Technical Memorandum

Date:	April 24, 2024
Project:	Chehalis River Basin Flood Damage Reduction Project
To:	Chehalis Basin Flood Control Zone District
From:	HDR Engineering, Inc.
Subject:	**Operation and Maintenance Considerations**

1.0 Background

The Chehalis River Basin Flood Damage Reduction project objective is to develop recommendations for a series of measures aimed at reducing damage to the communities of the Chehalis River Basin from Pe Ell to Centralia during major flood events. Among these measures is a proposed Flood Retention Expandable (FRE) structure on the Chehalis River, south of the town of Pe Ell.

The Chehalis River Basin Flood Damage Reduction, Revised Project Description Report (RPDR) is a supplemental report documenting the relocation of and changes to the FRE facility (Proposed Project) as originally documented within the Combined Dam and Fish Passage Conceptual Design Report (HDR Engineering, Inc. [HDR] 2017) and FRE Dam Alternative Report (HDR 2018).

The RPDR describes, supports, contrasts, and illustrates the changes to the Proposed Project in a single comprehensive document.

2.0 Introduction and Purpose

The Proposed Project includes both an FRE structure and a flood fish passage facility (FFPF), which are currently at a conceptual level of development.

As Appendix J to the RPDR, this technical memorandum (TM) documents operation and maintenance (O&M) considerations of the Proposed Project, primarily the FRE and FFPF, and provide the foundation for the Proposed Project's O&M Manual. O&M considerations will be updated periodically as the Proposed Project design progresses.

This TM is not intended to be a standalone document and is supplemented by several other documents, including but not limited to the following:

- Revised Project Description Report (RPDR) (HDR 2024a)
- *Hydraulic Design of Fish Passage and Evacuation Conduits* TM (HDR 2023b)
- *Landslide Desktop Evaluation* TM (HDR 2023a)

- *Access Roads and Best Management Practices* TM (HDR 2024b)
- *Large Woody Material Downstream Passage and Placement Clarification* TM (referred to hereafter as the Debris Management TM) (HDR 2021)
- *Dam Safety Standards and Seismic Fault Study Review* TM (HDR 2022)

3.0 Operating Entities

Currently, it is unknown what entity will be responsible for operating the FRE and FFPF. This will be determined during future phases of Proposed Project development. Personnel considerations that are applicable regardless of the operating entity are discussed in Section 4.1.

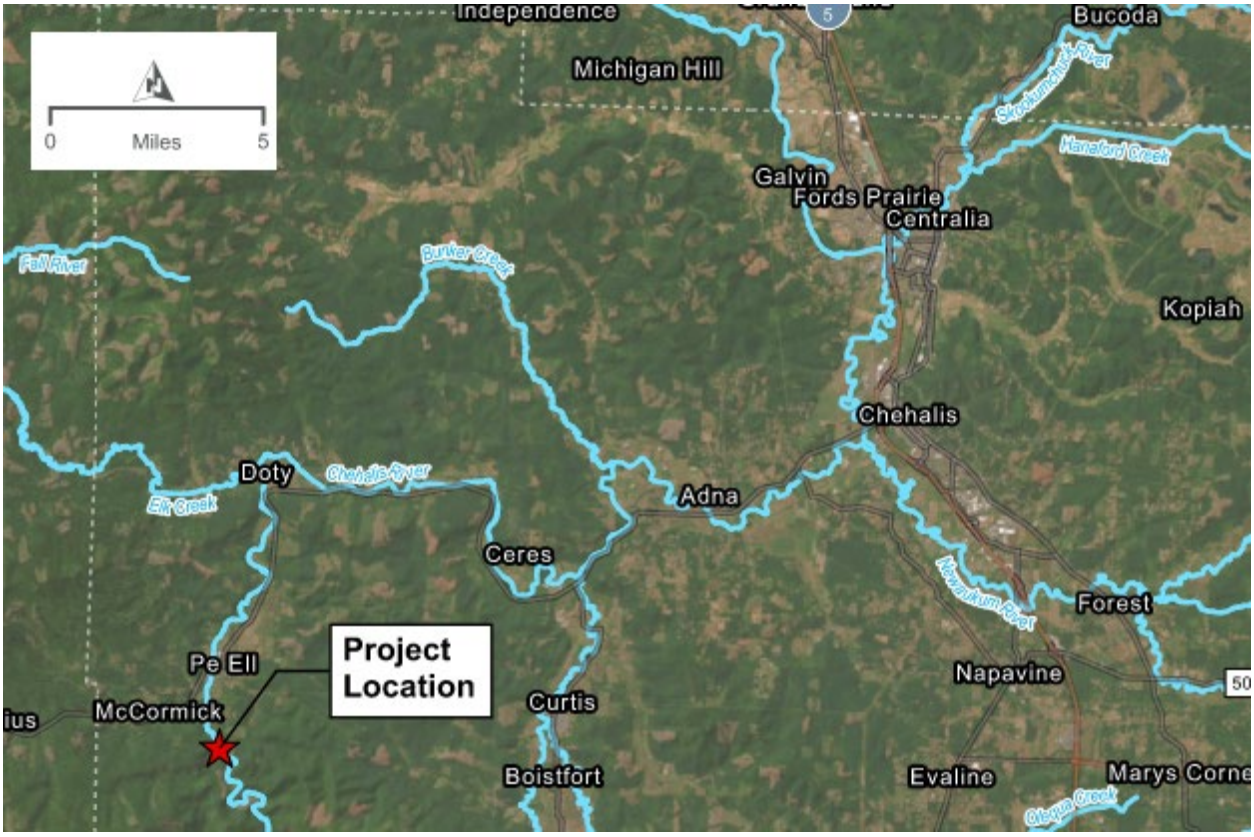
4.0 Facilities Overview

This section presents an overview of the Proposed Project facilities, including location, access, and layout.

4.1 Location

The Proposed Project is located on the Chehalis River, immediately downstream of its confluence with Crim Creek, approximately 2 miles south of the town of Pe Ell in Lewis County, Washington. Figure 1 shows the location of the Proposed Project relative to regional landmarks.

Figure 1. Proposed Project Vicinity



4.2 Access

The Proposed Project site is accessible from State Route 6 via S 3rd Street, Muller Road, then Forest Service Road 1000. Once at the Proposed Project site, access roads branch off to the major project facilities. The proposed layout includes three bridges: two existing bridges crossing the Chehalis River (one upstream and one downstream of the FRE) and one proposed bridge crossing Crim Creek. Additionally, the proposed FRE itself will be crossable with a road along the FRE crest and bridge across the spillway. For a detailed layout of proposed access roads, refer to the *Access Roads and Best Management Practices* TM (HDR 2024b). Final access to the Proposed Project site should be gated and limited to site personnel only, for security and public safety.

4.3 Layout

The Proposed Project includes the following major components:

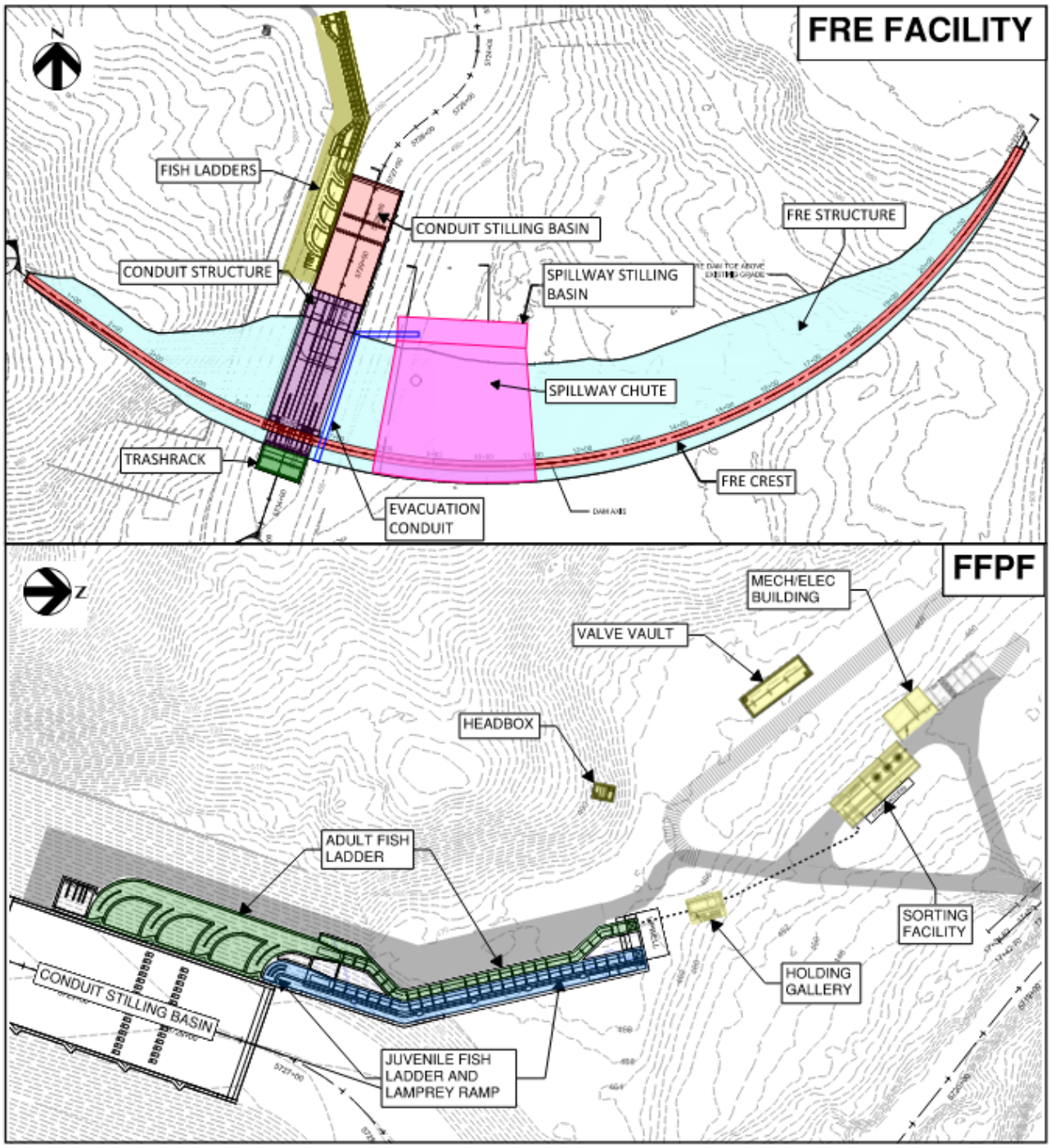
- **Spillway:** An uncontrolled concrete ogee crest, which is 316 feet wide, used to pass infrequent floods and sized so that the probable maximum flood will not overtop the dam.
- **Adult and juvenile fish ladders, and lamprey ramp:** The fishways that allow fish to enter the FFPF during impoundment. The adult and juvenile fish ladders are concrete

Half-Ice Harbor style ladders while the lamprey ramp is a stainless-steel flume parallel to the fish ladders.

- **Fish sorting and holding facilities:** The hoppers and holding gallery hold fish after they ascend the ladders and transport them to the sorting building. The sorting building is an elevated structure that houses personnel who sort and examine fish prior to loading them into transport trucks to be hauled upstream.
- **Conduit structure:** This is the portion of the dam located to the left (west) of the spillway through which the fish passage conduits and evacuation conduit pass through the dam. The fish passage conduits consist of a central 12-foot-wide by 20-foot-tall conduit and two 10-foot-tall by 16-foot-tall conduits on each side of the central conduit. The evacuation conduit consists of a 9-foot-diameter conduit to the right of the fish passage conduits used to lower the reservoir in a controlled manner and sized to make the dam safety emergency reservoir evacuation discharges.
- **Trashrack:** This structure, provided on the upstream face of the dam, protects the conduit structure. This helps prevent large debris from damaging or blocking flow of water through the conduits yet allows fish passage through the dam.
- **Mechanical and electrical building:** This structure houses mechanical and electrical equipment and provides storage for equipment and materials associated with operation of the FFPF.

The general layout of the Proposed Project facilities is shown in Figure 2. For detailed descriptions of each project component, refer to the RPDR (HDR 2024a) and/or specific TMs.

Figure 2. Conceptual Layout of Proposed Project Facilities



5.0 Authorization/Notification

This section presents authorization/notification protocols at the Proposed Project facilities for O&M personnel, facility operation, and emergency response.

5.1 Operations and Maintenance Personnel

To operate the FRE and FFPF effectively, it is expected that several teams will be required for day-to-day operations, routine maintenance, record keeping, and flood operations. The number of O&M personnel may vary seasonally as there may be long periods (i.e., years) when the flood operations portion of the Proposed Project does not operate. Despite this infrequency, personnel required exclusively for flood operations would be on call annually during the normal operating period (i.e., wet season). Most personnel would likely be dedicated to operation and maintenance of the FFPF, which is a labor-intensive facility that must run continuously, 24 hours per day during impoundment events.

During design permitting, coordination with state and federal agencies will determine specific requirements for facility personnel, such as what qualifications/trainings are required for FFPF personnel and how often those qualifications/trainings must be renewed.

5.2 Operation Authorization/Notification

The FRE facility is operated as run-of-river, meaning that during normal operation the Chehalis River passes uncontrolled via conduits through the structure. The FRE impounds water only to mitigate flooding in downstream populated areas during high river flows. This temporary storage event will occur only when the Chehalis River is forecasted to exceed 38,800 cubic feet per second (cfs) within 48 hours at the downstream river monitoring gage at Grand Mound, Washington (United States Geological Survey [USGS] Gage 12027500). While this may appear to be a defined threshold for impounding water, there will likely be a highly prescribed protocol requiring multiple levels of authorization and coordination. Defining this protocol will occur during later stages of Proposed Project development. Factors that should be considered when developing this protocol, based on the conceptual design, include the following:

- **Forecasting:** A forecasting system should be developed to give ample warning to operators, agencies, and the public prior to an impoundment event. During the normal operating season, forecasting would likely be updated daily. Forecasting should be based on publicly available data (precipitation, streamflow, etc.) and/or project-specific monitoring equipment, and models calibrated/validated to the Proposed Project location.
- **Increased monitoring:** If forecasting predicts that a flood event will occur, a stage of increased monitoring and readiness should immediately be triggered. During this time, the facility should be prepared assuming that operation is imminent. This stage would prepare for an operation without fully mobilizing.
- **Notification and communication:** A predefined notification and communication structure should be followed. At a minimum, landowners, the public, governing

agencies, tribes, and local municipalities should be notified of any major operational changes at the facility.

- **Potential for human activity within the reservoir inundation footprint:** A plan will be developed that will include specific steps taken to address human safety within the inundation area prior to operation. Some ways to address public safety could include a siren audible throughout the reservoir area[1], a physical search of the reservoir area, and/or other related efforts.
- **Availability of O&M personnel:** The FRE and FFPF may need to be operational within a few days' notice. Any on-call and reserve personnel should be adequately trained, equipped, and available should they be required.
- **Status of facilities:** The status of pertinent mechanical and safety equipment should be known and documented to best inform operations and minimize potential for normal and emergency outages. This should be completed as part of the pre-season/facility startup maintenance activities discussed in Section 5.2.1.

5.3 Emergency Response

Facility personnel are primarily responsible for notifying the appropriate first responders when emergencies are identified at the Proposed Project. Examples of potential emergency situations include loss of communications, loss of access, breach of security, major seismic events, major rainfall events, fire in the watershed, and other such emergencies as identified.

Immediate response to on-site emergencies will likely be provided by O&M personnel normally stationed in nearby Lewis County or public first responders, such as the Lewis County Sheriff's Department and Lewis County Fire District, depending on the type of emergency. Emergency response procedures are further described in Section 8.0. A rigorous site-specific Emergency Action Plan (EAP) will be developed during final stages of design.

6.0 Normal Startup and Operating Procedures

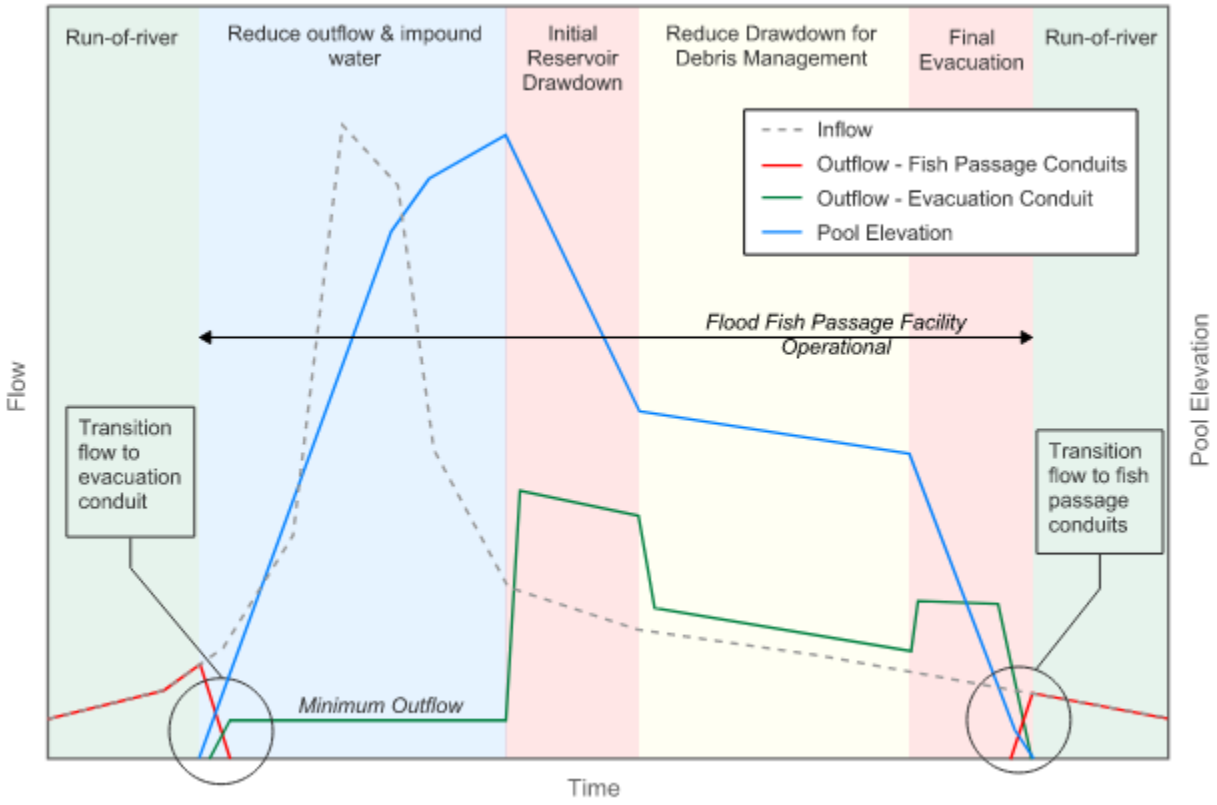
This section presents normal startup and operating procedures at the Proposed Project facilities.

6.1 System Rule Curve

Figure 3 presents the conceptual operational rule curve for flood retention operations during an example flood hydrograph. This process is described further in Section 5.2.2.2.

[1] Per Lewis County Ordinance 1.23.030, sounds from warning devices or public-works projects are exempt from public-disturbance restrictions. Considerations for wildlife protection relating to noise are discussed in Section 9.6 of this TM.

Figure 3. Conceptual System Rule Curve



During run-of-river operations, inflow and outflow at the FRE are equal, conveyed by the fish passage conduits. When flood retention operations are initiated and prior to the rising limb of the inflow hydrograph, the fish passage conduits will begin to close to reduce outflow and impound water behind the FRE, shown by the declining red line and increasing blue line in Figure 3, respectively. Gradually, outflow will transition to the 9-foot-diameter evacuation conduit (green line in Figure 3) while the fish passage conduits are fully closing to maintain continuous flow downstream. Thereafter, outflow through the evacuation conduit is maintained at or above a minimum outflow that is sufficient to meet instream flow requirements downstream of the FRE. This state is maintained through the rising and falling limbs of the inflow hydrograph, thus raising the pool elevation and storing water.

Once the inflow hydrograph has attenuated, reservoir drawdown will commence. Reservoir drawdown is categorized into the following distinct phases:

1. **Initial reservoir drawdown:** Outflow through the evacuation conduit will increase to lower the pool elevation.
2. **Reduce drawdown for debris management:** Outflow will be reduced to slow the reservoir drawdown and allow debris removal to commence.
3. **Final evacuation:** After debris removal, outflow will increase for a final reservoir drawdown until the pool is low enough to transition outflow to the fish passage conduits and run-of-river operations will resume.

Specific drawdown rates will be determined in future design phases, considering both operational goals and minimization of environmental impacts (i.e., fish stranding).

Upstream fish passage will be provided continuously via the FFPF during flood retention operations, including transitional periods. The FFPF will be inactive during full run-of-river operations only.

6.2 Facility Operational Strategy

This section provides considerations for normal startup, operation, and non-operational intent and strategies for the facility. Facility startup refers to activities necessary to bring the facility to a normal operational status. Normal operation refers to the conditions, procedures, and settings necessary for the facility to function as intended through anticipated operating periods and situations. Non-operational periods refer to the periods when the facility is idle and not intended to function given that a maintenance event has occurred, an environmental condition outside of normal parameters exists, or it is within a time frame outside of the normal operating periods.

Generally, the normal operating period will be September through April based on the historical record of floods large enough to trigger operation. Analysis of historical flood events including changes because of climate change, which will inform expected operational frequency, is in progress and will be finalized after completion of the RPDR.

6.2.1 Facility Startup

At least 1 month prior to a predetermined facility startup date (e.g., August 1), all adaptive management measures and changes to the O&M Manual shall be completed. Updates to procedures could include incorporating lessons learned from the previous operational season, updates because of staff/organizational changes, facility modifications, regulatory changes, and recommendations.

Prior to the facility startup date (e.g., September 1) all pre-season operational readiness activities should be completed. Such readiness activities include facility equipment maintenance per manufacturer guidance, equipment inspection and testing, new personnel training, and completion/renewal of any required certification for personnel.

After the facility startup date, the facility, personnel, and all such equipment should be ready to operate as intended in a normal operational mode.

6.2.2 Normal Operations

This section describes the main operational states expected during the normal operating period (season).

6.2.2.1 Run-of-River Operations

Run-of-river (non-flood) operation describes when the fish passage conduit gates are open and the Chehalis River flows through the FRE unimpeded. Upstream and downstream fish passage is provided through the fish passage conduits.

6.2.2.2 Flood Retention Operations

Flood retention operation describes when the conduit gates are closed to impound incoming floodwaters behind the FRE. Upstream fish passage is provided continuously by the FFPF; no downstream fish passage is provided while the conduit gates are closed. Refer to the Fish Passage section of the RPDR for additional detail on FFPF operations (HDR 2024a).

Once flood operations are initiated (refer to Section 4.2) and the measured flow at the FRE exceeds the high fish passage design flow (2,200 cfs), the FFPF will begin to operate and provide upstream fish passage, supplied by water pumped from the Chehalis River downstream of the conduits. Once the FFPF is operational, the conduit gates will gradually close to reduce flows passing through the FRE. As the water surface elevation upstream of the FRE rises, the conduit gates will close at an allowable ramp-down rate and flow will transition to the 9-foot-diameter reservoir evacuation conduit. Refer to the *Hydraulic Design of Fish Passage and Evacuation Conduits* TM for a detailed description of the transition operation (HDR 2023b). Above a certain water surface elevation, the FFPF water will be supplied by gravity from the storage pool and the pump station will not be required until the water surface elevation is lowered.

After the incoming flood has peaked and receded, an initial reservoir drawdown through the reservoir evacuation conduit will lower the storage pool at a manageable level for debris removal to commence. Debris removal concepts are described in the Debris Management TM (HDR 2021). After debris has been removed, the reservoir will continue to be drawn down until pool elevation 510 feet where the flow control will be transferred to the fish passage conduits individually, following ramp-up rates, and run-of-river operations will resume. At this point, the FFPF will be deactivated and dewatered.

Following reservoir drawdown, post-inundation maintenance activities should be performed. Most notably, inspection and repair of access roads (Section 6.2.2) inundated by the reservoir, known landslides (Section 6.2.3), and hydraulic concrete structures (Section 6.2.1). Performance of the facility should be documented for use in the adaptive management strategy (Section 5.5). Equipment should be inspected and repaired as needed to ensure reliable operation during the next flood. The goal of this post-inundation period is to identify and prioritize maintenance activities and prepare the facility for the next potential operation.

6.2.3 Facility Shut-Down

Once the normal operating period end date is reached, shutdown procedures will commence to transition from normal operations to the non-operational period. Considerations for this procedure include inspection and maintenance, equipment storage, and documentation.

6.2.4 Non-Operational Period

During the non-operational period the FRE and FFPF are inactive and there will likely be reduced personnel on site. It is important that the adaptive management process take place during this period. Details of the adaptive management strategy are provided in Section 5.5.

The non-operational period could range in duration from one dry season (a few months) to many years. Mechanical equipment and valves should be exercised at regular intervals during this period to mitigate issues from inactivity.

6.3 System Equipment and Operating Procedures

This section describes specific equipment used to operate various facility components, the conditions in which they can be operated, and operational procedures. This level of detail is beyond the current scope of conceptual design; this section will be updated to reflect specific equipment operational procedures and needs as appropriate during final design.

6.4 Debris Management and Disposal

Debris management is critical to successful operation of the facility. During a flood, significant debris is expected to accumulate in the reservoir, specifically at the FRE trashrack, which must be removed prior to resuming run-of-river operations. Additionally, large woody debris smaller than 24 inches in diameter may be transported by natural processes past the trashrack and into the conduits and stilling basin during run-of-river operations. Considerations for how to collect, sort, recycle, and dispose of debris are discussed in the Debris Management TM (HDR 2021).

6.5 Adaptive Management Strategy

The proposed facility is complex and unique and may require a steep learning curve as the various systems, maintenance requirements, and interaction with the natural operating environment become apparent. An adaptively managed operational strategy can be used to optimize facility performance primarily over the first several years/instances of operation, but could continue in some capacity as part of normal facility operations. Lessons learned from the prior operating season are valuable only if they are recorded, discussed, and incorporated into the following season's operating strategy. The adaptive management strategy should be developed in cooperation with all parties involved. As impacts from climate change are realized, the adaptive management strategy is a critical tool to provide flexibility and resilience to the Proposed Project. Climate change will likely impact specific operating criteria for the Proposed Project, such as the normal operating period, frequency of operation, and statistical likelihood of different flow events.

The primary objective of an adaptive management strategy is to improve facility performance. Facility performance should be assessed using measurable performance criteria defined prior to the start of operation, and criteria can be added or removed over time if deemed necessary. Key phases that compose an effective adaptive management strategy include the following:

- **Operate and observe:** After performance criteria have been established and a monitoring program (per permitting requirements) has been developed, the facility is operated and maintained as planned. Data are collected and recorded at regular intervals through various media such as system instrumentation, digital imagery, and empirical measurements. This process is integrated into daily operation and maintenance of the facility.

- **Evaluate and report:** Collected data are synthesized and performance metrics are calculated. Performance metrics are compared to goals and values are developed as part of the previous season's operations. Results, analytical analysis, and key findings are documented in an annual report. Discussions occur through a series of meetings/workshops, lessons learned are reviewed and best management practices are fully developed, and any refinements to equipment or operational strategies are proposed.
- **Implement adaptive measures:** Refinements to facility equipment or operational strategies are integrated. The O&M Manual is updated. Changes are field-tested to the extent possible prior to the start of the next operational period.

Examples of data that could be collected as part of the adaptive management strategy include forecasted/recorded flows, water surface elevations, gate positions, adjustable parameters and set points, debris management records, and inspection records. This applies to the FRE and FFPF, though the FFPF would likely collect additional biological data from the fish sorting process such as the number, species, size, health, and migration timing of observed fish.

6.6 Conditional Operating Criteria for Facility Systems

The preliminary design will investigate areas for operational refinement with the ultimate goal of minimizing adverse impacts associated with the Proposed Project. One such opportunity is conditional ramping rates and reservoir releases based on regional conditions. For example, a storm that causes a major flood downstream at Grand Mound but is centered outside of the basin contributing to the FRE location may change how the FRE is operated. In this case, inflows at the FRE may not govern when the reservoir is evacuated and how quickly the reservoir can be evacuated, because other river systems (e.g., the Newaukum River or Skookumchuck River) could be driving flooding.

7.0 Scheduled Maintenance Procedures

This section presents scheduled maintenance procedures at the Proposed Project facilities, including the inspection and maintenance schedule and structure inspection and preventive maintenance.

7.1 Inspection and Maintenance Schedule

Regularly scheduled inspection and maintenance are integral to reliable facility performance and longevity. Inspection and maintenance intervals could range from daily to annually, depending on many factors such as likelihood of failure, severity of failure, ease of inspection, and manufacturer recommendations. Specific maintenance intervals will be developed for all major facility components and documented in the O&M Manual, with input from regulators, as the design progresses.

7.1.1 Electrical Systems

An annual review of all electrical systems should be performed, including instrumentation and controls, on-site cameras, alarms, communications, cybersecurity, and backup power. Software and firmware should be kept up to date.

7.2 Structure Inspection and Preventive Maintenance

This section presents scheduled structure inspection and preventive maintenance at the Proposed Project facilities, including major concrete structures, access roads, and slope stability.

7.2.1 Major Concrete Structures

All major concrete structures should be inspected regularly for structural integrity, cracking, and other signs of damage. If damage is found it should be reported, further investigated, and repaired (if warranted). Known problems should be monitored for worsening conditions. All inspections should be performed by a licensed, qualified engineer/inspector for the appropriate discipline responsible for the structure (e.g., geotechnical engineer for retaining walls). Of particular importance is the integrity of the FRE itself, especially when impounding water. Considerations specific for dam safety and engineering guidelines are discussed in the *Dam Safety Standards and Seismic Fault Study Review* TM (HDR 2022) and the State of Washington Department of Ecology Dam Safety Guidelines.

Additional inspection and maintenance should be performed following flood operations. The fish passage conduits should be inspected for concrete damage/erosion from sediment mobility. The fish ladder and other flow conveyance structures should be cleaned regularly to remove debris that may accumulate through operation (e.g., sediment, vegetation/woody material, trash, etc. conveyed by flow) or inactivity (e.g., fallen leaves/wood, moss, dust, etc.). In the event that high-velocity flow is conveyed through the spillway or conduits, inspection for cavitation damage should be performed.

Major concrete structures for the Proposed Project include the following:

- **FRE facility:** FRE structure, trashrack structure, fish passage conduits, evacuation conduit, conduit stilling basin, spillway stilling basin, and spillway (includes crest, face, training walls, and bridge piers and decking)
- **Flood fish passage facility (FFPF):** fish ladder, holding gallery, sorting building, mechanical/electrical building, headbox, and valve vault
- **Other:** retaining walls

7.2.2 Access Roads

Access roads should be inspected and maintained/repaired if necessary to retain access to the Proposed Project. A primary concern is to keep water drained away from the roadway. Wet weather and unusually heavy hauls are common causes of deterioration in gravel roadways (all planned access roads are gravel). Key elements that would likely require maintenance are the driving surface, shoulder, and ditch or drainage slope. The access roads should be inspected

annually, at a minimum, and following any heavy rain event. Additionally, any access roads within the inundation area should be inspected and repaired as soon as possible following reservoir drawdown. Critical access roads, such as routes essential to FFPF operation, should be prioritized for inspection and maintenance following heavy rains and inundation events. Refer to the *Access Roads and Best Management Practices* TM (HDR 2024b) for the layout of permanent access roads to the site and specific maintenance and repair actions for access roads.

7.2.3 Slope Stability

There are several active landslides in the vicinity of the FRE and inundation footprint, some of which are proposed to be stabilized as part of the Proposed Project. All stabilized landslides should be monitored to some extent to ensure continued stability. Existing landslides are discussed in detail in the *Landslide Desktop Evaluation* TM (HDR 2023a).

Four landslides (LS-1, LS-3, LS-3A, and LS-4) that pose a direct risk to the FRE and appurtenant structures should be monitored regularly with inclinometers (subsurface movement) and piezometers (pore water pressure) to assess slope stability over time. Measurements could be read manually or equipped with remote datalogging. Other landslides that are lower risk and/or more distant should be visually monitored on at least an annual basis. Following an inundation event and reservoir drawdown, all stabilized landslides should be inspected for instability and repaired accordingly. If a slope failure occurs it may be prudent to manage debris per the Debris Management TM (HDR 2021).

8.0 Reporting and Record Keeping

Accurate record keeping is essential to effective operations. Records aid troubleshooting, provide justification for decision making, and inform the adaptive management strategy. Records can be categorized generally as follows:

- **Operation records** should log all information pertaining to operational activities throughout a 24-hour period. Data should be transferred and stored efficiently without compromising the quality and continuity of the data.
- **Maintenance records** should log all information pertaining to maintenance activities, including equipment malfunctions and corrective actions taken. Pictures are highly recommended when documenting conditions of equipment and problems observed during maintenance. Additionally, some special or high-risk activities like confined-space entry must be documented per regulatory requirements.
- **Emergency records** should be thoroughly documented and may differ depending on the type and severity of an emergency.

9.0 Emergency Action Plan and Operating Procedure

A comprehensive EAP will be developed as the design progresses so that personnel are prepared to act in the event of incidents, failures, or damage/malfunctions that would endanger

life or property. The EAP should address duties such as establishing a chain of command, contacting appropriate first responders, taking preventive action, and otherwise managing the emergency in the quickest and safest means possible.

Potential emergencies and high-level considerations for the EAP are summarized in Table 1.

Table 1. Considerations for Emergency Action

Type of emergency	Considerations
Loss of access	• Primary, secondary, and emergency access routes (refer to *Access Roads and Best Management Practices* TM [HDR 2024b]) • Remote operation of the facility • Backup fuel reserves • Operational capabilities during loss of access
Loss of communication	• Short-term vs. long-term loss of communication • Increased monitoring and inspection • Operational capabilities during loss of communication
Loss of power	• Adequacy/duration of backup power systems (refer to Electrical section of the RPDR [HDR 2024a)) • Power loss during different operations (i.e., run-of-river vs. flood operations) • Operational capabilities during loss of power • Inspect system equipment for damage and/or incorrect operating positions
Major rain/flood event	• Potential to cause another type of emergency (e.g., loss of power, loss of access) • Debris removal activities • Slope stability
Major seismic event	• Classify seismic events by severity • Seismic event during flood impoundment • Visible damage to structures • Inspect and evaluate for damage and potential danger of failure • Slope stability
Fire in the watershed	• Increased debris removal activities • Slope stability

10.0 Facility-Specific Health, Safety, and Environment

This section presents -specific health, safety, and environmental considerations for the Proposed Project.

10.1 Personal Protective Equipment

Typical PPE for operation of water-resources infrastructure facilities will be required for certain O&M tasks at the facility. PPE should meet all local and federal regulatory requirements. PPE

requirements by maintenance task should be determined prior to facility startup and adjusted accordingly.

10.2 Confined Spaces

A confined space is defined as a space that meets the following criteria:

- Is large enough and configured so that an employee can bodily enter and perform assigned work
- Has limited or restricted entry or exit
- Is not designed for continuous employee occupancy

It is expected that many confined spaces will exist at the Proposed Project and require entry for maintenance tasks. Standard procedures for confined spaces should be developed to minimize risk when entering confined spaces, and confined space should be addressed in the EAP. Preventive measures for confined-space entry include proper training and permitting, de-energizing equipment/devices, conducting risk assessments, providing sufficient ventilation and air testing, providing confined-space PPE and rescue equipment, and maintaining continuous communication.

10.3 Fall Protection

Fall protection is the backup system planned for a worker who loses his or her balance at a height, to control or eliminate injury potential. Fall protection requirements should be incorporated into the Proposed Project design and passive and/or active fall protection systems should be provided for workers at the site.

10.4 Wet Weather Access to the Site

Access to the site is currently provided via a series of one-lane unpaved roads, and access improvements to the site are not planned to be paved. While the existing roadway is in generally satisfactory condition, landslides, debris sluffing, scour around culverts, and degradation from storm action could make the roads hazardous or impassable, particular during rainfall events. Defensive driving should always be exercised when traveling to and from the Proposed Project site.

The Proposed Project site could experience freezing temperatures and snowfall, potentially with little warning, during the normal operating period. Planned access and maintenance roads may have some steep grades, up to 10 percent, which could become hazardous in icy conditions. Equipment for safe and continuous mobility in icy conditions for personnel, vehicles, and heavy machinery (i.e., fish transport trucks) should be available on site. This could include rock salt, grit, vehicle snow chains, and micro-spikes.

10.5 Safety Considerations for Remote and Automatic Operations

Certain systems at the Proposed Project facilities may be operated in remote or automatic modes. These systems may operate without warning and some without human intervention. Special care must be taken when working in the vicinity of these systems, including avoidance,

lock-out/tag-out, and communication with other personnel at the site. There must be hazard notices on the site around equipment that is set to operate automatically.

10.6 Wildlife Protection

Because the facility is in a remote, natural landscape, wildlife is and will continue to be present around the proposed facility. For the purposes of this TM, wildlife encompasses all aquatic organisms, terrestrial organisms, and vegetation within the area impacted by the Proposed Project. In some cases, conflicts between wildlife and facility operations may occur. It is expected that wildlife monitoring and management will be required to operate the Proposed Project; however, specific actions are unknown at this time. This will be defined during the Proposed Project's permitting process.

At this stage of development, the District acknowledges that some Proposed Project elements are more likely to have additional wildlife protection considerations that should be investigated as the design progresses. For example, if the use of sirens as a warning system is explored, the District should consider restrictions to noise-producing activities and coordinate with the appropriate agency. During the marbled murrelet (a seabird that nests in coastal forests) nesting season, there can be restrictions on noise-producing activities. In this case, the District would coordinate with the United States Fish and Wildlife Service to determine if nesting habitat exists in the vicinity of the Proposed Project and if applying restrictions to the Proposed Project is practicable. This is just one example of the steps that the District is taking to minimize impact to wildlife from operation and maintenance of the Proposed Project.

11.0 Literature Cited

HDR

2017 Combined Dam and Fish Passage Conceptual Design Report. June 2017.

2018 Combined Dam and Fish Passage Supplemental Design Report FRE Dam Alternative Report. September 2018.

2021 *Large Woody Material Downstream Passage and Placement Clarification* TM. August 20.

2022 *Dam Safety Standards and Seismic Fault Study Review* TM. February 23.

2023a. *Landslide Desktop Evaluation* TM. Chehalis River Basin Flood Damage Reduction Project. Flood Reduction Expandable Project. November 14.

2023b *Hydraulic Design of Fish Passage and Evacuation Conduits* TM. 7 December.

2024a Revised Project Description Report. February 2024.

2024b *Access Roads and Best Management Practices* TM. Chehalis River Basin Flood Damage Reduction Project.

12.0 Abbreviations List

cfs	cubic foot/feet per second
District	Chehalis River Basin Flood Control Zone District
EAP	Emergency Action Plan
FFPF	flood fish passage facility
FRE	flood retention expandable
O&M	operation and maintenance
PPE	personal protective equipment
Project	proposed Chehalis River Basin Flood Damage Reduction Project
RPDR	Revised Project Description Report
USGS	U.S. Geological Survey