEIS estimates that construction of the FRE facility would result in 1,949.9 metric tons of CO<sub>2e</sub> per year during construction. The SEPA DEIS estimates more than 10 times that amount, positing that construction would result in 21,738 metric tons of CO<sub>2e</sub> per year. Approximately 50% of the difference between the two estimates can be accounted for in the NEPA DEIS assumption that woody material removed from the inundation area would not be burned. The assumption is correct, as the District has committed to not burning removed woody material from the inundation area

**The NEPA DEIS qualifies the potential impacts from a FRE facility failure during an earthquake as low; the SEPA DEIS qualifies the potential impacts as significant and unavoidable.**

While both the NEPA DEIS and SEPA DEIS qualify dam failure as an unlikely event, the NEPA DEIS accounts for extremely low probability that the reservoir would be also be in operation when an earthquake of significant magnitude would occur. This is reflected in the level of impact. The NEPA DEIS determines that the combination of (1) the unlikely nature of the event and (2) the fact that the applicant would be required to meet all applicable design standards and comply with the Washington Dam Safety Program would result in a low impact. The SEPA DEIS acknowledges the unlikely nature of the event. In a public meeting of the Office of the Chehalis Basin, Ecology reported that the likelihood of such an event occurring are 1 in 2.5 billion. But the SEPA DEIS fails to consider that unlikely nature when making the determination that the potential impacts would be significant and unavoidable. The District agrees with the Corps approach in qualifying the potential impacts from a FRE facility failure during an earthquake, and will comply with all necessary requirements of the Washington Dam Safety Program.

**The NEPA DEIS should provide additional analysis of recreational use and better reflect actual impacts to recreation activities.**

The NEPA DEIS concludes that there would be high indirect impacts from the loss of more than 6 miles of fishing and boating in the Chehalis River upstream; the SEPA DEIS concludes that there would be permanent loss of 13.8 miles of the Chehalis River for kayaking notwithstanding the fact that public access for kayaking is not available above the proposed FRE site. The NEPA DEIS concludes that there would be low indirect impacts from the loss of less than 1% of the Pe Ell South Permit Area for recreational use; the SEPA DEIS concludes that these impacts would be moderate. The District appreciates the refinement in the level of impacts reported; however, the District requests that the Corps further quantify the level of current recreational use of the study area and re-examine the impact findings on recreational resources. The NEPA DEIS provides little information to substantiate the conclusion of high impact from the loss of 6 miles of fishing and boating upstream of the FRE facility. Currently private landowners restrict access to a large area of their landholdings which includes the Project site, and a



permit is required to enter the area this entire area. The NEPA DEIS provides no information as to whether permits are issued to recreationalists that specifically use the Project area or the much larger permit area and to what extent whitewater boaters or recreational fishers activities are occurring. The impact analysis should consider that the area where the FRE facility is located is not currently available for public use without a permit and that relatively few permits are annually available. It should be noted that the District is committed to working with the public, public agencies, and private landowners to discuss options for recreational access by the public within the area eventually controlled by the District.

**The land use analysis in the NEPA DEIS correctly identifies a high impact on structures in the study area from continued flooding under the No Action Alternative.**

Both the NEPA and SEPA DEISs consider the potential impact of continued flooding on structures in the study area under the No Action Alternative. The NEPA DEIS qualifies the impact as “high,” while the SEPA EIS does not qualify the impact. This is an important consideration in the impacts discussion, and the District believes that the NEPA DEIS has more accurately qualified the potential impact.

#### **4- Corrections or clarifications of project features, assumptions, and items of material interest in the NEPA DEIS**

The District requests that the NEPA Final EIS incorporate the following corrections and clarifications.

**Outlet gates.** Section 4.1.3.3 page 58 of main document

The NEPA DEIS states that at flows above 8,000 cubic feet per second (cfs), the capacity of the outlets may be exceeded. This statement occurs again in Section 6.4.1.2.1 of Appendix G. This analysis appears to be based on a prior design of the FRE facility. The most current design of the FRE facility has a total of five large sluices, whose combined capacity at the crown of the sluice tunnels is 12,500 cfs, which is much greater than 8,000 cfs (see Section 6a, page 9 of the DAPA). The District requests that the Corps correct this assumption in the FEIS to reflect the most current design of the FRE facility. This change in the analysis presented in the FEIS of the projects impacts on surface water hydrology would need to be revised.

**Picket weir.** Appendix K page 49, 4th bullet; Section 6.4.2.2.9 page 81, paragraph 3; Table 6.4-6

The NEPA DEIS assumes the use of a picket weir structure as part of the temporary trap and transport facility. As described in Appendix K, this assumption leads to lower passage survival for upstream migrating adult salmonids and downstream migrating steelhead and coastal cutthroat kelts, given its likelihood to fail in winter and the poor performance of kelts passing through a picket barrier. However, a picket weir is unlikely to be the type of barrier used as part of the temporary trap and transport facility. It is anticipated that a velocity barrier or similar structure would instead be used and would result in passage rates more closely matching those of the permanent collection, handling, transfer, and release facility and a diversion tunnel without a picket barrier downstream (Combined Dam and Fish Passage Report, Appendix G, Tables 4-4 and 4-2, respectively). The District provided clarification on the use of a picket

weir in comments on the SEPA DEIS Appendix E3 (see comment E-19<sup>1</sup>), and the District requests that the Corps also consider this comment in their assumptions for the temporary trap and transport facility design in the NEPA FEIS. The NEPA DEIS should be updated to reflect the most likely barrier to be used and reasonable estimates of survival

**Wetland losses due to Airport Levee Improvements.** Section 4.4.3.3 page 106 of main document

The NEPA DEIS quantifies permanent loss of wetlands at the Airport Levee due to excavation and fill activities under the assumption that the levee would need to be widened. The District expects that the proposed Airport Levee Improvements would be constructed within the existing Airport Levee footprint with limited use of reinforced earth techniques, similar to those implemented during Phase 1 Improvements, in areas where there is not enough room for 2H:1W side slopes, to avoid impacts on wetlands or cultural resources. The assumption in the NEPA DEIS is not consistent with what the District has communicated to Corps staff: that no excavation or fill will occur in order to avoid impacts to cultural

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<sup>1</sup> District comment E-19 to the SEPA DEIS: "Picket weirs are unlikely to be the selected barrier technology, as they will have worse performance compared to other barrier technologies. The District requests that the EIS be revised to reflect the use of a barrier the would perform better under the required conditions, such as a concrete velocity barrier, instead of a picket weir barrier and revise the assumptions in selecting a velocity barrier over a picket barrier considering the following:

- The DEIS indicates a picket barrier was selected based on WDFW's familiarity with the technology, but does not indicate that the hydrologic, environmental, and operational constraints of the site and project were considered in selection of the technology. Include a discussion of the evaluation of the hydrologic, environmental, and operational constraints of the site and project that were considered in selection of the technology for inclusion in the EIS.
- Picket weir technology is unlikely to be selected for the barrier for the temporary trap and transport due to its poor fish passage performance. The temporary trap and transport facility will have to operate year-round. High flows, debris, and bedload during the winter months are likely to damage a picket weir barrier, making it ineffective or causing it to be removed during extended periods of the year. Lack of a full barrier for extended periods of time has a substantial negative impact on fish passage performance. A picket weir will also become clogged with debris from the flow moving downstream, thus harming downstream survival of kelts, adult and juvenile salmonids, and resident fish, whereas a velocity barrier will pass all fish species and life stages as well as debris downstream impinged. For these reasons, a channel-spanning velocity barrier is more likely to be the selected barrier technology. A channel spanning velocity barrier designed to NMFS and WDFW criteria will continue to provide a full, effective barrier during winter months, thus reducing escapement, directing more fish into the fish trap, and improving overall performance of the temporary trap and transport compared to a comparable facility with a picket weir fish barrier.
- A picket weir would also require a fish ladder and supplying the ladder with water at all times because the fish trap would have to be located at the top of bank. The reach of river cited for a T&T has tall, steep banks on either side of the river. The traps would have to be located at top of bank to:
  - Protect the traps from flooding, and thus, loss of fish (decreased performance),
  - Readily access the fish transport tanks for transport and release upstream,
  - Accommodate trapping fish at river levels for the full range of fish passage flows, and
  - Protect the traps, hoisting mechanisms, and other steel and mechanical items from damage from debris, bedload movement, and high flows.
- Inflatable dams and other velocity-type barriers have a long history of performance in high flow, high bedload, debris-passing rivers; and are currently designed and installed in such environments throughout the country. For example, USFWS's Quinalt Hatchery and WDFW's Voights Creek Hatchery both utilize Obermeyer weir crest gate type barriers and WDFW's Skamania Hatchery utilizes a concrete velocity barrier to prevent upstream migration in conjunction with their fish ladder and trap operations.
- The cost to install an inflatable dam or velocity-type barrier with fish trap would be nearly the same as that required to install a picket weir type barrier with fish trap as:
  - Both barrier types will require a fish ladder and trap/holding facility at the top of bank, and a picket weir will likely require a concrete foundation that spans the width of the river in order to minimize downtime to replace pickets when they are damaged or washed out, similar to an inflatable dam or velocity-type barrier."

resources and wetlands (please see letters to the Corps dated November 22, 2019, and March 12, 2019, and Section 6e page 26 of the DAPA submittal). The District requests that the NEPA FEIS reflect the most recent assumptions regarding construction of the Airport Levee Improvements and strike any direct impacts on wetlands from the construction of the airport levee improvement component of the project in the FEIS.

**Special status species listings for terrestrial species.**

Fisher (*Pekania pennanti*). Sections 5.1.1.3, 5.5.3.3, and Table A-2: The NEPA DEIS lists the west coast Distinct Population Segment (DPS) of fisher as proposed for listing under the Endangered Species Act. In this revised proposed listing rule, the West Coast DPS of the fisher has been revised to no longer include Washington. “Our decision to revise the DPS was predominantly based on: (a) The apparent absence of any extant historically native subpopulations in Washington or northern Oregon; and (b) the marked separation of the fisher subpopulations in the NCSO, SOC, NSN, and SSN from fishers reintroduced in Washington.” The District requests that the Corps remove the fisher from the list of Federally proposed species.

Tenino pocket gopher (*Thomomys mazama pugetensis*). Sections 5.5.3.3, 6.4.3.3.3, and Table A-2: The three listed subspecies of Mazama pocket gopher are listed in Thurston County, but only the range of the Yelm pocket gopher (*Thomomys mazama yelmensis*) overlaps with the floodplain study area. Mazama pocket gophers are not wide-ranging species, and the Olympia and Tenino subspecies would not disperse into the study area; therefore, the District requests that the Corps include only the Yelm subspecies of Mazama pocket gopher in the analysis.

\* \* \* \* \*

The importance of the proposed Project coupled to the Aquatic Species Restoration Program<sup>2</sup> to the people and the ecosystem of the Chehalis Basin cannot be overstated. The extensive process and years of study that have culminated in the production of the SEPA and NEPA DEISs now inform all who are affected by, and seek to bring to fruition, solutions to flood damage reduction and aquatic habitat restoration in the basin. As the Corps considers the Districts comments and initiates development of the NEPA Final EIS the District will make our staff and consultants who have assisted us available for consultation concerning these comments. The District is also continuing efforts to find additional means to avoid and minimize the Projects impacts as well as advancing our initial efforts regarding the feasibility of mitigating impacts. As they are developed we will communicate any relevant findings to you. If you have any immediate questions or require clarification of our comments please contact me or Betsy Dillin, Project Manager at the District. Betsy can be reached at [Betsy.Dillin@lewiscountywa.gov](mailto:Betsy.Dillin@lewiscountywa.gov) or (360) 740-1138.

Respectfully Submitted,



Erik Martin, District Administrator

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<sup>2</sup> Aquatic Species Restoration Program – A separate parallel program within the Chehalis River Basin to restore and enhance aquatic resources.

On behalf of:

Supervisors:

Edna J. Fund, Chair

Robert C. Jackson, Vice-Chair

Gary Stamper, Member

Attachments:

Conceptual Vegetation Management Plan

# Conceptual Vegetation Management Plan

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## Chehalis River Basin Flood Damage Reduction Project

Submitted by the Chehalis River Basin Flood Control Zone District

November 2020

# Preface

## Preface

This document contains a draft Conceptual Vegetation Management Plan (VMP) for the Chehalis River Basin Flood Damage Reduction Project (Project) proposed by the Chehalis River Basin Flood Control Zone District. The purpose of the Conceptual VMP is to provide avoidance and minimization components to the overall ecosystem mitigation approach for the Project. A primary objective of the conceptual VMP is to minimize the extent of tree clearing and vegetation removal in the Flood Retention Expandable (FRE) facility and temporary reservoir footprint to the extent practical, while balancing the need to reduce the amount of woody material that would be generated within the area during a flood event that triggers FRE operation.

This document expands upon the *Technical Memorandum on Proposed Flood Retention Facility Pre-Construction Vegetation Management Plan* submitted by Anchor QEA, LLC, in 2016. The Conceptual VMP includes a summary of existing vegetation conditions in the proposed FRE Facility and temporary reservoir area, mapping of inundation in the FRE temporary reservoir during major flood events and the anticipated vegetation community responses likely to result from construction and operation of the Project, a conceptual pre-construction and facility operations selective tree harvest plan, and a conceptual adaptive management plan. The Conceptual VMP will be used for future stakeholder and agency coordination efforts and serve as the basis for a more detailed Final VMP once project permitting commences.

## Acronyms and Abbreviations

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|            |                                                                      |
|------------|----------------------------------------------------------------------|
| Anchor QEA | Anchor QEA, LLC                                                      |
| BMPs       | Best management practices                                            |
| cfs        | cubic feet per second                                                |
| CMZ        | channel migration zone                                               |
| Corps      | U.S. Army Corps of Engineers                                         |
| DAHP       | Washington State Department of Archaeology and Historic Preservation |
| dbh        | diameter at breast height                                            |
| DSM        | digital surface model                                                |
| DTM        | digital terrain model                                                |
| Ecology    | Washington State Department of Ecology                               |
| EIS        | Environmental Impact Statement                                       |
| FCZD       | Chehalis River Basin Flood Control Zone District                     |
| FEMA       | Federal Emergency Management Agency                                  |
| FRE        | Flood Retention Facility - Expandable                                |
| GIS        | geographic information system                                        |
| HDR        | HDR Engineering, Inc.                                                |
| I-5        | Interstate 5                                                         |
| LCC        | Lewis County Code                                                    |
| LiDAR      | light detection and ranging                                          |
| mxd        | map exchange document                                                |
| NEPA       | National Environmental Policy Act                                    |
| NHPA       | National Historic Preservation Act                                   |
| NMFS       | National Marine Fisheries Service                                    |
| NPDES      | National Pollutant Discharge Elimination System                      |
| NRCS       | Natural Resources Conservation Service                               |
| OHWM       | ordinary high water mark                                             |
| Project    | Chehalis River Basin Flood Damage Reduction Project                  |
| RCW        | Revised Code of Washington                                           |
| RMZ        | riparian management zone                                             |
| SMP        | Shoreline Master Program                                             |

## Acronyms and Abbreviations

---

|       |                                            |
|-------|--------------------------------------------|
| USDA  | U.S. Department of Agriculture             |
| USFWS | U.S. Fish and Wildlife Service             |
| VMP   | Vegetation Management Plan                 |
| WAC   | Washington Administrative Code             |
| WDNR  | Washington Department of Natural Resources |
| WMZ   | wetland management zone                    |
| WSEL  | water surface elevation                    |



# Contents

|       |                                                                                                             |    |
|-------|-------------------------------------------------------------------------------------------------------------|----|
| 1.0   | Introduction .....                                                                                          | 1  |
| 1.1   | Project Background.....                                                                                     | 1  |
| 1.2   | Project Location .....                                                                                      | 1  |
| 1.3   | Project Description .....                                                                                   | 1  |
| 2.0   | Regulatory Considerations.....                                                                              | 3  |
| 2.1   | Federal .....                                                                                               | 3  |
| 2.1.1 | U.S. Army Corps of Engineers .....                                                                          | 3  |
| 2.1.2 | U.S. Fish and Wildlife Service and National Marine Fisheries Service .....                                  | 3  |
| 2.2   | Tribal .....                                                                                                | 4  |
| 2.3   | State .....                                                                                                 | 4  |
| 2.3.1 | Washington Department of Ecology.....                                                                       | 4  |
| 2.3.2 | Washington Department of Fish and Wildlife .....                                                            | 5  |
| 2.3.3 | Washington Department of Natural Resources .....                                                            | 5  |
| 2.4   | Local and Regional .....                                                                                    | 5  |
| 2.4.1 | Lewis County.....                                                                                           | 5  |
| 3.0   | Existing Conditions.....                                                                                    | 7  |
| 3.1   | Existing Vegetation Mapping.....                                                                            | 7  |
| 3.1.1 | Vegetation Mapping Methods.....                                                                             | 7  |
| 3.1.2 | Existing Vegetation Mapping Results .....                                                                   | 10 |
| 4.0   | FRE Temporary Reservoir Inundation Impacts .....                                                            | 11 |
| 4.1   | Inundation Mapping .....                                                                                    | 11 |
| 4.1.1 | Inundation Mapping Methods.....                                                                             | 11 |
| 4.1.2 | Inundation Mapping Results.....                                                                             | 12 |
| 4.2   | Vegetation Responses to Flooding .....                                                                      | 16 |
| 4.2.1 | General Flood Tolerance Themes .....                                                                        | 16 |
| 4.2.2 | Flood Tolerance of Plant Species in the FRE Temporary Reservoir .....                                       | 17 |
| 4.3   | Inundation Effects in FRE Temporary Reservoir and Proposed Pre-Construction<br>Tree Harvest Rationale ..... | 22 |
| 5.0   | Pre-Construction and Facility Operations Selective Tree Harvest Plan .....                                  | 24 |
| 5.1   | Pre-Construction Selective Tree Harvest Plan .....                                                          | 24 |
| 5.1.1 | Tree Removal Methods and Guidelines.....                                                                    | 25 |
| 5.1.2 | Pre-Construction Vegetation Removal Goals and Objectives .....                                              | 30 |

|       |                                                       |    |
|-------|-------------------------------------------------------|----|
| 5.2   | Facility Operations Selective Tree Harvest Plan ..... | 32 |
| 5.2.1 | Monitoring Methods.....                               | 32 |
| 5.2.2 | Facility Operations Selective Tree Harvest Plan ..... | 32 |
| 6.0   | Conceptual Adaptive Management Plan .....             | 33 |
| 6.1   | Overview .....                                        | 33 |
| 6.2   | Pre-Construction Monitoring.....                      | 35 |
| 6.3   | Adaptive Management Goals and Objectives .....        | 36 |
| 6.3.1 | Goals and Objectives .....                            | 36 |
| 6.4   | Adaptive Management Monitoring .....                  | 37 |
| 6.4.1 | Methods.....                                          | 37 |
| 6.4.2 | Revegetation Guidelines.....                          | 37 |
| 6.4.3 | Contingency Plan .....                                | 39 |
| 7.0   | References .....                                      | 40 |

## Tables

|          |                                                                                                                               |    |
|----------|-------------------------------------------------------------------------------------------------------------------------------|----|
| Table 1. | Summary of Land Cover Classifications.....                                                                                    | 7  |
| Table 2. | Acreage and Duration of Inundation for Historical and Modeled Flood Events during Temporary Reservoir Evacuation Stages ..... | 13 |
| Table 3. | Inundation Zones Based on Temporary Reservoir Evacuation Stages.....                                                          | 14 |
| Table 4. | Relative Flood Tolerance of Common Native Woody Plants in the FRE Temporary Reservoir ....                                    | 18 |
| Table 5. | Riparian Management Zone (RMZ) Widths in the Project Area <sup>a</sup> .....                                                  | 28 |
| Table 6. | Requirements for Retaining Leave Trees and Down Logs in Western Washington.....                                               | 30 |
| Table 7. | Proposed Plant Palette by Replanting Zone.....                                                                                | 38 |
| Table 8. | Potential Contingency Actions for the Vegetation Management Zones .....                                                       | 39 |

## Figures

|           |                                                                             |    |
|-----------|-----------------------------------------------------------------------------|----|
| Figure 1. | FRE Temporary Reservoir Inundation Acreage over Time.....                   | 15 |
| Figure 2. | Land Cover Acreage by Evacuation Stage in the FRE Temporary Reservoir ..... | 23 |
| Figure 3. | Pre-Construction Selective Tree Harvest Plan .....                          | 26 |
| Figure 4. | Vegetation Management Zones.....                                            | 34 |

# Appendices

|                                                                        |     |
|------------------------------------------------------------------------|-----|
| Appendix A. Existing Vegetation Mapping.....                           | A-1 |
| Appendix B. Inundation Maps for Historic and Modeled Flood Events..... | B-1 |
| Appendix C. Hydrographs for Major Flood Events.....                    | C-1 |

# 1.0 Introduction

## 1.1 Project Background

The Chehalis River Basin Flood Control Zone District (FCZD) is proposing to construct a flood retention facility near the town of Pe Ell and conduct airport levee improvements at the Chehalis-Centralia Airport in Lewis County, Washington (Project). The Project would reduce the extent and intensity of flooding from the Chehalis River and improve levee integrity at the Chehalis-Centralia Airport to reduce potential flood damage in the Chehalis-Centralia area.

Flooding has become more frequent in the Chehalis-Centralia area in recent years. The three most recent floods in 1996, 2007, and 2009 were the largest on record and caused extensive physical, emotional, and economic damage. The 2007 and 2009 floods occurred only 13 months apart, affording the community a short window of opportunity to restore the area between floods. These extreme floods caused the loss of homes, farms, and businesses, and floodwater inundation resulted in the closure of Interstate 5 (I-5) for several days. These floods also caused damage to and closure of the Chehalis-Centralia Airport. Most of the flood damage occurred in the cities of Chehalis and Centralia, where there is more intensive development in the floodplain. Peak flows from the 1996, 2007, and 2009 floods rank in the top five ever observed at stream gages in the Chehalis River near Grand Mound, the Newaukum River near Chehalis, and the South Fork Chehalis River.

## 1.2 Project Location

The flood retention facility would be located on Weyerhaeuser and Panesko Tree Farm property, south of State Road 6 in Lewis County. It would be constructed on the mainstem Chehalis River at approximately River Mile 108, about 1 mile south of (upstream of) Pe Ell. The facility would be located in Section 3, Township 12N, Range 5W at parcel number 016392004000. The watershed area upstream of the flood retention facility location is 68.9 square miles. Property within the flood retention facility and reservoir footprint would no longer be managed as commercial forestland.

At the Chehalis-Centralia Airport, the FCZD is proposing to raise the existing airport levee and part of NW Louisiana Avenue. The property is located in Section 30, Township 14N, Range 2W, and the parcel number is 005605080001. This construction would take place concurrently with flood retention facility construction but could be completed within 1 construction year.

## 1.3 Project Description

The proposed Flood Retention Expandable (FRE) facility would temporarily store floodwater during major floods and then release retained floodwater following the flood peak. Specific flow release operations would depend on inflow and the need to hold water to relieve downstream flooding. Major floods include events with river flows forecasted to reach 38,800 cubic feet per second (cfs) or more as

measured at the Chehalis River Grand Mound gage located in Thurston County. Events of this magnitude have a 15% probability of occurrence in any one year, or a 7-year recurrence interval. Major floods also include those with a lower frequency of occurrence, such as 10-year, 100-year, and 500-year floods. Except during flood reduction operations, the Chehalis River would flow through the structure's low-level outlet works at its normal rate of flow and volume, and no water would be stored in the temporary reservoir. This mode of operation would allow fish to pass both upstream and downstream.

The FRE facility would operate when flood forecasts predict a major or greater flood. The FRE facility conduit gates would begin to close and start holding water approximately 48 hours before flows at the Grand Mound gage (USGS 12027500) were predicted to exceed 38,800 cfs due to heavy rainfall in the Willapa Hills. Once conduit gates begin to close, flows through the conduit gates would be reduced until reaching a flow of 300 cfs. A 300-cfs flow is a naturally occurring winter low flow on the Chehalis River. The outflow rate would be adjusted based on observed flows and revised predictions. The FRE facility would be operated to keep river outflow at a reduced rate until the peak flood passes the Grand Mound gage.

FRE facility operation would cause the temporary reservoir to fill. The size of the temporary reservoir depends on the peak of the flood flow and its duration, but in no case would it be greater than 808 acres and would have a maximum depth of 212 feet (measured at conduit invert elevation 408 feet). Peak flood flows for major or greater floods are predicted to last on the order of 2 to 3 days. Once the peak flood flow has passed, a three-stage reservoir evacuation operation would be implemented (see Section 4.0). The duration of temporary reservoir evacuation would depend on the magnitude of the flood event and the amount of water temporarily stored. For catastrophic floods on the order of 75,100 cfs, it is estimated that inundation would last approximately 36 days total from closing of conduit gates through final reservoir evacuation.

The proposed construction of the FRE facility would require removal of vegetation for construction, staging, and access in and around the FRE facilities footprint, as well as selective vegetation removal and tree harvest within the temporary reservoir area before the project is commissioned and available for operation.

Operation of the FRE facility would also require routine vegetation management in the temporary reservoir area to ensure that the FRE facility could be safely operated. Vegetation management would involve periodic selective tree harvest in the temporary reservoir. This would happen about every 7 to 10 years to keep larger trees from growing in areas that would be frequently flooded when the FRE facility is activated.

## 2.0 Regulatory Considerations

The Conceptual Vegetation Management Plan (VMP) is a component of the overall ecosystem effects mitigation approach for the Project. Vegetation communities in the Project area, and specifically streamside riparian vegetation, can help moderate local temperatures, intercept runoff and rainfall and uptake nutrients that may affect downstream water quality. Vegetation also provides habitat for wildlife. Functions provided by vegetation affect a variety of natural resources that are regulated at the federal, state, and local level. The VMP aims to avoid and minimize impacts to vegetation communities to the extent practical at the FRE facility and within the temporary reservoir area.

The following agencies and stakeholders may use the VMP to inform permit reviews, but do not have discretionary authority to approve or deny the VMP as part of their permit approval process. The exception is Washington State Department of Natural Resources (WDNR), who will need to issue a Forest Practices Permit per the Washington State Forest Practices Rules (Title 222 Washington Administrative Code [WAC]) in order for the FCZD to conduct selective and tree harvest and long-term vegetation management during Project construction and operations. WDNR would approve the VMP as part of the Forest Practices Permit issuance. This permit is discussed in detail in Section 2.3.3.1.

### 2.1 Federal

#### 2.1.1 U.S. Army Corps of Engineers

##### 2.1.1.1 Section 404 Clean Water Act Permit

Section 404 of the Clean Water Act requires discharges of dredged and fill material into waters of the U.S. be done only under the authorization of a permit. Because construction of the FRE facility would involve excavation and fill placement in the Chehalis River and adjoining wetlands that are Waters of the U.S., the Project would require a Section 404 permit from the Corps. The Corps is expected to review the VMP as part of their evaluation of impacts to Waters of the U.S., and measures to avoid and minimize such impacts.

#### 2.1.2 U.S. Fish and Wildlife Service and National Marine Fisheries Service

##### 2.1.2.1 Endangered Species Act and Magnuson-Stevens Fishery Conservation and Management Act

The Project could affect species listed under the Endangered Species Act (ESA) or designated critical habitats. The U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) would evaluate the effects on listed and proposed species and critical habitats and require specific conservation measures for unavoidable impacts.

The Magnuson-Stevens Fishery Conservation and Management Act requires federal action agencies to consult with NMFS on all actions, or proposed actions, authorized, funded, or undertaken by the agency

that may adversely affect Essential Fish Habitat. USFWS and NMFS may review the VMP as part of their evaluation of potential impacts to listed species and habitats.

## 2.2 Tribal

The Corps, as federal lead agency, is conducting a review of the Project under the National Environmental Policy Act (NEPA). This includes consultation under Section 7 of the federal Endangered Species Act with the USFWS and NMFS and under Section 106 of the NHPA with tribes and DAHP.

Washington's salmon and steelhead fisheries are also managed cooperatively in a unique co-management relationship. Co-management of fisheries occurs through government-to-government cooperation, communications, and negotiations. One government is the State of Washington, and the other is Indian tribes whose rights were preserved in treaties signed with the federal government in the 1850s. The Tribes may review the VMP as part of government-to-government consultation relating to project effects on fisheries.

## 2.3 State

### 2.3.1 Washington Department of Ecology

#### 2.3.1.1 Shoreline Conditional Use and Substantial Development Permit

Chehalis River, Crim Creek, and Rogers Creek are Shorelines of the State located in the Project Area. The FRE facility would be considered an in-water structure within Lewis County's Shoreline Master Program (SMP), which is a conditional use within the Rural Conservancy shoreline designation (Lewis County 2017). Tree harvest conducted within shoreline jurisdiction must be in compliance with the Lewis County SMP. Forest practices are a permitted use within the Rural Conservancy shoreline environment designation (Lewis County 2017). Ecology has final approval for these permits under the Shoreline Management Act (Chapter 90.58 Revised Code of Washington [RCW]). Ecology may review the VMP as part of their evaluation of potential impacts to shoreline ecological functions.

#### 2.3.1.2 Section 401 Clean Water Act Water Quality Certification

Because a federal (Corps) permit would be required to construct the Project, a Section 401 Water Quality Certification from Ecology would be needed to document the state's review of the Project and its concurrence that the FCZD has demonstrated that the Project and associated activities will meet state water quality standards. This certification is intended to provide reasonable assurance that the FCZD's project would comply with state water quality standards and other requirements for protecting aquatic resources, and covers both construction and operation of the facility. Ecology is expected to review the VMP as part of their evaluation of potential impacts to wetlands and aquatic waterbodies regulated by Ecology under Section 401.

## **2.3.2 Washington Department of Fish and Wildlife**

### **2.3.2.1 Hydraulic Project Approval**

A hydraulic project approval is required because the Project would use, divert, obstruct, and change the natural flow and bed of Chehalis River and its tributaries, which are regulated as waters of the state. The Project would include work in and adjacent to waters of the state. WDFW may review the VMP as part of their evaluation of potential impacts to waters of the state.

## **2.3.3 Washington Department of Natural Resources**

### **2.3.3.1 Forest Practices Permit**

Selective tree harvest within the reservoir footprint during pre-construction and facility operations would be subject to Forest Practices Act Rules administered by the Washington Department of Natural Resources (WDNR) through the Forest Practices Application. In addition, activities for construction and operation of the FRE facility taking place on private or state forestland, including development of quarries and expanding, maintaining, or abandoning roads, would also be subject to Forest Practices Act Rules. These rules provide direction on how to implement the Forest Practices Act (Chapter 76.09 RCW) and Stewardship of Non-Industrial Forests and Woodlands (Chapter 76.13 RCW), and are designed to protect public resources such as water quality and fish habitat while maintaining a viable timber industry in Washington.

It is anticipated that selective tree harvest required for the Project would deviate from prescribed Forest Practices Act Rules, and therefore an Alternate Plan would need to be developed in order to acquire a Forest Practices Permit. WDNR may convene an Interdisciplinary Team to advise the applicant on how to successfully complete and implement an alternate plan to adequately maintain functions of riparian corridors and other sensitive areas. The Interdisciplinary Team is typically led by a Forest Practices Forester who serves as the representative of WDNR, and may include stakeholders such as Ecology field staff, representative(s) of the affected Native American Tribe(s), local or federal authorities that have jurisdiction, and other interested parties that may participate at the discretion of the applicant. WDNR will need to approve the VMP as part of their Forest Practices Permit issuance.

## **2.4 Local and Regional**

### **2.4.1 Lewis County**

#### **2.4.1.1 Critical Areas Review**

The Project would be within, abutting, or likely to affect critical areas regulated by Lewis County (i.e., wetlands, wetland buffers, and Fish and Wildlife Habitat Conservation Areas [FWHCAs]). Therefore, review of critical areas and associated permits will be required in accordance with Lewis County Code (LCC) Chapter 17.38. Lewis County may review the VMP as part of their evaluation of potential impacts to critical areas.



#### **2.4.1.2 Shoreline Conditional Use and Shoreline Substantial Development Permit**

The FRE facility would be considered an in-water structure within Lewis County's SMP, which is a conditional use within the Rural Conservancy shoreline environment designation. Development of the FRE facility and forest practices associated with Conceptual VMP implementation would require a Shoreline Substantial Development Permit. Lewis County issues these permits in accordance with the Lewis County SMP. Lewis County may review the VMP as part of their evaluation of potential impacts to shoreline ecological functions.

## 3.0 Existing Conditions

### 3.1 Existing Vegetation Mapping

#### 3.1.1 Vegetation Mapping Methods

Existing vegetation communities were documented in the FRE temporary inundation study area, which encompasses the temporary reservoir pool from water surface elevation (WSEL) 425 up to WSEL 620 feet, the maximum WSEL for the 2007 event of record. Vegetation mapping used geographic information system (GIS) data and aerial photography available from public sources. A map exchange document (mxd) was set up in GIS with an empty feature class with defined domains for each land cover community that would be digitized. The mxd was populated with the following GIS reference files from previous studies and publicly available information: digital surface models (DSMs) showing the height of tree canopy (WDNR 2020a); digital terrain models (DTMs) representing the ground elevation (WDNR 2020b); streams, wetlands, and ditches mapped by Anchor QEA, LLC (Anchor QEA 2018); and logging road data (WDNR 2020c).

Using the reference data above as well as Google Earth aerial imagery from 1990 through 2018 (Google, LLC 2019), vegetation was characterized in the study area and digitized into distinct land cover classes using the vegetation communities identified in the Proposed Flood Retention Facility Pre-construction Vegetation Management Plan (Anchor QEA 2016), as amended with additional land use classifications such as open water, bare ground/roads, and logged lands to accurately capture current conditions in the study area. A reconnaissance-level site visit was conducted by FCZD biologists in June 2020 to qualitatively ground-truth the desktop mapping of the land cover types.

Table 1 summarizes land cover classifications, typical vegetation within each cover classification, and distinct characteristics that were used to map identified land cover types in the study area.

**Table 1. Summary of Land Cover Classifications**

| Land Cover Classification     | % Cover in Study Area | Typical Vegetation                                                   | Distinct Characteristics                                                                                                |
|-------------------------------|-----------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Wetlands                      | 1%                    | See Anchor QEA (2018)                                                | Wetlands delineated by Anchor QEA 2018.                                                                                 |
| Open Water/Sand Bar           | 10%                   | Unvegetated                                                          | Mapped aquatic features (Anchor QEA 2018) and associated sand bars, rock features, etc.                                 |
| Terrestrial Bare Ground/Roads | 4%                    | Unvegetated                                                          | Lack of vegetation over multiple growing seasons; often associated with wide logging roads and equipment staging areas. |
| Herbaceous/Grass              | 1%                    | Reed canarygrass ( <i>Phalaris arundinacea</i> ), colonial bentgrass | Grasses and forbs present during growing season;                                                                        |

| Land Cover Classification                      | % Cover in Study Area | Typical Vegetation                                                                                                                                                                                                                                                                                                                         | Distinct Characteristics                                                                                                                  |
|------------------------------------------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
|                                                |                       | ( <i>Agrostis capillaris</i> ), sword fern ( <i>Polystichum munitum</i> ), western lady fern ( <i>Athyrium angustum</i> ), piggyback plant ( <i>Tolmiea menziesii</i> ), creeping buttercup ( <i>Ranunculus repens</i> )                                                                                                                   | often found adjacent to wetlands, riparian corridors, and recently disturbed areas.                                                       |
| Deciduous Riparian Shrubland                   | <1%                   | Various willows ( <i>Salix</i> spp.), young red alder ( <i>Alnus rubra</i> ), red-osier dogwood ( <i>Cornus alba</i> ), vine maple ( <i>Acer circinatum</i> ), Indian plum ( <i>Oemleria cerasiformis</i> ), thimbleberry ( <i>Rubus parviflorus</i> ), salmonberry ( <i>Rubus spectabilis</i> )                                           | Dominated by deciduous shrub/saplings less than 6 meters (20 feet) tall (>75% cover).                                                     |
| Deciduous Riparian Forest with Some Conifers   | 17%                   | Red alder, Western red cedar ( <i>Thuja plicata</i> ), Western hemlock ( <i>Tsuga heterophylla</i> ), black cottonwood ( <i>Populus balsamifera</i> ), cascara ( <i>Frangula purshiana</i> ), willows, big leaf maple ( <i>Acer macrophyllum</i> ), red elderberry ( <i>Sambucus racemosa</i> ), snowberry ( <i>Symphoricarpos albus</i> ) | Dominated by deciduous tree species 6 meters (20 feet) tall or taller (>75% cover).                                                       |
| Mixed Coniferous/Deciduous Transitional Forest | 29%                   | Douglas fir ( <i>Pseudotsuga menziesii</i> ), red alder, big leaf maple                                                                                                                                                                                                                                                                    | Approximately equal distribution of deciduous and coniferous species (not clearly dominated by one or the other).                         |
| Coniferous Forest                              | 28%                   | Douglas fir                                                                                                                                                                                                                                                                                                                                | Dominated by coniferous species (>75% cover).                                                                                             |
| Logged, replanted 0–5 years                    | 7%                    | Sun-tolerant grasses and forbs, Douglas fir seedlings                                                                                                                                                                                                                                                                                      | Evidence of logging (i.e., clearcutting) on historic aerial imagery; replanting visible within last 5 years (2015–2020) or not replanted. |
| Logged, replanted 5–15+ years                  | 3%                    | Douglas fir saplings                                                                                                                                                                                                                                                                                                                       | Evidence of logging on historic aerial imagery; replanting identified 5 or more years ago (prior to 2015).                                |

#### 3.1.1.1 Wetland and Open Water/Sand Bar

Wetlands and streams mapped in the *Wetland, Water, and Ordinary High Water Mark Delineation Report* (Anchor QEA 2018) were imported into GIS to create the Wetland and Open Water/Sand Bar land cover classifications, respectively.

The ordinary high water marks (OHWM) for Crim Creek, Roger Creek, and the Chehalis River were not delineated in their entirety during field visits conducted by Anchor QEA due to access limitations and the length of reaches within the project area. Instead, Anchor QEA conducted a desktop-based GIS analysis using light detection and ranging (LiDAR)-generated topography to interpret the OHWM elevation between each point that was gathered in the field. Minor adjustments were made to GIS-based stream mapping to more accurately reflect the spatial extent of streams visible on aerial photography.

#### **3.1.1.2 Terrestrial Bare Ground/Roads**

The Terrestrial Bare Ground/Roads land cover class includes wide logging roads and equipment staging areas. Historic aerial imagery was used to identify areas lacking vegetation for multiple growing seasons that were not associated with aquatic areas. To account for the surface area of logging roads obscured by dense vegetation and not visible on aerial imagery, a 7.5-foot buffer was applied to the centerline of mapped road features.

#### **3.1.1.3 Herbaceous/Grass**

The Herbaceous/Grass class accounts for upland areas dominated by grasses and forbs that are not wetlands. Herbaceous vegetation was distinguished from bare ground by comparing multiple years of aerial imagery to confirm the presence of vegetation during the growing season. Herbaceous vegetation was also commonly associated with areas recently disturbed by logging operations, and was found adjacent to areas categorized as Terrestrial Bare Ground. Species typically found in these areas include reed canarygrass (*Phalaris arundinacea*), colonial bentgrass (*Agrostis capillaris*), sword fern (*Polystichum munitum*), western lady fern (*Athyrium angustum*), piggyback plant (*Tolmiea menziesii*), and creeping buttercup (*Ranunculus repens*).

#### **3.1.1.4 Deciduous Riparian Shrubland**

The Deciduous Riparian Shrubland class was modeled after the Cowardin “Scrub-Shrub” class, which includes areas dominated by woody vegetation less than 6 meters (20 feet) tall, including true shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions (Cowardin et al. 1979). This class was identified and mapped based on the prevalence of deciduous shrub species and proximity (generally within 200 feet) to mapped streams and aquatic areas. Species typically found in these areas include various willows (*Salix* spp.), red-osier dogwood (*Cornus alba*), vine maple (*Acer circinatum*), Indian plum (*Oemleria cerasiformis*), thimbleberry (*Rubus parviflorus*), salmonberry (*Rubus spectabilis*), and red alder (*Alnus rubra*) saplings.

#### **3.1.1.5 Deciduous Riparian Forest with Some Conifers**

The Deciduous Riparian Forest classification was established based on the Cowardin “Forested” class, which includes forested areas characterized by woody vegetation that is 6 meters (20 feet) or taller (Cowardin et al. 1979). Deciduous forest stands were differentiated from scrub-shrub communities using the DSM GIS layer to determine approximate tree height. Although the class is dominated by deciduous tree species (approximately >75% deciduous cover), scattered conifer trees were also commonly observed in these areas. Deciduous species were distinguished from conifers using multiple years of

aerial imagery to identify seasonal differences in canopy cover. Species typically found in the Deciduous Riparian Forest class includes red alder, Western red cedar (*Thuja plicata*), Western hemlock (*Tsuga heterophylla*), black cottonwood (*Populus balsamifera*), cascara (*Frangula purshiana*), willows, big leaf maple (*Acer macrophyllum*), red elderberry (*Sambucus racemosa*), and snowberry (*Symphoricarpos albus*).

#### **3.1.1.6 Mixed Coniferous/Deciduous Transitional Forest**

Mixed Coniferous/Deciduous Transitional Forest represents areas with an approximately equal distribution of coniferous and deciduous tree species. Tree heights were estimated using the DSM layer, and the distribution of coniferous and deciduous species was determined using seasonal differences in canopy cover from historic aerial imagery. Species typically found in these areas include Douglas fir (*Pseudotsuga menziesii*), red alder, and big leaf maple.

#### **3.1.1.7 Coniferous Forest**

Areas dominated by coniferous tree species (>75% cover) were characterized as Coniferous Forest. The Coniferous Forest class is typically dominated by Douglas fir and often includes stands of various age classes managed for logging.

#### **3.1.1.8 Recently Logged Areas**

Areas with evidence of recent logging activity (i.e., clearcutting) were identified by comparing multiple years of aerial imagery. Recently logged areas with evidence of replanting within the last 5 years (2015 to present) or no evidence of replanting were characterized as “Logged, replanted 0-5 years.” Areas with evidence of replanting more than 5 years ago (prior to 2015) were characterized as “Logged, replanted 5-15+ years.” The 5-year threshold represents an approximation of time required for logged lands in the Pacific Northwest to transition from an early seral stage, in which grasses and forbs are predominant, to a shrub-sapling stage in which Douglas-fir seedlings accelerate in growth (Burns and Honkala 1990; Lam and Maguire 2011; USDA Forest Service 2012).

### **3.1.2 Existing Vegetation Mapping Results**

An existing land cover map of the study area is presented in Appendix A.

## 4.0 FRE Temporary Reservoir Inundation Impacts

### 4.1 Inundation Mapping

#### 4.1.1 Inundation Mapping Methods

The methods described below were used to generate the temporary reservoir inundation limits anticipated for the regulation of flood events by the proposed FRE facility. The inundation limits are the same as the vegetation study area, encompassing WSEL 425 to 620 feet.

Topography data were obtained from public light detection and ranging (LiDAR) databases. A series of digital terrain models (DTMs) provided by the Washington State Department of Natural Resource's LiDAR program were used to generate contour lines (datum: North American Vertical Datum of 1988 [NAVD88]). HDR Engineering, Inc. (HDR), used ArcGIS's "Mosaic to New Raster" tool to merge multiple DTMs into a single DTM that covers the entire project area. Once created, the new DTM was used to derive contours using the ArcGIS Contour tool. This tool was used to define the base contour, contour interval, and maximum vertices per contour. No unit conversion factor (Z factor) was used to generate the project contours. For the purpose of modeling, contours at a 5-foot contour interval were created with a base contour of zero.

The contour files were imported to AutoCAD 2018 and used to generate the inundation contour lines and show the aerial extent of these inundation limits. The following key WSEL contours were selected to illustrate the aerial (i.e., planform) extent of inundation during each of the three stages of temporary reservoir evacuation that would be implemented to evacuate the reservoir after a major flood event (i.e., events with river flows forecasted to reach 38,800 cfs or more) when the FRE facility is activated:

1. **Initial Reservoir Evacuation (Max. WSEL to WSEL 528 feet):** The maximum WSEL for each major flood event will vary depending on the intensity of the flood event. To evacuate the temporary reservoir after a major flood event, the partially closed reservoir outlet gates will open and increase outflow by 1,000 cfs each hour, from 300 cfs (minimum outflow during flood operations) to a maximum outflow of 5,000 to 6,500 cfs. This will cause evacuation of the temporary reservoir from its peak WSEL at the maximum pool, which will be limited to 10 feet per day (5 inches per hour) to reduce risk of landslides. During all major flood events, the 10-feet-per-day evacuation rate will continue until the pool elevation reaches 528 feet. Once the pool elevation reaches 528 feet, debris management operations will begin.
2. **Debris Management Evacuation (WSEL 528–500 feet):** During major flood events, debris from surrounding tributaries and hillsides may be swept into the reservoir. Debris management procedures will be used to ensure that large woody debris will not impact dam operations or cause damage to the FRE facility.

Debris management will begin once the pool elevation falls to 528 feet. At this time, evacuation rates will be slowed to 2 feet per day (1 inch per hour) for a 14-day period. During this period, crews operating from boats will move large debris to an existing log-sorting yard within the reservoir area previously operated previously by Weyerhaeuser. The slowed evacuation rate will continue until the pool elevation fall to 500 feet. Once the pool elevation reaches 500 feet, debris management operations will conclude.

3. **Final Reservoir Evacuation (WSEL 500–425 feet):** When the pool elevation falls to WSEL of 500 feet, evacuation rates will increase to 10 feet per day (5 inches per hour) once debris management operations are complete. Evacuation will continue at this rate until the pool elevation returns to 425 feet (empty reservoir). At this point, the reservoir will no longer be impounding water and the Chehalis River will return to a free-flowing state.

The State Environmental Policy Act Draft Environmental Impact Statement: Proposed Chehalis River Basin Flood Damage Reduction Project (EIS; Ecology 2020) analyzed three historical flood events and two theoretical events, the 10-year event and the 100-year event (see Table 2). To determine the predicted maximum reservoir pool WSELs resulting from FRE operations for each of these flood events, the regulated and unregulated flood hydrographs were obtained from the EIS and notations were added to the hydrograph plots to clarify key evacuation stages. Similar information was applied to the inundation limit map created in AutoCAD 2018. Additionally, the total inundation time above each of the three key reservoir evacuation elevations—maximum WSEL, WSEL 528 feet, and WSEL 500 feet—was determined from the time steps obtained from the flood hydrographs provided in the EIS.

#### 4.1.2 Inundation Mapping Results

Table 2 shows the acreage and duration of inundation expected during the three stages of temporary reservoir drawdown for each major flood event evaluated. Inundation maps for historical and modeled flood events are presented in Appendix B. The figures show the Initial Reservoir Evacuation, Debris Management Evacuation, and Final Reservoir Evacuation areas in blue, yellow, and orange, respectively. Hydrographs for each major flood event are provided in Appendix C.

The terms used in Table 2 are defined as follows:

- **Area of inundation** refers to the area (in acres) of reservoir inundated during each stage of temporary reservoir drawdown. As described above, the Debris Management Evacuation and Final Reservoir Evacuation stages will have uniform operation during all major flood events; therefore, the acreage will be consistent during these operational milestones. The area inundated at the start of the Initial Reservoir Evacuation stage differs based on the severity of the flood event.
- **Duration of inundation** represents the maximum number of days of inundation during each stage of reservoir evacuation. The duration differs depending on the severity of the historical or

**Table 2. Acreage and Duration of Inundation for Historical and Modeled Flood Events during Temporary Reservoir Evacuation Stages**

| Historical/Modeled Event | Initial Reservoir Evacuation<br>(WSEL >528 feet) |                                            |                                   |                           | Debris Management Evacuation<br>(WSEL 528–500 feet) |                                                          |                      | Final Reservoir Evacuation<br>(WSEL 500–425 feet) |                                                          |                      |
|--------------------------|--------------------------------------------------|--------------------------------------------|-----------------------------------|---------------------------|-----------------------------------------------------|----------------------------------------------------------|----------------------|---------------------------------------------------|----------------------------------------------------------|----------------------|
|                          | Area of Inundation above WSEL 528 feet           | Duration of Inundation above WSEL 528 feet | Total Reservoir Area <sup>a</sup> | Maximum WSEL <sup>b</sup> | Area of Inundation at WSEL 500–528 feet             | Duration of Inundation at WSEL 520–500 feet <sup>c</sup> | Total Reservoir Area | Area of Inundation at WSEL 425–500 feet           | Duration of Inundation at WSEL 500–425 feet <sup>d</sup> | Total Reservoir Area |
| 10-year event            | 238 acres                                        | Up to 5.9 days                             | 519 acres                         | 568 feet                  | 122 acres                                           | Up to 20.2 days                                          | 281 acres            | 159 acres                                         | Up to 26.9 days                                          | 159 acres            |
| 100-year event           | 426 acres                                        | Up to 10.7 days                            | 707 acres                         | 604 feet                  | 122 acres                                           | Up to 25.0 days                                          | 281 acres            | 159 acres                                         | Up to 31.8 days                                          | 159 acres            |
| 1996 flood event         | 410 acres                                        | Up to 9.8 days                             | 691 acres                         | 601 feet                  | 122 acres                                           | Up to 24.5 days                                          | 281 acres            | 159 acres                                         | Up to 31.0 days                                          | 159 acres            |
| 2007 flood event         | 527 acres                                        | Up to 11.1 days                            | 808 acres                         | 620 feet                  | 122 acres                                           | Up to 25.2 days                                          | 281 acres            | 159 acres                                         | Up to 32.3 days                                          | 159 acres            |
| 2009 flood event         | 324 acres                                        | Up to 7.8 days                             | 605 acres                         | 585 feet                  | 122 acres                                           | Up to 22.0 days                                          | 281 acres            | 159 acres                                         | Up to 28.8 days                                          | 159 acres            |

<sup>a</sup> This value also represents the maximum area of inundation for the modelled flood event.

<sup>b</sup> This value also represents the maximum WSEL for the modelled flood event.

<sup>c</sup> Includes 14 days for debris-clearing activities starting when evacuation following flood peak falls to WSEL 528 feet.

<sup>d</sup> This value also represents the maximum number of days of flooding for the modelled flood event.



- modeled flood event. For the Debris Management Evacuation stage, this number includes 14 days for debris-clearing activities.
- **Maximum WSEL** gives the peak temporary reservoir pool WSEL for each flood event prior to the start of the Initial Reservoir Evacuation stage.

The results of the inundation mapping show that the maximum pool WSEL of the Initial Reservoir Evacuation area will range between 620 and 568 feet. The acreage of inundation above 528 feet (lower limit of the Initial Reservoir Evacuation area) will range between 238 and 527 acres, and the duration of inundation will range between 5.9 and 11.1 days. The Debris Management Evacuation area will have 122 acres of inundation between WSEL 528 and 500 feet, and will be inundated between 20.2 and 25.2 days. The Final Reservoir Evacuation area will have 159 acres of inundation between WSEL 500 and 425 feet. This area will be inundated at least 26 days under each flood event, and up to 32 days under the event of record (historic 2007 flood event).

Table 3 summarizes the range of acreage, inundation extent, and duration at each evacuation stage from the more frequent (10% chance) major flood event to the least frequent (<1% chance) major flood event. Figure 1 graphically depicts each evacuation stage for each flood event plotted as acreage of inundation over time. The standardized three-stage evacuation operations that will be implemented when the dam is activated during all major flood events provides a more accurate depiction of the duration and extent of inundation to evaluate impacts during operation of the dam. During any major flood event, nearly half of the reservoir or more will be inundated for only 6 to 11 days. Longer periods of inundation that will have greater potential effects on vegetation will commence at the Debris Management Evacuation stage.

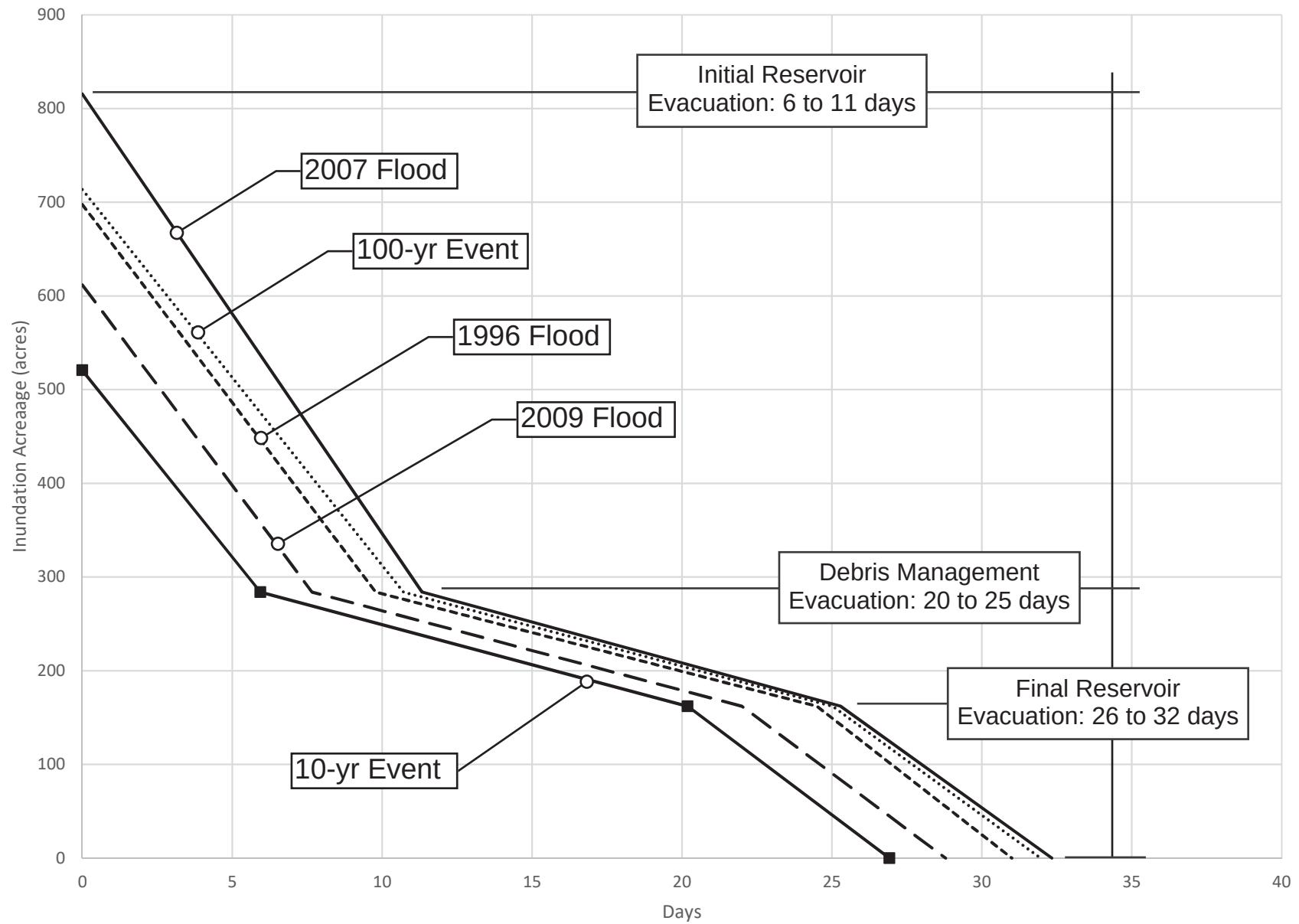
**Table 3. Inundation Zones Based on Temporary Reservoir Evacuation Stages**

| Temporary Reservoir Drawdown Stage | % Chance of being Flooded in a Year | Duration        | WSEL Range | Total Reservoir Area |
|------------------------------------|-------------------------------------|-----------------|------------|----------------------|
| Initial Reservoir Evacuation       | 10%                                 | Up to 5.9 days  | 568–528    | 238 acres            |
|                                    | <1%                                 | Up to 11.1 days | 620–528    | 527 acres            |
| Debris Management Evacuation       | 10%                                 | Up to 20.2 days | 528–500    | 122 acres            |
|                                    | <1%                                 | Up to 25.2 days | 528–500    | 122 acres            |
| Final Reservoir Evacuation         | 10%                                 | Up to 26.9 days | 500–425    | 159 acres            |
|                                    | <1%                                 | Up to 32.3 days | 500–425    | 159 acres            |

The graph illustrates the reduction in temporary reservoir inundation acreage over a 35-day period for different flood events and management strategies. The y-axis represents 'Inundation Acreage (acres)' from 0 to 900, and the x-axis represents 'Days' from 0 to 40. Key features include:

- Initial Reservoir Evacuation:** A horizontal line at approximately 820 acres from Day 0 to Day 6.
- 100-yr Event:** A solid line with open circles starting at ~715 acres and decreasing to ~190 acres by Day 17.
- 2007 Flood:** A solid line with open circles starting at ~610 acres and decreasing to ~160 acres by Day 20.
- 1996 Flood:** A solid line with open circles starting at ~520 acres and decreasing to ~160 acres by Day 20.
- 2009 Flood:** A solid line with open circles starting at ~450 acres and decreasing to ~160 acres by Day 20.
- 10-yr Event:** A solid line with open circles starting at ~330 acres and decreasing to ~160 acres by Day 20.
- Debris Management:** A solid line with open circles starting at ~280 acres and decreasing to ~160 acres by Day 20.
- Final Reservoir Evacuation:** A horizontal line at approximately 160 acres from Day 20 to Day 26.
- Post-Evacuation Scenarios:** From Day 26 to Day 32, several lines show the final inundation levels: a solid line with open circles (100-yr Event) reaching 0 acres, a solid line with open circles (2007 Flood) reaching 0 acres, a solid line with open circles (1996 Flood) reaching 0 acres, a solid line with open circles (2009 Flood) reaching 0 acres, a solid line with open circles (10-yr Event) reaching 0 acres, and a solid line with open circles (Debris Management) reaching 0 acres.

| Days | 100-yr Event | 2007 Flood | 1996 Flood | 2009 Flood | 10-yr Event | Debris Management |
|------|--------------|------------|------------|------------|-------------|-------------------|
| 0    | 715          | 610        | 520        | 450        | 330         | 280               |
| 3    | 670          | 560        | 450        | 330        | 280         | 230               |
| 6    | 620          | 510        | 400        | 280        | 230         | 180               |
| 10   | 550          | 440        | 330        | 210        | 160         | 110               |
| 17   | 190          | 160        | 160        | 160        | 160         | 160               |
| 20   | 160          | 160        | 160        | 160        | 160         | 160               |
| 26   | 160          | 160        | 160        | 160        | 160         | 160               |
| 32   | 0            | 0          | 0          | 0          | 0           | 0                 |



## 4.2 Vegetation Responses to Flooding

### 4.2.1 General Flood Tolerance Themes

The likelihood of woody vegetation to survive a flood event is dependent on a variety of factors, including time of year, soil type, age and health of plants, frequency, duration and depth of inundation, and plant species. Flooding also causes mechanical destruction of vegetation through the direct impact of flood waters and the debris they transport, and through the erosion of substrate (Bendix 1998). It has also been noted that standing water is more harmful than moving flood water and that flood-tolerant plants are often injured by flooding in standing water (Kozlowski 1982, as cited in Kozlowski 1984).

Flooding also contributes to changes in the physical status of soil, as waterlogging causes large aggregates to break into smaller particles. As flood levels recede, the small particles are rearranged into a more dense structure, creating smaller soil-pore diameters, higher mechanical resistance to root penetration, low oxygen concentrations and the inhibition of resource use (Engelaar et al. 1993).

Flooding that occurs during the growing season is significantly more harmful to plant survival than flooding that occurs during the dormant season (Kozlowski 1984, 1997). The growing season for the project area was determined based on the period in which temperatures are above 28 degrees Fahrenheit in 5 out of 10 years using the long-term climatological data collected by the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) (2020a). Using the USDA NRCS Climate Analysis for Wetlands table for the nearest station (Centralia), the growing season was approximated to be typically between March 6 and November 23, or a total of 262 days.

The depth of flooding also introduces stresses to vegetation. Partially to fully submerged plants have partial to full loss of direct contact with atmospheric oxygen, which limits the ability for gas exchange to occur in leaves. Sunlight is also greatly reduced or extinguished, hampering photosynthesis (Parolin 2009). Trees that are submerged only partially during a flood event generally have greater survivability than fully submerged trees (Siebel et al. 1998; North Dakota State University 2000).

The types of soils found in the inundated area and their ability to drain or retain water also influences vegetation survival. Sandy soils drain much faster than predominantly clay-based soils, which hold water and remain wet for longer periods (Jull 2008). Soils in the study area are mapped by USDA NRCS as Winston loam (45.6%), Bunker loam (20.3%), Katula-Rock outcrop complex (10.9%), Aquic Xerofluvents (5.0%), and others (USDA NRCS 2019). In their natural state, nearly all soils found in the study area are classified as "well drained," meaning that water is removed from the soil readily but not rapidly (Soil Science Division Staff 2017).

The age and health of the plants also contribute to an individual plant's ability to survive a flood event. Young seedlings have been found to be more sensitive to flooding injury than older seedlings (Kozlowski 1997). Established, healthy trees and shrubs are also more tolerant of flooding than old, stressed, or young plants of the same species (Jull 2008).

#### **4.2.2 Flood Tolerance of Plant Species in the FRE Temporary Reservoir**

Flood-tolerant plants survive in anaerobic environments using various morphological and physiological adaptations, depending on the species and environmental conditions. Specifically, red alder exhibits adaptations that permit flood tolerance, including the formation of adventitious roots when subject to flooding (Batzli and Dawson 1997; Harrington 2006). Other studies recorded 100% survival of red alder seedlings when subjected to a 20-day flood and a 20-day recovery period (Harrington 1987).

In a controlled flooding experiment conducted by Minore in 1968, winter inundation did not significantly affect the survival or growth of western hemlock, red alder, Sitka spruce, lodgepole pine, or western redcedar, but even 1 week of winter inundation was detrimental to Douglas fir. In the same experiment, summer flooding survival rates for both western redcedar and lodgepole pine were significantly better than Douglas fir after 4 weeks of summer flooding. Minore (1968) concluded that short periods of winter flooding will likely not injure western hemlock, red alder, Sitka spruce, lodgepole pine, or western redcedar seedlings, but found that Douglas fir seedlings are very intolerant of flooding. It was also found that photosynthesis and transpiration of Douglas fir have been shown to decrease within 4 to 5 hours after flooding, indicating rapid stomatal closure (Zaerr 1983, as cited in Kozlowski and Pallardy 2002).

Based on a comprehensive literature review, existing vegetation species commonly found in the project area were sorted into three categories of anticipated flood tolerance:

- Low: 1–7 days of inundation
- Moderate: 8–14 days of inundation
- Medium-High: 6–30 days of inundation
- High: 15–30+ days of inundation

Table 4 summarizes the relative flood tolerance of common native woody plants found in the project area. Species with low anticipated flood tolerance, including Douglas fir, are likely to exhibit signs of flood stress after only a few days. Signs of flood stress in plants includes yellowing or browning of leaves, curled leaves, leaf wilt and drop, reduced size of new leaves, early fall color, branch dieback, formation of sprouts along stems or trunk, and gradual decline and death (Jull 2008). Stressed trees are also more susceptible to secondary organisms such as canker fungi and insects that bore into phloem and wood (Jull 2008).

**Table 4. Relative Flood Tolerance of Common Native Woody Plants in the FRE Temporary Reservoir**

| Common Name        | Scientific Name                                    | Tilley et al. 2012      | Walters et al. 1980                                        | Withrow-Robinson et al. 2011 | Whitlow and Harris 1979     | Wenger 1984         | USDA PLANTS Database <sup>a</sup> | Miscellaneous Sources                                                                                                                                                                              |
|--------------------|----------------------------------------------------|-------------------------|------------------------------------------------------------|------------------------------|-----------------------------|---------------------|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Red-osier dogwood  | <i>Cornus alba</i>                                 | High (10–30+ days)      | Very tolerant (2+ growing seasons)                         | High tolerance               | Very tolerant (>1 year)     | N/A                 | High                              | N/A                                                                                                                                                                                                |
| Narrow leaf willow | <i>Salix exigua</i>                                | Medium-high (6–30 days) | Very tolerant (all willows; 2+ growing seasons)            | High tolerance (all willows) | Very tolerant (>1 year)     | Moderately tolerant | High                              | 94.9 days of maximum flooding at elevations where species was most common <sup>b</sup>                                                                                                             |
| Hooker's willow    | <i>Salix hookeriana</i>                            | N/A                     | Very tolerant (all willows; 2+ growing seasons)            | High tolerance (all willows) | Very tolerant (>1 year)     | Moderately tolerant | High                              | N/A                                                                                                                                                                                                |
| Pacific willow     | <i>Salix lasiandra</i>                             | Medium-high (6–30 days) | Very tolerant (all willows; 2+ growing seasons)            | High tolerance (all willows) | Very tolerant (>1 year)     | Moderately tolerant | High                              | 146.3 days of maximum flooding at elevations where species was most common <sup>b</sup>                                                                                                            |
| Lodgepole pine     | <i>Pinus contorta</i>                              | N/A                     | Intermediately tolerant (1–3 months during growing season) | N/A                          | Tolerant (1 growing season) | Moderately tolerant | Low                               | 100% survival of seedlings inundated 1–4 weeks in winter; 100% survival after 4 weeks in summer; 50% survival after 8 weeks in summer; <sup>c</sup> tolerated submergence for 14 days <sup>d</sup> |
| Black cottonwood   | <i>Populus balsamifera</i> ssp. <i>Trichocarpa</i> | Medium (6–10 days)      | Tolerant (most of 1 growing season)                        | High tolerance               | Tolerant (1 growing season) | Moderately tolerant | Medium                            | 100% survival but varied growth response after 20-day flooding and 20-day recovery period <sup>e</sup>                                                                                             |
| Red elderberry     | <i>Sambucus racemosa</i>                           | Medium (6–10 days)      | N/A                                                        | High tolerance               | Tolerant (1 growing season) | N/A                 | N/A                               | N/A                                                                                                                                                                                                |
| Hardhack           | <i>Spiraea douglasii</i>                           | N/A                     | N/A                                                        | High tolerance               | Tolerant (1 growing season) | N/A                 | High                              | Suffered no obvious injury after being inundated and covered in fine layer of silt during flood event <sup>f</sup>                                                                                 |

| Common Name       | Scientific Name           | Tilley et al. 2012 | Walters et al. 1980                                        | Withrow-Robinson et al. 2011 | Whitlow and Harris 1979              | Wenger 1984         | USDA PLANTS Database <sup>a</sup> | Miscellaneous Sources                                                                                                                                                                                                       |
|-------------------|---------------------------|--------------------|------------------------------------------------------------|------------------------------|--------------------------------------|---------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Western red cedar | <i>Thuja plicata</i>      | N/A                | Tolerant (most of 1 growing season)                        | High tolerance               | Tolerant (1 growing season)          | Weakly tolerant     | N/A                               | 100% survival of seedlings inundated 1–4 weeks in winter and 4 and 8 weeks in summer <sup>c</sup>                                                                                                                           |
| Sitka spruce      | <i>Picea sitchensis</i>   | N/A                | Tolerant (most of 1 growing season)                        | N/A                          | Slightly tolerant (30 days)          | Weakly tolerant     | Low                               | 100% survival of seedlings inundated 1–4 weeks in winter; 84% survival after 4 weeks in summer; 34% after 8 weeks in summer; <sup>c</sup> actively growing seedlings were alive after 22 days of root flooding <sup>g</sup> |
| Ponderosa pine    | <i>Pinus ponderosa</i>    | N/A                | Intermediately tolerant (1–3 months during growing season) | Medium tolerance             | Slightly tolerant (30 days)          | Intolerant          | N/A                               | N/A                                                                                                                                                                                                                         |
| Western hemlock   | <i>Tsuga heterophylla</i> | N/A                | Tolerant (most of 1 growing season)                        | N/A                          | Slightly tolerant (30 days)          | Weakly tolerant     | N/A                               | 100% seedling survival after 1–4 weeks inundation in winter; 34% survival after 4 weeks in summer; 16% survival after 8 weeks in summer <sup>c</sup>                                                                        |
| Big leaf maple    | <i>Acer macrophyllum</i>  | N/A                | Intermediately tolerant (1–3 months during growing season) | Medium tolerance             | Intolerant (no more than a few days) | Weakly tolerant     | Medium                            | In repeated flood events in British Columbia, Canada, some maples succumbed, particularly if they were growing very actively <sup>f</sup>                                                                                   |
| Vine maple        | <i>Acer circinatum</i>    | N/A                | Tolerant (most of 1 growing season)                        | Low tolerance                | N/A                                  | N/A                 | N/A                               | N/A                                                                                                                                                                                                                         |
| Red alder         | <i>Alnus rubra</i>        | Medium (6–10 days) | Very tolerant (2+ growing seasons)                         | High tolerance               | Intolerant (no more than a few days) | Moderately tolerant | Low                               | Recovered after 50-day flood and 20-day recovery; <sup>h</sup> 100% seedling survival but varied growth response after 20-day flood and 20-day                                                                              |

| Common Name   | Scientific Name              | Tilley et al. 2012 | Walters et al. 1980                                        | Withrow-Robinson et al. 2011 | Whitlow and Harris 1979              | Wenger 1984 | USDA PLANTS Database <sup>a</sup> | Miscellaneous Sources                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------|------------------------------|--------------------|------------------------------------------------------------|------------------------------|--------------------------------------|-------------|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                              |                    |                                                            |                              |                                      |             |                                   | recovery; <sup>e</sup> 100% seedling survival after 1–4 weeks in winter; 50% survival after 4 weeks in summer; 65% survival after 8 weeks in summer; <sup>c</sup> static flooding killed 2-year-old saplings after 4–6 days of flooding when water was above soil surface; <sup>i</sup> suffered “markedly” in flooded lowland forest after inundation; died in large numbers and regarded as one of the trees most susceptible to damage by flooding <sup>f</sup> |
| Indian plum   | <i>Oemleria cerasiformis</i> | N/A                | N/A                                                        | Low to Medium                | N/A                                  | N/A         | Medium                            | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Snowberry     | <i>Symphoricarpos albus</i>  | Medium (6–10 days) | Intermediately tolerant (1–3 months during growing season) | Medium tolerance             | N/A                                  | N/A         | N/A                               | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Thimbleberry  | <i>Rubus parviflorus</i>     | N/A                | N/A                                                        | Low tolerance                | N/A                                  | N/A         | Low                               | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Salmonberry   | <i>Rubus spectabilis</i>     | N/A                | N/A                                                        | High tolerance               | N/A                                  | N/A         | Medium                            | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Mock orange   | <i>Philadelphus L.</i>       | Unknown            | N/A                                                        | Medium tolerance             | Intolerant (no more than a few days) | N/A         | N/A                               | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Bitter cherry | <i>Prunus emarginata</i>     | N/A                | Intermediately tolerant (1–3 months during growing season) | N/A                          | Intolerant (no more than a few days) | N/A         | N/A                               | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

| Common Name | Scientific Name              | Tilley et al. 2012 | Walters et al. 1980                 | Withrow-Robinson et al. 2011 | Whitlow and Harris 1979              | Wenger 1984     | USDA PLANTS Database <sup>a</sup> | Miscellaneous Sources                                                                                                                                                  |
|-------------|------------------------------|--------------------|-------------------------------------|------------------------------|--------------------------------------|-----------------|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Douglas fir | <i>Pseudotsuga menziesii</i> | N/A                | N/A                                 | Low tolerance                | Intolerant (no more than a few days) | Intolerant      | Low                               | Winter flooding for 1–4 weeks causes severe injury; 0% seedling survival after 4 or 8 weeks during summer; <sup>c</sup> tolerated submergence for 14 days <sup>d</sup> |
| Cascara     | <i>Frangula purshiana</i>    | N/A                | N/A                                 | Medium tolerance             | Intolerant (no more than a few days) | N/A             | N/A                               | N/A                                                                                                                                                                    |
| Oregon ash  | <i>Fraxinus latifolia</i>    | N/A                | Tolerant (most of 1 growing season) | High tolerance               | N/A                                  | Weakly tolerant | High                              | Static flooding killed 2-year-old saplings after 4–6 days of flooding when water was above soil surface <sup>i</sup>                                                   |

<sup>a</sup>USDA NRCS 2020b.

<sup>b</sup>Wakefield 1966, as cited in Whitlow and Harris 1979. Looks at days of average maximum flooding at elevations where species was found to be most common.

<sup>c</sup>Minore 1968.

<sup>d</sup>McCaughey and Weaver 1991.

<sup>e</sup>Harrington 1987.

<sup>f</sup>Brink 1954.

<sup>g</sup>Coutts 1981, as cited in McCaughey and Weaver 1991.

<sup>h</sup>Batzli and Dawson 1997.

<sup>i</sup>Ewing 1996.



### 4.3 Inundation Effects in FRE Temporary Reservoir and Proposed Pre-Construction Tree Harvest Rationale

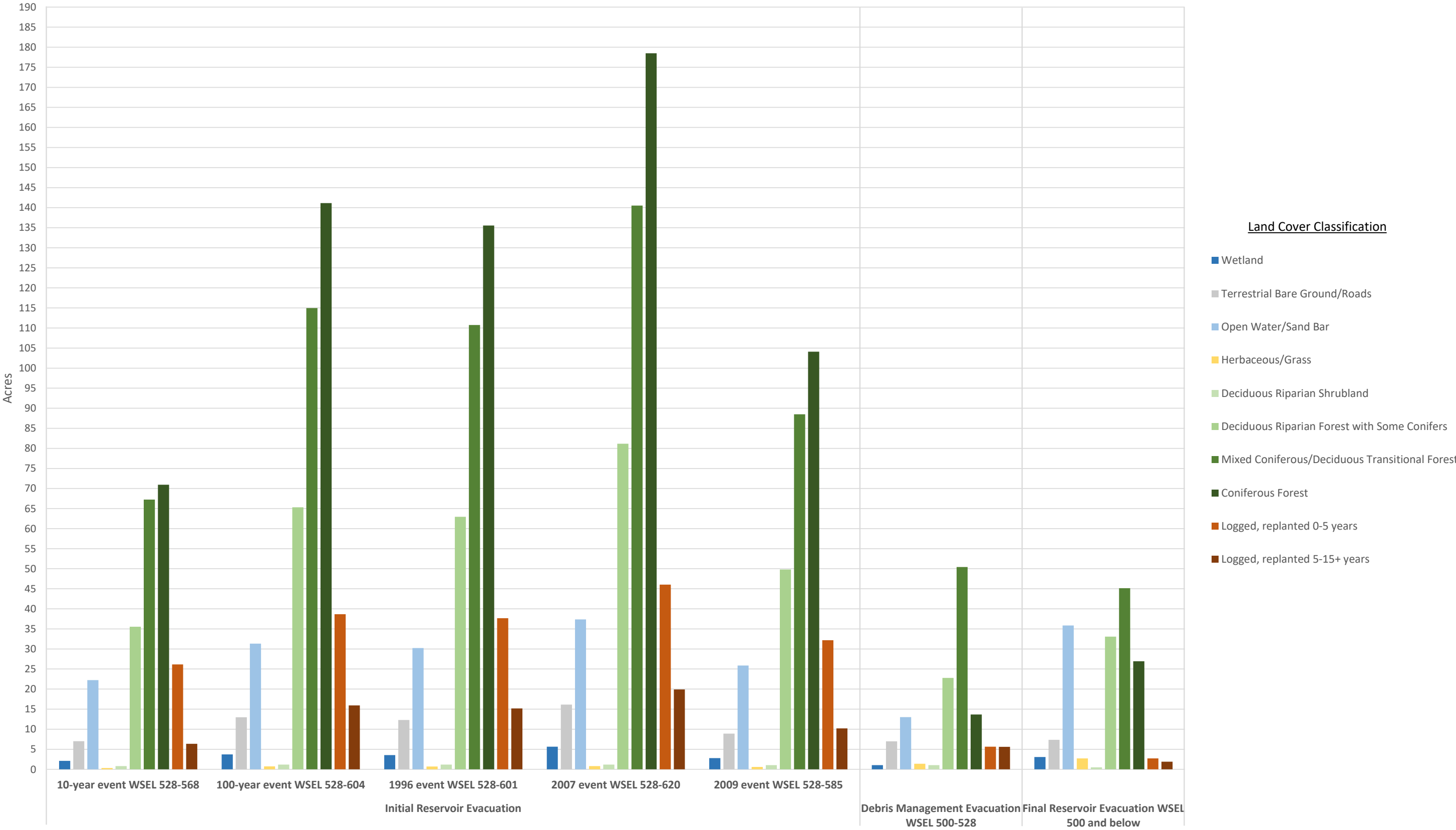
Figure 2 shows land cover acreage mapped within the project area at each evacuation stage. An existing land cover map of the study area is presented in Appendix A.

The Initial Reservoir Evacuation area consists mainly of Coniferous Forest, dominated by Douglas fir, and Mixed Coniferous/Deciduous Transitional Forest, dominated by Douglas fir, red alder, and big leaf maple. The Initial Reservoir Evacuation area would be inundated between 6 to 11 days during a flood event and some trees could be partially submerged, depending on the severity of the flood. As such, species with low anticipated flood tolerance (e.g., Douglas fir) would likely exhibit signs of flood stress and some mortality in the Initial Reservoir Evacuation area. These trees should be monitored and removed if they exhibit significant injury or mortality during facility operations. Species with moderate flood tolerance are not expected to experience significant mortality in the Initial Reservoir Evacuation area, but should be monitored for signs of flood stress after periods of prolonged inundation. Monitoring methods are described in more detail in Section 5.2.1.

The Debris Management Evacuation area consists primarily of Mixed Coniferous/Deciduous Transitional Forest, dominated by Douglas fir, red alder, and big leaf maple, and Deciduous Riparian Forest with Some Conifers, including species such as red alder, Western red cedar, Western hemlock, black cottonwood, willows, and big leaf maple. The Debris Management Evacuation area would be inundated between 20 and 25.2 days, and most trees throughout this area would be partially or fully submerged for the duration of this time. Submergence introduces additional novel stresses to trees, decreasing their likelihood of survival. Therefore, all tree species that are not highly tolerant of flooding—all species except for willows and black cottonwood—would need to be removed throughout the area.

The Final Reservoir Evacuation area consists mainly of Deciduous Riparian Forest with Some Conifers, Mixed Coniferous/Deciduous Transitional Forest, and Open Water land cover classifications. The Final Reservoir Evacuation area would be inundated between 26 and 32 days and trees in this zone would be fully submerged. It is highly unlikely that any trees would be able to survive in this area after prolonged inundation and full submergence. Therefore, all trees in this area would need to be removed.

Figure 2. Land Cover Acreage by Drawdown Stage



## 5.0 Pre-Construction and Facility Operations Selective Tree Harvest Plan

Selective tree harvest within the reservoir footprint during pre-construction and facility operations would be subject to Forest Practices Act Rules administered by the Washington Department of Natural Resources (WDNR) through the Forest Practices Application.

The Project would likely require deviations from the methods and requirements prescribed in the Forest Practices Act Rules. Through the use of alternate plans, applicants are permitted to develop management prescriptions that will achieve resource protection through alternative methods from the Forest Practices Act. The alternate plan policy for WDNR is outlined in WAC 222-12-040 and also discussed in the Forest Board Practices Manual Section 21 (WDNR 2013). To be approved, alternate plans must provide protection for public resources at least equal in overall effectiveness to the protection provided by the Forest Practices Act and rules (WAC 222-12-040(1)). Alternate plans should be submitted with the Forest Practices Application and must include a site map showing affected resources and proposed management activities. The plan must also include descriptions of current site conditions and proposed management activities, a list of the Forest Practices Act Rules that the alternate plan is intended to replace, and, if applicable, a monitoring and adaptive management plan and corresponding implementation schedule.

The selective tree harvest plan below describes the conceptual approach for selective tree harvest, and an overview of Forest Practices Act Rules that will need to be considered in development of the Alternate Plan for acquisition of a Forest Practices Permit.

### 5.1 Pre-Construction Selective Tree Harvest Plan

The proposed Project would require clearing of all vegetation from the proposed FRE facility and construction access and staging areas. As discussed in Section 4.3, most trees in the Debris Management Evacuation and Final Reservoir Evacuation areas of the temporary reservoir would experience significant stress or mortality resulting from prolonged inundation during a flood event. Dead or dying trees and woody debris pose a hazard to dam operations personnel and could potentially damage dam facilities (e.g., intake structure, flood gates). Due to these safety and logistical concerns, the FCZD proposes to selectively harvest trees from the Debris Management Evacuation area and harvest all trees from the Final Reservoir Evacuation area (Figure 3). This Pre-Construction Selective Tree Harvest Plan provides methods to identify trees within different inundation areas that will need to be targeted for removal prior to commencement of facility operations. The plan also outlines options for tree removal using

guidance from the WDNR Forest Practices Board Manual and the Washington State Forest Practices Rules (Title 222 WAC).

The FCZD commits to the avoidance of burning of trees and other cleared vegetation at the FRE facility site, along routes of new roads, and within the FRE temporary reservoir area. To the extent practical, harvested trees would be used in the construction of mitigation measures or released downstream to resupply woody material to maintain natural aquatic habitats. Any surplus material would be sold.

Additional best management practices (BMPs) to avoid and minimize impacts on threatened and endangered species during vegetation management activities are in the *DRAFT Biological Assessment and Essential Fish Habitat Assessment – Chehalis River Basin Flood Damage Reduction Project: Flood Retention Facility, Airport Levee Improvements, and Mitigation Actions* (HDR 2020).

### **5.1.1 Tree Removal Methods and Guidelines**

Trees and other vegetation would be completely cleared from the FRE facility site footprint and construction areas. In the Initial Reservoir Evacuation area, where inundation is expected to last between 6 to 11 days during a flood event, selective tree harvest is not proposed to occur prior to construction of the FRE facility. Species with low flood tolerance, such as Douglas fir, should be monitored and removed if they exhibit significant injury or mortality during facility operations, as outlined in the Facility Operations Selective Tree Harvest Plan below.

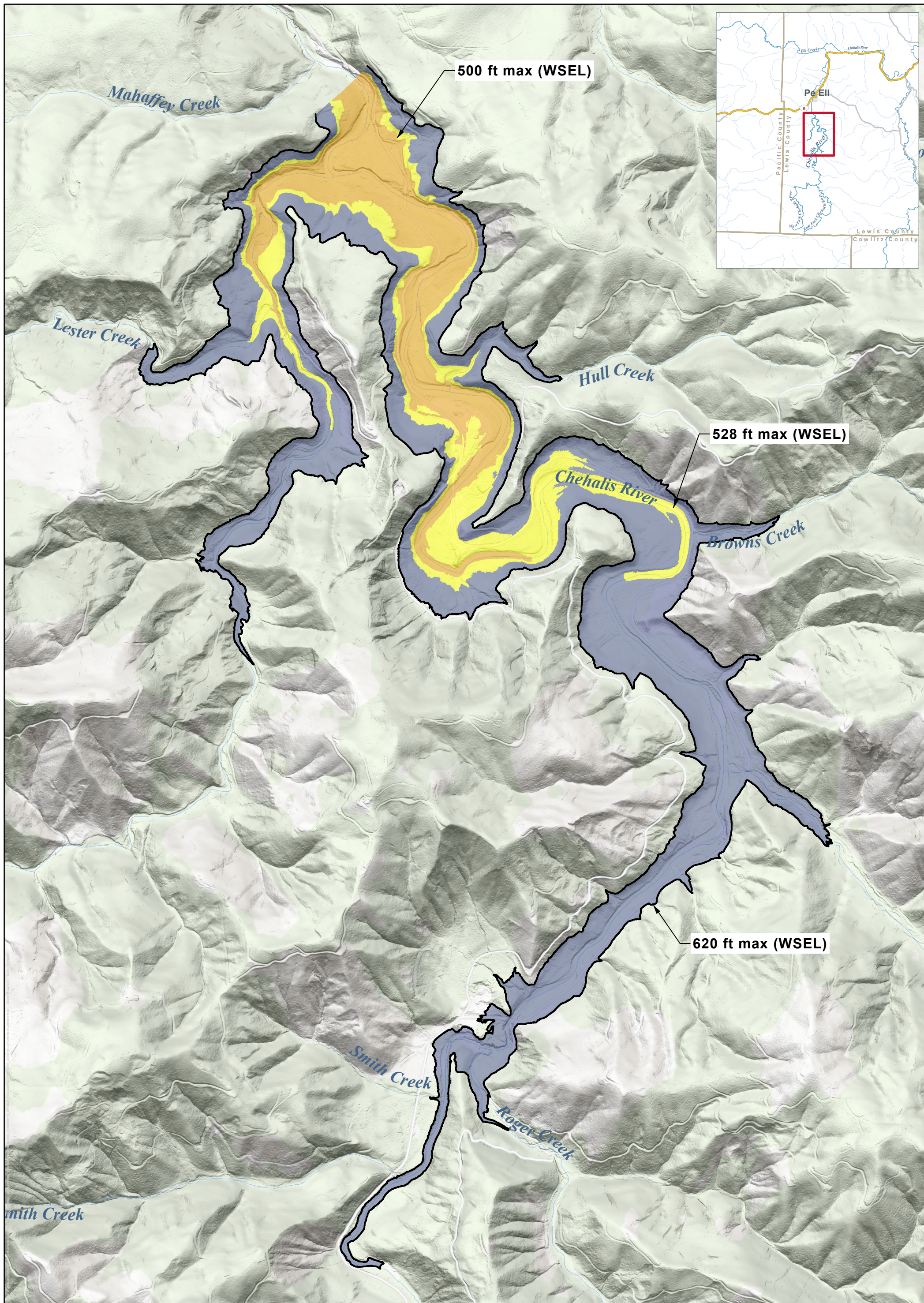
Selective tree harvest in the Debris Management Evacuation area would need to target all tree species that are not highly flood-tolerant (i.e., all tree species except for willows and black cottonwood). All trees in the Final Reservoir Evacuation area would need to be removed. Project pre-construction and facility operations tree harvest would require a Forest Practices Permit from WDNR under the Forest Practices Act; therefore, the selective tree harvest plans would need to comply, to the extent practical, with applicable timber harvest requirements outlined in the WDNR Forest Practices Board Manual and the Washington State Forest Practices Rules (Title 222 WAC).

#### **5.1.1.1 Washington State Forest Practices Rules**

##### **5.1.1.1.1 Riparian Management Zones**

The Forest Practices Rules designate a Riparian Management Zone (RMZ) on each side of a stream that to retain riparian function after timber harvest. In Western Washington, the RMZ is measured horizontally from the outer edge of the bankfull width or the outer edge of the Channel Migration Zone (CMZ), whichever is greater (WAC 222-16-010). The width of the RMZ is based on the “site-potential tree height” of a typical tree at age 100 and stream size (i.e., bankfull width) (Washington Forest Protection Association 2004). Site-potential tree height is derived by WDNR’s site classes, which refer to the growing conditions of the soil as described by the USDA NRCS (2019), and is a measure of the forest site productivity or growth potential of the forest.





Source: Landcover, FRE Facility - HDR; Streams - DNR; Basemap - ESRI Online; Hillshade - DNR LiDAR Portal

- Final reservoir evacuation area.  
Total inundation up to 32.3 days (776.0 hrs) from elevation 500 ft to 425 ft. Pre-construction harvest of all trees.
- Debris management evacuation area  
Inundation up to 25.2 total days (605.0 hrs) above elevation 500 ft. Pre-construction harvest of all trees that are not highly flood-tolerant.

- Initial reservoir evacuation area  
Inundation up to 11.1 days (266.0 hrs) above elevation 528 ft  
No pre-construction tree harvest
- Maximum inundation limit

**FIGURE 3: PRE-CONSTRUCTION TREE HARVEST PLAN**

Chehalis River Basin Flood Damage Reduction Project



Review of WDNR Site Class GIS Data (WDNR 2018) determined that the site class along the Chehalis River is primarily Site Class II, with some areas of Site Classes III and IV at higher elevations and along tributaries such as Crim Creek and Rogers Creek. Based on this assessment, the RMZ along the Chehalis River is generally 170 feet wide in areas categorized as Site Class II, with a width of 140 feet and 110 feet in areas of Site Classes III and IV, respectively (Table 5).

The RMZ is comprised of three different zones: the core zone, inner zone, and outer zone, defined below per WAC 222-16-010:

- In Western Washington, the **RMZ core zone** is defined as the 50-foot buffer of a Type S or F water, measured horizontally from the outer edge of the bankfull width or the outer edge of the channel migration zone, whichever is greater.
- In Western Washington, the **RMZ inner zone** is the area measured horizontally from the outer boundary of the core zone of a Type S or F water to the outer limit of the inner zone. The outer limit of the inner zone is determined based on the width of the affected water, site class, and management option chosen for timber harvest within the inner zone.
- The **RMZ outer zone** is the area measured horizontally between the outer boundary of the inner zone and the RMZ width, measured from the outer edge of the bankfull width or the outer edge of the channel migration zone, whichever is greater.

No timber harvest or construction is allowed in the 50-foot core zone except operations related to forest roads as detailed in WAC 222-30-021(1).

Forest practices in the inner zone must be conducted in such a way as to meet or exceed stand requirements to achieve the goal outlined in WAC 222-30-010(2), which seeks to “protect aquatic resources and related habitat to achieve restoration of riparian function; and the maintenance of these resources once they are restored.” To harvest in the inner zone, adequate shade must be present based on the guidelines outlined in WAC 222-30-040. Furthermore, harvest is permitted within the inner zone of an RMZ adjacent to a Type S or F<sup>1</sup> water in Western Washington only if the timber stand exceeds the “stand requirements” described in WAC 222-30-021(1). To determine inner zone harvest opportunity, detailed tree data must be entered into the WDNR Desired Future Condition Worksheet (WDNR 2009) for each stream segment within the reservoir footprint. If inner zone harvest is permitted, trees can be harvested using one of two options: thinning from below or leaving trees closest to the water.

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<sup>1</sup> Type S waters means all waters, within their bankfull width, that are inventoried as "shorelines of the state" under chapter 90.58 RCW. The segments of the Chehalis River, Crim Creek, and Rogers Creek that occur in the Project area are designated as Type S waters. Type F waters means segments of natural waters other than Type S Waters that are known to be used by fish, or meet the physical criteria to be potentially used by fish per WAC 222-16-030. For the purposes of this Conceptual VMP, it is assumed that all waters within the temporary reservoir area are Type S or Type F waters. Stream typing will be refined and confirmed with WDNR and WDFW during the permitting phase of the Project.

For the purposes of this VMP, the option to thin from below will be used as feasible, as this option reduces the amount of woody debris that could come loose and damage dam facilities following prolonged inundation, starting with smaller-diameter trees. Under this option, thinning must retain a minimum of 57 conifer trees per acre. Since the Chehalis River is more than 10 feet wide, the inner zone varies from 33 to 78 feet wide, depending on site class (WAC 222-30-021(I); Table 5).

Using the option of thinning from below in the inner zone, the outer zone width will vary depending on stream width and site class, outlined in Table 5. Timber harvest in the outer zone must leave 20 conifer riparian-leave trees per acre after harvest, either dispersed or clumped. Riparian-leave trees must be at least 12 inches diameter at breast height (dbh) and must be left uncut throughout all future harvests (WAC 222-30-021(1)(c)).

**Table 5. Riparian Management Zone (RMZ) Widths in the Project Area<sup>a</sup>**

| Site Class <sup>b</sup> | RMZ Width | Core Zone Width <sup>c</sup> | Inner Zone Width <sup>d</sup>   |                                 | Outer Zone Width <sup>e</sup>   |                                 |
|-------------------------|-----------|------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|                         |           |                              | Stream bankfull width ≤ 10 feet | Stream bankfull width > 10 feet | Stream bankfull width ≤ 10 feet | Stream bankfull width > 10 feet |
| II                      | 170 feet  | 50 feet                      | 63 feet                         | 78 feet                         | 57 feet                         | 42 feet                         |
| III                     | 140 feet  | 50 feet                      | 43 feet                         | 55 feet                         | 47 feet                         | 35 feet                         |
| IV                      | 110 feet  | 50 feet                      | 23 feet                         | 33 feet                         | 37 feet                         | 27 feet                         |
| V                       | 90 feet   | 50 feet                      | 10 feet                         | 18 feet                         | 30 feet                         | 22 feet                         |

<sup>a</sup> RMZ widths from WAC 222-30-021(1)(b)(ii)(B)(1). For the purposes of this Conceptual VMP, the following are assumed: (1) all waters within the temporary reservoir area are Type S or Type F waters and (2) thinning from below in the inner zone is the treatment for tree harvest that will be required within the 50-foot core zone. Stream typing will be refined and confirmed with WDNr and WDFW during the permitting phase of the Project.

<sup>b</sup> Site Class I not present in project study area.

<sup>c</sup> Core zone measured from outer edge of bankfull width or outer edge of CMZ of water (WAC 222-16-010).

<sup>d</sup> Inner zone measured from outer edge of core zone to the outer limit of the inner zone.

<sup>e</sup> Outer zone measured from outer edge of inner zone to outer limit of the RMZ.

#### 5.1.1.1.2 Wetland Management Zone

Selective tree harvest occurring near wetlands is also subject to wetland management zone (WMZ) requirements outlined in WAC 222-30-020 and WAC 222-16-035. The width of the WMZ is determined based on the size of the wetland and the wetland type, as described in WAC 222-30-020. Under the Washington State Forest Practices Rules, wetlands that require protection are categorized as Type A (nonforested), Type B (nonforested), or Forested Wetlands, defined below per WAC 222-16-035:

- **Nonforested wetlands** means any wetland or portion thereof that has, or if the trees were mature would have, a crown closure of less than 30%.
  - **Type A Wetland** classification applies to all nonforested wetlands that are greater than 0.5 acre in size, including acreage of open water where the water is completely surrounded by

the wetland; and are associated with at least 0.5 acre of ponded or standing open water. The open water must be present on the site for at least 7 consecutive days between April 1 and October 1 to be considered for the purposes of these rules.

- o **Type B Wetland** classification applies to all other nonforested wetlands greater than 0.25 acre.
- **Forested wetland** means any wetland or portion thereof that has, or if the trees were mature would have, a crown closure of 30% or more.

WMZ protection applies to Type A and Type B wetlands, and is measured horizontally from the wetland edge or the point where a nonforested wetland becomes a forested wetland (WAC 222-30-020(8)). The WMZ width for Type A wetlands ranges from 25 to 200 feet, depending on wetland size and if the wetland meets the definition of a bog. For Type B wetlands with more than 0.5 acre of nonforested wetland, the WMZ width ranges from 25 to 100 feet; no WMZ is required for Type B wetlands with less than 0.5 acre of nonforested wetland (WAC 222-30-020). No WMZ is required for forested wetlands; however, unless otherwise approved in writing by WDNR, harvest methods shall be limited to low-impact harvest or cable systems (WAC 222-30-020(7)).

In Western Washington, a total of 75 trees greater than 6 inches dbh must be left per acre of WMZ (WAC 222-30-020(8)(b)). Of these, 25 trees must be greater than 12 inches dbh and 5 must be greater than 20 inches dbh. Furthermore, ground-based equipment cannot be used within the minimum WMZ without written permission from WDNR (WAC 222-30-020(8)(e)). In areas where WMZ and RMZ protections overlap, the one providing the most protection to the resource shall be used (WAC 222-30-020(8)).

#### 5.1.1.1.3 Other Considerations for Tree Removal

The Forest Practices Rules stipulate that no harvest or construction is permitted within the boundaries of a channel migration zone or within the bankfull width of any Type S or F water (WAC 222-30-020). There are also minimum shade requirements to prevent excessive increases in water temperature within a proposed harvest area. Shade requirements outlined in WAC 222-30-040 must be met regardless of harvest opportunities provided in the inner zone RMZ rules (WDNR 2000; WAC 222-30-021). Based on regional water temperature characteristics and the elevation of the Chehalis River and the tributaries where selective tree harvest is proposed, a minimum of 75% tree canopy cover is required after harvest (WDNR 2000, 2019; WAC 222-30-040(2)).

Landowners are also required to leave a minimum number and size of trees and down logs to provide current and future wildlife habitat within the harvest area. In Western Washington, for each acre of timber harvested, three wildlife reserve trees, two green recruitment trees, and two down logs must be left after harvest (Table 6; WAC 222-30-020(12)(b)). Wildlife reserve trees are defined as defective, dead, damaged, or dying trees that provide or have the potential to provide habitat for those wildlife species dependent on standing trees (WAC 222-16-010). Green recruitment trees are trees left after harvest for the purpose of becoming future wildlife reserve trees under WAC 222-30-020(12).



As outlined in Table 6, wildlife reserve trees must be at least 10 feet in height and 12 or more inches dbh to be counted toward wildlife reserve tree retention requirements (WAC 222-30-020(12)(c)). Green recruitment trees must be at least 10 inches dbh and 30 feet in height, with at least one-third of their height in live crown to be counted toward green recruitment tree requirements (WAC 222-30-020(12)(c)). Large, live defective trees with broken tops, cavities, or other severe defects are preferred as green recruitment trees. Down logs must have a small end diameter greater than or equal to 12 inches and a length greater than or equal to 20 feet or equivalent volume to be counted.

**Table 6. Requirements for Retaining Leave Trees and Down Logs in Western Washington**

| Wildlife Tree Type    | Number per acre | Minimum Height              | Minimum Diameter           |
|-----------------------|-----------------|-----------------------------|----------------------------|
| Wildlife Reserve Tree | 3               | 10 feet                     | 12 inches dbh              |
| Down Log              | 2               | 20 feet                     | 12 inches dbh at small end |
| Green Recruitment     | 2               | 30 feet with 1/3 live crown | 10 inches dbh              |

Source: WAC 222-30-020(12).

To facilitate safe and efficient harvesting operations, wildlife reserve trees and green recruitment trees may be left in clumps. For the purposes of distribution, no point within the harvest unit shall be more than 800 feet from a wildlife reserve tree or green recruitment tree retention area (WAC 222-30-020(12)(e)).

### 5.1.2 Pre-Construction Vegetation Removal Goals and Objectives

The following goals and objectives for pre-construction vegetation removal have been established to minimize impacts on environmental resources in the Project area while meeting the safety and operational needs of the FRE facility.

#### 5.1.2.1 **Goal 1: Reduce potential for future damage to dam facilities and ensure safety of dam operations personnel.**

Objective: Completely clear woody vegetation from the dam site and from any areas where temporary construction and associated access and staging will be required.

Objective: Remove vegetation that could pose a hazard to dam operations personnel, especially those responsible for wood material collection and transport.

Objective: Avoid burning of all cleared vegetation.

#### 5.1.2.2 **Goal 2: Harvest marketable timber in areas where projected inundation depths and durations would be expected to kill tree species that do not tolerate extended flooding or submersion.**

Objective: Coordinate with landowners and WDNR to allow for removal of trees within RMZs along the Chehalis River and tributaries in the reservoir footprint.

Objective: Remove all tree species that are not highly flood-tolerant (all tree species except for willows and black cottonwood) in the Debris Management Evacuation area (Figure 3).

Clearly mark highly flood-tolerant trees that are designated to be retained.

Objective: Remove all trees in the Final Reservoir Evacuation area.

Objective: Avoid disturbing understory upland vegetation.

Objective: Harvest trees so as to retain stumps in order to minimize ground disturbance and potential sedimentation.

Objective: Avoid burning of all removed trees.

**5.1.2.3 Goal 3: Harvest timber in a manner to avoid and minimize impacts to aquatic and riparian functions along the Chehalis River and its tributaries in the reservoir footprint.**

Objective: Apply applicable BMPs as described in WAC 222-30-030 through 222-30-090 to all waterbodies and riparian management zones. Key BMPs include, but are not limited to:

- (1) Avoid disturbing understory riparian vegetation.
- (2) Avoid disturbing stumps and root systems and any logs embedded in the bank.
- (3) Leave high stumps where necessary to prevent felled and bucked timber from entering the water.
- (4) Leave any retained trees that display large root systems embedded in the bank.
- (5) Use reasonable care during timber yarding to minimize damage to the vegetation providing shade to the stream or open water areas and to minimize disturbance to understory vegetation, stumps, and root systems.
- (6) Minimize the release of sediment to waters downstream from the yarding activity.

**5.1.2.4 Goal 4: Harvest timber in a manner to avoid and minimize impacts to wetland functions in the temporary reservoir footprint to the extent practical.**

Objective: Apply applicable BMPs as described in WAC 222-30-030 through 222-30-090 to all wetlands and wetland management zones. Key BMPs include, but are not limited to:

- (1) Avoid disturbing understory wetland vegetation.
- (2) Avoid cable yarding timber in or across Type A or B wetlands except with approval by the WDNR.
- (3) Minimize the release of sediment to waters downstream from the yarding activity.

**5.1.2.5 Goal 5: Minimize temporal loss of tree canopy in the temporary reservoir footprint.**

Objective: 20% of the proposed selective tree harvest would occur each construction year over the five-year construction period. Selective tree harvest would be sequenced such that trees within the Riparian Management Zones of the Chehalis River and its tributaries (Figure 4) are harvested last.

Objective: Replace trees removed each construction year at a 1:1 ratio with tree saplings. Replaced trees will be planted during the planting season (October-March) immediately

following tree harvest. Tree species selection will be based on the reservoir evacuation area where replanting is needed (Table 7 in Section 6.4.2.1).

## **5.2 Facility Operations Selective Tree Harvest Plan**

### **5.2.1 Monitoring Methods**

During facility operations, trees in the temporary reservoir area would be monitored for significant stress and mortality in areas where selective harvest was not conducted prior to construction. Flood stress in plants can cause yellowing or browning of leaves, curled leaves, leaf wilt and drop, reduced size of new leaves, early fall color, branch dieback, the formation of sprouts along stems or trunk, and greater susceptibility to harmful organisms such as canker fungi and insects (Jull 2008). There would be uncertainty in predicting an elevation at which trees would likely be severely stressed or killed once the FRE facility is activated during major flood events. The uncertainty is due in part to the unpredictable nature of flood events and in part to the difficulty in predicting how individual trees will respond to inundation.

Trees in the FRE temporary reservoir should be monitored by a forester or other WDNR-approved professional annually and after periods of prolonged inundation for signs of flood stress. Unhealthy and dead trees should be marked and removed on an as-needed basis to eliminate potential risks to dam operations personnel and facility infrastructure. Monitoring efforts should also evaluate the reestablishment of tree species in areas where selective harvest was conducted prior to construction (i.e., Debris Management Evacuation and Final Reservoir Evacuation areas).

Since a small portion of trees must be left in place in the Debris Management Evacuation and Final Reservoir Evacuation areas to comply with Forest Practices Rules, it is anticipated that a number of these trees will experience significant stress and mortality. Leave trees in the RMZ and WMZ and those selected to serve as wildlife habitat should be identified and evaluated annually and after periods of prolonged inundation. These trees should be removed if they become a safety hazard or pose a risk of damage to dam facilities.

### **5.2.2 Facility Operations Selective Tree Harvest Plan**

The FCZD proposes that every 7 to 10 years, trees that are not highly tolerant of flooding (all tree species except for willows and black cottonwood) larger than 6 inches in diameter within the Debris Management Evacuation area and all trees in the Final Reservoir Evacuation area be removed to reduce accumulation of woody material at the FRE conduits. Tree harvest conducted during facility operations would be subject to the Forest Practices Rules outlined in Section 5.1.1.1, and would adhere to pre-construction vegetation removal Goals and Objectives described in Section 5.1.2.

# 6.0 Conceptual Adaptive Management Plan

## 6.1 Overview

As described in Chapter 5, the FCZD anticipates that an Alternate Plan will need to be developed with an Interdisciplinary Team in order to acquire a Forest Practices Permit from WDNR since tree harvest activities during pre-construction and facility operation would likely vary from prescribed Forest Practices Rules. Therefore, the framework of the adaptive management plan focuses primarily on criteria that would be required for an Alternate Plan.

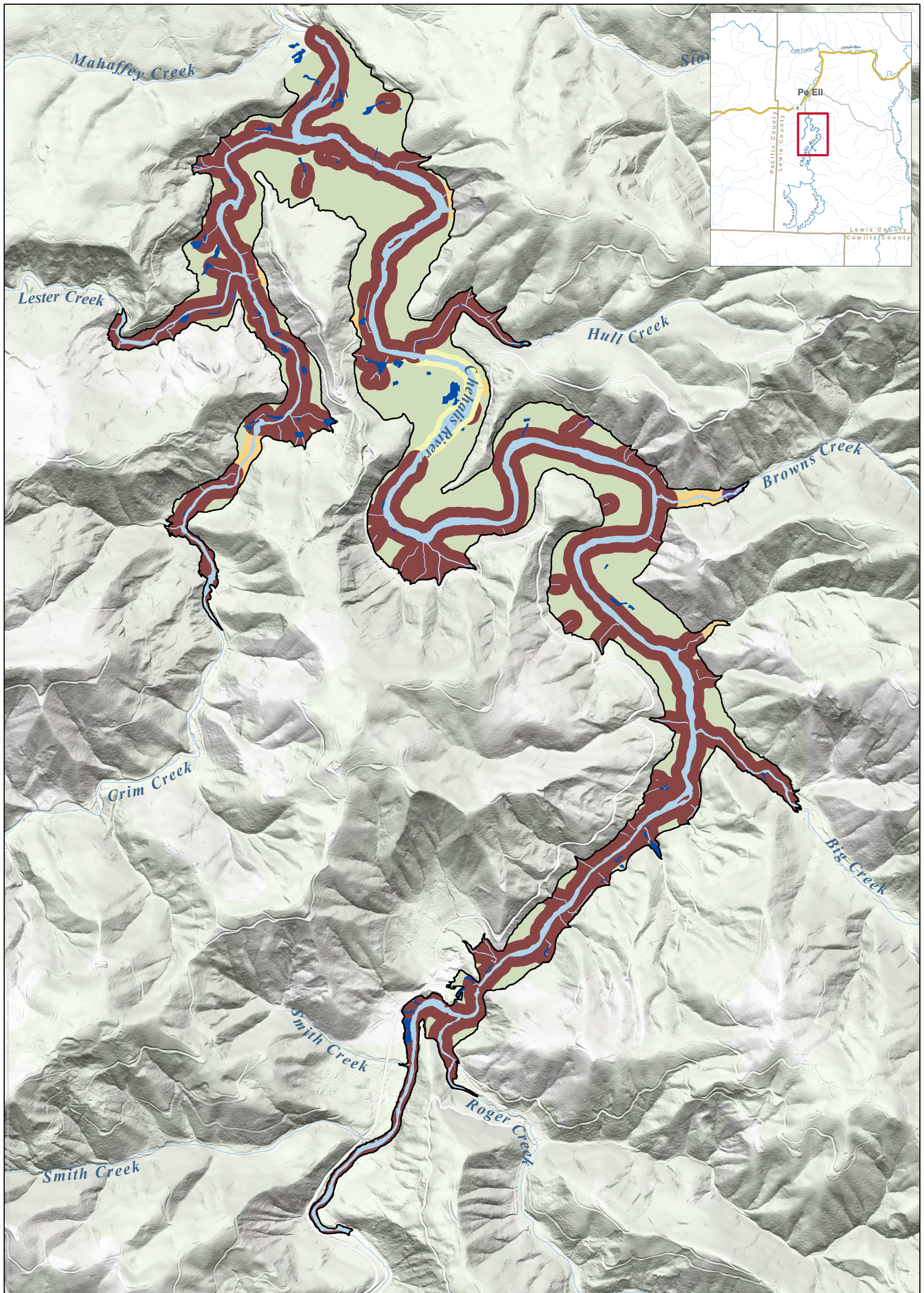
This adaptive management plan addresses how uncertainties regarding the frequency, duration, and intensity of future flood events and resulting impacts to vegetation will be considered in order to inform the management of vegetation in the reservoir footprint. For the purposes of this plan, “adaptive management” refers to actions taken as part of the project to:

- Establish long-term ecological goals and objectives to avoid and minimize long-term impacts to riparian, wetland, and upland habitats;
- Identify uncertainties associated with future flood events and potential impacts to vegetation in the temporary reservoir footprint;
- Identify potential problems, possible solutions, and site management adjustments to rectify foreseeable issues based on results of long-term monitoring;
- Provide contingency plans if needed for proposed vegetation management; and
- Serve as part of the feedback loop between vegetation monitoring and management actions that will lead to appropriate adjustment.

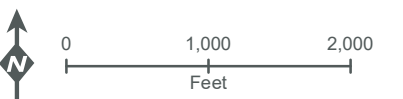
Figure 4 delineates proposed zones for which pre-construction monitoring, adaptive management goals and objectives, and replanting treatments will be applied:

- Riparian Vegetation Management Zone (RMZ): these zones are established based on the RMZ widths outlined in Section 5.1.1.1. The RMZ’s would encompass approximately 16.3 river miles of streams and 444 acres of adjoining riparian lands.
- Wetland Vegetation Management Zone: these zones are established based on wetlands identified and delineated by Anchor QEA (2018).
- Upland Vegetation Management Zone: remaining lands within the FRE temporary reservoir extent that are not wetlands, waterbodies, or RMZs.





Source: Landcover, FRE Facility - HDR; Streams - DNR; Basemap - ESRI Online; Hillshade - DNR LiDAR Portal



- Streams

Maximum Inundation Limit

**Vegetation Management Zones**

  - Upland Vegetation Management Zones
  - Wetland Vegetation Management Zones
- Riparian Vegetation Management Zones**

**WDNR Site Class**

  - II (RMZ 170 ft wide)
  - III (RMZ 140 ft wide)
  - IV (RMZ 110 ft wide)
  - VIII (RMZ 90 ft wide)

**FIGURE 4: VEGETATION MANAGEMENT ZONES**

Chehalis River Basin Flood Damage Reduction Project



The conceptual adaptive management plan described below presents basic plan elements that will be developed in more detail into a Final Adaptive Management Plan in coordination with the Project's WDNR Interdisciplinary Team once permitting is underway.

## 6.2 Pre-Construction Monitoring

Monitoring will be conducted throughout the FRE Temporary Reservoir to document pre-construction riparian functions, wetland management zone conditions, and upland habitat conditions as they pertain to vegetation community composition.

### 6.2.1.1 Methods

#### 6.2.1.1.1 Riparian Functions

Pre-construction riparian functions will be documented along the Riparian Management Zones of streams in the FRE temporary reservoir footprint (Figure 4). The following functions will be assessed using the "Assessing Riparian Function" guidelines presented in Section 21, Guidelines for Alternate Plans, in the *Forest Practices Board Manual* (WDNR 2000):

- Stream shading
- Stream bank stability
- Woody debris availability and recruitment
- Sediment filtering
- Nutrients and leaf litter fall

#### 6.2.1.1.2 Wetland Management Zone Existing Conditions

Pre-construction monitoring of wetland management zones in the FRE temporary reservoir footprint shall be coordinated with the wetland impact analyses required for federal, state, and local wetland permitting. Pre-construction wetland functions have been documented in the Anchor QEA (2018) *Wetland, Water, and Ordinary High Water Mark Delineation Report*. Pre-construction monitoring will confirm status of wetland functions as they pertain to vegetation communities, as documented in the delineation report.

#### 6.2.1.1.3 Uplands Existing Conditions

Pre-construction monitoring of uplands in the FRE temporary reservoir footprint will evaluate the condition and extent of upland habitats as presented in Section 3.1. Similar desktop and field reconnaissance methods will be utilized to confirm current upland habitat conditions. Pre-construction monitoring of upland conditions will be conducted in conjunction with the pre-construction marbled murrelet nesting habitat suitability surveys described in the *DRAFT Biological Assessment and Essential Fish Habitat Assessment – Chehalis River Basin Flood Damage Reduction Project: Flood Retention Facility, Airport Levee Improvements, and Mitigation Actions* (HDR 2020).

#### 6.2.1.2 Monitoring Schedule

Pre-construction monitoring should be conducted once, 1 to 2 years prior to start of construction activities during the growing season.

### 6.3 Adaptive Management Goals and Objectives

Adaptive Management Goals describe the overall intent of the adaptive management plan; Adaptive Management Objectives describe individual components of the adaptive management plan designed to achieve the goals. Performance standards, which identify measurable, quantifiable indicators of performance relative to the restoration goals and objectives, will be developed as part of the final VMP once proposed goals and objectives are confirmed with the Interdisciplinary Team during permitting.

#### 6.3.1 Goals and Objectives

##### 6.3.1.1 **Goal 1: Maintain the minimal acceptable level of riparian function in the temporary FRE reservoir footprint compared to pre-construction conditions.**

Objective: Maintain the following functions in Riparian Management Zones at the minimal acceptable level as determined with the Interdisciplinary Team:

- (1) Stream shading
- (2) Stream bank stability
- (3) Woody debris availability and recruitment
- (4) Sediment filtering
- (5) Nutrients and leaf litter fall

##### 6.3.1.2 **Goal 2: Minimize loss of tree and shrub wetland vegetation communities in the FRE temporary reservoir compared to pre-construction conditions.**

Objective: The net acreage of wetlands identified as forested wetlands during pre-construction monitoring shall be retained as forested or forested, scrub-shrub wetlands per the definitions in Cowardin et al. (1979).

Objective: There will be no net loss of acreage of scrub-shrub wetlands as defined by Cowardin et al. (1979) pre-construction monitoring.

##### 6.3.1.3 **Goal 3: Minimize loss of forested and shrub upland vegetation communities in the Upland Vegetation Management Zones compared to pre-construction conditions.**

Objective: The net acreage of forested upland vegetation communities quantified during the pre-construction monitoring shall not degrade to a condition below shrubland.

Objective: There will be no net loss of acreage of shrubland vegetation communities quantified during pre-construction monitoring.

##### 6.3.1.4 **Goal 4: Limit the establishment of noxious and invasive weeds throughout the FRE**

**temporary reservoir footprint following periods of prolonged inundation.**

Objective: Eradicate all Class A weeds and control selected Class B weeds on Lewis County's noxious weed list (2020) if identified in the reservoir footprint.

## **6.4 Adaptive Management Monitoring**

### **6.4.1 Methods**

Long-term monitoring will be conducted annually to evaluate vegetation conditions in the FRE temporary reservoir footprint during FRE facility operations, especially following periods of prolonged inundation. Monitoring efforts will focus on evaluating whether performance standards are being met; performance standards will be identified in the final VMP. The monitoring phase of the project is expected to consist of iterative and corrective measures, such as removing invasive species, and is expected to occur for the lifetime of the FRE facility operations. Performance standards will be identified in the final VMP.

### **6.4.2 Revegetation Guidelines**

This section presents concepts for potential revegetation treatments if long-term adaptive management goals and objectives are not being met. Detailed planting plans are not proposed to be developed at this time, since the actual frequency, intensity, and extent of flood events over time will determine which areas need to be revegetated and cannot be predicted during the design phase. It is anticipated that some areas that are subject to more frequent flooding may need to be revegetated soon after start of facility operations to allow establishment of more flood-tolerant species. Conversely, some vegetation communities will likely show slower transition over time and not need immediate or whole-scale revegetation efforts.

#### **6.4.2.1 Conceptual Plant Palette**

Areas within the FRE temporary reservoir that are determined to require revegetation with trees and/or shrubs will need to be primarily assessed based on the evacuation area where revegetation is needed, as duration, extent, and frequency of flooding will be the primary drivers for survival of vegetation in replanted areas. Therefore, the plant palettes presented below are based on respective evacuation zones as opposed to specific Vegetation Management Zones. Revegetation in the Debris Management Evacuation and Final Reservoir Evacuation areas likely will experience more prolonged and deeper flooding after major flood events, and therefore will require revegetation with more flood-tolerant species. The Initial Reservoir Evacuation area will experience shorter, shallower periods of flooding and therefore moderately flood-tolerant species are expected to survive in this zone. Plant species identified in Section 4.2.2 and other flood-tolerant native species found in wetlands in the study area (Anchor QEA 2018) have been selected for proposed plant palettes by replanting zone (see Table 7).



**Table 7. Proposed Plant Palette by Replanting Zone**

| Replanting Zone                   | Scientific Name              | Common Name        |
|-----------------------------------|------------------------------|--------------------|
| Initial Evacuation Area           | <b>Trees</b>                 |                    |
|                                   | <i>Alnus rubra</i>           | Red alder          |
|                                   | <i>Picea sitchensis</i>      | Sitka spruce       |
|                                   | <i>Thuja plicata</i>         | Western red cedar  |
|                                   | <b>Shrubs</b>                |                    |
|                                   | <i>Acer circinatum</i>       | Vine maple         |
|                                   | <i>Oemleria cerasiformis</i> | Indian plum        |
|                                   | <i>Frangula purshiana</i>    | Cascara            |
|                                   | <i>Rubus spectabilis</i>     | Salmonberry        |
|                                   | <i>Sambucus racemosa</i>     | Red elderberry     |
|                                   | <i>Symphoricarpos albus</i>  | Snowberry          |
| Debris Management Evacuation Area | <b>Trees</b>                 |                    |
|                                   | <i>Fraxinus latifolia</i>    | Oregon ash         |
|                                   | <i>Populus balsamifera</i>   | Black cottonwood   |
|                                   | <i>Salix lasiandra</i>       | Pacific willow     |
|                                   | <b>Shrubs</b>                |                    |
|                                   | <i>Cornus alba</i>           | Red-osier dogwood  |
|                                   | <i>Lonicera involucrata</i>  | Twinberry          |
|                                   | <i>Rubus spectabilis</i>     | Salmonberry        |
|                                   | <i>Rosa nutkana</i>          | Nootka rose        |
|                                   | <i>Rubus parviflorus</i>     | Thimbleberry       |
|                                   | <i>Rubus spectabilis</i>     | Salmonberry        |
| Final Reservoir Evacuation Area   | <b>Trees</b>                 |                    |
|                                   | <i>Salix lasiandra</i>       | Pacific willow     |
|                                   | <b>Shrubs</b>                |                    |
|                                   | <i>Cornus alba</i>           | Red-osier dogwood  |
|                                   | <i>Salix exigua</i>          | Narrow-leaf willow |
|                                   | <i>Salix hookeriana</i>      | Hooker's willow    |
|                                   | <i>Spiraea douglasii</i>     | Hardhack           |

#### 6.4.2.2 Site Preparation and Planting Details

Site preparation will be focused mainly on preparing revegetation areas so that plantings can successfully establish with minimal maintenance, and avoid disturbance to surrounding live vegetation. Site preparation methods shall include use of native soils and stockpiling native soils if necessary, scarifying or disking to break up any compacted soils, and use of compost or other soil amendments to improve soil media.

Plant material will be provided from commercial nurseries. Inspection of all woody plants will be conducted to ensure compliance with the revegetation plan specifications regarding size requirements, root ball mass, and overall health of the plant. Planting zones will be delineated per the revegetation plan, with planting conducted under the supervision of FCZD biologists or other qualified staff. Planting is to occur from October through March, avoiding times of FRE operation.

### 6.4.3 Contingency Plan

Contingency plans describe what actions can be taken to correct deficiencies in achieving a plan's goals and objectives. The adaptive management plan goals, objectives, and performance standards create a baseline by which to measure whether the site is performing as proposed and whether or not a contingency plan is necessary. All contingencies cannot be anticipated.

The contingency plan will be flexible so that modifications can be made if portions of the adaptive management plan do not produce the desired results. Problems or potential problems will be evaluated by the FCZD and Interdisciplinary Team. Specific contingency actions will be developed, agreed to by consensus, and implemented based on all scientifically and economically feasible recommendations.

**Table 8. Potential Contingency Actions for the Vegetation Management Zones**

| Resource/Issue                                                           | Contingency Action <sup>a</sup>                                                                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Sites do not meet goals and objectives for scrub-shrub or forested cover | <ul style="list-style-type: none"> <li>• Revegetate with appropriate woody plant species.</li> <li>• Re-evaluate the suitability of the plant species for site conditions.</li> <li>• Consider use of alternate species.</li> <li>• Undertake additional monitoring.</li> </ul>                                 |
| Over-competition by invasive species                                     | <ul style="list-style-type: none"> <li>• Identify/Evaluate predominant invasive species in the mitigation areas.</li> <li>• Initiate invasive species control protocols appropriate to species type, conditions of infestation area, and level of infestation (e.g., herbicide application, mowing).</li> </ul> |

<sup>a</sup> Contingency actions listed are only a subset of potential actions. All contingency actions discussed above should be considered and the appropriate actions taken based on an understanding of the actual causes of poor performance.

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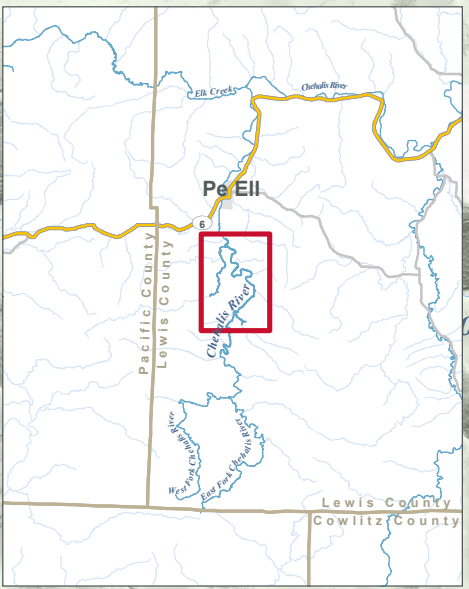
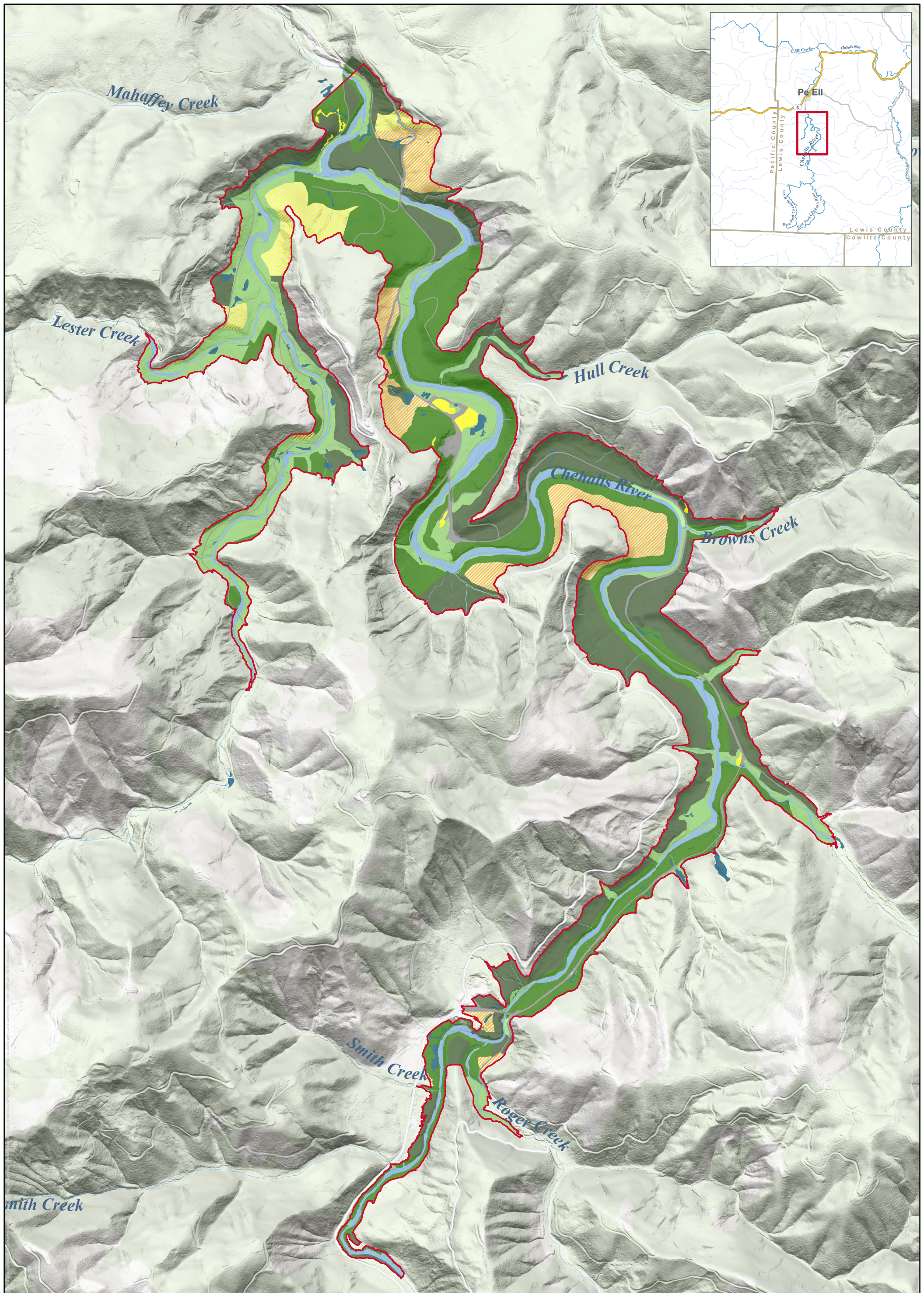
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# Appendix A. Existing Vegetation Mapping





Source: Landcover - FRE Facility - HDR; Streams - DNR; Basemap - ESRI Online; Hillshade - DNR LiDAR Portal

**Landcover**

- Coniferous Forest
- Mixed Coniferous/Deciduous Transitional Forest
- Deciduous Riparian Forest w/some Conifers
- Deciduous Riparian Shrubland
- Herbaceous/Grass

- Wetland
- Logged, replanted 5-15+ years
- Logged, replanted 0-5 years
- Open Water/Sand Bar
- Terrestrial Bare Ground/Roads

- Streams
- Study Area (WSEL: 628ft)

**LAND COVER CLASSIFICATION**

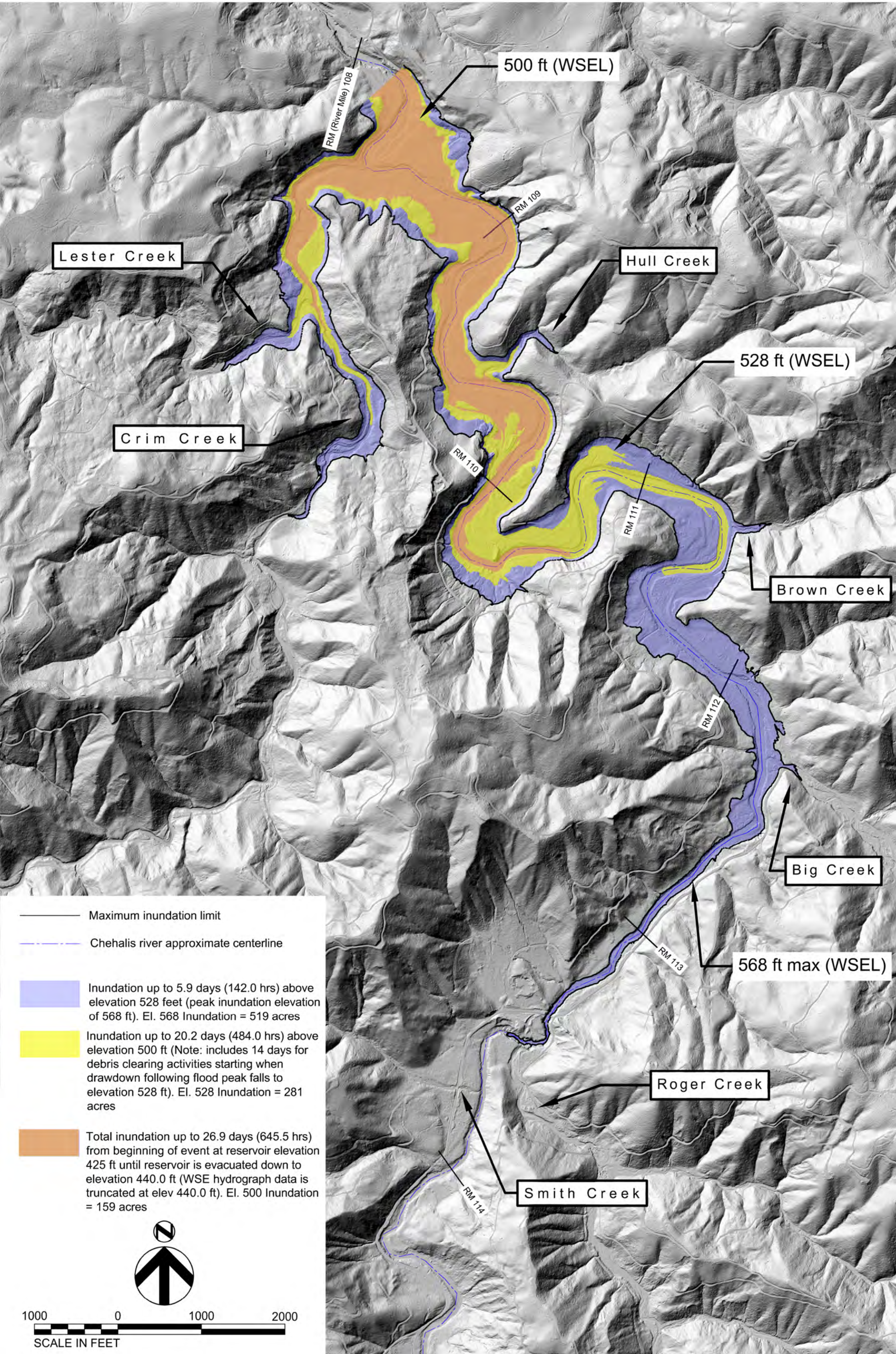
Chehalis River Basin Flood Damage Reduction Project



## Appendix B. Inundation Maps for Historic and Modeled Major Flood Events

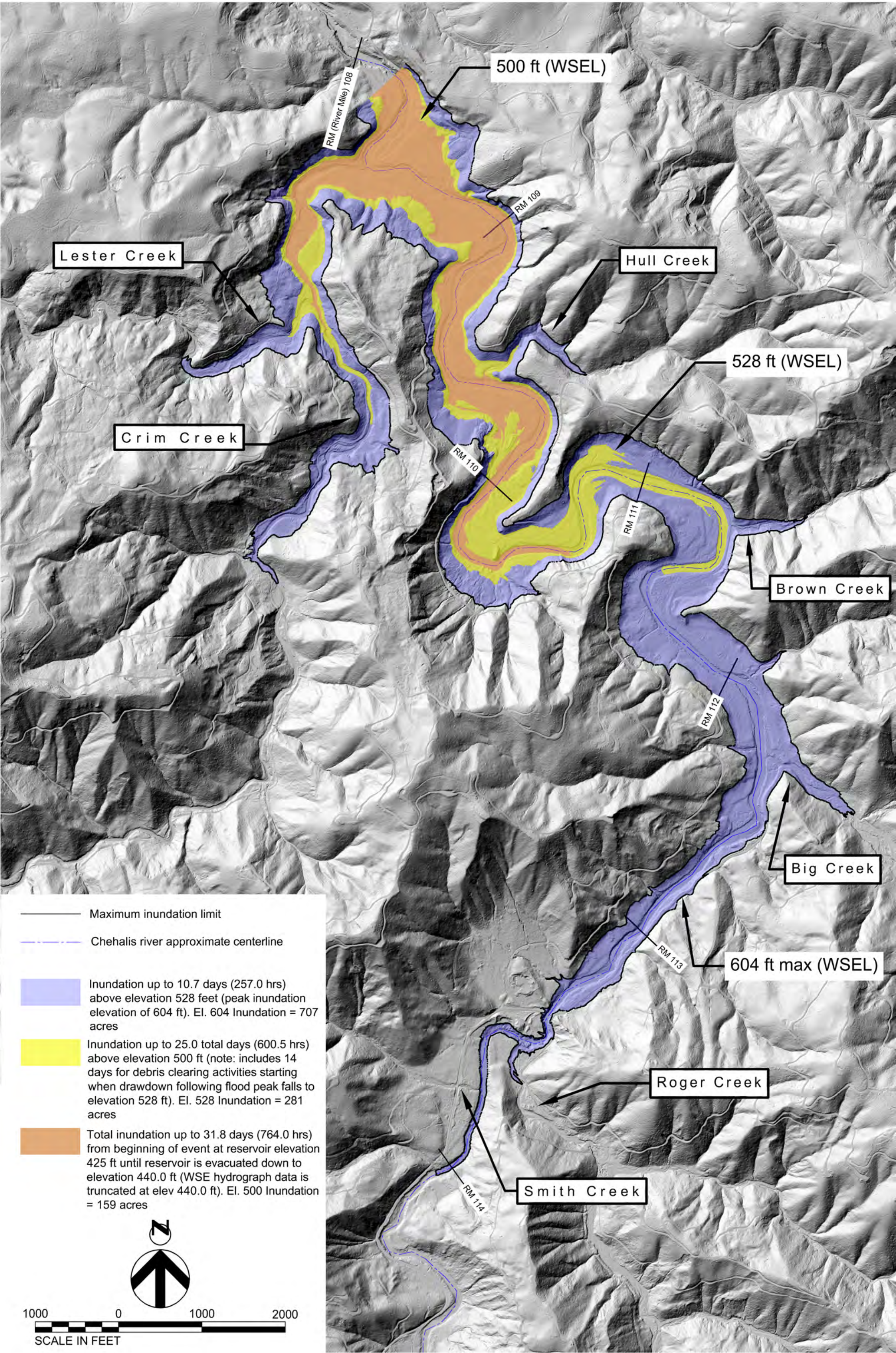


10 Year Event Inundation Map for Proposed Dam (FRE)



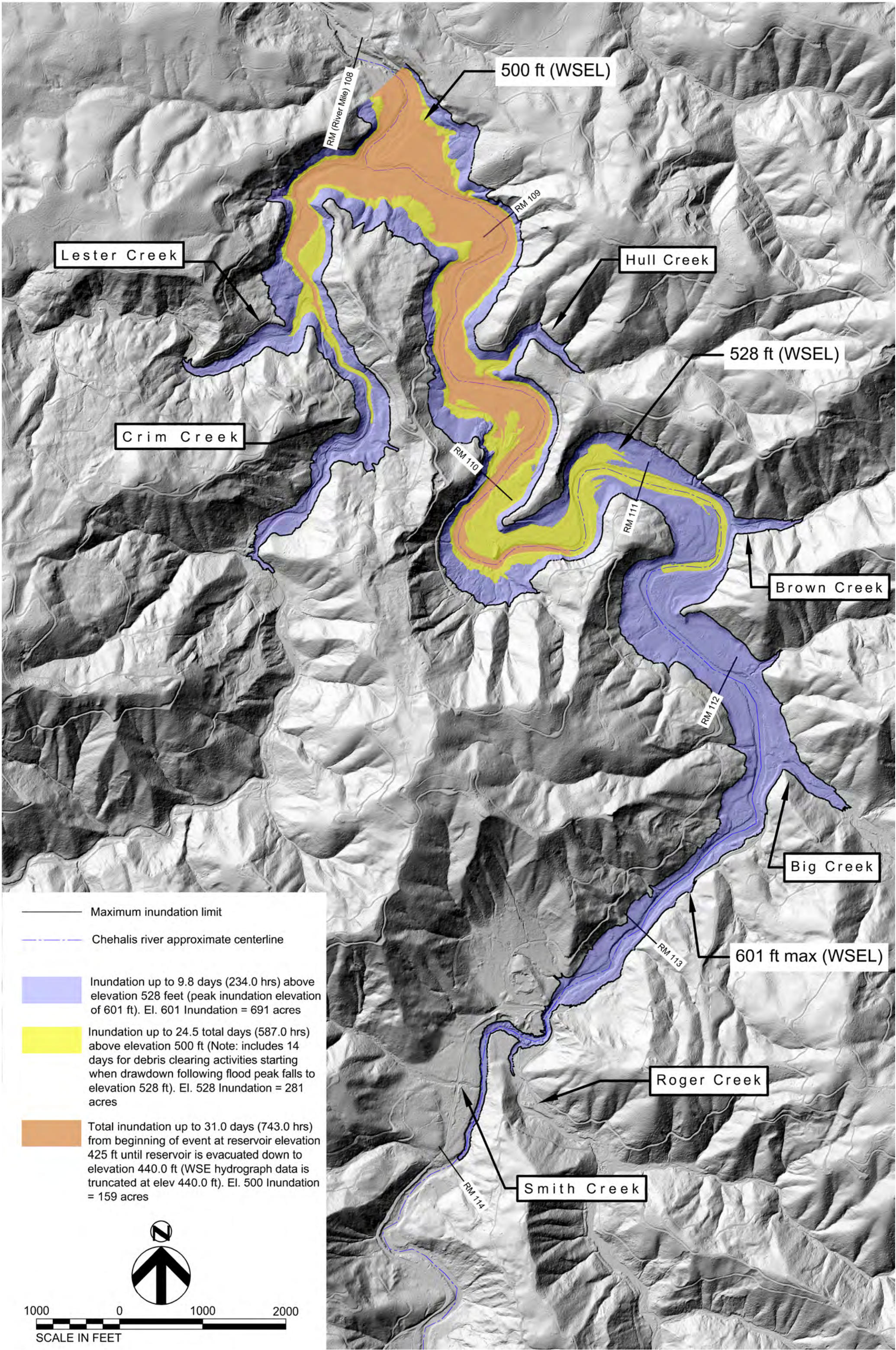


100 Year Event Inundation Map for Proposed Dam (FRE)



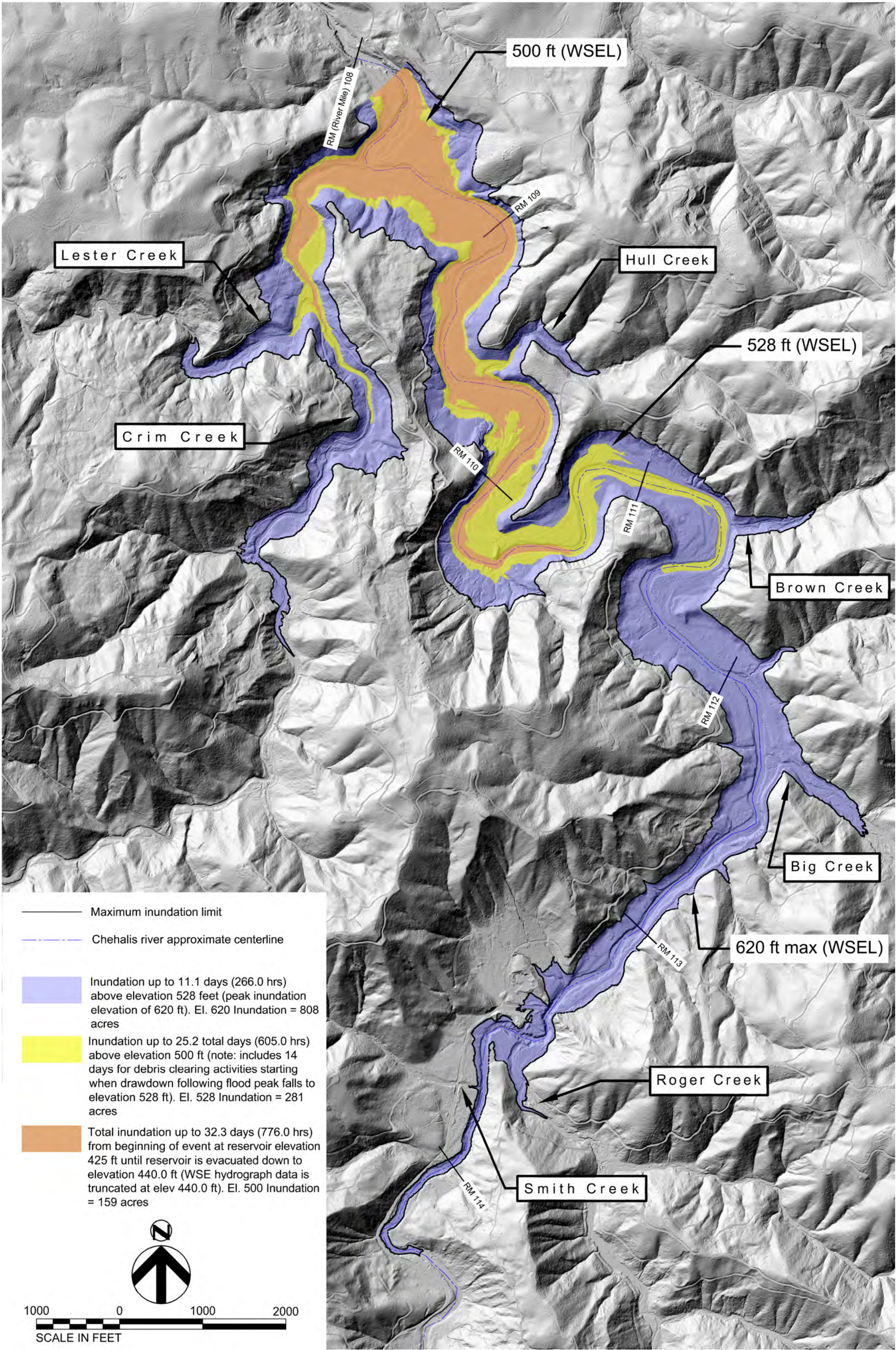


1996 Event Inundation Map for Proposed Dam (FRE)



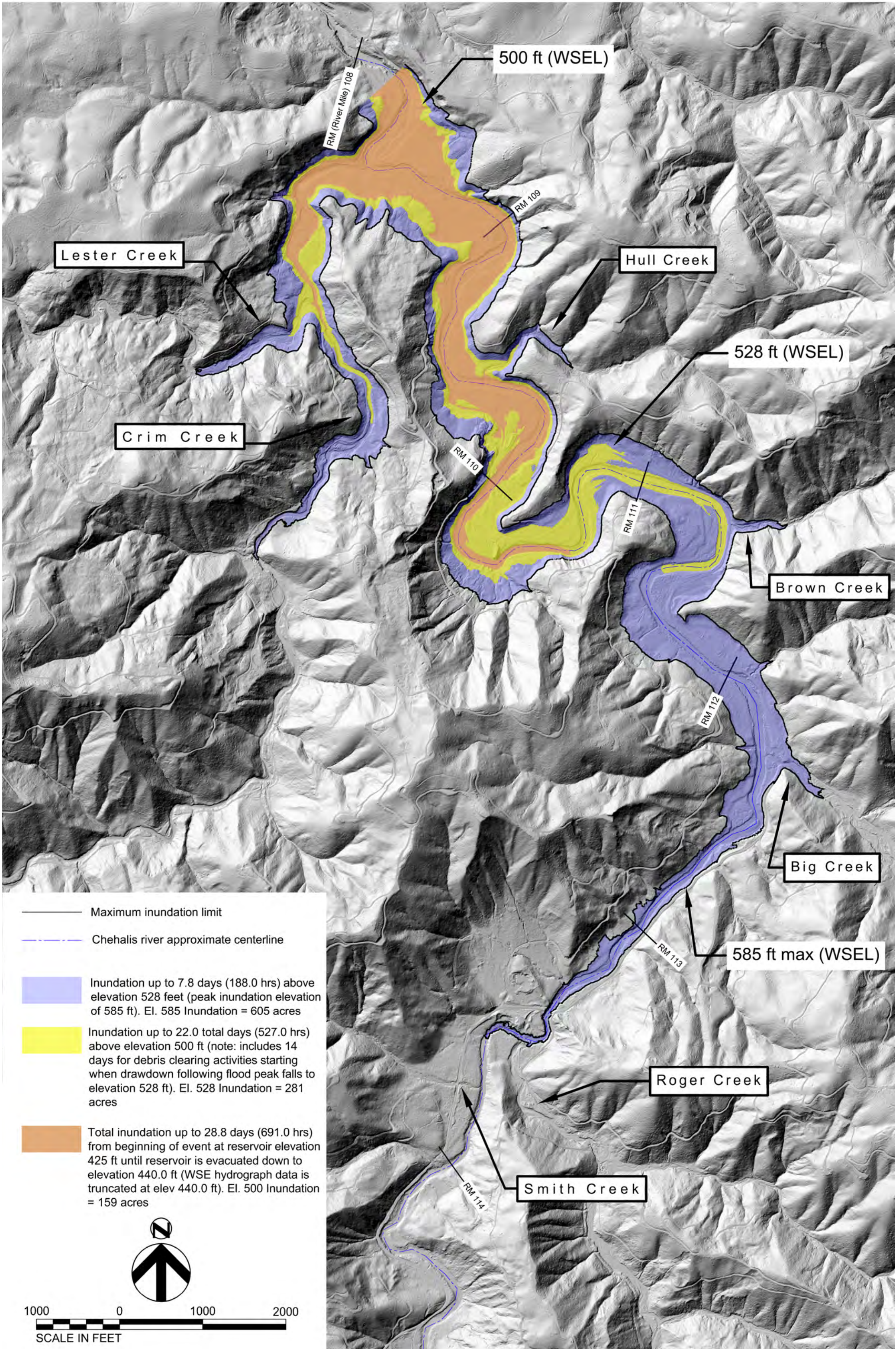


2007 Event Inundation Map for Proposed Dam (FRE)





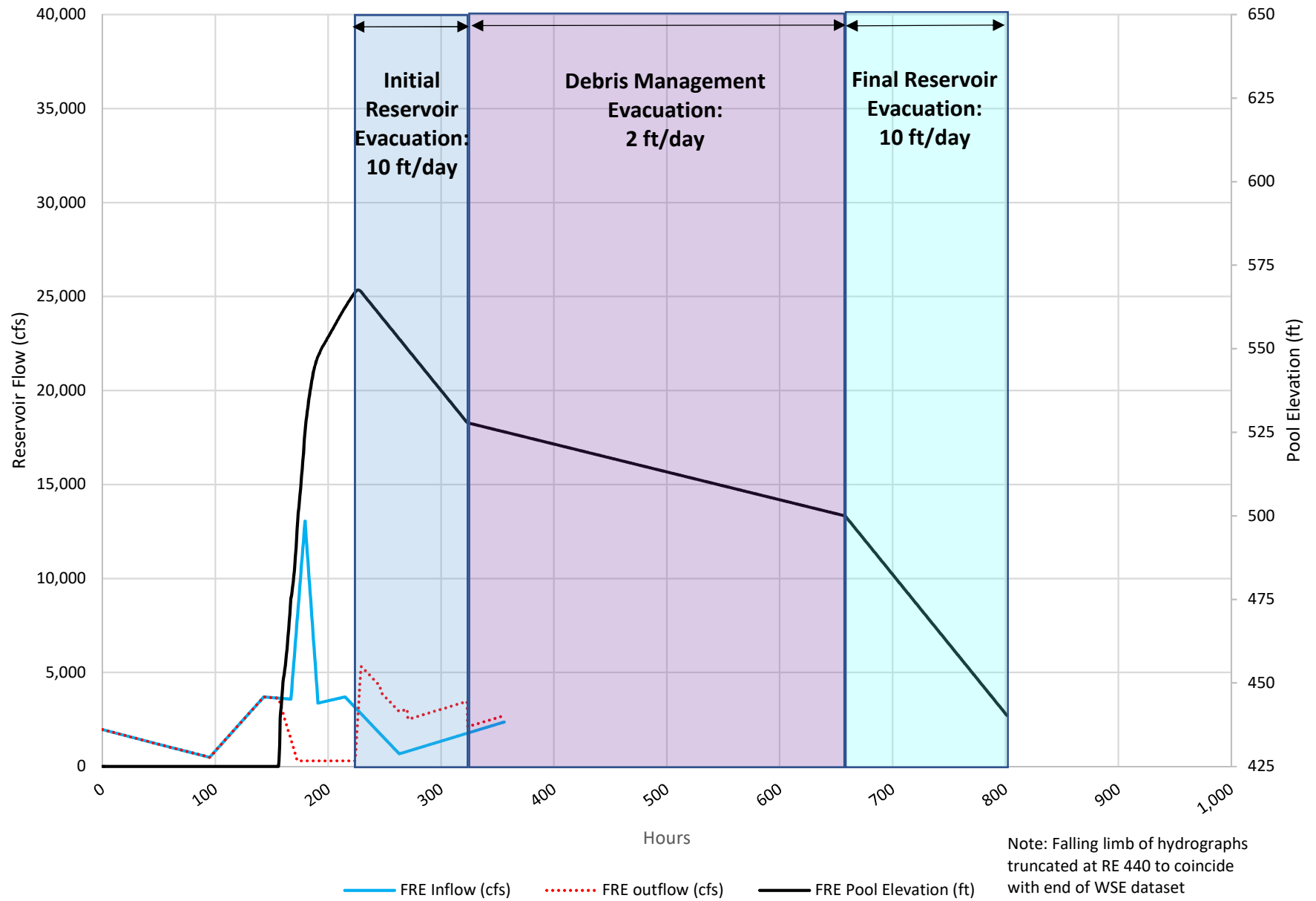
2009 Event Inundation Map for Proposed Dam (FRE)



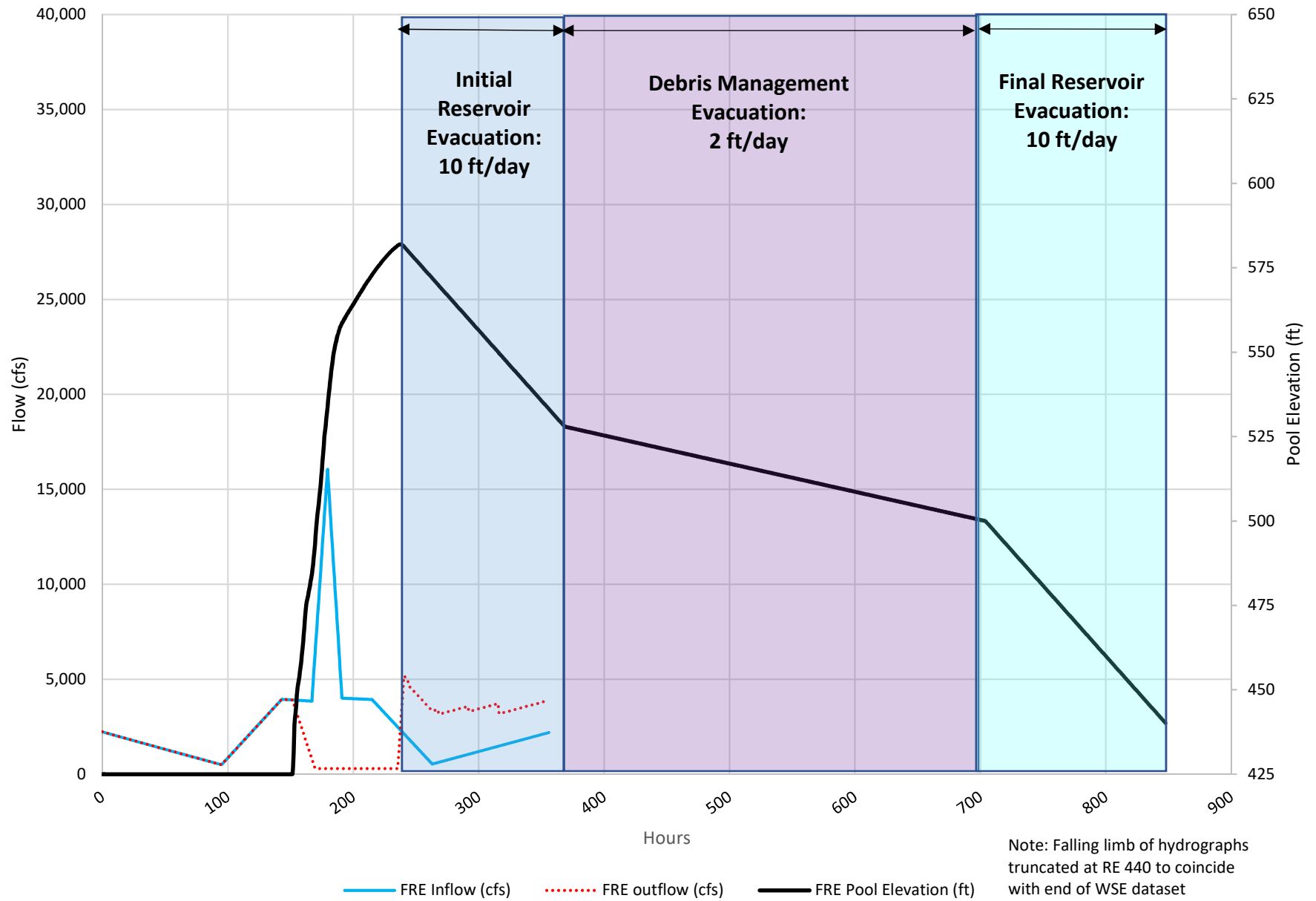


## Appendix C. Hydrographs for Major Flood Events

# 10 Year Simulated Event (Source: WSE, 2017)

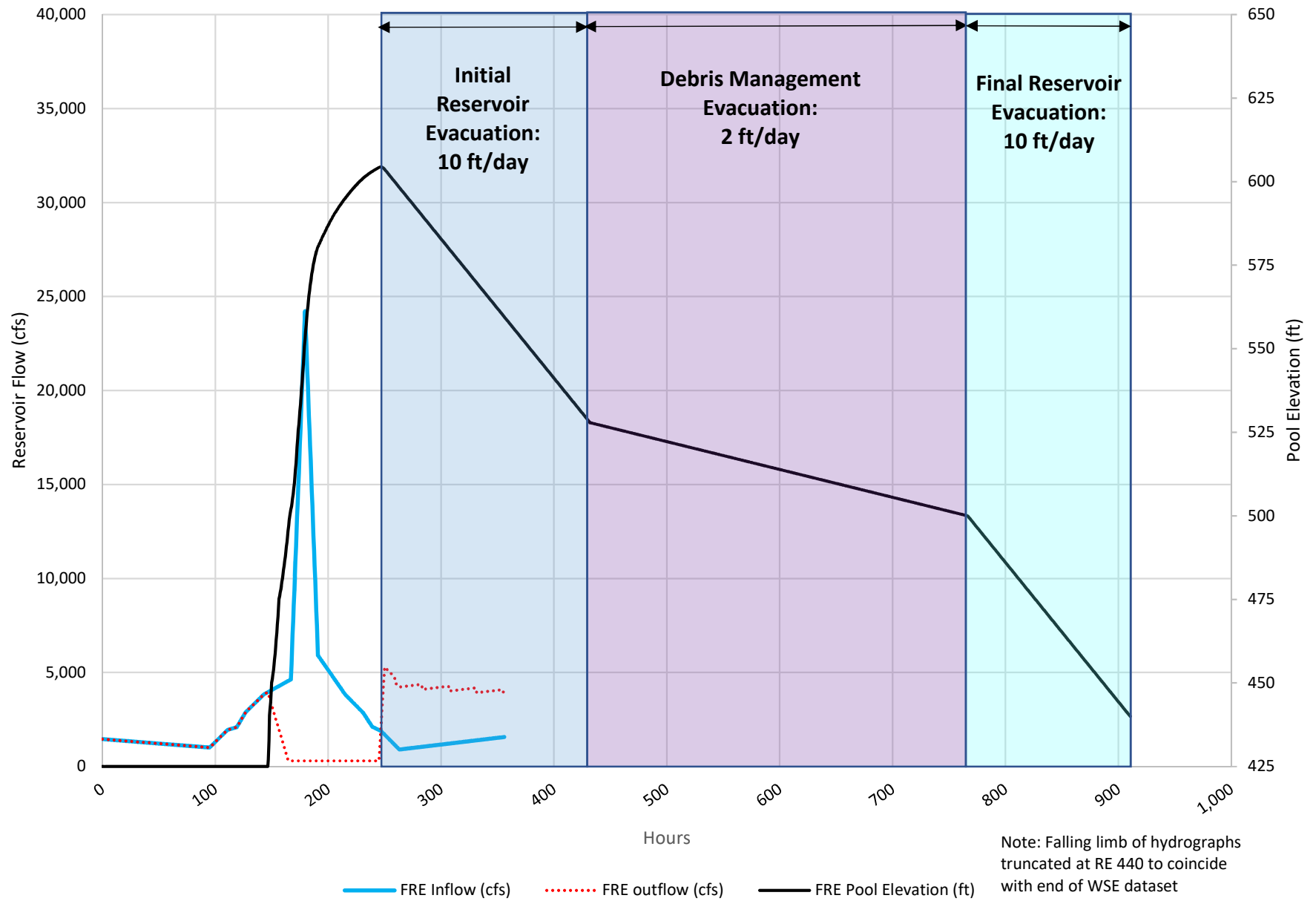


# 20 Year Simulated Event (Source: WSE, 2017)

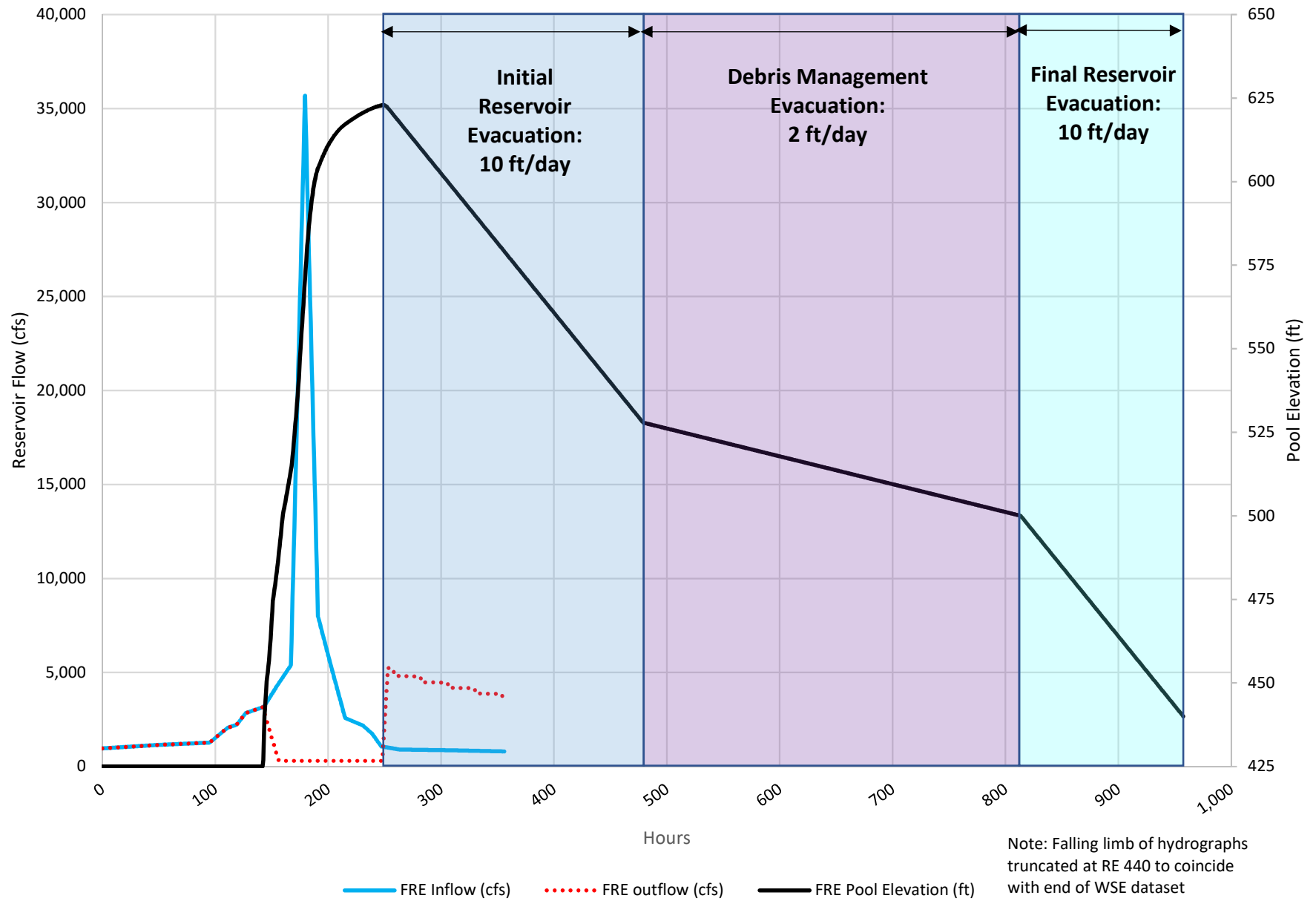




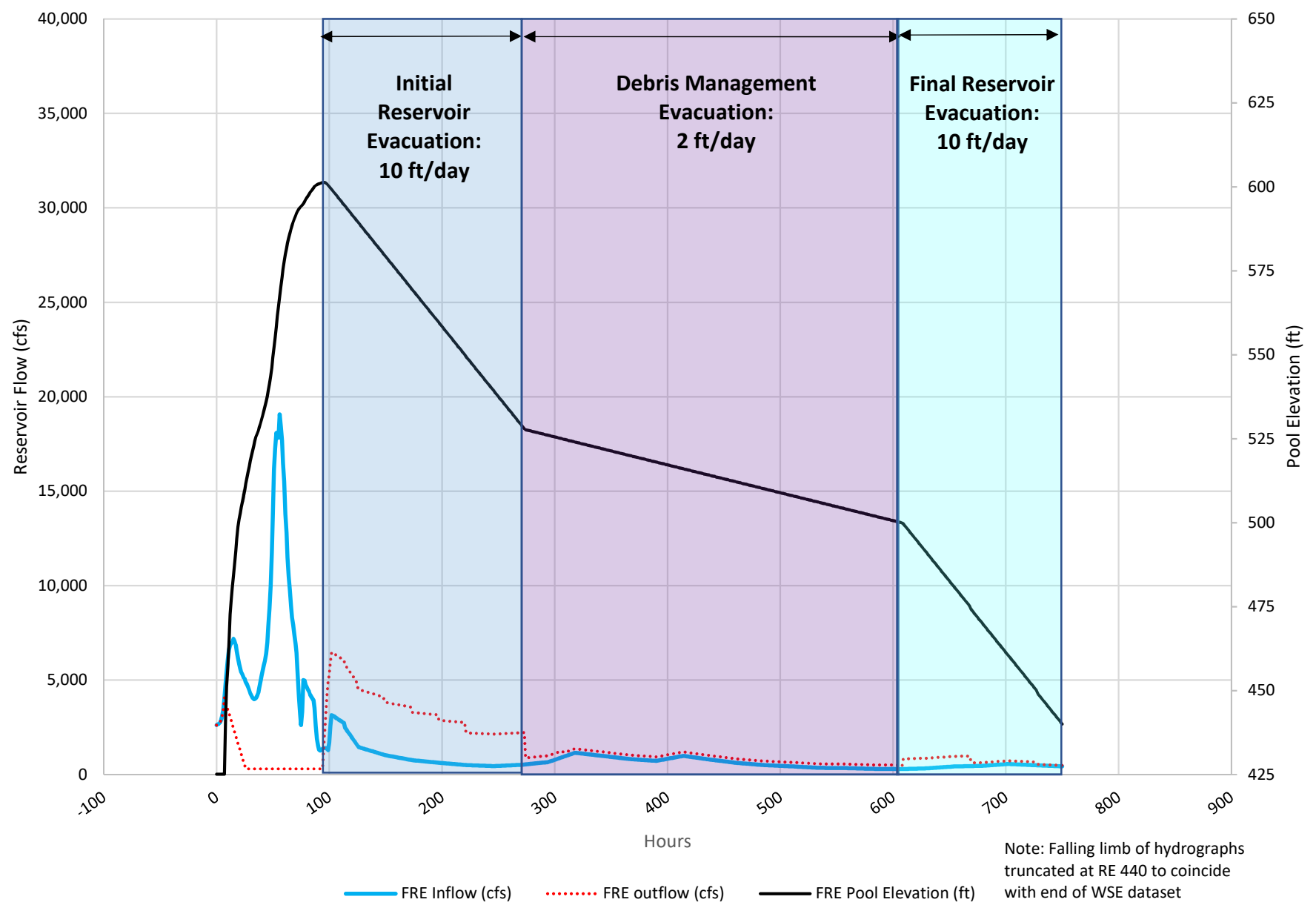
100 Year Simulated Event (Source: WSE, 2017)



500 Year Simulated Event (Source: WSE, 2017)

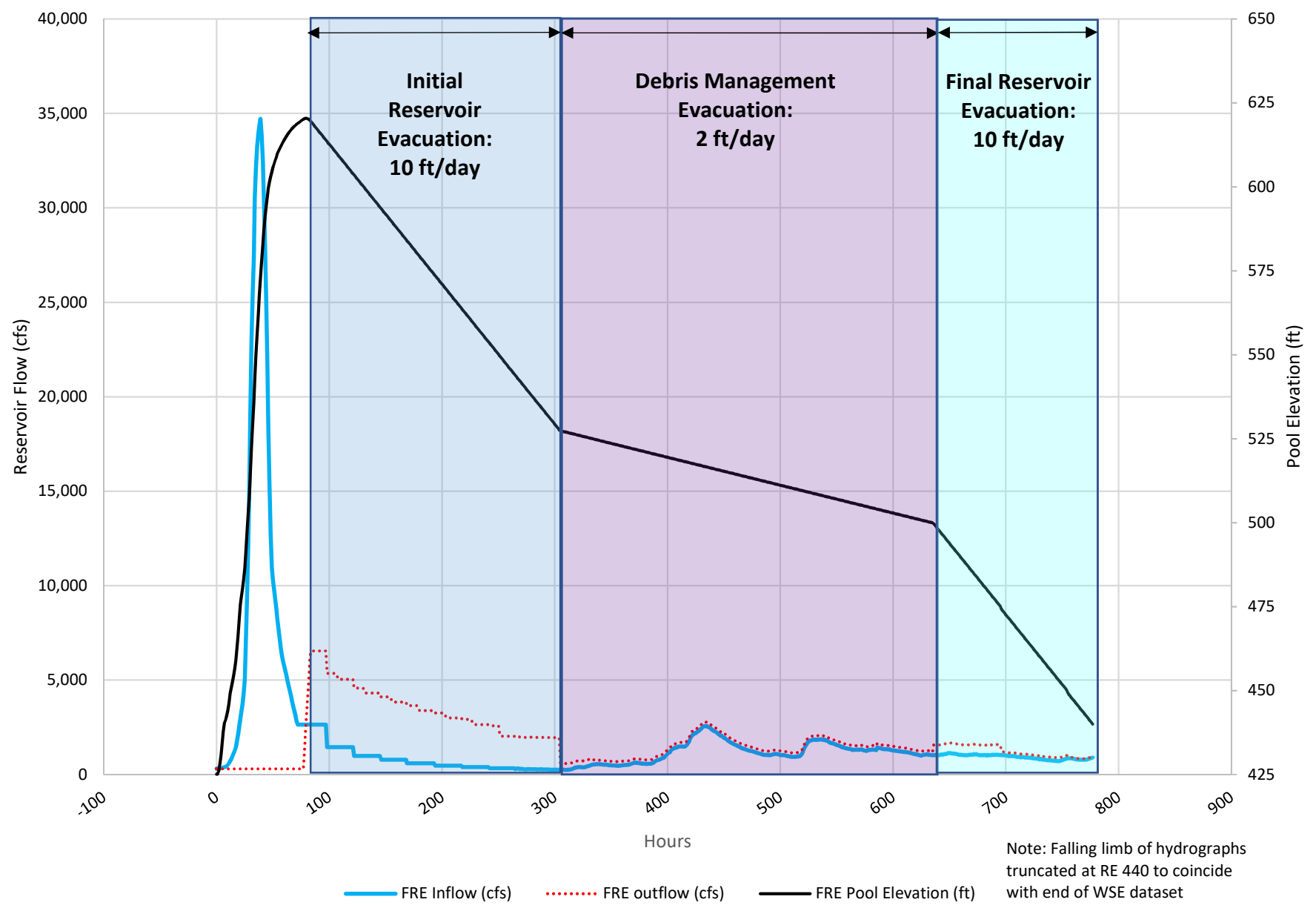


1996 Simulated Flow Event (2/6/1996 - 3/11/1996; Source: WSE, 2017)





2007 Simulated Flow Event (12/1/2007 - 1/4/2008; Source: WSE, 2017)



2009 Simulated Flow Event (1/6/2009 - 2/6/2009; Source; WSE, 2017)

