February 2020
Proposed Chehalis River Basin Flood Damage Reduction Project
SEPA Draft Environmental Impact Statement

# Appendix 1
# Proposed Project Description and Alternatives

Publication No.: 20-06-002

DEPARTMENT OF
ECOLOGY
State of Washington

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| Applicant | Chehalis River Basin Flood Control Zone District |
| BFE | Base Flood Elevation |
| CFAR | Community Flood Assistance and Resilience |
| cfs | cubic feet per second |
| CHTR | collection, handling, transport, and release |
| Corps | U.S. Army Corps of Engineers |
| DNR | Washington Department of Natural Resources |
| Ecology | Washington Department of Ecology |
| EIS | Environmental Impact Statement |
| FEMA | Federal Emergency Management Agency |
| FIRM | Flood Insurance Rate Map |
| Flood Authority | Chehalis River Basin Flood Authority |
| FR | Forest Road |
| FRE | Flood Retention Expandable |
| FRFA | Flood Retention Flow Augmentation |
| FRO | Flood Retention Only |
| I-5 | Interstate 5 |
| IPCC | Intergovernmental Panel on Climate Change |
| LLO | low-level outlet |
| LWM | large woody material |
| NOAA | National Oceanic and Atmospheric Administration |
| OHWM | ordinary high water mark |
| RCC | roller-compacted concrete |
| RCW | Revised Code of Washington |
| RM | river mile |
| RMZ | riparian management zone |
| SEPA | State Environmental Policy Act |
| SR | State Route |
| US | U.S. Highway |
| USGS | U.S. Geological Survey |
| WAC | Washington Administrative Code |
| WDFW | Washington Department of Fish and Wildlife |
| WSDOT | Washington State Department of Transportation |

# 1 INTRODUCTION

This document has been prepared as part of the Washington Department of Ecology's (Ecology's) State Environmental Policy Act (SEPA) Environmental Impact Statement (EIS) to evaluate a proposal from the Chehalis River Basin Flood Control Zone District (Applicant). The Applicant seeks to construct a new flood retention facility and temporary reservoir near Pe Ell, Washington, and make changes to the Chehalis-Centralia Airport levee in Chehalis, Washington (Figure 1-1). The purpose of the Applicant's proposal is to reduce flooding originating in the Willapa Hills and improve the levee protection level at the Chehalis-Centralia Airport to reduce flood damage in the Chehalis-Centralia area.

Ecology determined the Applicant's proposal is likely to have a significant adverse impact on the environment, requiring a SEPA EIS. Ecology issued a Determination of Significance on September 24, 2018, starting the EIS process (Ecology 2018).

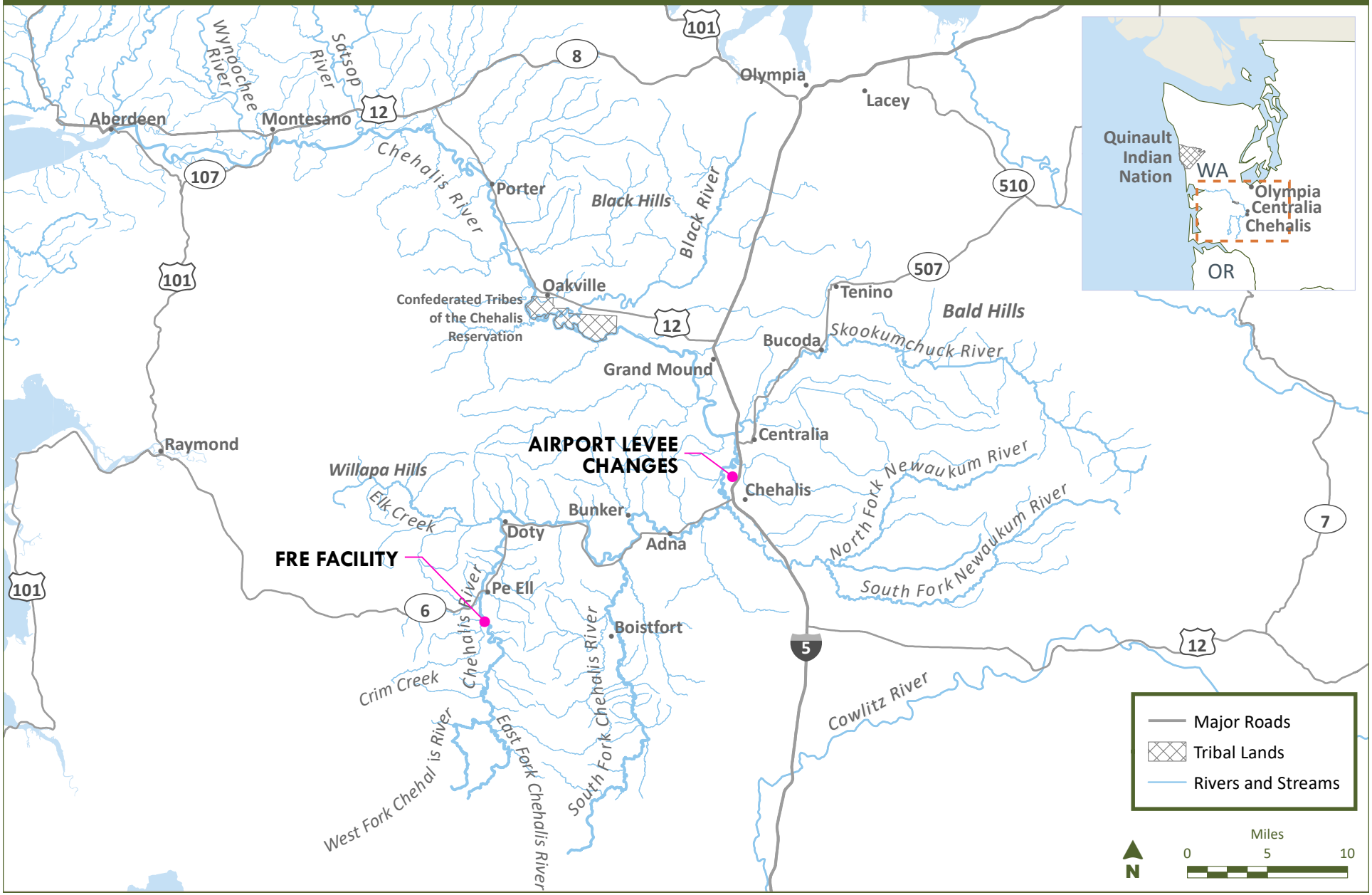
This EIS appendix provides details on the Applicant's proposal (Proposed Action) and other alternatives that are considered in the EIS. This document describes the following:

- **Section 1** provides background and identifies information used for analysis throughout the EIS including: construction and operation periods, flood scenarios and flood level terminology, and climate change.
- **Section 2** includes information on the Applicant and a description of their proposed Chehalis River Basin Flood Damage Reduction Project (Proposed Action) including the project purpose, objectives, description, and location.
- **Section 3** describes how alternatives were considered and developed.
- **Section 4** describes the alternatives evaluated in this EIS.
- **Section 5** identifies alternatives that were considered but eliminated from further review.

## 1.1 Background of Proposed Project

Significant flooding has occurred in the Chehalis River Basin (Chehalis Basin) eight times in the past 60 years, causing major damage to the environment. Damages include adverse effects on public health and safety, adverse impacts on species and habitat, adverse impacts on natural resources, damage or loss of property, and major disruptions and damage to transportation systems, including the temporary closure of Interstate 5 (I-5).

**Figure 1-1**
**Vicinity Map**



The Chehalis River Basin Flood Authority (Flood Authority) was formed in 2008 through an interlocal agreement among 11 jurisdictions in the Chehalis Basin in response to the 2007 flood. The interlocal agreement now includes 13 jurisdictions: Lewis County, Grays Harbor County, and Thurston County, Aberdeen, Centralia, Chehalis, Hoquiam, Montesano, Oakville, Cosmopolis, Napavine, Bucoda, and Pe Ell (Chehalis River Basin Flood Authority 2019a). The Flood Authority proposed the establishment of a flood control zone district (authorized by the Revised Code of Washington [RCW] Chapter 86.15) to undertake and maintain flood control projects in the Chehalis Basin.

The Chehalis River Basin Flood Control Zone District was formed on February 14, 2011, through Resolution 11-049 adopted by the Board of County Commissioners of Lewis County. The resolution established the District's jurisdiction as the portions of Lewis County in the Chehalis Basin watershed. In this resolution, the Chehalis River Basin Flood Control Zone District adopted all powers set forth in RCW 86.15, including, but not limited to: taking action necessary to protect property and life in the district from flood damage, acquiring property, accepting and providing funds, and controlling and removing floodwater and stormwater.

A Programmatic EIS for the Chehalis Basin Strategy was completed June 2, 2017, and assessed broad program-level actions related to implementing an integrated strategy for reducing damages from catastrophic floods and restoring degraded aquatic species habitat in the Chehalis Basin. This programmatic study evaluated large- and local-scale actions to restore aquatic species habitat and construct various flood retention facilities and levees. The Programmatic EIS evaluated impacts and alternatives broadly. The flood retention facilities evaluated in the Programmatic EIS included the Flood Retention Flow Augmentation (FRFA) facility with a permanent reservoir and the Flood Retention Only (FRO) facility with a temporary reservoir. After review of the Programmatic EIS, the Governor's Work Group recommended a project-level EIS be conducted to identify the potential impacts of a flood retention facility (Chehalis Basin Board 2018).

On October 13, 2017, the Chehalis River Basin Flood Control Zone District's Board of Supervisors decided to become the project sponsor and Applicant for the Proposed Action. The Proposed Action was developed from the FRO facility concept evaluated in the Programmatic EIS. The Applicant would be responsible for the construction of the Proposed Action. The operator for the Proposed Action has not yet been identified. Ecology determined the Applicant's proposal is likely to have a significant adverse impact on the environment, requiring a SEPA EIS. Ecology issued a Determination of Significance on September 24, 2018, starting the EIS process (Ecology 2018).

## 1.2 Construction and Operation Times Evaluated in this EIS

The Applicant has stated the construction of the Flood Retention Expandable (FRE) facility, if permitted, would occur from 2025 to 2030 and operations, if permitted, would begin in 2030. The levee construction, if permitted, would take place concurrently with flood retention facility construction but is planned to be completed within 1 construction year. For analysis in this EIS, operations of the Proposed

Action were evaluated from 2030 to 2080. Any impacts identified in this EIS that would occur in the late-century would also apply beyond 2080 for the lifetime of the Proposed Action.

For purposes of analysis in this EIS, the term "mid-century" applies to the operational period from approximately 2030 to 2060. The term "late-century" applies to the operational period from approximately 2060 to 2080.

## 1.3 Flood Level Terminology Used in this EIS

Terminology to describe floods varies by the organization and by the time period referenced. This terminology can be confusing when discussing future events because flood terms like "a 100-year flood" are based on statistics and historical records, but the actual frequency can vary as flood records change. Since the 100-year flood level is statistically computed using data based on the past, the level of the 100-year flood will change over time, especially if there has been a large flood recently (USGS 2019). So the size of a 100-year flood in 2000 is likely to be different from a 100-year flood in 2080. This terminology can also be confusing because a 100-year flood could happen 3 years apart, though the statistical probability stays the same.

This EIS uses the terms "major" and "catastrophic" floods and a "recurring flood" scenario for the analysis. These are referenced to the cubic feet per second (cfs) measured at the U.S. Geological Survey (USGS) stream gage on the Chehalis River at Grand Mound. For analysis in this EIS:

- A **major flood** is when 38,800 cfs is measured at the Grand Mound gage.
- A **catastrophic flood** is when 75,100 cfs is measured at the Grand Mound gage.
- A **recurring flood** scenario is when a major flood or greater occurs in each of 3 consecutive years.

This approach provides consistency across the studies when describing past floods and potential future floods. Table 1-1 provides a cross-reference of flooding terms used in other plans and guidance.

**Table 1-1**
**Flood Level Terminology**

| QUALITATIVE TERM USED IN THE EIS | CHANCE OF OCCURRENCE IN 1 YEAR | ASSOCIATED FLOOD-YEAR TERM | FLOW AT (CFS) | OTHER NOTES |
|---|---|---|---|---|
| **Major Flood** | Current: 14%<br>Mid-century: 20%<br>Late-century: 25% | Current: 7-year<br>Mid-century: 5-year<br>Late-century: 4-year | 38,800 at Grand Mound gage | • **Similar Sized Chehalis Basin Floods for Reference**<br>– 2009 flood |
| **Catastrophic Flood** | Current: 1%<br>Mid-century: 2%<br>Late-century: 4% | Current: 100-year<br>Mid-century: 44-year<br>Late-century: 27-year | 75,100 at Grand Mound gage | • **Similarity to Other Flood Plan Terminology (but the flow rates within plans are different)**<br>– Comprehensive Flood Hazard Management Plans<br>– Base flood level used by National Flood Insurance Program<br>– High-risk FEMA flood zones<br>– Special Flood Hazard Area on FEMA maps<br>– Base flood level used by Lewis County floodplain development regulations<br>• **Similar Sized Chehalis Basin Floods for Reference**<br>– 1996 flood |

## 1.4 Climate Change Analysis in this EIS

The Intergovernmental Panel on Climate Change (IPCC) released a Special Report in 2018 (Allen et al. 2018) which says, "human influence on climate has been the dominant cause of observed warming since the mid-20th century." It further states, "temperature rise to date has already resulted in profound alterations to human and natural systems, including increases in droughts, floods, and some other types of extreme weather; sea level rise; and biodiversity loss ‑ these changes are causing unprecedented risks to vulnerable persons and populations." Scientists project that these trends will continue and, in some cases accelerate, posing significant risks to human health, forests, agriculture, freshwater supplies, coastlines, and other natural resources (Snover et al. 2019). While people have experience dealing with natural weather variability, climate change is moving beyond a range where past experience can provide a reliable guide for what can be expected in the future. Computer models are often used to identify future impacts that are likely to occur.

For the northwest region of the U.S., the Fourth National Climate Assessment (May et al. 2018) identified the following climate change impacts that are likely to occur:

- **Fish, wildlife, and natural systems** will face increased stress. Climate change will more likely damage and destroy certain types of habitats, increase threats to certain species such as fish, alter natural patterns such as animal migrations or flower blooms, and alter the presence of pests and invasive species.
- Climate change could have severe consequences on **human health** and will likely increase the number of people exposed to illness and injuries due to declining air quality and more frequent and severe heat waves, drought, wildfires, and flooding.
- **Communities and transportation, energy, and other infrastructure** could face increased damage costs and disruptions from more frequent and severe flooding, wildfires, changes in energy supply and demand, and other climate impacts.
- **Coastal communities and ecosystems** could face increased risks from sea level rise and storm surge. Increasing ocean acidity poses risks to our shellfish industry and could alter the marine food web.
- **The quantity and quality of water available** for communities, irrigation, fish, hydropower generation, recreation, and other uses will be affected by declining snowpack, changes in precipitation and seasonal streamflow, and increases in summer demand for water.

In 2019, junior water rights for the Chehalis River were curtailed due to lower than normal stream flows. This was the fifth consecutive year when curtailment orders or notices for junior surface water irrigation users in the Chehalis Basin were issued. Also in summer 2019, the Washington Department of Fish and Wildlife (WDFW) closed the Chehalis River, South Fork Chehalis River, North Fork Newaukum River, South Fork Newaukum River, and Skookumchuck River to fishing of all species due to lower than normal stream flows. A report issued by the Climate Impact Group at the University of Washington identifies risks to infrastructure and human health in the Puget Sound region, including the Chehalis Basin, from climate change (Mauger et al. 2016). More intense heat waves and higher flood risks are predicted, along with the indirect effects of increased wildfire frequency, shortage of summer water supply, shifting infectious disease dynamics, and decreased air quality.

In order to evaluate probable significant adverse impacts from the Applicant's Proposed Action and the alternatives, this EIS incorporates climate change projections for precipitation, temperature, and streamflows throughout the analyses as part of the future conditions in mid- and late-century for major and catastrophic flood scenarios. This decision by Ecology recognizes the reality that climate change is underway and will continue.

Projected climate changes have been included in the impact analyses for resource areas to identify potential impacts. Data and models for predicted climate change conditions used in this EIS are from the

University of Washington Climate Impacts Group, the Watershed Science and Engineering, National Oceanic and Atmospheric Administration, Portland State University, and Anchor QEA, LLC.

Climate change data were included in models for hydrology, geomorphology, and salmonid populations and lifecycles in this EIS. All discipline reports prepared for the EIS considered climate change data to identify probable impacts at mid-century and late-century timeframes for major and catastrophic flood conditions. The *Water Resources Discipline Report* (ESA 2020a) provides details on the forecasted streamflow rates and changes in flood levels and extent. Analysis of greenhouse gas emissions is included in the *Air Quality and Greenhouse Gases Discipline Report* (ESA 2020b). The *Fish Species and Habitat Discipline Report* (Anchor QEA 2020a) and *Wildlife Species and Habitat Discipline Report* (Anchor QEA 2020b) include details on increases in temperature and decreases in streamflow that would affect species and habitat.

Recent hydrologic and hydraulic studies within the Chehalis Basin identified future streamflows using a Basin-wide hydrologic model that incorporated climate change projections (WSE 2019). Updated climate change projections were generated by the Climate Impacts Group at the University of Washington using three new dynamically downscaled climate simulations, reflecting recent advances in both regional-scale and global climate modeling (Mauger and Karpack 2019). Earlier climate change studies included results from a large geographic area and used older data for projections (Mauger et al. 2016). These previous studies used a statistically based approach to downscaling data to the Chehalis Basin level, which is not as robust as the dynamically based approach used for the most recent study. In addition, previous studies did not have the more detailed hydrologic data that allows the hydrologic model to be calibrated to local conditions.

The results of the most recent climate change precipitation modeling provides forecasted streamflow rates showing mid-century (2016 to 2060) peak flows would increase 12%, and late-century (2055 to 2099) peak flows would increase 26% (Anchor QEA and WSE 2019). The increased peak flows have been incorporated into the applicable EIS analyses. To avoid bias in estimating streamflow under climate change for particular locations or gages, the adjustments to streamflow Basin-wide were applied to historical flows from active USGS gages. Both hourly and daily flows under future climate change conditions were developed for use in models, technical studies, and discipline reports.

Air and water temperature are predicted to increase under climate change projections. At the FRE facility site, daily maximum water temperature is predicted to be several degrees warmer under future conditions (PSU 2017). Climate change projections for the region from the Climate Impacts Group identify likely future changes in air temperature. The Pacific Northwest experienced a total average annual warming of about 1.3°F, or 0.11°F per decade, from 1895 to 2011. Regionally downscaled climate models project increases in annual temperature of 3.3°F to 9.7°F by 2070 to 2099 (compared to the period 1970 to 1999), depending on total global emissions of heat-trapping gases. These increases are projected to be the largest in the summer (Mote et al. 2014).

Climate change can also have impacts upon a proposed project. The construction and operations of the Proposed Action are not likely to be affected significantly by sea level rise, increased temperatures, or drought. The purpose of the Proposed Action is to reduce flood damage, so the impacts of increased precipitation and flooding on operations of the FRE facility and Airport Levee Changes are evaluated throughout this EIS and in detail in the *Water Resources Discipline Report* (ESA 2020a). The increased threat of wildfires may occur in the forested area near the FRE facility, but the structure and its operations are not likely to be significantly affected by wildfires because the FRE facility is not expected to be in operation during the wildfire season. For the Proposed Action, the effects of climate change upon the FRE facility or Airport Levee Changes are not likely to be significant and therefore are not evaluated further in this EIS.

# 2 APPLICANT'S PROPOSED ACTION

This section provides information provided by the Applicant on the Proposed Action that has been evaluated in this EIS. In some cases, the Applicant's information was supplemented with information on the analysis of the Proposed Action from the EIS. Additional technical information and a series of specific Applicant clarification letters can be found in Attachment A to this appendix.

## 2.1 Applicant Proposed Project Purpose and Objectives

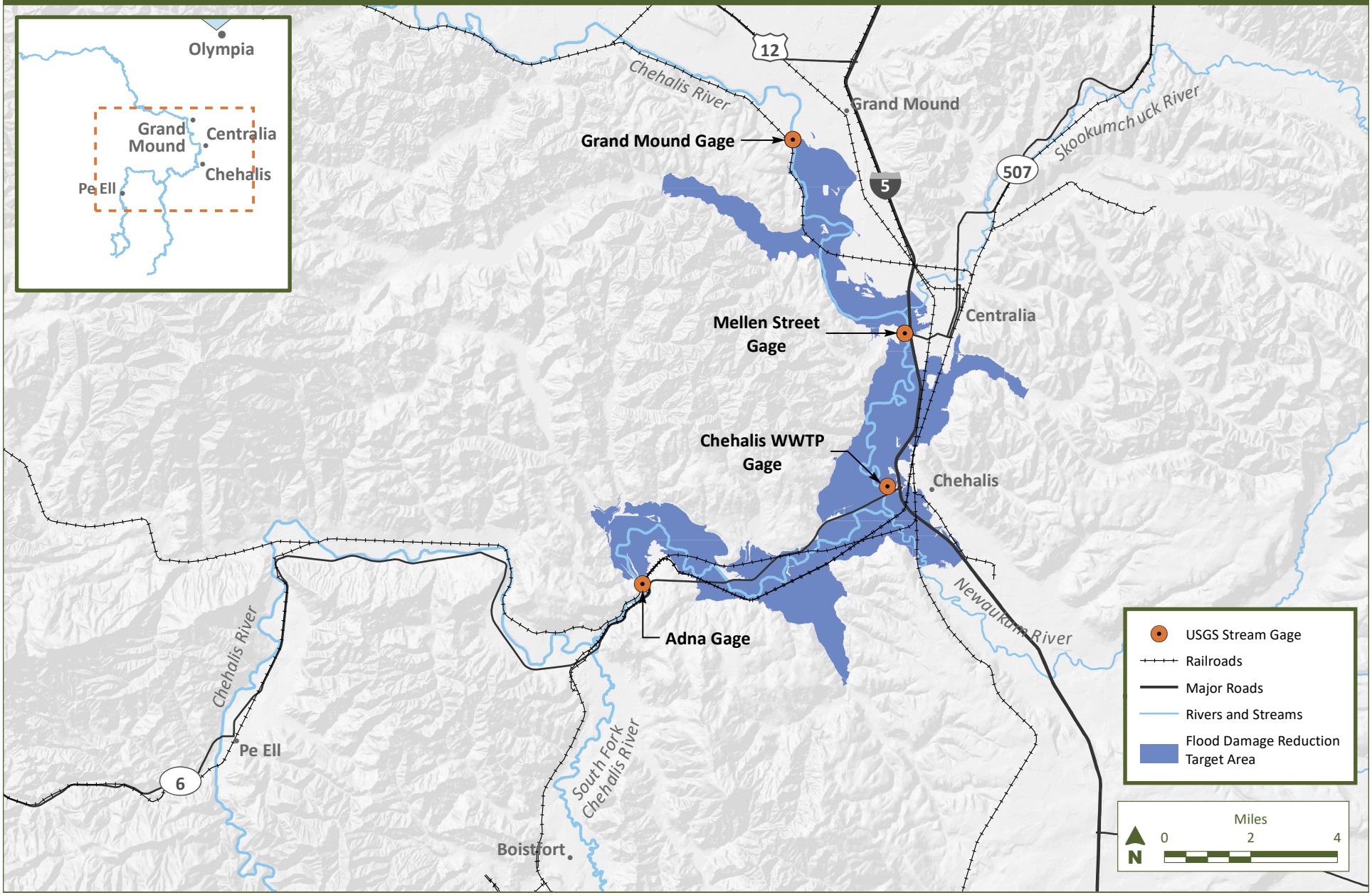
The Applicant's purpose for the Proposed Project is to construct a flood retention facility and temporary reservoir near Pe Ell and make changes to the Chehalis-Centralia Airport levee (Figure 1-1) to reduce flood damage in the Chehalis-Centralia area.

The objective of the Proposed Project is to reduce flooding originating in the Willapa Hills and improve the levee protection level at the Chehalis-Centralia Airport to reduce flood damage in the Chehalis-Centralia area (Figure 1-2).

The Applicant's Proposed Action includes the following elements:

- **Construct a flood retention facility and associated temporary reservoir** near Pe Ell on the Chehalis River to reduce peak flood levels during a major flood from floods originating in the Willapa Hills. A major flood is determined by when the water flow rate of the Chehalis River is at 38,800 cfs or greater at the Grand Mound stream gage. A major flood is also called a 7-year flood, which currently has a 14% probability of occurring in a given year. The applicant intends the FRE facility to store up to 65,000 acre-feet of floodwater in a temporary reservoir during major or larger floods, then slowly release it over a period of time. In normal conditions or for smaller floods, the Chehalis River would flow through the structure at its normal rate. The proposed FRE facility is considered expandable because it would be built with a foundation and hydraulic structure extents capable of supporting the future construction of a larger facility that could expand the water storage from approximately 65,000 acre-feet to up to 130,000 acre-feet. This expansion may or may not occur, and, if pursued in the future, it would be subject to a separate environmental review and permitting process.
- **Make changes to the Chehalis-Centralia Airport levee** by raising the levee 4 to 7 feet, widening portions of the levee, and raising a portion of NW Louisiana Avenue to reduce flood damage from a catastrophic (100-year) flood.

**Figure 1-2**
**Flood Damage Reduction Target Area**



The Applicant intends the following results of the Proposed Action:

- Reduce flood elevations during a 100-year flood at the following locations:
  - 10 feet at the Doty gage (USGS No. 12020000)
  - 1 foot at the Mellen Street gage (USGS No. 12025500)
- Not extend the boundaries of the existing 100-year floodplain
- Provide future leaders in the Chehalis Basin the flexibility to address additional increases in peak flood levels through an adaptable design approach

The Applicant intends to measure the reduced flood damage from the Proposed Action using the following metrics:

- Approximately 635 structures of value removed from flooding risk during a 100-year flood
- Disruption of access via main transportation routes reduced, specifically ensuring access along State Route (SR) 6 and that I-5 is open within 24 hours of a 100-year flood
- Flood-related impacts (e.g., closure) at the Chehalis-Centralia Airport minimized

## 2.2 Location

The Chehalis Basin is primarily in Lewis County and includes smaller portions of Grays Harbor, Thurston, Pacific, Cowlitz, and Wahkiakum counties. The Chehalis Basin includes managed forestlands, agricultural lands, and the cities of Chehalis, Centralia, Montesano, and many smaller cities. The Chehalis River flows approximately 125 miles north-northwesterly to Grays Harbor and the Pacific Ocean, and drains an area of approximately 2,700 square miles. The mainstem Chehalis River is formed by the confluence of the East Fork Chehalis River and West Fork Chehalis River in the central Willapa Hills above Pe Ell in Lewis County.

The Applicant's Proposed Action, described in Section 2, includes an FRE facility—located on the mainstem Chehalis River about 1 mile south (upstream) of Pe Ell—and Airport Levee Changes along the northern, western, and southern boundaries of the Chehalis-Centralia Airport in Chehalis, Washington, around latitude 46.678 and longitude -122.986. Figure 1-1 shows the vicinity of the Applicant's Proposed Action.

The flood retention facility would be located on property currently owned by Weyerhaeuser and Panesko Tree Farm, south of SR 6 in Lewis County, on the mainstem Chehalis River at approximately river mile (RM) 108, about 1 mile south of (upstream of) Pe Ell. The property is located in Section 3, Township 12N, Range 5W on Government Lot 13 and a portion of Government Lot 14 (the west half of the southwest quarter and the southeast quarter of the southwest quarter, excluding roads).

The watershed area upstream of the flood retention facility is 68.9 square miles. The FRE facility site and associated reservoir area is currently managed forestland and is subject to Washington State Forest Practices Rules (Title 222 of the Washington Administrative Code [WAC]). Property acquisition for the

flood retention facility and reservoir footprint would be required, and the Applicant has stated the land would no longer be managed as commercial forestland.

The Applicant is also proposing to raise the existing Chehalis-Centralia Airport levee and part of NW Louisiana Avenue (Figure 1-1). The property is located around latitude 46.545/longitude -123.299 in Section 30, Township 14N, Range 2W on a portion of Sections 19 and 30 between the highway, St. Helens Avenue, and Lawrence Road; on a portion on the highway; and on a portion of Louisiana Street. The surrounding area includes the Twin City Town Center commercial shopping area to the east, the Riverside Golf Course to the west, and the Chehalis Regional Water Reclamation Facility to the south. Other adjacent land uses include agricultural and residential.

## 2.3 Flood Retention Facility

The proposed flood retention facility, referred to as the FRE facility, would store floodwater during major or larger floods (Table 1-2). Except during these events, the river would flow through the facility unimpeded. The FRE facility includes fish passage facilities and an associated temporary reservoir (Figure 1-3). The FRE facility would reduce the severity and duration of major floods triggered by rainfall in the Willapa Hills. It would neither protect communities from all flooding, nor would it be designed to stop regular annual flooding from the Chehalis River. The FRE facility would be located on private property that is currently actively managed timberland and is not intended to result in any residential or community development at or around the reservoir.

**Table 1-2**
**Applicant's Flood Level Terminology**

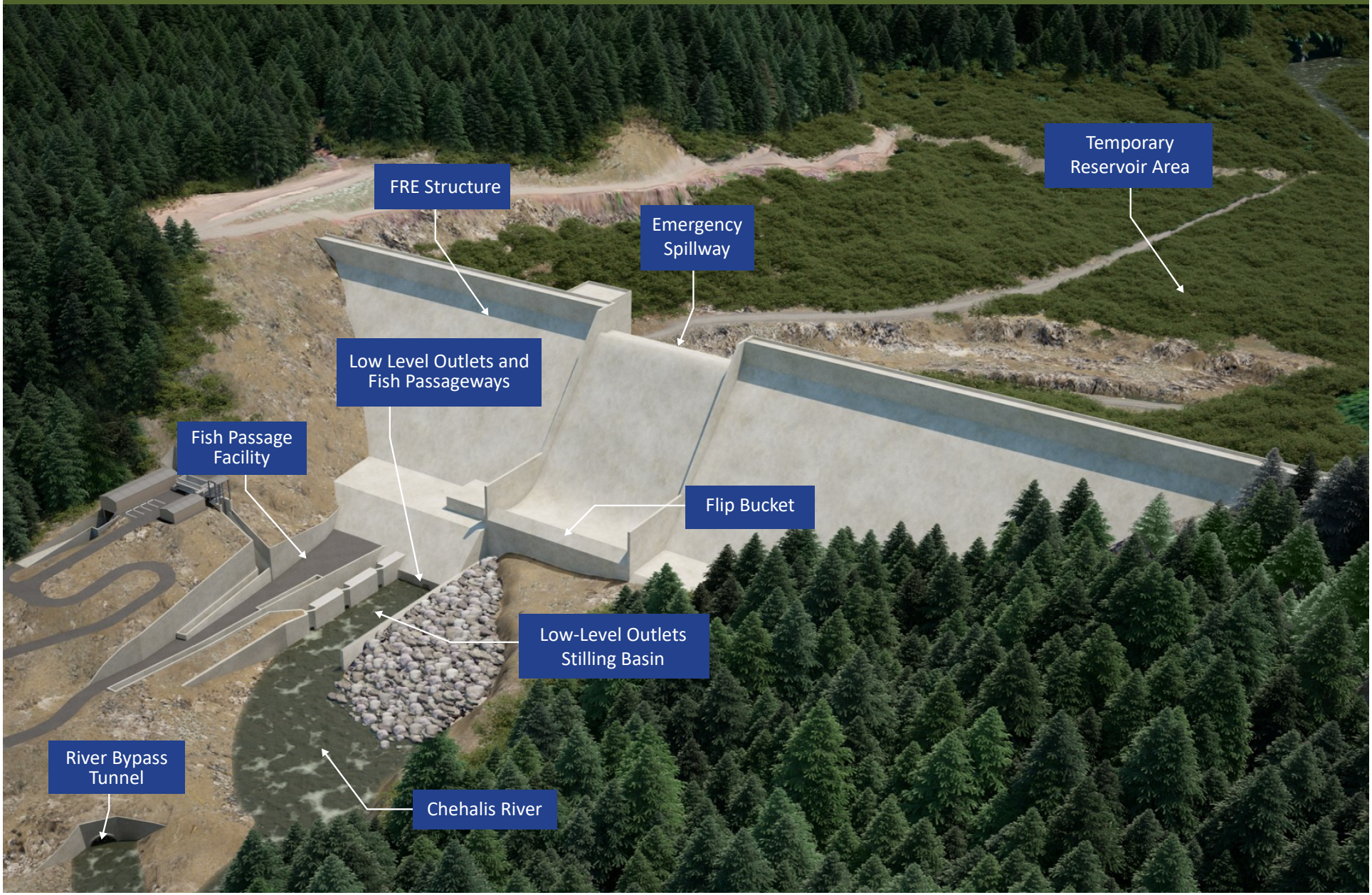
| QUALITATIVE TERM | ANNUAL CHANCE OF OCCURRENCE[1] | FLOOD-YEAR[2] | FLOW AT GRAND MOUND STREAM GAGE[3] |
|---|---|---|---|
| Major flooding | 14% | 7-year | 38,800 cfs |
| Catastrophic flooding | 1% | 100-year | 75,100 cfs |

Notes:
1. Percent chance a flood of this size would occur in any given year
2. Average number of years between a flood of this magnitude
3. USGS 12027500

### 2.3.1 FRE Facility Design and Construction Details

During a major flood, the proposed FRE facility is designed to reduce flood damage from Pe Ell to Centralia by storing water in a temporary reservoir (Figure 1-4) and releasing it slowly over time. For major floods, the reservoir would extend an average of 5.3 miles. When it is safe to do so, retained floodwater water would be released slowly back to the river over time (up to 32 days). Most of the time, however, the Chehalis River would flow through conduits in the facility at the river's normal rate of flow and volume, allowing fish to pass without obstruction upstream and downstream (Figure 1-5).

**Figure 1-3**
**Flood Retention Facility Illustration**




Source: HDR 2018

**Figure 1-4**
**Temporary Reservoir Extent**

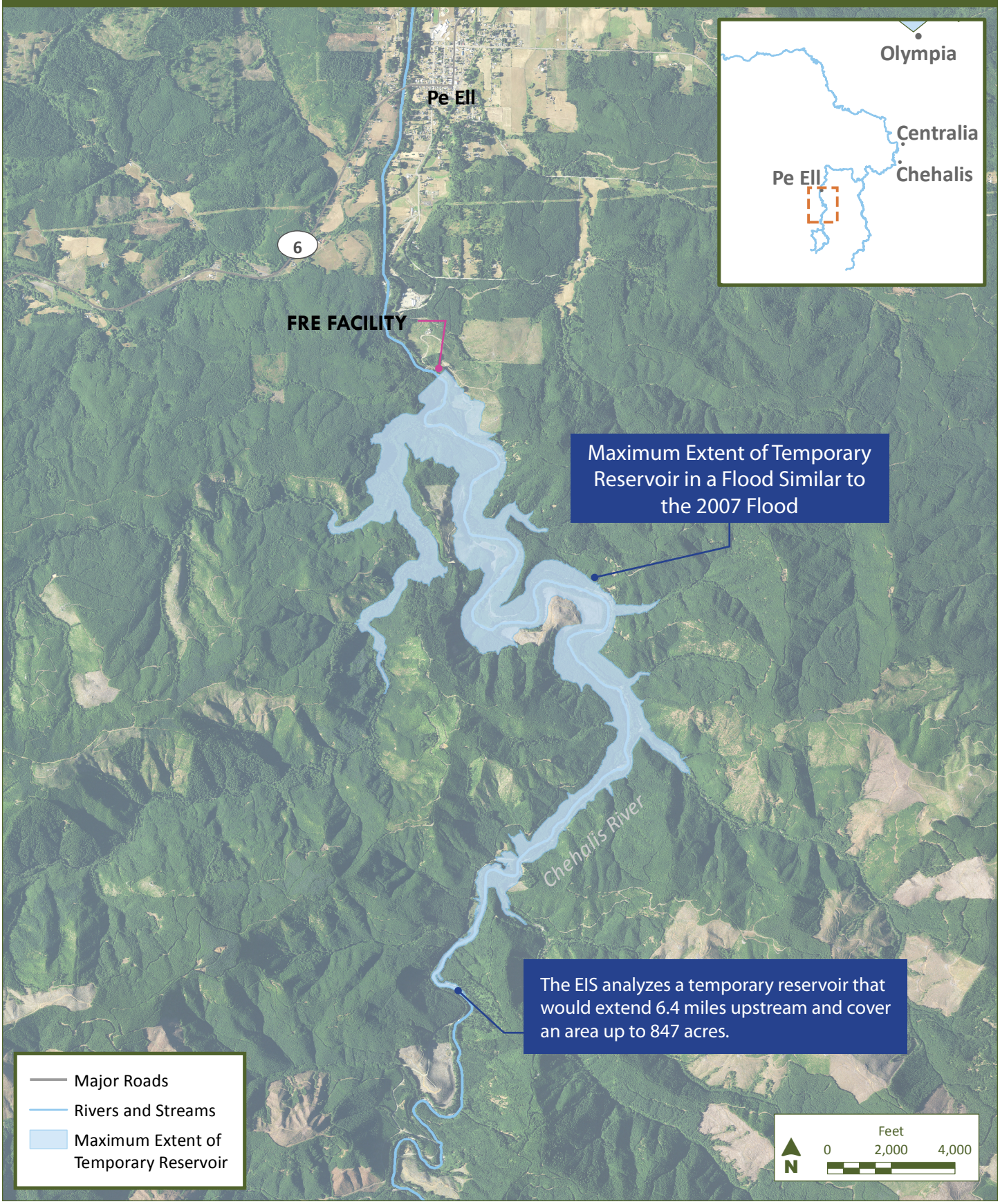
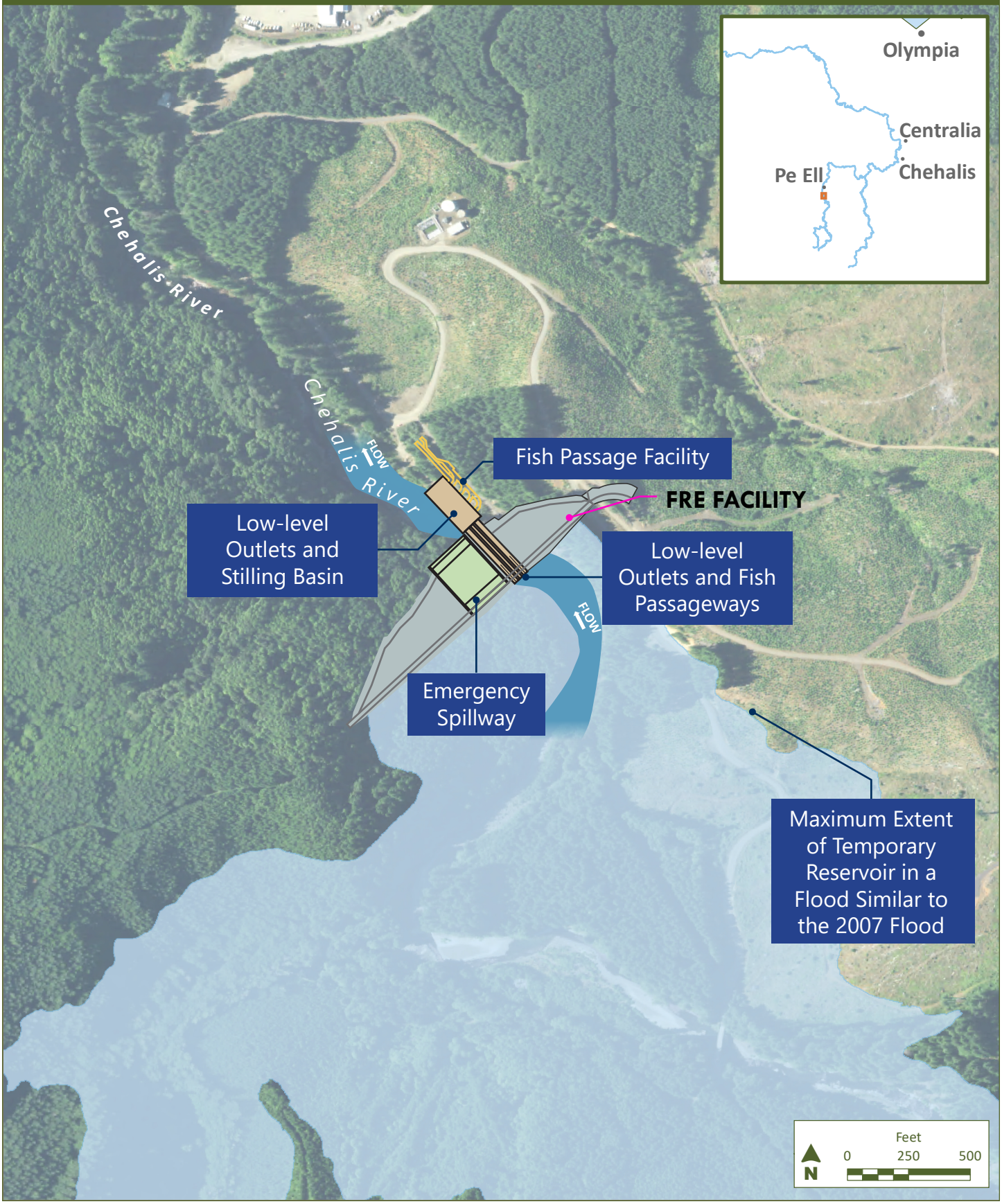


**Figure 1-5**
**FRE Facility Plan View**




Source: HDR 2018

The proposed FRE facility is considered to be expandable because it would be built with a foundation and hydraulic structure capable of supporting the future construction of a larger structure and reservoir that could expand the water storage from 65,000 acre-feet up to 130,000 acre-feet. This expansion may or may not occur. If pursued, it would be subject to a separate environmental review and permitting process.

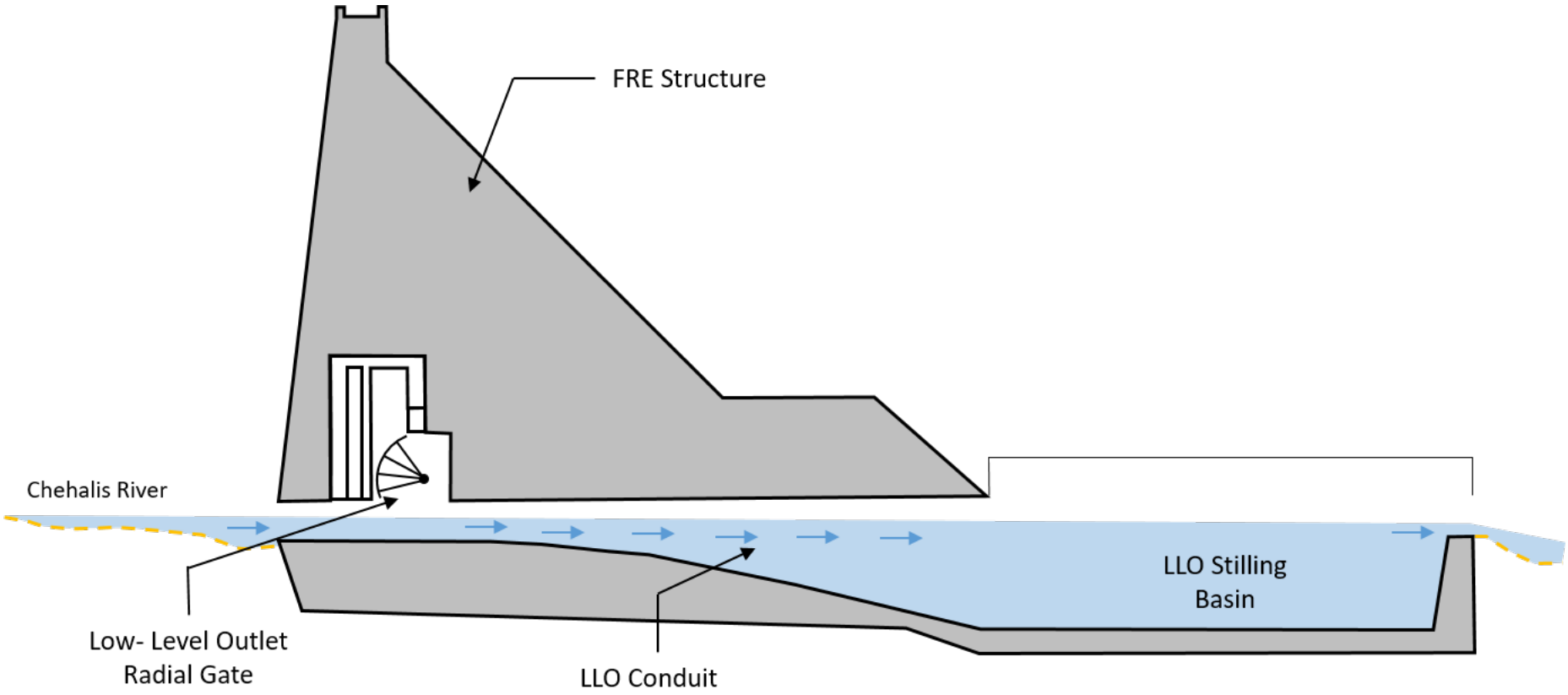
#### *2.3.1.1 Permanent Structure*

The FRE facility would be a roller-compacted concrete (RCC) gravity structure, which is a concrete structure designed to retain water primarily by using the weight of the structure to resist the pressure of water pushing against it. The top of the proposed FRE facility would be 1,550 feet long and up to 270 feet high (including 3 to 5 feet of freeboard for safety and a 200-foot-wide emergency spillway; HDR 2018). Freeboard refers to the height above a given water level on which the lowest floor of a structure is built. The emergency spillway would discharge over a concrete-lined chute to a flip bucket terminal structure. The spillway is expected to be used very rarely, and for events of very short duration. The flip bucket would launch the spillway flow a safe distance downstream of the FRE facility and would dissipate the energy in the river channel (Figure 1-6). The non-overflow top of parapet elevation (654 feet) would be above the maximum estimated reservoir storage pool elevation for a catastrophic flood.

The facility would have five outlet conduits (low-level outlets [LLOs]) for the Chehalis River to pass through: one that is 12 feet wide by 20 feet high and four that are 10 feet wide by 16 feet high. The LLOs would allow the river to pass through the structure unimpeded outside of floods. During flood retention periods, river flow through the LLOs would be restricted to 300 cfs. The LLOs would typically be open, but could be closed for an anticipated flood using radial control gates (Figures 1-5 and 1-6). Most sediment and most small debris would pass through the LLOs. The LLOs would discharge to a 230-foot-long stilling basin, a concrete structure where the channel widens temporarily to reduce the speed and energy of the water coming out of the outlets and minimize downstream channel erosion, before re-entering the natural river channel downstream of the FRE facility.

Table 1-3 includes details on temporary reservoir conditions, as analyzed in the EIS and as described by the Applicant, with some technical clarifications. Table 1-3 also provides details on the conditions that are evaluated in the EIS, with the incorporation of climate change projections. The *Chehalis River Basin Flood Control: FRE Dam Alternative Combined Dam and Fish Passage Supplemental Design Report* (HDR 2018; Attachment A.2) provides additional details on the FRE facility design.

**Figure 1-6**
**Cross Section of FRE Facility Showing Flow During Normal Conditions**




Source: HDR 2020 (Attachment A.17)

**Table 1-3**
**FRE Facility Temporary Reservoir Conditions**

| ELEMENT | MAJOR FLOOD | | CATASTROPHIC FLOOD | |
|---|---|---|---|---|
| | CONDITIONS UNDER CURRENT CLIMATE (APPLICANT'S CONDITIONS) | CONDITIONS WITH CLIMATE CHANGE AT LATE-CENTURY (EIS CONDITIONS) | CONDITIONS UNDER CURRENT CLIMATE (APPLICANT'S CONDITIONS) | CONDITIONS WITH CLIMATE CHANGE AT LATE-CENTURY (EIS CONDITIONS) |
| Duration of temporary reservoir inundation upstream of the FRE facility | Up to 32 days | **Up to 35 days** | Up to 32 days | **Up to 35 days** |
| Inundation extent | 5.3 miles | **5.5 miles** | 6.2 miles | **6.4 miles** |
| Inundated area | 188 acres | **604 acres** | 778 acres | **847 acres** |
| Reservoir elevation | 513 feet | **590 feet** | 620 feet | **627 feet** |
| Reservoir depth | 88 feet | **165 feet** | 195 feet | **202 feet** |
| Capacity | 65,000 acre-feet | **65,810 acre-feet** | 65,000 acre-feet | **65,810 acre-feet** |
| Probability of a flood occurring in a given year | 14% | **25%** | 1% | **4%** |

### *2.3.1.2 Permanent Infrastructure*

Construction and operation activities would necessitate constructing a detour or bypass road for Forest Road (FR) 1000, which is a main access road for Weyerhaeuser forestry operations. The FR 1000 bypass or detour would also provide access to the reservoir area on a permanent basis when the FRE facility is in operation and FR 1000 is inundated. There may be occurrences when the bypass is also temporarily inundated during flood operations. Up to 6 miles of the existing FR 1000 would be inundated and unavailable during major peak flood retention, at which time a detour would be used, consisting of FR A-line, FR F-line, and FR 2000, to rejoin FR 1000 upstream of the reservoir. Specific locations and the extent of improvements to the bypass road for FR 1000 would be defined during the detailed design phase, in conjunction with permitting.

A new power line would be constructed to operate the facility's pumps, gates, instruments, and other controls. The new power lines for the fish passage facility and gate operations would connect to existing local transmission lines, and the new power lines would be located along existing road alignments and areas cleared for FRE facility construction.

### *2.3.1.3 Construction*

If permitted, the Applicant expects construction would occur between 2025 and 2030 and would last approximately 5 years (see Attachment A.14 for additional FRE facility construction schedule details).

Prior to construction, the Applicant expects final design would take approximately 1.5 to 2 years to complete, with an additional 1-year for permitting, and contract bidding and awarding would take from 4 to 6 months.

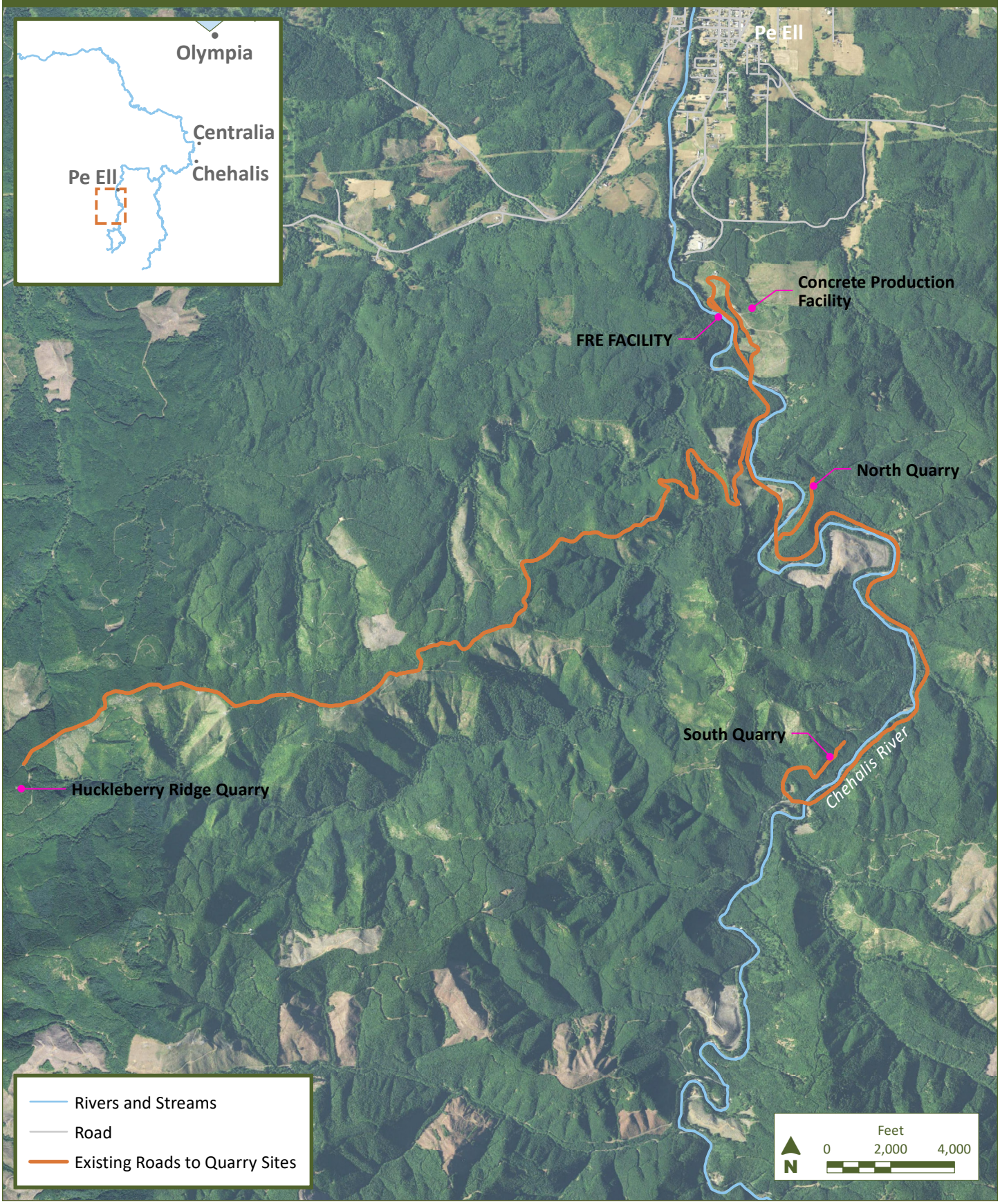
FRE facility construction would require developing a quarry to provide aggregate for the FRE facility. This would also include upgrading roads to the quarry, identifying material storage and processing sites, and constructing areas for offices and storing equipment.

Concrete aggregate could be mined within the FRE facility site or nearby, depending on aggregate availability. The proposed quarry sites are the North Quarry, South Quarry, and Huckleberry Ridge (Figure 1-7). The North Quarry option would require widening 1.9 miles of FR 1000. FR 1000G would also require widening, surfacing, and moderate improvements to the subgrade. The South Quarry option would require the same as the North Quarry option with additional upgrades and widening of FR 1000 and FR 1020. The Huckleberry Ridge Quarry option would include 3.01 miles of simple improvements, 2.93 miles of moderate improvements and excavation, and 0.81 mile of complex improvements, including heavy excavation, drilling, and blasting. For additional information, refer to the *Chehalis Dam Feasibility Study–Road Improvement Requirements for Dam Construction* (PFR 2019; Attachment A.7) and Attachment A.14.

A concrete production facility would also be located near the FRE facility and would include both RCC and conventional concrete production. The site would include the following:

- RCC batch plant
- Conventional concrete batch plant
- Aggregate crushing and screening
- Aggregate storage
- Fly ash storage
- Cement storage

**Figure 1-7**
**Quarry Sites**



Construction equipment would include the following, which would be refined as the FRE facility progresses into the permitting phase:

- A range of mid- to large-size bulldozers, track excavators, front-end loaders, off-road fixed-wheel and articulated haul trucks, integrated tool carriers, and rollers
- A range of cranes up to 250 tons or larger, such as boom trucks, hydraulic trucks, and rough terrain and track-mounted cranes
- Quarry and material processing equipment, including the following:
  - Track drills (pneumatic and hydraulic)
  - Blasting product storage and transfer
  - Crushing plants, including feeders, primary (jaw), secondary (cone) and tertiary crushers, utility and potentially overland conveyors, screen decks, potentially wash plants, large generators, and electrical control and parts vans
- Concrete production and delivery equipment, such as generators, compressors, mobile to semi-mobile concrete plants, feeders, water chillers, ice plants, nitrogen systems, cement storage silos or trailers, conveyors, overland conveyors, and specialty fabricated equipment
- Support equipment, including the following:
  - Trucks (vacuum trucks, water, mechanic, fuel and lube, booms, and flatbeds)
  - Storage (vans, CONEX boxes, and temporary buildings)
  - Other (generators, welders, compressors, pumps, and office trailers)

Excavation and earthwork operations, or soil movement, would involve soil disturbance as well as varying degrees of foundation rock excavation. Blasting equipment would include hydraulic and air track drills as well as explosive equipment handling and storage equipment. Production rates for earthwork operations would vary considerably based on the specific operation but would not exceed 5,000 cubic yards per day. The Applicant has indicated that in-water work means work completed within the existing river channel below the ordinary high water mark (OHWM). For the purposes of this EIS, in-water work includes work below OHWM as well as water within the bypass tunnel regardless of elevation.

Work in the river would begin with the isolation and installation of upstream and downstream bypass tunnel portals. This work is expected to occur during low-flow times. The temporary upstream fish passage trap-and-transport facility would be installed before the bypass tunnel. Temporary upstream and downstream berms across the river channel would then be constructed. It is assumed a temporary upstream cofferdam would be constructed with RCC behind the temporary berm to an assumed height of 665 feet mean sea level. A smaller downstream cofferdam would be constructed to a height assumed to be 635 feet mean sea level to protect the construction area on the downstream side.

Once the bypass tunnel is completed and is ready for use, river water would be diverted into the prepared diversion channel and tunnel by removing the material that isolates the tunnels. Once the river is diverted, it would flow uninhibited through the bypass tunnel during construction of the

FRE facility. With an RCC cofferdam, seepage would be minimized, but precipitation within the construction site runoff area and minor seepage through the cofferdam and foundation would be pumped to appropriate containment for treatment prior to being returned to the river. The duration of diversion through the bypass tunnel is likely to be on the order of 24 months.

After completion of construction (including the permanent fish passage facilities), the process would be reversed with preparation of the water passage features within the FRE facility, removal of the upstream and downstream cofferdams, and diversion of the river back to the original channel. A berm would be constructed to isolate the upstream and downstream tunnel portals so they may be plugged.

Water for construction use is likely to be drawn or predominantly drawn upstream of the cofferdam from the bypass tunnel forebay area. Water use is likely to be between 75 and 150 million gallons, with as much as 80% of the draw occurring in a 10- to 20-month window. A plan for where water would be drawn, or how much would be used, would need to be developed. If sand or aggregates are washed on site, water use would be on the high side of this range. However, it is not anticipated that conventional concrete sand or other aggregates would be washed on site.

Access to the construction site is anticipated via Muller Road and FR 1000. Trips to and from the FRE facility site have not been evaluated, but would include labor and project support, all permanent materials and consumable materials, and construction equipment. A rough range for two-axle truck off-site round trips would be between 100,000 and 180,000 loads, and three-axle or larger off-site truck round trips would be between 16,000 and 26,000 loads. On-site hauling of earthwork and quarried aggregates would use site-developed roads dedicated for construction use. These estimates would be refined in future phases of design development in conjunction with, and in preparation for, permitting.

For additional information, refer to the *Combined Dam and Fish Passage Design Conceptual Report* (HDR 2017; Attachment A.1) and *Chehalis River Basin Flood Control: FRE Dam Alternative Combined Dam and Fish Passage Supplemental Design Report* (HDR 2018; Attachment A.2).

#### *2.3.1.3.1 Fish Passage During Construction*

Downstream fish passage would be provided during construction by the river bypass tunnel, which would include a 20-foot-diameter, 1,630-foot-long, modified horseshoe-shaped, unlit tunnel to carry water past the construction site. An upstream cofferdam would direct upstream water into the bypass tunnel. A much smaller downstream cofferdam would be constructed to protect the construction area for the stilling basin and fish collection channel. The temporary bypass tunnel would accommodate downstream fish passage consistent with National Oceanic and Atmospheric Administration (NOAA) Fisheries and WDFW criteria during FRE facility construction.

Upstream fish passage would be provided during construction by a temporary fish trap-and-transport facility, which would include a fish passage barrier downstream of the tunnel outlet to direct the fish

passing upstream into the fish trap. The temporary trap-and-transport facility is not currently designed to collect juvenile salmonids, native non-salmonid fish, or lamprey. The Applicant states that juvenile salmonids, native non-salmonid fish, and lamprey collected in the temporary trapping facility will be considered incidental to the collection of adult salmonid species target for collection, and that species and life stages that are incidentally captured will be transported upstream of the construction area and released back to the Chehalis River (Martin 2019). The Applicant also states that upstream and downstream passage of juvenile salmonids, resident fish, and lamprey during operation of the temporary passage facility would be discussed with WDFW as the project progresses.

Once in the trap, fish would be transferred to tanks specially designed for their transportation. Personnel would drive the tanks upstream to pre-determined release sites selected by fisheries biologists. The fish would then be released back into the river to continue their migration upstream. See Attachment A.14 for figures showing both downstream and upstream fish passage sequencing during construction.

#### *2.3.1.4 FRE Facility Operations*

During non-flood conditions, the temporary reservoir would be empty and the Chehalis River would flow through the reservoir footprint and through the LLOs at its normal rate. Operations are proposed to begin in 2030.

The stages of FRE facility operation are as follows:

- Threshold for operations
- Operations prior to and during floods
- Initial drawdown after floods
- Debris management
- Drawdown after debris management
- Operations outside of flood storage periods

Additional details on FRE facility operation are included in the *Chehalis Basin Strategy Operations Plan for Flood Retention Facilities* (Anchor QEA 2017; Attachment A.4) in the sections referring to the FRO facility.

**Threshold for Operations**

The FRE facility would retain river flows temporarily, only during floods that are predicted to have a flow rate exceeding 38,800 cfs at the Grand Mound gage (USGS No. 12027500). When the prediction exceeds 38,800 cfs, water retention would begin within 48 hours of the forecasted flood peak. A 48-hour period gives a reasonable amount of time to predict flows with confidence while also providing enough time to reduce flow rates to designated minimum release rates before major flood flows occur.

Grand Mound is approximately 48 miles downstream of the FRE facility site, so the operators of the FRE facility would rely on flooding predictions up to 4 days in advance. The source of the forecast for

major flooding would be the Northwest River Forecast Center, operated by NOAA. The Northwest River Forecast Center uses the National Weather Service Community Hydrologic Prediction System to simulate soil, snow, and stream channel and temporary reservoir conditions. Daily forecasts are made using observations of temperature and precipitation. Forecast of meteorological parameters are included in the river forecast model (NOAA 2016).

**Operations Prior to and During Floods**

Once flood operations are triggered, flow retention would begin by partially closing the temporary reservoir outlet gates. FRE facility outflow would be reduced at a rate of 200 cfs per hour 2 days prior to the predicted start of major flooding. A maximum rate of change in reservoir outflow of 200 cfs per hour was selected for this period to minimize the potential for fish stranding downstream of the temporary reservoir. The 200-cfs-per-hour rate was determined by applying a 2-inch-per-hour decline in river stage downstream of the FRE facility (to reduce the potential for fish stranding) using the HEC-RAS model developed for the Chehalis Basin Strategy (WSE 2014). The flow rate used for that calculation was 1,000 cfs, the median flow for November to March during which most floods occur. That rate of change would be adjustable and could be adaptively managed during operations.

FRE facility outflows would decrease at 200 cfs per hour until reaching 300 cfs, the minimum outflow during flood operations. A 300-cfs flow is a naturally occurring winter low flow on the Chehalis River. The 300-cfs outflow would exist for only a short distance downstream of the FRE facility where tributary streams enter the Chehalis River and increase flows. The 300-cfs outflow would continue until the peak of the flood passes Grand Mound, which would typically take 48 to 72 hours.

**Outflow from the FRE Outlets**

Operation of the FRE facility would change sediment transport and channel forming processes by eliminating large peak flows at the FRE location during major or greater flood events. For example, the estimated peak flow at the FRE facility site during the 2007 flood event was 34,700 cfs and if the FRE had been in place the outlet gates would have been closed. Flows of this magnitude would be reduced to the levels described below for the closed and drawdown periods.

Estimates of the maximum flow through the FRE outlets would vary under different conditions. These are based on the historical record and are estimates for the late-century catastrophic flood scenario.

- When FRE gates are open: Up to 18,520 cfs. The FRE gates would be closed when the water level at the Grand Mound gage is predicted to be 38,800 cfs. However, if the prediction is less than 38,800, the flow through the outlet could be up to 18,520 cfs, based on the historical record.
- When FRE gates are being closed: 300 to 6,000 cfs
- When FRE gates are closed: 300 cfs
- During FRE drawdown periods: 4,320 to 10,600 cfs

**Initial Drawdown After Floods**

In order to evacuate the temporary reservoir, the FRE outlet gates would open and increase outflow by 1,000 cfs per hour to a maximum outflow of 5,000 to 6,500 cfs, causing a drawdown of the reservoir from its peak water surface elevation. Drawdown rates would be limited to 10 feet per day (5 inches per hour) due to risks of landslides, which would limit the duration of the flow increases to about 5 hours. A maximum outflow rate would be reached in that time period and would decrease as the reservoir is drawn down. This is because there is less storage volume per foot of drawdown as the reservoir level drops. The inflow to the reservoir during drawdown could also affect the discharge, because the greater the inflow, the greater the discharge from the reservoir. The maximum duration of reservoir inundation upstream of the FRE facility would be up to 32 days for a catastrophic flood, as described in Table 1-2.

**Debris Management**

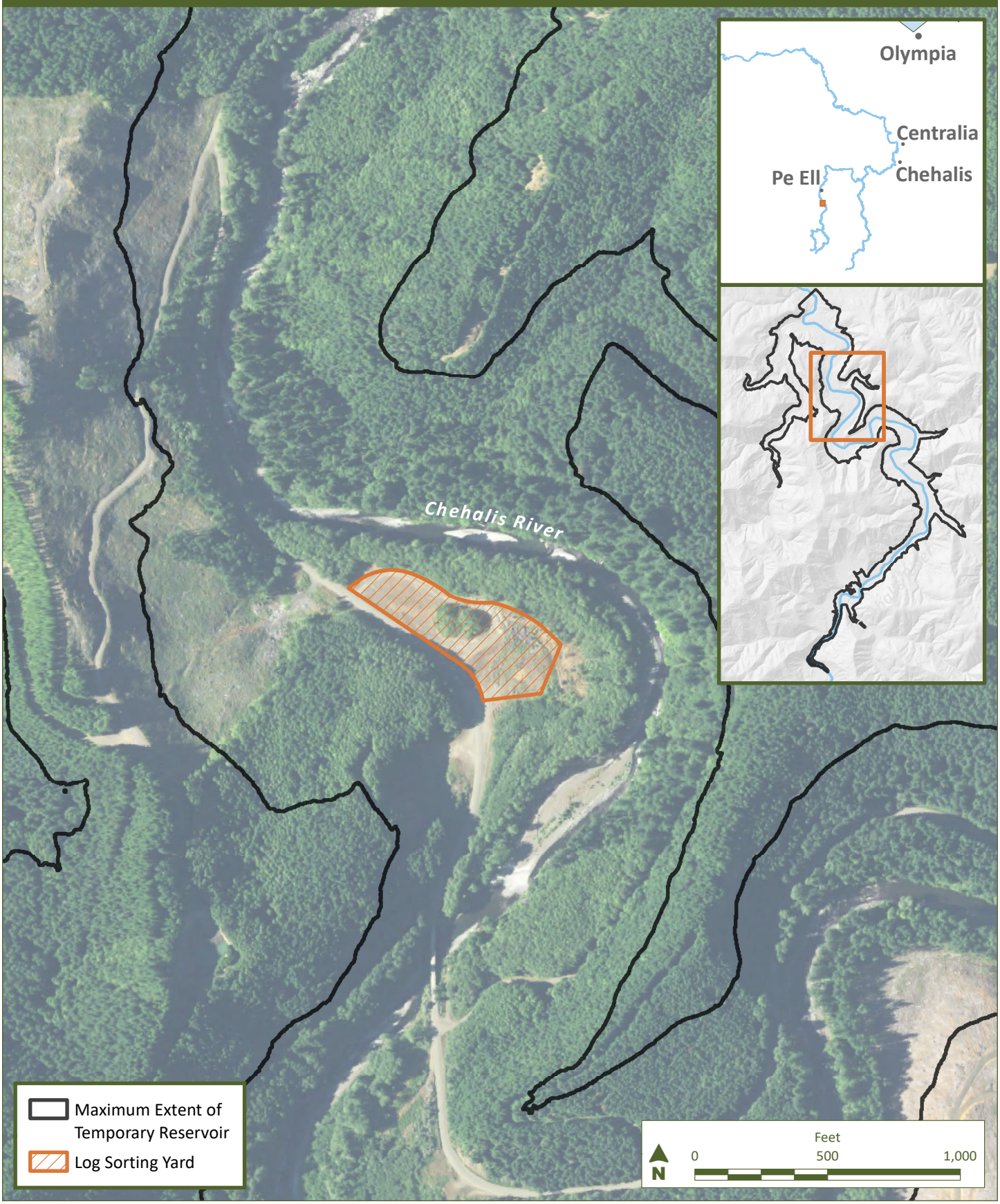
When major floods and reservoir operations occur, debris from surrounding tributaries and hillsides would be transported into the reservoir. A concern is that large woody material (LWM) could affect the operations of the FRE facility by obstructing the LLOs. Debris up to 3 feet in diameter and 15 feet in length could pass through the LLOs, but large accumulations are expected during flood operations.

Upstream of the FRE facility, an anchored log boom would help contain LWM. At the FRE facility, steel bar racks would protect the river opening entrances from LWM that could not pass through the LLOs downstream.

Debris management procedures would use a boat to move large debris entering the reservoir during a flood to an existing log sorting yard previously operated by Weyerhaeuser. The log sorting yard is located on the west bank of the Chehalis River between RM 109.6 and RM 109.9 (Figure 1-8). It was selected because of its relatively flat topography, ground elevation, and proximity to existing roadways. Debris would be transported away from the log sorting yard by truck.

To give boats time to move logs to the sorting yard location, drawdown rates would be slowed to 2 feet per day (1 inch per hour) for a 2-week period. The decrease in drawdown rate would occur when the storage pool elevation reaches approximately 528 feet. At a storage pool elevation of 528 feet, debris could be readily moved to the designated sorting yard. After corralling the debris onto the sorting yard location, drawdown would continue, and the sorting yard would no longer be inundated. Debris would be either cut up and disposed of, or wood suitable for habitat projects in the Chehalis Basin would be sorted and trucked out of the reservoir area. The removal of the wood debris would occur after the reservoir is drained and once the ground dries out enough to allow heavy equipment onto the sorting yard. The operation of the temporary reservoir (length of time water is retained) would be variable and the process to manage debris accumulations would be adaptive to account for the amount of wood accumulated and the ability of operations personnel to move wood to the sorting yard location.

**Figure 1-8**
**Sorting Yard Location**




Source: Anchor QEA 2017

**Drawdown After Debris Management**

Drawdown rates would increase to 10 feet per day (5 inches per hour) when debris management operations have concluded and the storage pool elevation reaches 500 feet. Drawdown rates would continue at this rate until the storage pool is emptied (elevation of 425 feet). At this point, the temporary reservoir would no longer be impounding water and the Chehalis River would return to a free-flowing state.

**Operations Outside of Flood Storage Periods**

FRE facility operations would be triggered by the prediction of 38,800 cfs of water flow at the Grand Mound gage. Outside of the flood storage period, the inflow to the temporary reservoir would be discharged through the FRE facility LLOs, the gates of which are normally open. The LLOs are designed to simulate the natural river channel condition through the structure reach to the extent possible. Water is expected to be near the top (crown) of the tunnel's opening with all LLOs operating at full open gate condition. For flows greater than 8,500 cfs, water ponding would occur at the entrance to the tunnels. The ponding level rises as the flow increases because greater water depth is needed to pass the flow through the tunnels. This is expected to provide small attenuation of the event peak flow.

## 2.3.2 Fish Passage Design Details

Fish passage facilities at the FRE facility would allow fish to pass both upstream and downstream during normal flows and during major or larger floods, as described in the following sections. For more information on construction and permanent fish passage design, refer to the *Draft Technical Memorandum: Simple Description of Fish Passage Operation* (HDR 2019; Attachment A.5) and the *Chehalis Basin Strategy: Fish Passage CHTR Preliminary Design* (Anchor QEA and HDR 2018; Attachment A.1).

### *2.3.2.1 Fish Passage During Normal Flows*

The FRE facility would allow fish to pass upstream and downstream freely in conditions that mimic the existing natural rock canyon at that location. During normal flows, fish would pass through the five unlit LLOs that would remain open during normal conditions and smaller floods. The LLOs would be 310 feet in length and are anticipated to replicate the natural streamflow and velocity exhibited by the natural channel up through river discharges of 4,000 cfs. The LLOs would discharge into a 230-foot-long stilling basin. Most of the year, when no impoundment is occurring, aquatic species passing upstream would be able to move from the river, into the stilling basin, through the LLOs, and back into the river upstream of the FRE facility. Aquatic species passing downstream would follow the same path in the opposite direction.

### *2.3.2.2 Fish Passage During Reservoir Impoundments*

A trap-and-transport facility—collection, handling, transport, and release (CHTR)—would be used to provide upstream fish passage during major or larger floods when the structure's LLOs are closed and a reservoir has formed. The trap-and-transport facility would consist of an attraction water supply to draw fish into the facility, fish ladders, and a lamprey ramp to guide them to the fish traps, trap and holding

facilities, a fish sorting building, fish transport tanks and trucks, and ancillary support structures (Figure 1-9). The CHTR is intended to collect migrating adult salmon and steelhead, juvenile salmon and steelhead, resident fish, and lamprey moving upstream, then safely transport them upstream of the FRE facility.

Operation of the CHTR facility would begin attracting and trapping fish immediately prior to the closure of the radial gates. Operation of the CHTR facility would continue through impoundment of water behind the FRE facility as the reservoir is evacuated, as release from the reservoir is slowed for debris management, and as the last remaining water in the reservoir is released. Fish would be released into the river at pre-selected release sites upstream of the FRE facility determined by fisheries biologists. Downstream fish passage would not be provided during major floods when the LLOs are closed, a period of up to 32 days.

### 2.3.3 Vegetation Management

In addition to removing vegetation for the FRE facility, tree clearing and vegetation removal would occur within the reservoir area before construction and during operations. Vegetation management would include an integrated harvest and replanting program to help minimize temperature impacts on the river.

**Pre-Construction Vegetation Management Plan**

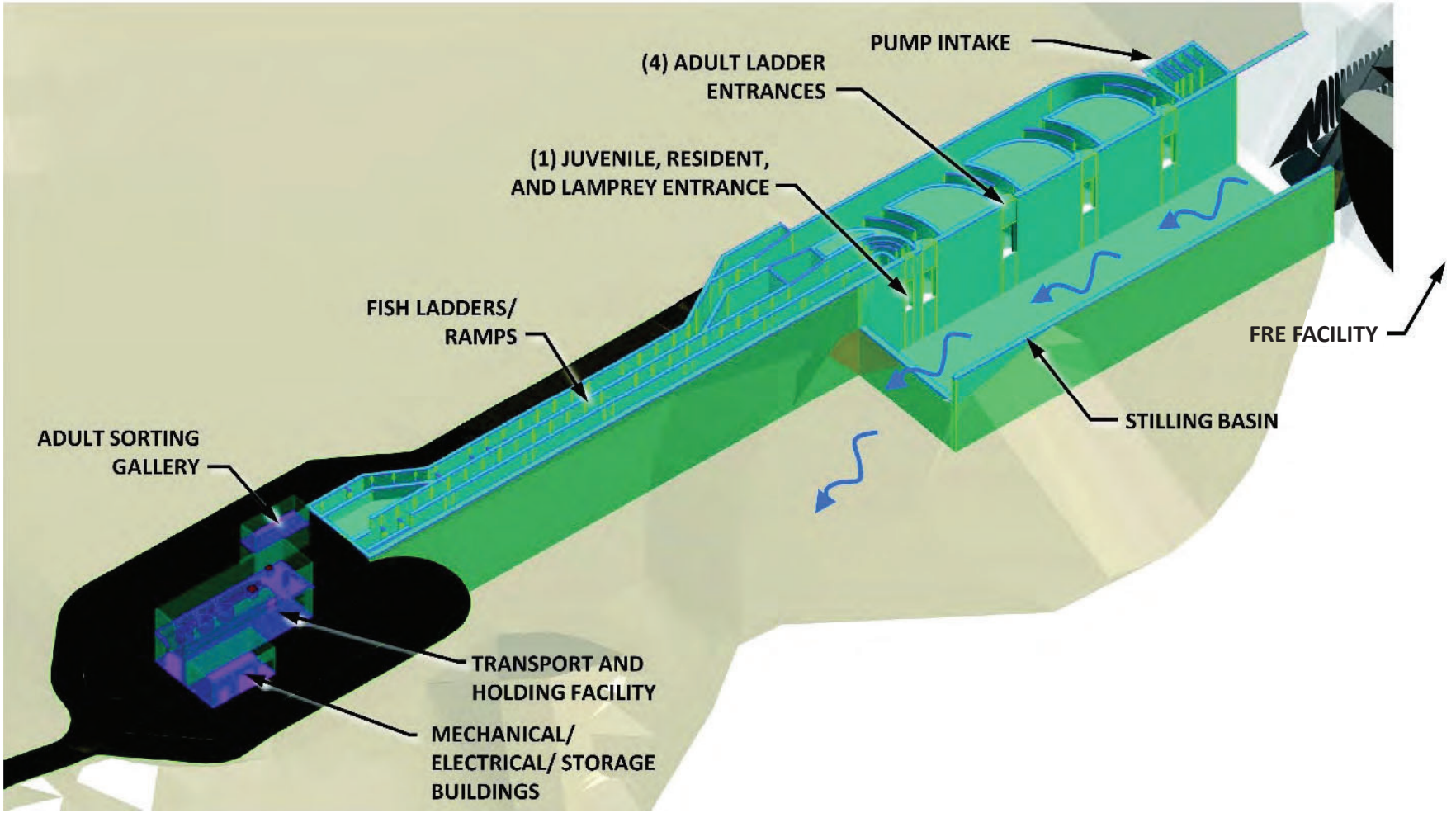
A pre-construction vegetation management plan would be implemented during the construction phase of the FRE facility. Table 1-4 shows the elevation of each inundation zone, the proposed pre-construction management actions that would be implemented in each zone, and the expected vegetation community type and vegetation that would be present in each zone after facility construction and operation. Figure 1-10 shows the expected extent of each vegetation community type.

The inundation zones are as follows:

- 10% chance of being flooded in a year (10-year flood); will be under water for 25 days per year when flooded
- 5% chance of being flooded in a year (20-year flood); will be under water for 4 days per year when flooded
- 1% chance of being flooded in a year (100-year flood); will be under water for 1 day per year when flooded
- Less than 1% chance of being flooded in a year (greater than a 100-year flood)

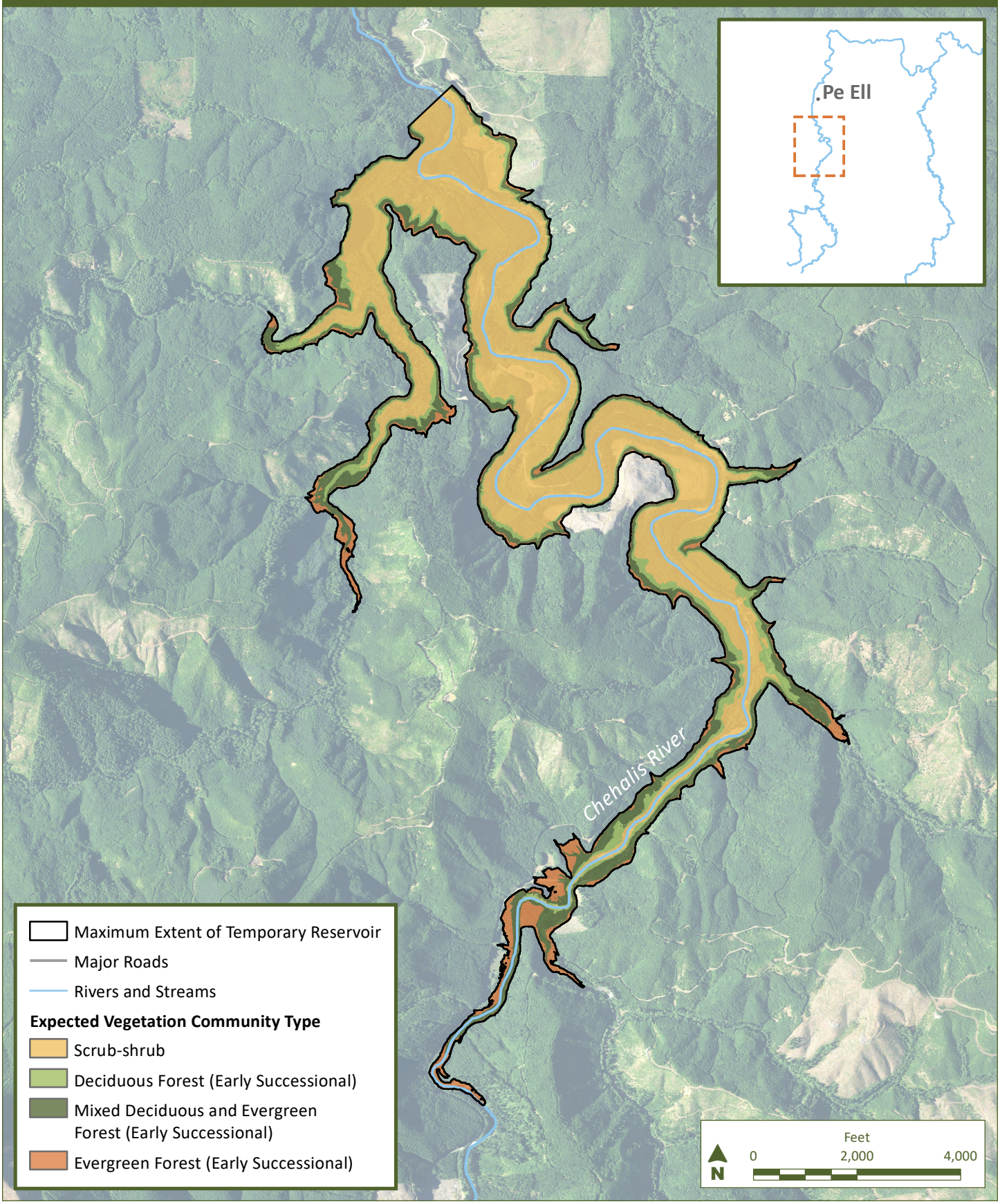
Woody vegetation would be completely cleared from the FRE facility site and from any areas where temporary construction access would be required. All non-flood-tolerant tree species would be removed from the zone where the inundation duration is expected to last 25 days or more when the reservoir is storing water (Table 1-4). Non-flood-tolerant tree species are defined as those that are unable to withstand more than a few days of flooding during the growing season without significant mortality (Whitlow and Harris 1979).

**Figure 1-9**
**Isometric View of the CHTR Fish Passage Facility**




Source: HDR 2018

**Figure 1-10**
**Expected Vegetation Community Type in the Temporary Reservoir**




Source: Anchor QEA 2020b (with updates to Applicant-provided information)

**Table 1-4**

**Expected Vegetation Community Types by Inundation Zone in the Temporary Reservoir**

| INUNDATION ZONE | CHANCE OF BEING FLOODED IN A YEAR | AVERAGE NUMBER OF DAYS UNDER WATER IF FLOODED[1] | ELEVATION RANGE (FEET)[2] | AREA (ACRES)[2] | PRE-CONSTRUCTION MANAGEMENT ACTIONS[3] | PRE-CONSTRUCTION TYPICAL VEGETATION COMMUNITY TYPE AND TYPICAL VEGETATION[1] | EXPECTED POST-CONSTRUCTION VEGETATION COMMUNITY TYPE AND TYPICAL VEGETATION[4] |
|---|---|---|---|---|---|---|---|
| 1 | 10% | 25 days | 424 to 567 | 514 | Selectively harvested to remove non-flood-tolerant species[4] | Evergreen Forest, Deciduous Forest, Developed: Douglas fir, red alder, various grasses | **Scrub-Shrub:** young willows, dogwood, elderberry, salmonberry |
| 2 | 5% | 4 days | 567 to 584 | 86 | No harvest | Evergreen Forest, Mixed Forest, Scrub-Shrub: Douglas fir, red alder, ocean spray, snowberry | **Deciduous Forest (early successional):** young alder, willows, dogwood, elderberry, salmonberry |
| 3 | 1% | 1 day | 584 to 612 | 154 | No harvest | Evergreen Forest, Scrub-Shrub: Douglas fir, ocean spray, snowberry | **Mixed Deciduous and Evergreen Forest**: young Douglas fir, western red cedar, red alder, big leaf maple |
| 4 | Less than 1% | Less than 1 day | 612 to 627 | 93 | No harvest | Evergreen Forest, Scrub-Shrub: Douglas fir, sword fern, salal, ocean spray | **Evergreen Forest:** young Douglas fir, western red cedar |

Notes:

1. Additional information used in EIS analysis.
2. North American Vertical Datum of 1988.
3. These management actions may be either periodically repeated on a regular management cycle (e.g., every 20 years) or as needed.
4. Information shown here varies slightly from Applicant's description to reflect what was used in EIS analysis.

Common Pacific Northwest non-flood-tolerant tree species identified in this document include Douglas fir (*Pseudotsuga menziesii*), big-leaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*), and bitter cherry (*Prunus emarginata*). Douglas fir will not survive flooding that lasts more than a few days.

The pre-construction management actions would be required to meet the Washington Department of Natural Resources' (DNR's) regulations. Proposed management actions would potentially include the removal of commercial timber from existing DNR-defined riparian management zones (RMZs) along sections of the Chehalis River and tributaries in the reservoir footprint. This approach would primarily target all Douglas fir in the RMZ, because this species would not be expected to survive in this inundation zone. For the remaining zones where the inundation duration would range from 1 to 4 days when flooded, no harvesting would occur. Depending on inundation timing and duration, some of the remnant non-flood-tolerant trees may eventually die and go on to provide wildlife habitat as snags or downed woody material. The uppermost inundation zone of the reservoir footprint would be left as a predominantly coniferous forest.

**Vegetation Management During Operation of the FRE Facility**

Existing conifers farther from the river may provide shade while the replacement species are growing and could remain in place. These trees may need to be removed if the facility reaches its maximum use and the longest holding and release period. Routine reservoir limit clearing activities are expected to be confined to the removal of trees larger than approximately 6 inches diameter at breast height and below the catastrophic flood level (i.e., 100-year flood stage, per the Applicant), should they regrow. A periodic clearing activity would occur about every 7 to 10 years, in which trees larger than that diameter would be felled and either left to decay or salvaged for biomass.

Adaptive management activities would focus primarily on controlling temperature effects on aquatic resources, reducing potential woody debris accumulation at the LLOs, and encouraging vegetation that provides slope stability. In addition, the adaptive management program would focus on maintenance of flood-tolerant vegetation that does not produce LWM or experience large-scale die-off in response to extended submergence during the flood season or growing season. Natural species selection would also be monitored over time to determine which native species persist in this changing environment and to encourage the growth of these species.

## 2.4 Airport Levee Changes

### *2.4.1.1 Airport Levee Design*

Changes to the airport levee, including raising the existing airport levee and part of NW Louisiana Avenue, are also proposed (Figure 1-11). The Proposed Action would result in up to 11,211 lineal feet of protective levee and includes the following elements:

- Add 4 to 7 feet to the height of the existing 9,511-foot-long levee with earthen materials or floodwalls

- Raise 810 feet of NW Louisiana Avenue along the southern extent of the airport
- Relocate the northwest corner of the levee to avoid interfering with the runway glide path
- Replace utility infrastructure
- Widen portions of the existing levee base in locations where there are retaining walls and remove the retaining walls

#### *2.4.1.2 Construction*

Construction activities would occur under the following general sequence:

- Mobilization of equipment
- Erosion control, clearing, and grubbing
- Removal of structures or obstructions
- Material placement and compaction
- Trimming, cleanup, and sod placement

Construction equipment would include the following, which would be refined as the project progresses into the permitting phase:

- Bulldozers, track excavators, front-end loaders, off-road fixed-wheel and articulated haul trucks, integrated tool carriers, and rollers in a range of equipment sizes (trending toward to mid- to large sizes)
- Support equipment, including the following:
  - Trucks (various dump trucks, water, mechanic, fuel and lube, and flatbeds)
  - Storage (vans, CONEX boxes, and temporary buildings)
  - Other (generators, compressors, pumps, and office trailers)

Excavation and earthwork operations would include removal of existing temporary retaining walls, removal of the crushed top course that is currently on top of the levee, and any excavation needed to place hydraulic structures such as culverts. No new quarries or borrow pits would be developed. Only existing sources would be evaluated for acceptable fill material, which would be brought in from off site. Typically, soil would only be displaced in areas where benching may occur or in areas of culvert placement.

Haul routes (Figure 1-12) would include Airport Road, and the top of the levee would be used for site access. Louisiana Avenue, to the south, is the preferred off-site route to avoid the congested traffic area east of the airport.

**Figure 1-11**
**Airport Levee Changes**

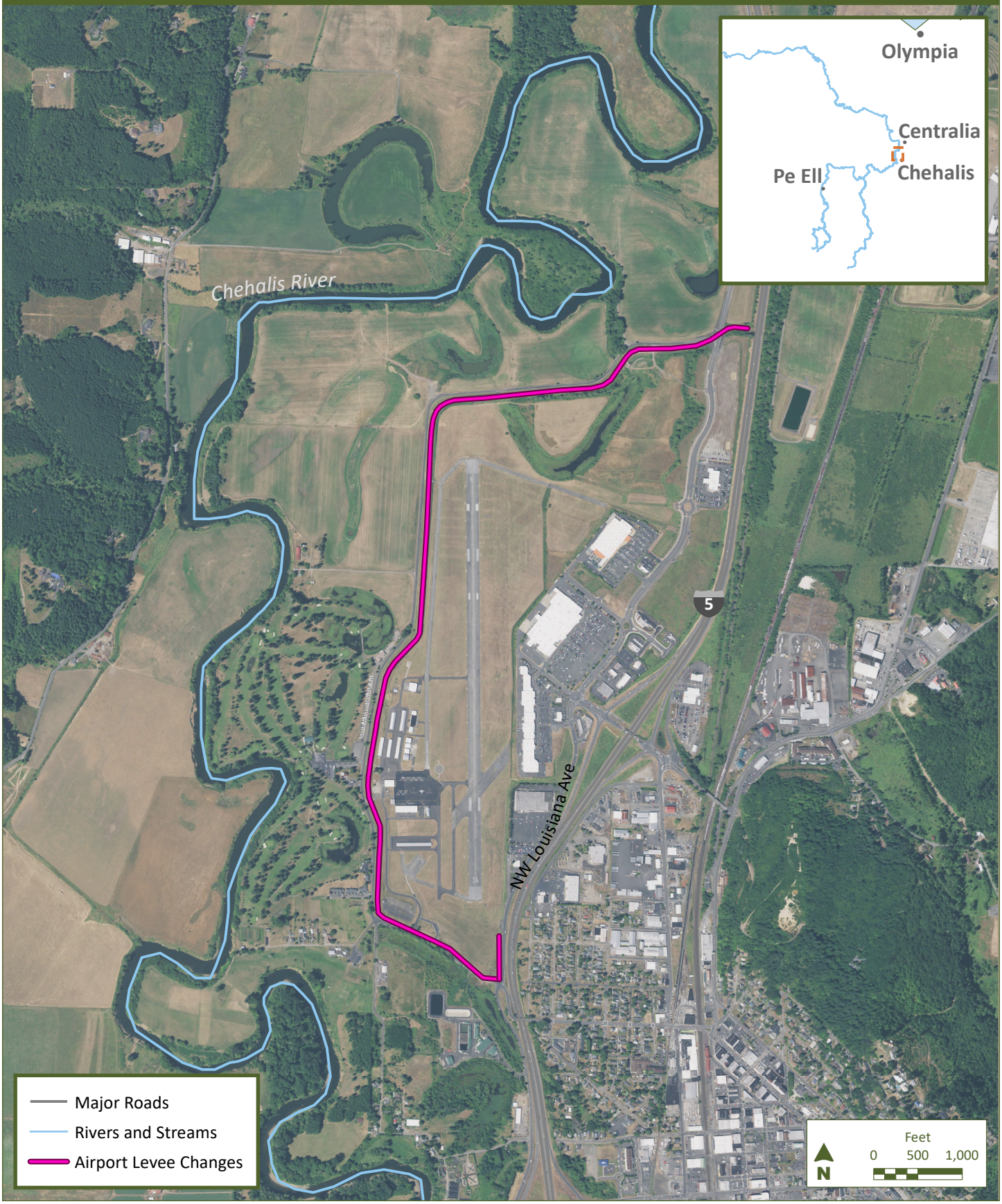
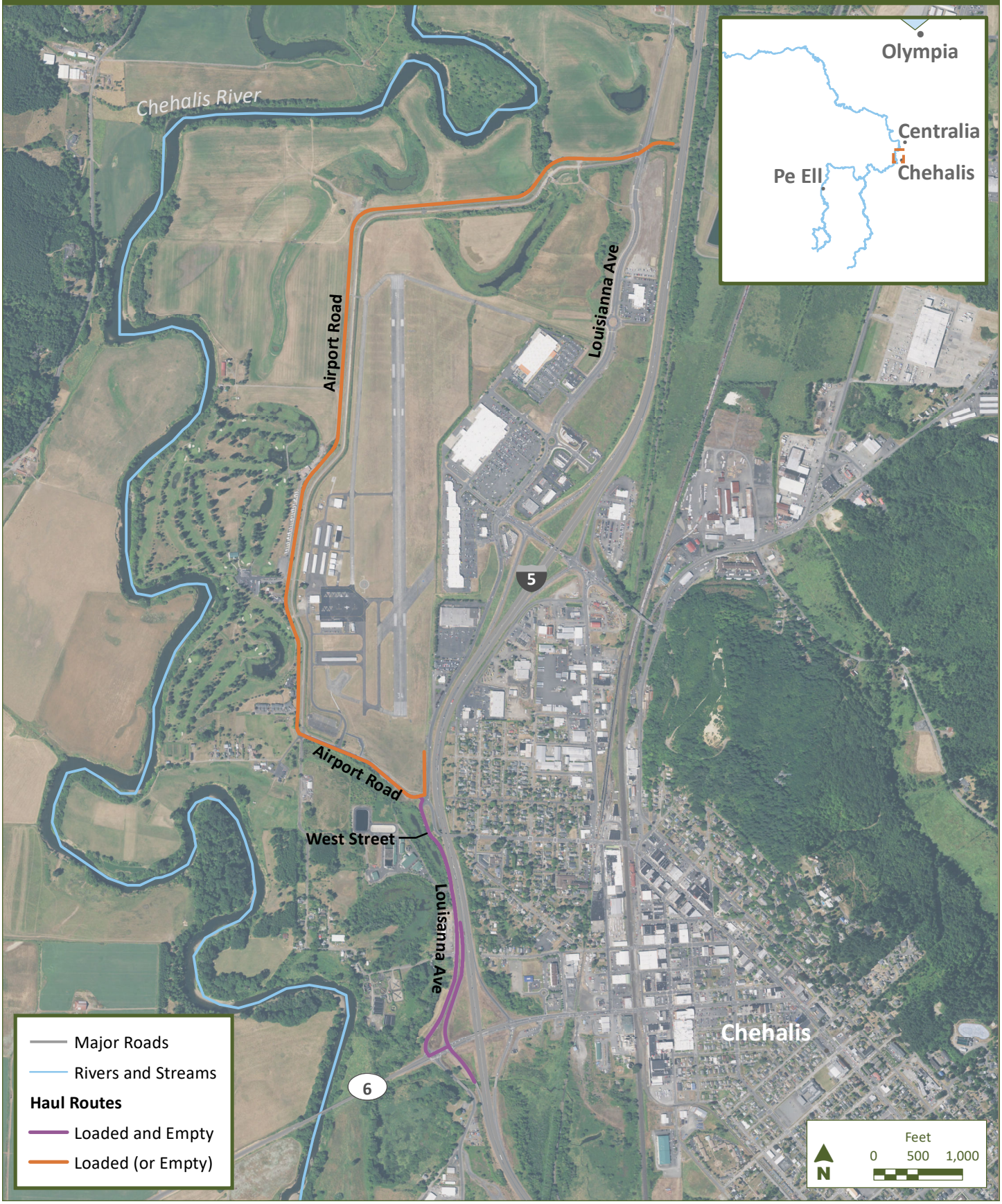


**Figure 1-12**
**Haul Routes Associated with Airport Levee Changes**




Note: Adapted from Lewis County Department of Public Works, Rebid Airport Levee Improvement Project Haul Route

# 3 DEVELOPMENT OF EIS ALTERNATIVES

This section provides information on the process used to identify alternatives under SEPA for inclusion in the EIS to be evaluated and compared against the Proposed Action. Section 4 describes the alternatives analyzed in this EIS. Section 5 identifies the alternatives considered but eliminated from further analysis.

## 3.1 Identification of Potential EIS Alternatives

### 3.1.1 SEPA Requirements for Alternatives Analysis

The SEPA regulations in WAC 197-11-440 state the EIS should identify "reasonable alternatives" to include "actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation." The regulations require a "no-action" alternative be evaluated in the EIS. WAC 197-11-600 states environmental documents that have been previously prepared may be used to evaluate alternatives.

### 3.1.2 Review of Past Studies

To support the identification of alternatives for inclusion in the EIS, Ecology reviewed multiple environmental documents and technical studies prepared over the past several decades that relate to water resources and flood damage reduction in the Chehalis Basin. Several of these studies include analysis of flood retention facility locations in the Chehalis Basin completed by the U.S. Army Corps of Engineers (Corps) and Lewis County (Corps 1982a; Tetra Tech 2003; PIE 1998a). Because of the geology and because Willapa Hills receives the most precipitation in the area, the location upstream of Pe Ell has been examined multiple times. In 2012, the *Chehalis Basin Flood Hazard Mitigation Alternatives Report* evaluated priority flood hazard mitigation projects in the Chehalis Basin (Ruckleshaus Center 2012). This report concluded that a flood retention facility on the mainstem Chehalis River upstream of Pe Ell would result in the greatest reduction in flood damage Basin-wide, as compared to other considered locations.

Many flood mitigation approaches in the Chehalis Basin have been suggested and studied over the past several years. Infrastructure bypass options, levees, floodwalls, flood retention facilities, local actions, and restoration actions have all been assessed for effectiveness in controlling, mitigating, and recovering from floods. Structural and nonstructural large-scale and local-scale projects have been examined as potential actions in the following reports:

- *Interim Feasibility Report and Environmental Impact Statement, Centralia, Washington, Flood Damage Reduction* (Corps 1982b)
- *Chehalis River Basin Flood Control Project Pre-Feasibility Analysis of Alternatives* (PIE 1998b)
- *Centralia Flood Damage Reduction Project, Chehalis River, Washington, General Reevaluation Study* (Corps 2003)
- *Chehalis Basin Partnership Multi-Purpose Water Storage Assessment* (Tetra Tech 2003)

- *Chehalis River Flood Water Retention Project Phase IIB Feasibility Study* (EES Consulting, Inc. 2011)
- *Chehalis Basin Flood Hazard Mitigation Alternatives Report* (Ruckelshaus Center 2012)
- *Centralia Flood Risk Management Project* (Corps 2012)
- *I-5 Protection from 13th Street to Mellen Street near Centralia and Chehalis* (WSDOT 2012)
- *Chehalis River Basin I-5 Flood Protection Near Centralia and Chehalis* (WSDOT 2014)
- *Chehalis Basin Strategy Programmatic Environmental Impact Statement* (Ecology 2017)
- *A Review of Past and Current Strategies to Reduce Flood Damage in the Chehalis Basin* (American Rivers 2018)
- *Chehalis River Basin Flood Damage Reduction Project: Project Description* (Chehalis River Basin Flood Control Zone District 2018)

As described in Section 1, the SEPA Programmatic EIS for the Chehalis Basin Strategy was published on June 2, 2017 (Ecology 2017). The Programmatic EIS evaluated broad program-level actions related to implementing an integrated strategy for reducing damages from catastrophic floods and restoring degraded aquatic species habitat in the Chehalis Basin. After review of the Programmatic EIS, the Governor's Work Group recommended a project-level EIS be conducted to identify the potential impacts of a flood retention facility (Chehalis Basin Board 2018).

The Programmatic EIS, along with technical studies and community planning documents described previously, have been considered to help inform the development of alternatives for the proposed Chehalis River Basin Flood Damage Reduction Project EIS.

### 3.1.3 Review of Scoping Comments

Ecology's scoping process began with the issuance and publication of a Determination of Significance and Request for Comments on the Scope of the Chehalis River Basin Flood Damage Reduction Project EIS. See Appendix 3 of the EIS for the full *Scoping Summary Report*.

Comments were received for consideration of less structural options to achieve flood damage reduction. Nonstructural ideas proposed by commenters included methods to restore floodplain functions, removing constrictions in the floodplain, restoring wetlands, reforestation, purchasing floodplain properties, purchasing farmlands next to rivers to restore floodplains, and looking at opportunities to remove shoreline armoring in areas to restore floodplain functions. Nonstructural land use management actions in scoping comments included considering voluntary incentives or buy-outs to relocate residences out of the floodplain, changing zoning requirements, limiting land uses in floodplains to agricultural and recreational uses, limiting new development in the floodplain, managing forestry lands, and encouraging preservation of old growth forestland.

Comments were also received about alternatives for different structural approaches to be considered in the EIS, including infrastructure-related activities such as re-routing or raising I-5, U.S. Highway (US) 6,

and US 12, constructing a higher dam with a permanent reservoir, and dredging the Chehalis riverbed. Dams in other locations on tributaries were also proposed by commenters.

## 3.2 Selection of EIS Alternatives

Ecology considered previous proposals and studies, scoping comments, and the Programmatic EIS to determine the alternatives to be studied in the EIS. Alternatives that did not meet the definition of a reasonable alternative were eliminated from further consideration and are identified in Section 5. These include alternatives that did not approximate the project's purpose or objective, as described in Section 2.1, or were not likely to have a lower environmental cost.

Ecology identified two alternatives to be evaluated in this EIS, the No Action Alternative and the Local Actions Alternative. The Local Actions Alternative includes a variety of local-scale actions that approximate the Applicant's objective through improving floodplain function, land use actions, buying out at-risk properties or structures, improving flood emergency response actions, and increasing water storage from Pe Ell to Centralia. The EIS also evaluates a No Action Alternative, as required under WAC 197-11-440 (5)(b)(ii). These alternatives are described in more detail in Section 4.

# 4 ALTERNATIVES

This section provides details on the two alternatives that are evaluated against the Proposed Action in the EIS, the Local Actions Alternative and the No Action Alternative.

## 4.1 Local Actions Alternative

The Local Actions Alternative represents a local and nonstructural approach to reduce flood damage in the Chehalis-Centralia area. The Local Actions Alternative considers a variety of local-scale options that local governments and agencies could choose to implement in the future. These actions could approximate the Applicant's objective to reduce flooding from storms in the Willapa Hills through improving floodplain function, land use management actions, buying out at-risk properties or structures, improving flood emergency response actions, and increasing water storage from Pe Ell to Centralia. Elements could include the following components, where the Applicant would support (through local regulatory powers, funding, or technical assistance) local efforts for flood damage reduction.

The following elements are described in further detail in the following subsections:

- Land use management
- Floodproofing
- Buy-out or relocation of at-risk properties or structures
- Floodplain storage improvement including:
  - Riparian restoration
  - Afforestation
  - Floodplain reconnection
  - Water flow abatement
- Channel migration protection
- Early flood warning systems

Local action elements that were considered but not further evaluated are explained in Section 4.1.7:

- Groundwater infiltration improvement
- Road and bridge constriction removal

Ecology considered actions that could be implemented by the Applicant either alone or with other agencies, private entities, or jurisdictions in the Chehalis Basin for this alternative. In addition to powers and immunities under the provisions of RCW 86.12 (Flood Control by Counties), the Applicant has general powers under the provisions of flood control zone districts under RCW 86.15.080, including the authority to cooperate or join with government agencies or private entities within Lewis County to exercise these powers. Powers also include the ability to take actions necessary to protect life and property within the district from floodwater damage; to control, conserve, and remove floodwaters and

stormwaters; to acquire property, property rights, facilities, and equipment; and acquire or reclaim lands. Implementation of actions by the Applicant could also include providing funding or technical assistance for flood damage reduction actions.

### 4.1.1 Land Use Management

This element involves land use management efforts by local governments, primarily in Lewis County, but may also involve local governments in Grays Harbor and Thurston counties. Existing land use management plans and actions and improved land use management would be implemented, which could protect floodplain functions and reduce or prevent flood damage by minimizing floodplain development. This could include providing technical support and assistance to local jurisdictions and landowners, using additional flood data in floodplain regulations, and implementing new flood protection development and construction standards.

Multiple projects to reduce flood damage have been completed, are in progress, or are planned by the Chehalis River Basin Flood Authority and to implement the Chehalis Basin Strategy. Completed projects are considered existing conditions, and those that are permitted, funded, or in progress are included in the No Action Alternative (Tables 1-6 and 1-7). The Local Actions Alternative does not include specific Chehalis Basin Strategy flood damage reduction projects but rather considers local government regulatory and planning actions for land use management.

#### *4.1.1.1 Technical Support and Assistance*

This element of land use management includes providing support and assistance to local land use management efforts that reduce flood damage in coordination with local governments and landowners, and could include the following:

- Funding for raising new or redeveloped structures or technical support in preparing designs using flood damage reduction strategies (e.g., raised or elevated structures and construction standards) based on existing local regulatory and planning documents
- Technical design support to local governments on local efforts to adopt model floodplain management ordinance language and include regulatory standards that exceed the State and National Flood Insurance Programs' minimum requirements
- Technical assistance to local governments in identifying the increased cost of future development in the floodplain due to local land use management requirements, including filling restrictions and freeboard elevation requirements
- Technical assistance to local governments in identifying long-range planning and comprehensive planning elements to minimize development in floodprone locations, including:
  - **Open Space Preservation:** Goals and policies that seek to minimize construction of new buildings, filling, and destruction of natural floodplain functions
    - For example, publicly owned areas that are currently open space in the floodplain could be required to remain open space (i.e., no buildings, filling, storage).

  - **Low-Density Zoning:** Goals and policies that seek to maintain existing zoning districts that require minimum lot sizes of more than 10 acres (e.g., not allowing amendments to existing zoning districts in the floodplain to allow for more dense development)
- Technical assistance in developing tailored floodplain management standards for local government jurisdictions to implement newly adopted standards

#### *4.1.1.2 Additional Flood Data*

This element of land use management proposes the use of additional regulatory flood data in floodplain regulations beyond what is provided on a community's Flood Insurance Rate Map (FIRM). This would provide additional protection from flood damage for new buildings within the floodplain.

- **Flood-of-Record Data:** Communities would adopt flood-of-record data to determine the extent of the regulatory floodplain and the regulatory flood elevation where there is no Base Flood Elevation (BFE) shown on the FIRM, or where the flood of record is higher than the BFE.
  - Table 1-5 contains the status of regulatory updates for counties, cities, and towns in the Chehalis Basin. The City of Chehalis is the only jurisdiction within Lewis County that has adopted and recognized the flood-of-record data.
- **Best Available or No Flood Data**: Under National Flood Insurance Program rules, if there are no BFEs on a FIRM (for example in Approximate A zones), new buildings do not have to be elevated above the flood level. This provision would support changed regulations that require permit applicants in Approximate A zones to conduct an on-site flood study or utilize an existing, current study to calculate the BFE. This would **not** be required under the following scenarios, consistent with the Federal Emergency Management Agency's (FEMA's) Community Rating System, which provides higher standards than the minimum requirements under the National Flood Insurance Program:
  - In Approximate A zones where flood-of-record elevations are used for regulations
  - Permit applicants for single-family residences on existing lots would have the option of elevating the house 5 feet or more above grade without needing a study

#### *4.1.1.3 Additional Flood Protection Development and Construction Standards*

This element of land use management includes implementing additional flood protection standards to minimize development in floodprone locations and protect natural floodplain functions. It also includes construction standards that set more effective protection levels for buildings constructed or substantially improved in the floodplain, as follows:

- **Subdivision Set-Asides:** This standard would require new subdivisions and other large developments to set aside all or part of their floodprone area as open space to avoid future flood damage.
- **Filling Restrictions:** Under this standard, filling in the floodplain would either be prohibited, or compensatory storage would be required to avoid raising flood levels within the floodplain.

- **Freeboard:** This standard requires the freeboard height of new buildings to be 3 feet above BFE to reduce the potential flood damage. This would also apply to substantial improvements of existing buildings. Freeboard refers to the height above a given water level on which the lowest floor of a structure is built. In this case, the water level is the BFE or flood of record, as defined by regulations.
- **Critical Facilities:** There are two types of critical facilities—those that are vital to flood response activities or to the health and safety of the public (e.g., hospitals, fire stations), and those that, if flooded, would exacerbate the effects of flooding (e.g., hazardous material facilities). This standard requires a higher level of protection for critical facilities than normal properties, including two options: 1) prohibit new critical facilities from the regulatory floodplain; or 2) protect them from damage and loss of access during a 500-year flood or the BFE plus 3 feet, whichever is higher. This would reduce the potential for flood damage to affect critical facility operations.
- **Non-Conversion Agreements:** This standard would require a permit applicant seeking to elevate or improve a building on floodwalls to sign an agreement that areas below the BFE or flood protection elevation would not be converted to a use (such as a residential living space) or be constructed with materials (e.g., insulation, carpeting, plumbing) that are subject to water damage. The agreement would be required to be recorded on the property deed or title with the county auditor's office to advise future buyers of the restriction, with the intent of protecting contents of structures from flood damage.

Table 1-5 provides a summary on the current status of regulatory standards for jurisdictions within the region of the project area discussed under the land use management actions.

**Table 1-5**
**Status of Improved Regulatory Standards**

| STANDARD | LEWIS COUNTY | CENTRALIA | CHEHALIS | NAPAVINE | PE ELL | THURSTON COUNTY | BUCODA | GRAYS HARBOR COUNTY | ABERDEEN | COSMOPOLIS | ELMA | HOQUIAM | MONTESANO | OAKVILLE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Flood of record | - | - | A | - | - | A | - | - | A | A | A | A | A | A |
| Best available or no available data | - | NR | NR | NR | NR | - | A | - | A | A | A | A | A | A |
| Subdivision set-asides | A | P | P | - | - | P | | - | A | A | A | A | A | A |
| Filling restrictions | - | P | P | - | - | A | A | - | A | A | A | A | A | A |
| Freeboard (3 feet) | P | P | P | P | P | P | P | P | P | A | - | A | A | A |
| Critical facilities[1] | P | P | P | A | P | A | P | - | A | A | A | A | A | A |
| Non-conversion agreements | - | - | - | - | - | - | - | - | A | A | A | A | A | A |

Source: French & Associates 2017, updated by Anchor QEA, LLC, in February 2019 based on a review of regulations of Lewis County jurisdictions

Notes:
1. The *Chehalis River Basin Comprehensive Flood Hazard Management Plan* (Chehalis River Basin Flood Authority 2010) is in the process of being updated and is expected to address critical facilities.

- : Not yet adopted
A: Adopted
NR: Not relevant; the best available data or no available data are only applicable to jurisdictions where the FIRM does not provide a BFE.
P: Partial adoption

### 4.1.2 Floodproofing

This element would reduce the repetitive damage to structures in the floodplain through a strategic program of floodproofing. It would also reduce or eliminate flood damage to real estate or improved real property by elevating structures and building berms or floodwalls around structures. Floodproofing also includes installing flood vents in houses that were elevated prior to the requirement for vents to further reduce the risk of flood damage.

The Programmatic EIS (Ecology 2017) found that within Lewis, Thurston, and Grays Harbor counties, approximately 75% of the residential homes in the Chehalis River floodplain could feasibly be elevated or floodproofed. For other buildings (commercial, industrial, government, schools), it was assumed that approximately 25% of the buildings in the 100-year floodplain of the Chehalis River could feasibly be raised, retrofitted, or floodproofed by constructing flood barriers or walls. For properties that are not

conducive to walls, berms, levees, or similar structural measures due to lack of space or business function, floodproofing is considered infeasible.

Floodproofing also includes constructing farm pads and creating livestock evacuation routes to protect livestock and farm investments during floods. Farm pads are constructed of fill and provide an area elevated above flood levels to hold livestock and critical farm equipment during a flood. However, the projects identified as part of the Chehalis Basin Strategy have largely been completed, and there is limited area in the Chehalis Basin for additional farm pad and livestock evacuation route projects.

### 4.1.3 Buy-Out of At-Risk Properties or Structures

This element would reduce the repetitive damage to floodprone structures or properties in the floodplain through buy-outs or relocations from willing landowners of at-risk properties or structures. Acquired properties would be cleared and remain as open space with potential reuse for public purposes. This could include the following:

- Assistance to local governments in identifying funding for buy-outs or relocations of at-risk properties or structures
- Technical assistance to local governments to identify at-risk structures that cannot be floodproofed through other means and alternate beneficial use of property (e.g., open space)

### 4.1.4 Floodplain Storage Improvement

This element includes riparian restoration, afforestation, floodplain reconnection, and water flow abatement activities to improve floodplain function and storage and reduce peak flows. Actions include placing wood in rivers and streams to increase roughness and water levels, causing floodwaters to more fully occupy floodplain areas, and restoring riparian areas and revegetating or reforesting floodplain areas to support improved floodplain function and increase floodplain storage.

The *Chehalis Basin Strategy Restorative Flood Protection Advanced Feasibility Evaluation for the North and South Forks of the Newaukum River, Washington* evaluated an approach to decrease peak flood flows in downstream areas by re-engaging the natural flood cycles in upland areas. The study's hydraulic modeling showed restorative flood protection activities would result in less than 10% decreases in peak flows for major floods and that it was not effective in reducing the peak flows of catastrophic floods downstream (Abbe et al. 2019). The approach may have benefits in low gradient valleys in the Chehalis Basin; however, the upper Chehalis River banks in the Willapa Hills are too steep for this approach to reduce peak flood flows. The Chehalis Basin Board discontinued further evaluation of the restorative flood protection approach (Doyle 2018).

### 4.1.5 Channel Migration Protection

This element identifies measures to reduce flood damage to properties at locations susceptible to river channel migration. Channel migration takes place during high-flow events in specific areas of the river

where river banks are naturally erodible. There are a variety of measures that could help to minimize migration hazards to structures in the migration zone while protecting aquatic and riparian habitat values, such as placement of large wood in locations where channel migration risks are identified. This element would include identifying channel migration and hazard mapping needs to help delineate areas susceptible to channel migration. Additionally, this element includes potential regulatory and incentive-based approaches to reducing flood damage to properties in channel migration areas.

### 4.1.6 Early Flood Warning Systems

This element would implement additional flood warning systems to protect people and livestock and reduce flood damage. The existing Chehalis Basin Flood Warning System relies on rainfall and stream gage data to provide real-time river levels and flood alerts to the Chehalis Basin community. Early warning systems could be improved by a more robust and interactive flood prediction and flood warning system that would allow high-value, moveable items and commodities (e.g., vehicles, machinery, animals) to be relocated prior to flooding. Additionally, a program could be developed to identify the most critical stream gages subject to operation funding and identify funding to secure continued maintenance and operation of the gages.

### 4.1.7 Local Actions Considered but Not Further Evaluated

The following elements were considered as potential local action elements but are not further evaluated under the Local Actions Alternative for the reasons identified here.

#### *4.1.7.1 Groundwater Infiltration Improvement*

This element was considered to enhance the infiltration of groundwater by implementing actions such as revegetation, surface rill creation, or temporary storage to hold water longer and increase groundwater infiltration to reduce peak flows. The Chehalis Basin contains soils that are classified as hydrologic soil group C on hillsides and hydrologic soil group B in floodplains and terraces (Gendaszek and Welch 2018). The maximum recharge rate of the soils is low (i.e., 0.6 inches per day for hydrologic soil group B and 0.24 inches per day for hydrologic soil group C). During a rainstorm, precipitation rates far exceed the infiltration rates of these soils. For example, in Pe Ell, the 100-year, 24-hour rainfall amount is approximately 5 inches while in Chehalis it is approximately 4 inches (MGS Engineering 2006). As a result, there are likely limited locations in the Chehalis Basin where groundwater infiltration improvement measures would reduce flood damage by reducing peak flows.

#### *4.1.7.2 Road and Bridge Constriction Removal*

This element was considered to support improved floodplain function and decreased flood damage by removing road and bridge constrictions from the river and floodplain. Road and bridge constrictions throughout the Chehalis Basin can constrain the flow of the Chehalis River and its tributaries during floods. Major floods have resulted in bridges overtopping and the inundation of access roads. Flood damage has occurred in areas such as upstream of SR 6, Mellen Street, and Galvin Road in Lewis County.

The *Chehalis Basin Flood Hazard Mitigation Alternatives Report* (Ruckelshaus Center 2012) included hydraulic modeling of constriction removals and found that benefits of bridge removal are limited and typically only seen for a short reach upstream of the bridge (replacement structures were not included in modeling). Floodwater bypass routes near Mellen Street and SR 6 were evaluated, but it was found they provided little flood reduction benefit and removing constrictions and passing more floodwater downstream could exacerbate downstream flood problems (see Appendix A of Ruckelshaus Center 2012). The Wakefield Road project near Porter Creek Road in Grays Harbor County was evaluated in 2014; however, the project was discontinued due to preliminary findings that it would not result in any significant flood damage reduction benefit (Karpack and Sabatine 2014).

## 4.2 No Action Alternative

SEPA regulations require a "no-action" alternative be compared with other alternatives (WAC 197-11-440 [5][b][ii]). The No Action Alternative is intended to represent the most likely future conditions if the Proposed Action were not constructed.

Basin-wide large- and small-scale efforts would continue as part of the Chehalis Basin Strategy work, and local flood damage reduction efforts would continue based on local planning and regulatory actions. Implementation of existing state and local floodplain regulations, existing land use regulations, planned updates to Comprehensive Plans, and planned or ongoing updates to Shoreline Master Programs are considered part of the No Action Alternative. Expected changes from local authorities in land use and development, based on these planning documents and census projections, are also included in the No Action Alternative.

The No Action Alternative would include projects and programs that have been planned and designed to reduce flood damage and are underway as well as flood damage reduction programs and projects that were being constructed or were funded and permitted as of June 2019. These projects include local floodproofing efforts and habitat restoration, as described in this section.

### 4.2.1 Chehalis River Basin Flood Authority Projects

The Chehalis River Basin Flood Authority maintains a list of projects proposed for implementation that could continue under the No Action Alternative—depending on the level of funding available—including projects to protect wastewater treatment plants, roads, and infrastructure, and to restore floodplains and certify existing levees through dike and levee improvements. Table 1-6 summarizes the Chehalis River Basin Flood Authority's projects within the study area that are in progress and proposed.

**Table 1-6**
**Chehalis River Basin Flood Authority Project List**

| PROJECT | SPONSOR | STATUS | START/END |
|---|---|---|---|
| **PERMITTED, FUNDED, OR IN PROGRESS** | | | |
| Frase Creek Fish Barrier Removal | Lewis County Public Works | In progress | January 2018 to January 2020 |
| Chehalis River Basin Comprehensive Flood Hazard Management Plan | Applicant | In progress | March 2018 to June 2021 |
| Independence Road Flood Study | Thurston County | In progress | March 2018 to June 2019 |
| China Creek Flood and Habitat Mitigation (Phase 2) | City of Centralia | In progress | November 2011 to June 2021 |
| Flood Warning System (Capital Improvements 2012-2019) | Lewis County | In progress | February 2016 to June 2019 |
| Flood Storage and Habitat Enhancement Master Plan (Phase I) | City of Chehalis | In progress | November 2016 to June 2021 |
| Multi-Jurisdictional Flood Warning and Response Plans | Lewis County | In progress | July 2019 to June 2021 |
| Berwick Creek Flood Reduction, Restoration | Port of Chehalis | In progress | July 2019 to June 2021 |
| **PROPOSED** | | | |
| Weather and Stream Flood Hazard Monitoring Telemetry | Thurston County | Proposed | July 2019 to June 2021 |
| Flood Storage and Habitat Enhancement Master Plan (Phase II) | City of Chehalis | Proposed | November 2016 to June 2021 |

Source: Chehalis River Basin Flood Authority 2019b

The Chehalis River Basin Flood Authority's local projects map, which documents complete or in-progress farm pad projects from 2012 to 2021, includes information on 29 farm pad projects in the Chehalis Basin that have been completed (Chehalis River Basin Flood Authority 2019b).

### 4.2.2 Land Use and Development

Land use and development includes baseline and development changes by local governments in study areas based on census projections and land use planning documents.

### 4.2.3 Floodproofing

Floodproofing includes existing floodproofing efforts that are programmed or funded for completion to protect existing structures in the Chehalis River floodplain.

### 4.2.4 Community Flood Assistance and Resilience Program

As part of the Chehalis Basin Strategy, the Community Flood Assistance and Resilience (CFAR) program will provide technical and financial assistance to local communities and landowners to protect lives and property from river flooding and channel migration. CFAR goals include reducing direct economic

damages to property, including buildings and their contents, and associated indirect adverse impacts on people, businesses, and communities in the Basin as well as encouraging compatible human uses, economic activities, and improved habitat conditions in floodprone and channel migration areas. The work is expected to include looking at additional floodproofing options and how to assist homeowners whose homes may be at risk.

### 4.2.5 Timber Harvest in Managed Forests

Timber harvest would be expected to continue in the managed forest areas in the Chehalis Basin under current forest practice regulations and typical harvest cycles.

### 4.2.6 Stream and Floodplain Habitat Restoration

Stream and floodplain restoration projects include baseline and forecasted conditions within stream channels, riparian areas, and floodplains. The following restoration actions considered are those currently underway or funded:

- Aquatic Species Restoration Plan projects within the Chehalis Basin, including:
  - Five early action reach-scale projects in the Newaukum, Stillman, Skookumchuck, Satsop, and Wynoochee subbasins
  - Fish barrier removals on Wildcat Creek, Berwick Creek, and tributaries to the Black River, Humptulips River, Newskah Creek, and the Chehalis River
  - Installation of large wood in managed forest stream reaches in multiple locations in the Basin
- U.S. Fish and Wildlife Service's Chehalis Fisheries Restoration Program, including:
  - Projects involving habitat restoration, environmental assessment, education, and outreach
  - Projects correcting fish passage barriers, removing invasive species and replanting native species, enhancing or restoring riparian and off-channel fish rearing habitat, restoring agricultural wetlands for fish use, and monitoring fish use of these habitats
- Washington State Recreation and Conservation Office's Salmon Recovery Funding Board projects, including several of the Aquatic Species Restoration Plan and Flood Authority Projects noted above, are in progress, including:
  - Installation of fish screens (15) on irrigation diversions throughout the Basin
  - Fish barrier removals (seven) on Geissler Creek and Bush Creek in Grays Harbor County and Prairie Creek and Lower Reach Berwick Creek in Lewis County
  - Land acquisitions to protect stream habitats
  - Hogue Berwick Creek Design project for Lewis Conservation District

# 5 ALTERNATIVES CONSIDERED BUT ELIMINATED

SEPA regulations (WAC 187-11) require that EISs analyze reasonable alternatives. Reasonable alternatives include "actions that could feasibly attain or approximate a proposal's objectives, but at a lower environmental cost or decreased level of environmental degradation" (WAC 197-11-440).

Many flood hazard mitigation approaches in the Chehalis Basin have been suggested and studied over the past several years. Infrastructure bypass options, levees, floodwalls, flood retention facilities, local actions, and restoration actions have all been assessed for effectiveness in controlling, mitigating, and recovering from floods. Structural and nonstructural large-scale and local-scale projects have been examined as potential actions in the following reports:

- *Interim Feasibility Report and Environmental Impact Statement, Centralia, Washington, Flood Damage Reduction* (Corps 1982b)
- *Chehalis River Basin Flood Control Project Pre-Feasibility Analysis of Alternatives* (PIE 1998b)
- *Centralia Flood Damage Reduction Project, Chehalis River, Washington, General Reevaluation Study* (Corps 2003)
- *Chehalis Basin Partnership Multi-Purpose Water Storage Assessment* (Tetra Tech 2003)
- *Chehalis River Flood Water Retention Project Phase IIB Feasibility Study* (EES Consulting, Inc. 2011)
- *Chehalis Basin Flood Hazard Mitigation Alternatives Report* (Ruckelshaus Center 2012)
- *Centralia Flood Risk Management Project* (Corps 2012)
- *I-5 Protection from 13th Street to Mellen Street near Centralia and Chehalis* (WSDOT 2012)
- *Chehalis River Basin I-5 Flood Protection Near Centralia and Chehalis* (WSDOT 2014)
- *Chehalis Basin Strategy: Reducing Flood Damage and Enhancing Aquatic Species* (Chehalis Basin Strategy 2014)
- *Chehalis Basin Strategy Programmatic Environmental Impact Statement* (Ecology 2017)
- *A Review of Past and Current Strategies to Reduce Flood Damage in the Chehalis Basin* (American Rivers 2018)
- *Chehalis River Basin Flood Damage Reduction Project: Project Description* (Chehalis River Basin Flood Control Zone District 2018)

In 1982, the Corps evaluated the feasibility of large-scale flood storage at six sites on the North and South Forks of the Newaukum River, South Fork Chehalis River, mainstem Chehalis River, and at the existing Skookumchuck Dam (Corps 1982a). The Corps concluded the new flood control structures were economically infeasible, and the work to modify the Skookumchuck Dam was halted in 1991 when it was determined it lacked economic justification. In 1998, Lewis County evaluated eight retention sites on the

Newaukum River, South Fork Chehalis River, mainstem Chehalis River, and Elk Creek (PIE 1998a; Tetra Tech 2003). The Corps concluded these were not cost effective (Corps 2003). After the 2007 flood, the Lewis County Public Utility District considered locations for flood retention structures and evaluated two locations, one upstream of Pe Ell on the upper Chehalis River and one on the South Fork Chehalis River. A 2011 feasibility study and benefit-cost analysis identified the upper Chehalis River project as possible but not the South Fork Chehalis project (EES Consulting, Inc. 2011).

In 2012, local community leaders and representatives of tribal governments met to discuss potential flood hazard mitigation projects (Ruckelshaus Center 2012). The potential projects included:

- A multi-purpose water retention dam on the mainstem Chehalis River located upstream of Pe Ell
- Improvements to the levee around the Chehalis-Centralia Airport
- Flood walls and levees to protect I-5 in the Chehalis-Centralia area
- Raising/improving the levee system around Centralia and Chehalis (the Corps "Twin Cities Project")
- Other potential construction projects and programmatic approaches, such as land use management, flood proofing, home elevations and buyouts, and livestock evacuation and sanctuary areas, and multiple local levee or other flood hazard mitigation construction projects and a number of additional alternatives to protect I-5

The work group recommended further analysis of the flood retention facility option, airport levee, I-5 improvements, and local projects that would provide immediate flood damage reduction.

Starting in the 1980s, the Corps considered a project consisting of 11 miles of new floodplain levees along the Chehalis River, Salzer Creek, and Dillenbaugh Creek (the "Twin Cities Project"), but stopped work on the project in 2011 after determining it would not protect I-5 in a 100-year flood and would not pass the benefit-cost test (Corps 2012). The Corps also evaluated modified outlet works and new gates on the spillway at the Skookumchuck Dam. In 1998, hydraulic capacity improvements were evaluated, including river channel excavation, floodway/floodplain excavation, and levee improvement (PIE 1998a).

Starting in 2007, the USACE evaluated the Centralia Flood Risk Management Project, which included: construction of a levee system designed to provide 100-year level of protection along the Chehalis River from approximately RM 75 to RM 64 and along most of the lower 2 miles of both Dillenbaugh Creek and Salzer Creek; construction of a levee along the lower approximately 2 miles of Skookumchuck River to the confluence with Coffee Creek that would provide 100-year level of protection; raising in elevation approximately eight structures that would incur induced damages from increased inundation as a result of the project; and modification of Skookumchuck Dam to allow 11,000 acre-feet of flood storage. This project was closed in 2012 when the USACE determined it was not economically feasible.

Transportation projects, including I-5 improvements, to reduce flood damage were evaluated in past studies. In 2012, floodwater bypass routes near Mellen Street and SR 6 were evaluated, but it was found they provided little flood reduction benefit and increased water levels downstream (Ruckleshaus Center 2012). An I-5 protection project from 13th Street to Mellen Street (near Centralia and Chehalis) with six alternatives was studied by the Washington State Department of Transportation (WSDOT) in 2012. The report did not recommend a specific alternative (WSDOT 2012). Floodwater bypass routes near Mellen Street and SR 6 were evaluated (Ruckelshaus Center 2012), and a Wakefield Road project in Grays Harbor County was evaluated (Karpack and Sabatine 2014), but the projects were found to provide little flood reduction benefit.

In 2014, a comparison of alternatives study was done for the Chehalis Basin Strategy to analyze potential impacts on potential flood reduction projects (Chehalis Basin Strategy 2014). It evaluated the following projects separately and in combination: a floodwater retention facility on the Upper Chehalis (FRO), a multi-purpose retention facility, airport levee, I-5 walls and levees, and flood-proofing of all residential homes within the 100-year floodplain and 25% of other buildings. It identified costs, benefits, and uncertainties. It found flood-proofing could eliminate residential damage but does not resolve issues with non-residential buildings or flooded roads and agricultural lands. It found the cost to construct walls and levees to protect I-5 exceeded the economic benefit.

In 2014, WSDOT evaluated protection projects for I-5 (raising and widening, express lanes, temporary bypass, viaduct, and relocation). WSDOT did not recommend further evaluation of these projects, deeming them either cost prohibitive, negatively impactful to the built and natural environment, or causing increased flood elevations in urban areas (WSDOT 2014). In 2014, WSDOT evaluated a project to construct levees and floodwalls along I-5, a new 1-mile-long Chehalis Avenue levee, and bridge replacements over Dillenbaugh and Salzer creeks. This project was not recommended to move forward based on WSDOT findings and the 2017 Programmatic EIS analysis (WSDOT 2014; Ecology 2017).

The 2017 Chehalis Basin Strategy Programmatic EIS evaluated large-scale and local-scale flood damage reduction options. The large-scale options included the FRO and FRFA flood retention facility concepts, airport levee improvements, I-5 projects, and the Restorative Flood Protection concept.

Using these earlier studies and reviews and the applying the definition of reasonable alternatives, the following alternatives were eliminated from moving to analysis in this EIS, for the following reasons:

- **Restorative Flood Protection:** The 2017 Programmatic EIS described a restorative flood protection approach as way to reduce flood damage and restore habitat. A feasibility study was conducted on the Newaukum River in 2018, but for areas with steep gradients like the upper Chehalis Basin, results showed only a 10% reduction in peak flood flows for major floods and no effect on reducing peak flood flows for catastrophic floods. The Chehalis Basin Board decided not to move forward with further development of this concept (NSD 2016, 2018; Abbe et al.

2019). This approach would not meet the project objective to reduce flood damage in the Centralia and Chehalis area.

- **Dredging the Chehalis River:** This alternative was evaluated by the Corps (as referenced in PIE 1998a) and found to result in potentially significant environmental impacts, including damage to high-quality habitat and riparian forest areas, would require long-term maintenance, and likely adversely affect water quality during construction (Ecology 2017).
- **Straightening the Chehalis River:** This alternative was evaluated by the Corps (as referenced in PIE 1998a) and found to incur the greatest environmental impact of the previously studied flood impact reduction options, and was also not economically feasible.
- **Multiple Dams or Dams on Other Tributaries:** This alternative was evaluated by the Corps and Lewis County (Corps 1982a; PIE 1998a; Tetra Tech 2003; Corps 2012) and found to be economically infeasible with minimal downstream benefit, or would result in significant impacts related to transportation and the built environment (Ecology 2017).
- **Airport Levee Changes Alone** (without being combined with other actions): This alternative was evaluated by WSDOT in combination with I-5 levees and walls, and did not meet the project objective of reducing flood damage to residences, businesses, or schools in the Chehalis-Centralia area (WSDOT 2012). The study found that while these activities would provide protection to homes and businesses in some parts of the Chehalis-Centralia area, flood elevations in other areas would likely increase.
- **Multiple Levee System** (airport levee and additional levees within the Chehalis Basin): This alternative was evaluated by the Corps in the 1980s and in 2012, which found it could increase flood damage to people and communities, particularly on the west side of I-5 near the Chehalis River, and was not economically feasible (Ruckelshaus Center 2012; Corps 2012).
- **Flood Retention Flow Augmentation (FRFA) Facility with a Permanent Reservoir:** This alternative was evaluated in the 2017 Programmatic EIS and found to have a higher level of environmental impact than the Proposed Action.
- **I-5 Infrastructure Changes** (re-route, raise, build business loop): This alternative was evaluated by WSDOT and was found to be not economically feasible with increased flood elevations in Centralia and impacts on the build and natural environment (WSDOT 2012). This approach would not attain the Proposed Action objectives and would not be likely to have lower environmental impacts.
- **I-5 Walls and Levees:** This alternative was evaluated in the 2014 Chehalis Basin Strategy study, which found the cost to construct exceeded the estimated economic benefits.
- **FRE Facility Without Airport Levee Changes:** This alternative was evaluated in the 2012 *Chehalis Basin Flood Hazard Mitigation Alternatives Report* (Ruckelshaus Center 2012), which found it did not meet the project objective to reduce flood damage to the Chehalis-Centralia Airport and transportation facilities (i.e., I-5).

The Chehalis Basin has a high probability of experiencing major and catastrophic floods, and this probability increases with climate change in the future. Implementation of the Proposed Action, if permitted, would not be expected to foreclose other options to reduce flood damage in the future.

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# Attachment A
# Applicant's Project Description and Clarifications

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# APPLICANT'S PROJECT DESCRIPTION AND CLARIFICATIONS INDEX

A.1. *Chehalis River Basin Flood Damage Reduction Project Description.* Chehalis River Basin Flood Control Zone District. September 2018.

- *Chehalis Basin Strategy: Combined Dam and Fish Passage Design Conceptual Report.* June 2017.
- *Chehalis Basin Strategy: Fish Passage CHTR Preliminary Design Report*. February 2018.

A.2. *Chehalis River Basin Flood Control Combined Dam and Fish Passage Supplemental Design Report, FRE Dam Alternative.* September 2018.

A.3. Letter from Erik Martin, PE (Chehalis River Basin Flood Control Zone District) to Bob Thomas and Janelle Leeson (U.S. Army Corps of Engineers). Regarding: Chehalis River Basin Water Retention Facility - Project Purpose and Need Clarification. November 30, 2018.

A.4. Letter from Erik Martin, PE (Chehalis River Basin Flood Control Zone District) to Bob Thomas and Janelle Leeson (U.S. Army Corps of Engineers). Regarding: Chehalis River Basin Water Retention Facility - Project Purpose and Need Clarification. January 11, 2019.

A.5. Letter from Betsy Dillin (Chehalis River Basin Flood Control Zone District) to Diane Butorac (Washington Department of Ecology) and Janelle Leeson (U.S. Army Corps of Engineers). Regarding: Chehalis River Basin Flood Control Zone District Project Description Clarification. January 14, 2019.

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A.15 Email from Betsy Dillin to Diane Butorac (Washington Department of Ecology). Regarding: Levee Trail and Pe Ell Roads. October 29, 2019.

A.16 Letter from Erik Martin, PE (Chehalis River Basin Flood Control Zone District) to Diane Butorac (Washington Department of Ecology) and Brandon Clinton (U.S. Army Corps of Engineers). Regarding: Airport Levee Design Update. November 22, 2019.

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